

Literature screening report

COVID-19 vaccines in the WHO's Emergency Use Listing (EUL) Report (11)

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Abstract

This report provides an in-depth review of the **eight**¹ World Health Organization's (WHO) Emergency Use Listing (EUL) authorized vaccines: 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/ Ad26CoV2.S/ Johnson & Johnson (Janssen, USA), Sinopharm/ BBIBP-CorV (China), Sinovac/ CoronaVac (China), COVAXIN/ BBV152 (Bharat Biotech, India), and Novavax/ NXV-CoV2373/ COVAVAX (USA, India)]. The current report summarises the latest data on COVID-19 vaccine-related literature as of 14 January 2022 and presents the information in the form of a synoptic table. This report covers vaccine effectiveness, protection against variants, transmissibility, breakthrough infections, booster doses, COVID-19 vaccines for children, and further important information for each vaccine. The latest changes and additions to the synoptic table are highlighted in yellow.

¹ Since the Covishield vaccine uses the same formulation and platform as Vaxzevria (AstraZeneca's COVID-19 vaccines), we combined both vaccines into one column in the synoptic table. Henceforth, seven vaccines will be referenced as WHO EUL approved (including Covishield)



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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, 59.6% of the world populations, of which only 9.5% of people in low-income countries, have received at least one dose of a marketed COVID-19 vaccine as of 14 January 2022². Currently, eight vaccines [namely, Comirnaty/BNT162b2 (Pfizer-BioNTech, USA), Spikevax/Moderna COVID-19 Vaccine/mRNA-1273 USA), nCoV-(Moderna, Vaxzevria/ChAdOx1 19/AZD1222/Covishield (AstraZeneca/Oxford, UK, India), Janssen Covid-19 vaccine/ Ad26CoV2.S/Johnson & Johnson (Janssen, USA), Sinopharm/BBIBP-CorV (China), Sinovac/CoronaVac (China), COVAXIN/BBV152 (Bharat Biotech, India), and Novavax/NXV-CoV2373/COVAVAX (USA, India)] were assessed and granted an authorization by WHO as of 23 December 2021³. Articles regarding the latest data on vaccine effectiveness, particularly against the omicron variant, vaccine induced immune response, breakthrough infections and transmission, booster doses, and children vaccination were prioritized during the literature search and are the latest additions to the table. Data from clinical trials and observational studies for the eight EUL-accepted vaccines regarding these highlighted topics were summarized and can be found in the synoptic table below.

https://extranet.who.int/pqweb/sites/default/files/documents/Status_COVID_VAX_11Nov2021.pdf [Last updated 23 December 2021; Accessed 11 January 2022]



² https://ourworldindata.org/covid-vaccinations (accessed on 14.01.2021).

³ Status of COVID-19 vaccines within WHO EUL/ PQ evaluation process. World Health Organization.



Methodology

We screened the data for the EUL-accepted vaccines and the vaccine candidate Novavax as of 14 January 2022 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 reports⁴.

Results

As phase III COVID-19 vaccine trials confirmed vaccine efficacy and safety for all eight 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).

The Newest Variant of Concern: Omicron (B.1.1.529)

Vaccine immunogenicity

Since the Omicron variant's (B.1.1.529) identification in early November, and its recognition by the WHO's Technical Advisory Group on 26 November 2021 as a variant of concern, Omicron cases have soared worldwide and is on the way to becoming the dominant variant across the globe⁵. The Omicron variant is characterised by its high (30-40) number of mutations in the virus spike (S) glycoprotein⁶, leading to higher affinities to the binding angiotensin-converting enzyme 2 (ACE-2) domain of the SARS-CoV-2 virus^{7,8}, and potential evasions of vaccine-

⁴ COVID-19 vaccines: efficacy and safety (Literature Review 1). *Swiss School of Public Health.* <u>https://www.bag.admin.ch/dam/bag/de/dokumente/mt/k-und-i/aktuelle-ausbrueche-pandemien/2019-</u> <u>nCoV/Literaturecherchen/literaturecherchen_covid-19-</u>

impfstoffe_20210209.pdf.download.pdf/20210209_Literaturrecherchen_Covid-19-Impfstoffe_EN.pdf
⁵ Weekly epidemiological update on COVID-19 – 11 January 2022. World Health Organization. https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---11-january-2022

 ⁶ In comparison to 7-10 mutations in the other VOCs; Neutralization and Stability of SARS-CoV-2 Omicron variant. *medRxiv*. <u>https://www.biorxiv.org/content/10.1101/2021.12.16.472934v1.full</u>

⁸ Structural insights of SARS-CoV-2 spike protein from Delta and Omicron variants. *bioRxiv*. <u>https://www.biorxiv.org/content/10.1101/2021.12.08.471777v1</u>



⁷ The Omicron variant increases the interaction of SARS-CoV-2 spike glycoprotein with ACE2. *bioRXiv*. <u>https://www.biorxiv.org/content/10.1101/2021.12.06.471377v2</u>



induced immunity^{9,10}. While certain data and knowledge (i.e. real world vaccine effectiveness & transmissibility) regarding the Omicron strain need further clarification and analysis, recently published studies have confirmed that although vaccineinduced immune responses against Omicron is substantially lower than that of the ancestral wild type (Wuhan) strain¹¹, and the Alpha, Beta and Delta VOCs¹², neutralizing antibody responses remain protective among boosted (three vaccine doses)^{13,14} individuals or in previous SARS-CoV-2 infected persons who are double vaccinated¹⁵. Among plasma specimens of persons recently vaccinated (1.3 months) with either the Pfizer-BioNTech or Moderna vaccines, the 50% neutralization titre (NT_{50}) values were on average **127** (± 66 standard deviations; SD) times lower for the Omicron variant than the ancestral Wuhan strain¹⁶. Five months post full immunization, the mRNA vaccines' neutralization potency was 27 (±17SD) times lower for Omicron than for wild type. Specimens obtained from Johnson & Johnson vaccine recipients "lacked detectable neutralizing activity against the Omicron variant" at 1and 5-months post vaccination¹⁷. Plasma specimens among persons who had prior SARS-CoV-2 infections and were additionally fully (two-dose schedule) vaccinated, NT₅₀ values against Omicron were **154 times greater** than the pre-vaccination convalescent phase titres. Likewise, Omicron NT₅₀ values from plasma samples of boosted individuals were **38 times greater** than non-boosted individuals¹⁸.

¹⁸ Plasma neutralization of the SARS-CoV-w Omicron variant. The New England Journal of Medicine. <u>https://www.nejm.org/doi/10.1056/NEJMc2119641</u>



⁹ Reduced neutralization of SARS-CoV Omicron B.1.1.529 variant by post-immunization serum. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.10.21267534v1</u>

¹⁰ Reduced neutralization of SARS-CoV Omicron B.1.1.529 variant by post-immunization serum. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.10.21267534v1</u>

¹¹ Reduced neutralization of SARS-CoV Omicron B.1.1.529 variant by post-immunization serum. *medRxiv*. https://www.medrxiv.org/content/10.1101/2021.12.10.21267534v1

¹² SARS-CoV-2 Omicron Variant neutralization in serum from vaccinated and convalescent persons. New England Journal of Medicine. <u>https://www.nejm.org/doi/full/10.1056/NEJMc2119236?query=featured_home</u>

¹³ Variable loss of antiboy potency against SARS-CoV-2 B.1.1.529 (Omicron). *medRxiv*. https://www.biorxiv.org/content/10.1101/2021.12.19.473354v1

¹⁴ Neutralization and Stability of SARS-CoV-2 Omicron variant. *medRxiv*. <u>https://www.biorxiv.org/content/10.1101/2021.12.16.472934v1.full</u>

¹⁵ Imprinted SARS-CoV-2-specific memory lymphocytes define hybrid immunity. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2022.01.12.22269192v1</u>

¹⁶ Plasma neutralization of the SARS-CoV-w Omicron variant. The New England Journal of Medicine. <u>https://www.nejm.org/doi/10.1056/NEJMc2119641</u>

¹⁷ Plasma neutralization of the SARS-CoV-w Omicron variant. *The New England Journal of Medicine*. <u>https://www.nejm.org/doi/10.1056/NEJMc2119641</u>



Neutralization activities were undetectable in plasma samples of unvaccinated SARS-CoV-2 recovered individuals and of persons with only two doses of an mRNA vaccine, while neutralizing titres ranged from 1,411 to 56,537 in vaccinated convalescent and booster persons¹⁹. Another study that aggregated and analysed Omicron neutralization data from 23 laboratories across Europe and the United Kingdom observed that Moderna's mRNA-1273 vaccine was the only vaccine to demonstrate an **100%** response rate to Omicron²⁰. Response rates were significantly lower for the BNT162b2 (33%; interestingly the response rate increased to 47% after six months, indicating Omicron cross-protection over time), AZD1222 (50%) and Ad26.CoV2.S (9%) vaccines²¹. Geometric mean titres (GMT) against the Omicron strain were reduced by factors of 15.8, 12.8, and 28.8, for the mRNA-1273, AZD1222 and BNT162b2 vaccines, respectively, as compared to the wild type neutralization titres²². Another study analysing the neutralizing antibody titres against the Omicron variant observed that the serum samples from vaccinated individuals neutralized the Omicron variant to a much lesser extent than any other variant, including Alpha, Beta, or Delta²³. Out of all the vaccinated individuals, people who received either a homologous BNT162b2 vaccination or a heterologous ChAdOx1-S/ BNT162b2 vaccination had some cross-neutralization of the Omicron variant²³. Overall, **1/10** participants who received the mRNA-1273 vaccine 4 to 6 months ago, 0/10 participants who received the ChAdOx1-S vaccine one month ago, 14/20 participants who received the ChAdOx1-S vaccines as their first dose and the BNT162b2 as their second dose one month ago, and 9/20 participants who received the BNT162b2 vaccine one month ago reported to have neutralizing antibodies above the 16 IC₅₀ limit²³. Lastly, studies confirm that despite mutations on the S glycoprotein, T cell reactivity against the

²³ SARS-CoV-2 Omicron Variant Neutralization in Serum from Vaccinated and Convalescent Persons. The New England Journal of Medicine. https://www.nejm.org/doi/full/10.1056/NEJMc2119236



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¹⁹ Plasma neutralization of the SARS-CoV-w Omicron variant. The New England Journal of Medicine. https://www.nejm.org/doi/10.1056/NEJMc2119641

²⁰ Diminished neutralization responses towards SARS-CoV-2 Omicron VoC after mRNA or vector-based COVID-19 vaccinations. medRxiv. https://www.medrxiv.org/content/10.1101/2021.12.21.21267898v1

²¹ Diminished neutralization responses towards SARS-CoV-2 Omicron VoC after mRNA or vector-based COVID-19 vaccinations. medRxiv. https://www.medrxiv.org/content/10.1101/2021.12.21.21267898v1

²² Diminished neutralization responses towards SARS-CoV-2 Omicron VoC after mRNA or vector-based COVID-19 vaccinations. medRxiv. https://www.medrxiv.org/content/10.1101/2021.12.21.21267898v1



Omicron strain is retained to a greater extent than neutralizing antibodies²⁴ (the Omicron variant is estimated to be still **83%** recognisable by the cellular and humoral component of the immune system²⁵), and that booster vaccinations substantially enhance CD4+ and CD8+ T cell responses to the Omicron strain²⁶.

It is important to note that given the rapid emergence and global transmission of the B.1.1.529 SARS-CoV-2 strain, some of the reported studies, particularly those related to vaccination neutralization capacities against Omicron, have not been peer-reviewed and findings should be "interpreted with due consideration of this limitation"²⁷.

Effectiveness and Duration of Protection

As COVID-19 continues to surge worldwide throughout the Winter season, the Omicron VOC has been identified to be the cause of the majority of cases in many countries. Current literature shows that vaccine effectiveness (VE) against the latest VOC is significantly lower than that against earlier VOCs such as Beta and Delta.

Preliminary studies conducted in Canada show evidence that 2-doses of Pfizer, Moderna, or AstraZeneca vaccines were not protective against Omicron at any time points. VE was found to be -38% (95% CI, -61.0% to -18.0%) 120-179 and -42% (95% CI, -69.0% to -19.0%) 180-239 days after the second dose.²⁸ Alternatively, a study in Denmark investigating VE against Omicron contradicts these findings and show that VE was 55.2% (95% CI, 23.5 to 73.7%) for BNT162b2 and 36.7% (95% CI: -69.9 to 76.4%) for mRNA-1273 in the first month after primary vaccination.²⁹ However, these resulting VE were found to be significantly lower compared with Delta infection and

²⁹ Vaccine effectiveness against SARS-CoV-2 infection with the Omicron or Delta variants following a two-dose or booster BNT162b2 or mRNA-1273 vaccination series: A Danish cohort study. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.20.21267966v3</u>



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²⁴ T cell reactivity to the SARS-CoV-2 Omicron variant is preserved in most but not all prior infected and vaccinated individuals. medRxiv. <u>https://www.medrxiv.org/content/10.1101/2022.01.04.21268586v1</u>

²⁵ Preserved T cell reactivity to the SARS-CoV-2 Omicron variant indicates continued protection in vaccinated individuals. medRxiv. <u>https://www.biorxiv.org/content/10.1101/2021.12.30.474453v1</u>

²⁶ T cell reactivity to the SARS-CoV-2 Omicron variant is preserved in most but not all prior infected and vaccinated individuals. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2022.01.04.21268586v1</u>

²⁷ Weekly epidemiological update on COVID-19 – 11 January 2022. World Health Organization. <u>https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---11-january-2022</u>

²⁸ Effectiveness of COVID-19 vaccines against Omicron or Delta infection. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.30.21268565v1</u>



declined rapidly over time.³⁰ Results of the Danish study regarding VE of mRNA-1273 against Omicron were further corroborated by a study conducted in the United States which evidenced that VE against Omicron infection was **30.4% (95% CI, 5.0%-49.0%)** at 14-90 days after complete vaccination and declined quickly thereafter.³¹

Further, a study conducted in South Africa investigating the VE of Pfizer against Omicron showed that test positivity rate appeared to be higher during the designated proxy Omicron period (24.4% positivity) compared to rates during the dominance of the Delta variant (6.4% positivity). Effectiveness against hospitalization during Omicron period was also found to be significantly different at VE 70% (95% CI, 62.0-76.0) compared with VE 93% (95% CI, 90.0-94.0) during the Delta period.³²

While current literature show that VE and protection against Omicron are significantly lower in comparison with other VOCs, investigations must be continued in order to guide decision making regarding booster vaccination campaigns and other health measures.

Breakthrough Infections

A study conducted in the United States using samples collected from 27 November 2021 to 20 December 2021 shows early evidence that while Omicron patients had increased rates of breakthrough infections in comparison with patients infected with Alpha or Delta variants, these individuals were younger and less likely to require hospitalization. Additionally, of Omicron patients who were admitted to the hospital, less intense medical treatments were needed and overall length of stay was shorter.³³

³³ Early signals of significantly increased vaccine breakthrough, decreased hospitalization rates, and less severe disease in patients with COVID-19 caused by the Omicron variant of SARS-CoV-2 in Houston, Texas. *medRxiv.* <u>https://www.medrxiv.org/content/10.1101/2021.12.30.21268560v2</u>



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³⁰ Vaccine effectiveness against SARS-CoV-2 infection with the Omicron or Delta variants following a two-dose or booster BNT162b2 or mRNA-1273 vaccination series: A Danish cohort study. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.20.21267966v3</u>

³¹ Effectiveness of mRNA-1273 against SARS-CoV-2 omicron and delta variants. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2022.01.07.22268919v1</u>

³² Effectiveness of BNT162b2 Vaccine against Omicron Variant in South Africa. *The New England Journal of Medicine*. <u>https://www.nejm.org/doi/10.1056/NEJMc2119270</u>



These findings are largely consistent with results examining breakthrough infections in the Sisonke Ad.26.COV2.S vaccine trial conducted in South Africa. Among a total of 40,538 breakthrough infections detected during the period of study, it was found that Omicron daily infections were three times the peak observed during predominance of the Delta variant.³⁴ Of the 1,914 breakthrough infection-related hospitalizations identified, **408 hospitalizations occurred during Omicron** study period in comparison with **77 during the Beta period** and **1,429 during the Delta variant**. Among hospitalized HCWs, **3% required intensive care** during the Omicron period compared with **7% during Delta** and **16% during Beta** study periods.³⁵ Finally, the length of hospital stay was significantly lower with Omicron cases (median length of **3 days)** compared with Beta and Delta cases (median length of **5-6 days**).³⁶

Alternatively, a study examining infectious viral load among unvaccinated and vaccinated individuals infected with Alpha, Delta, and Omicron variants was conducted in Switzerland to gain insight regarding viral shedding kinetics and understand viral load in vaccine breakthrough infections. Results showed that among vaccinated, Delta infected individuals, infectious viral titers (IVTs) were significantly lower and virus cleared faster compared with unvaccinated individuals. Interestingly, vaccinated individuals infected with Omicron exhibited similar IVTs to those with Delta. Based on these early findings, researchers suggest that factors other than increased viral load may explain high infectiousness of the Omicron variant.³⁷

³⁷ Infectious viral load in unvaccinated and vaccinated patients infected with SARS-CoV-2 WT, Delta and Omicron. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2022.01.10.22269010v1</u>



³⁴ Breakthrough Covid-19 infections during periods of circulating Beta, Delta and Omicron variants of concern, among health care workers in the Sisonke Ad26.COV2.S vaccine trial, South Africa. *medRxiv.* <u>https://www.medrxiv.org/content/10.1101/2021.12.21.21268171v2.full.pdf</u>

³⁵ Breakthrough Covid-19 infections during periods of circulating Beta, Delta and Omicron variants of concern, among health care workers in the Sisonke Ad26.COV2.S vaccine trial, South Africa. *medRxiv.* <u>https://www.medrxiv.org/content/10.1101/2021.12.21.21268171v2.full.pdf</u>

³⁶ Breakthrough Covid-19 infections during periods of circulating Beta, Delta and Omicron variants of concern, among health care workers in the Sisonke Ad26.COV2.S vaccine trial, South Africa. *medRxiv.* <u>https://www.medrxiv.org/content/10.1101/2021.12.21.21268171v2.full.pdf</u>



At this point in time, early research findings show that breakthrough infections with the Omicron variant are more common, but are less severe compared with other VOCs. Further investigations are needed to confirm disease character from these preliminary studies.

Transmissibility

While the substantial increase of Omicron cases throughout the world "may indicate a higher rate of transmission compared to other variants"³⁸, few studies have analysed Omicron's true transmissibility rate in real-life populations, thus far. A model-inference system estimated B.1.1.529 transmission dynamics (adjusting for under-detection of infection, seasonality, vaccination rates, and implementation of nonpharmaceutical measures) using real life data from the Guateng province (first identified epicentre of the Omicron outbreak) in South Africa³⁹. Based on the study's real-life estimates, the Omicron variant is **100.3%** (95% CI, 74.8-140.4) more transmissible than the ancestral wild type (Wuhan) strain and 36.5% (95% CI, 20.9-60.1) more transmissible than the Delta VOC. Additionally, the Omicron variant was estimated to evade 63.7% (95% CI, 52.9-73.9) of the populations' pre-existing immunity (i.e., those recovered from SARS-CoV-2 and/or are vaccinated against SARS-CoV-2)⁴⁰. A Danish study corroborates the South-African data: Danish households infected with the Omicron VOC demonstrated secondary attack rates of 31%, while Delta-infected households' secondary attack rates were **21%**⁴¹. Whereas unvaccinated secondary cases had similar infection rates in Omicron-infected households (29%) to Delta-infected households (28%), fully vaccinated individuals had a secondary attack rate of 32% in Omicron households and 19% in Delta infected households⁴², demonstrating the variant's ability to evade vaccine immunity. Nevertheless, the secondary attack rate

⁴² SARS-CoV-2 Omicron VOC Transmission in Danish Households. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.27.21268278v1.full-text#T3</u>



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³⁸ Neutralization and Stability of SARS-CoV-2 Omicron variant. *medRxiv*. https://www.biorxiv.org/content/10.1101/2021.12.16.472934v1.full

³⁹ SARS-CoV-2 transmission dynamics in South Africa and epidemiological characteristics of the Omicron variant. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.19.21268073v1.full-text</u>

⁴⁰ SARS-CoV-2 transmission dynamics in South Africa and epidemiological characteristics of the Omicron variant. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.19.21268073v1.full-text</u>

⁴¹ SARS-CoV-2 Omicron VOC Transmission in Danish Households. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.27.21268278v1.full-text#T3</u>



diminished for boosted (three-dose schedule) individuals; the attack rate was **25%** for Omicron and **11%** for Delta⁴³. The odds ratio (OR) for becoming infected with Omicron was **1.04** (95% CI, 0.87-1.24) for unvaccinated persons and **0.54** (95% CI, 0.4-0.71) for boosted individuals⁴⁴. Lastly, a case report described a possible airborne transmission of the Omicron variant "between 2 fully vaccinated persons [who had no contact whatsoever] across the corridor of a quarantine hotel" in Hong Kong⁴⁵.

Booster Dose

The variant Omicron (B.1.1.529), first detected in South Africa and Botswana and with a large number of accumulated spike mutations, has rapidly spread over seas and has overthrown other variants of concern, such as Delta, by becoming the predominant variant in many nations. With the massive and rapid transmission of Omicron, various countries have expanded, accelerated, and encouraged the administration of a booster dose in the general population with the hopes of boosting the decreasing number of neutralization antibodies in individuals vaccinated over 5 to 6 months ago. Thus far, the administration of a booster dose, regardless of it being homologous or heterologous to the primary schedule, has shown to re-establish and provide an increased protection against the Omicron variant compared to the two initial doses in terms of neutralizing antibodies and effectiveness. Despite this increase, a reduction in neutralizing antibodies and effectiveness is reported for Omicron when comparing it to the wild type and previous variants.

Booster Doses (Homologous & Heterologous)

Although the longevity of vaccine-induced immunity remains an ongoing discussion and continues to spark debate for the use of booster doses, multiple studies and a great deal of evidence have demonstrated that the immunogenicity of fully vaccinated

⁴⁵ Probable transmission of SARS-CoV-23 Omicron variant in quarantine hotel, Hong Kong, China, November 2021. *Emerging Infectious Diseases*. <u>https://wwwnc.cdc.gov/eid/article/28/2/21-2422_article</u>



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 ⁴³ SARS-CoV-2 Omicron VOC Transmission in Danish Households. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.27.21268278v1.full-text#T3</u>
 ⁴⁴ SARS-CoV-2 Omicron VOC Transmission in Danish Households. *medRxiv*.

https://www.medrxiv.org/content/10.1101/2021.12.27.21268278v1.full-text#T3



individuals wanes over time, especially in immunocompromised and older individuals. This issue has been highlighted after the exponential increase in breakthrough infections with the Omicron variant. Multiple countries have approved and started implementing booster vaccination programs to prioritize risk-groups and older individuals, all while expanding the program to include all individuals. New WHO EUL approved vaccines such as the Novavax (NVX-CoV2373) and the Covaxin (BBV152) vaccines have published their results on the administration of booster doses. Based on the results, the administration of a third dose of Covaxin **increased** the neutralizing antibodies against SAR-CoV-2 by a 19- to 97-fold and the neutralizing antibodies against Delta by a **174-fold** compared to the initial two doses⁴⁶. Additionally, the third dose was proven to be safe and well tolerated amongst the participants. As for Novavax's booster dose, the results reported to enhance the immune response by increasing the neutralizing antibodies against SAS-CoV-2 and its variants of concern (Alpha, Beta, Delta, and Omicron) all while remaining safe and well tolerable⁴⁷. Regarding the administration of heterologous booster doses, a similar and at times higher increase in antibodies and immune response can be seen in participants receiving heterologous booster doses.

Currently, literature regarding the duration and possible waning of antibodies induced by the booster doses remains limited. One study examining the durability of the response to the third dose of the BNT162b2 vaccine in adults aged 60 years and older demonstrated that the **anti-spike IgG and neutralizing antibody levels remain adequate 3 months after the booster dose**⁴⁸. On the other hand, another study examining the viral-dose reduction effectiveness of the BNT162b2 booster dose over

⁴⁸ Durability of response to the third dose of the SARS-CoV-2 BNT162b2 vaccine in adults aged 60 years and older: Threemonth follow-up. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.25.21268336v1</u>



 ⁴⁶ Persistence of immunity and impact of a third (booster) dose of an inactivated SAR-CoV-2 vaccine, BBV152; a phase 2, double-blind, randomized controlled trial. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2022.01.05.22268777v1</u>

⁴⁷ Immunogeneicity and Safety following a Homologous Booster Dose of a SARS-CoV-2 recombinant spike vaccine (NVX-CoV2373): A Phase 2 Randomized Placebo-Controlled Trial. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.23.21267374v1</u>



time, reported a **significant decline within months after the booster dose**⁴⁹. While the duration of protection of the booster doses remains relatively unknown, countries such as Israel begun vaccinating citizen aged 60 years and over and health-care workers with the fourth dose of a COVID-19, on 2 January 2022, amid the rapid spread of Omicron and the increasing spike of COVID-19 infections⁵⁰.

Children Vaccination

Since 29 October 2021, The BNT162b2 vaccine has been approved in the US for usage in children as young as 5 years old. Since then, many other countries have moved on to this step of the vaccination scheme. Studies to assess the safety and effectiveness of vaccination in children are on-going, and many studies are pending in this area. The vaccine with the most available data so far is the BNT162b2 (Pfizer-BioNTech) vaccine. Interim findings from a US study assessing the effectiveness of the BNT162b2 vaccine against hospitalization and severe Covid-19 among adolescents aged 12-18 showed that effectiveness against hospitalization was 94% (95% CI, 90-96). Vaccine effectiveness against requiring ICU services was 98% (95% CI, 93-99), and vaccine effectiveness against requiring life support was similar.⁵¹ Falling in line with the trend of waning vaccine duration over time seen in adults, an Israeli study evaluated the duration of protection provided by the BNT162b2 vaccine among adolescents aged 12-16 and found that vaccine effectiveness against breakthrough infection reduced to 75% (95% CI: 71%, 79%) after 90-149 days after receipt of a second dose and was reduced to 58% (95% CI: 52%, 64%) 150-180 days after the second dose. Vaccine effectiveness against symptomatic infection was 78% (95% CI: 73%, 82%) after 90-140 days since receipt of a second dose and 65% (95% CI: 58%, 71%) after 150-180 days since receipt of a second dose.⁵²

⁵⁰ Fourth dose of COVID-19 vaccines in Israel. *The Lancet – Respiratory Medicine.* <u>https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(22)00010-8/fulltext</u>

⁵² Prunas O, Weinberger DM, Pitzer VE, Gazit S, Patalon T. Waning Effectiveness of the BNT162b2 Vaccine Against Infection in Adolescents. medRxiv. 2022:2022.01.04.22268776. doi:10.1101/2022.01.04.22268776



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⁴⁹ Waning of SARS-CoV-2 booster viral-load reduction effectiveness. *medRxiv*. <u>https://www.medrxiv.org/content/10.1101/2021.12.27.21268424v1</u>

⁵¹ Olson SM, Newhams MM, Halasa NB, et al. Effectiveness of BNT162b2 Vaccine against Critical Covid-19 in Adolescents. New England Journal of Medicine. 2022;doi:10.1056/NEJMoa2117995



Previous reports have mentioned the rare yet concerning adverse event of multiinflammatory syndrome in children (MIS-C). A US study identified 21 potential cases of MIS-C after vaccination through a national surveillance program and found that of the 21 adolescents with MIS-C, 15 (71%) had evidence of SARS-CoV-2 infection. Of these 15 cases, 47% (7) were aged 12-15, 33% (5) were aged 16-17, 20% (3) were aged 18-20. 66% of these patients had only received one dose of the vaccine. The remaining 6 cases had no evidence of SARS-CoV-2 infection. All patients observed showed clinical improvement, did not have major complications beyond MIS-C, and were sent home.⁵³

Studies on the safety and immunogenicity of both the BBIP-CorV and BBV152/Covaxin vaccines in children showed mild to moderate immediate local side effects, with the most common being injection site pain/tenderness for both studies. The study on Covaxin stated the most common systemic adverse event as mild to moderate fever, with no age group reaching more than 15% occurrence. Both studies showed robust immunogenic responses to the vaccines among adolescent recipients when compared to adult recipients. This study further confirms the finding of improved immunogenicity of children as opposed to adults for other vaccines as well.^{54 55}

Vaccine Safety and Adverse Events

The first case of thrombotic thrombocytopenic purpura was reported in a 25-year-old male patient, after receiving the Spikevax vaccine (mRNA-1273, Moderna BioTech, USA)⁵⁶.

⁵⁶ First diagnosis of thrombotic thrombocytopenic purpura after SARS-CoV-2 vaccine – case report. *BMC Nephrology*. <u>https://bmcnephrol.biomedcentral.com/articles/10.1186/s12882-021-02616-3</u>



⁵³ Yousaf AR, Cortese MM, Taylor AW, et al. Reported Cases of Multisystem Inflammatory Syndrome in Children (MIS-C) Aged 12–20 Years in the United States Who Received COVID-19 Vaccine, December 2020 through August 2021. medRxiv. 2022:2022.01.03.22268681. doi:10.1101/2022.01.03.22268681

⁵⁴ Tawinprai K, Siripongboonsitti T, Porntharukchareon T, et al. Safety and immunogenicity of the BBIBP-CorV vaccine in adolescents aged 12-17 years in Thai population, prospective cohort study. medRxiv. 2022:2022.01.07.22268883. doi:10.1101/2022.01.07.22268883

⁵⁵ Vadrevu KM, Reddy S, Jogdand H, et al. Immunogenicity and safety of an inactivated SARS-CoV-2 vaccine (BBV152) in children from 2 to 18 years of age: an open-label, age-de-escalation phase 2/3 study. medRxiv. 2021:2021.12.28.21268468. doi:10.1101/2021.12.28.21268468



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





Synoptic Table

Synoptic table about SARS-CoV-2 vaccines accepted in the WHO's Emergency Use Listing (as of 14 January 2022)

	BNT162b2/ COMIRNATY (Pfizer-BioNTech, USA)	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273 (Moderna, USA)	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield (AstraZeneca/Oxf ord, UK, India)	Janssen COVID- 19 vaccine/Johnson & Johnson (Janssen, USA)	BBIBP-CorV, (Sinopharm, China)	CoronaVac (Sinovac, China)	COVAXIN / BBV152 (Bharat Biotech, India)	Novavax/ NVX- CoV2373
			GENER	AL VACCINE INFOR	MATION			
Platform	mRNA-based vaccine	mRNA-based vaccine	Non-replicating vector-based vaccine	Non-replicating vector-based vaccine	Inactivated virus (Vero cell)	Inactivated virus (Vero cell)	Whole-virion inactivated Vero cell	Recombinant protein (nanoparticle) vaccine with Matrix-M adjuvant
Dose and frequency	2 doses, 21 days apart	2 doses, 28 days apart	2 doses, 4-12 weeks apart	1 dose, once [Phase III trials currently testing 2- dose regime, 56 days apart] ⁱ	2 doses, 21 days apart	2 doses, 14 days apart	2 doses, 28 days apart	2 doses, 21 days apart
Target population	12 years old and over	12 years old and over	18 years old and over	18 years old and over	18 years old and over	18 years old and over	18 years old and over	18 years old and over
Storage conditions	2°C to 8 °C (for 1 month)	2°C to 8 °C (for 1 month)	2°C until 8 °C	2°C to 8 °C (for 3 months)	2°C until 8 °C	2°C until 8 °C	2°C until 8 °C	2°C to 8 °C

ⁱ Johnson & Johnson Announces Real-World Evidence and Phase 3 Data Confirming Strong and Long-Lasting Protection of Single-Shot COVID-19 Vaccine in the U.S. Johnson & Johnson. <u>https://www.jnj.com/johnson-johnson-announces-real-world-evidence-and-phase-3-data-confirming-strong-and-long-lasting-protection-of-single-shot-covid-19-vaccine-in-the-u-s</u>

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Approving authorities	FDA (11.12.20) ⁱⁱ ; EMA (21.12.20); WHO EUL (31.12.20); and list of 112 countries (including Switzerland – approved on 20.12.20)	FDA (18.12.20); EMA (06.01.21); WHO EUL (30.04.21); and list of 79 countries (including Switzerland – approved 12.01.21)	FDA (awaiting on approval); EMA (29.01.21); WHO EUL (15.02.21); and list of 127 countries (Switzerland awaiting on approval)	FDA (27.02.21); EMA (11.03.21), WHO EUL (12.03.21), and list of 85 countries (including Switzerland – approved 22.03.21)	WHO EUL (07.05.21); and list of 72 countries (including Argentina, Bahrain, Brazil, China, Indonesia, United Arab Emirates, Zimbabwe)	WHO EUL (01.06.21), and list of 47 countries (including Albania, Chile, Egypt, Hong Kong, Malaysia, Tunisia, Turkey, Ukraine)	WHO EUL (03.11.21) and list of 12 countries (including Guyana, Inidia, Iran, Mauritius, Mexico, Nepal, Paraguay, Philippines & Zimbabwe)	Waiting on approval (Not-yet-approved by countries or WHO for emergency use)
Booster shot approving authorities	EMA approved booster for those aged 18 and above, 6 months after the 2 nd dose ¹ FDA approved booster for those ages 16 and above, 6 months after the 2 nd dose ⁱⁱⁱ Swissmedic approves booster	EMA authorised booster dose for immunocompromi sed individuals ^v FDA approved third booster dose for individuals >65 and high-risk individuals, 6 months after the 2 nd dose ^{vi} Swissmedic approves booster dose for adults	-	-	-	-	-	-

^{vi} F.D.A. Panel recommends booster for many Moderna vaccine recipients. The New York Times. <u>https://www.nytimes.com/2021/10/14/us/politics/fda-moderna-vaccine-boosters.html</u>



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ⁱⁱ Pfizer-BioNTech's Comirnaty Vaccine received full FDA approval on 23 August 2021 for people age 16 and above, moving it beyond emergency use status. <u>https://www.fda.gov/news-events/press-announcements/fda-approves-first-covid-19-vaccine</u>

iii FDA authorizes booster dose of Pfizer-BioNTech COVID-19 vaccine for certain populations. FDA News Release. https://www.fda.gov/news-events/press-announcements/fda-authorizes-boosterdose-pfizer-biontech-covid-19-vaccine-certain-populations

^v Comirnaty and Spikevax: EMA recommendations on extra doses and boosters. European Medicines Agency. <u>https://www.ema.europa.eu/en/news/comirnaty-spikevax-ema-recommendations-extra-doses-boosters</u>



	dose for everyone aged 16 and over ^{iv}	aged 18 and over ^{vii}						
			EFFECTIVENESS	AGAINST ANY SAR	S-COV-2 INFECTIO	N		
	BNT162b2/ COMIRNATY	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield	Janssen COVID- 19 vaccine/Johnson & Johnson	BBIBP-CorV,	CoronaVac	COVAXIN / BBV152	Novavax/ NVX- CoV2373
Effectiveness single dose	Against any SARS-CoV-2 infection: 70% ² . 77.6% (95% Cl, 70.9-82.7) ³ 36.8% (95% Cl, 33.2-40.2) [3 weeks after first dose] ⁴ 57% (95% Cl, 52- 61; Spain) [Apr- Aug] ⁵ 72% (pooled meta-analysis) ⁶ 64% (95% Cl, 59%-68%; United	Against SARS- CoV-2 infection: 60% (95% CI, 57- 64; >2 weeks after dose) ^{10,ix} 88.9% (95% CI, 78.7-94.2) ³ 66% (95% CI, 56- 73; Spain) [Apr- Aug] ⁵ 69% (pooled meta-analysis) ⁶ 64% (95% CI, 59%-68%; United States) [May to July 2021] ^{7x} 39.6% (95% CI, 36.3-42.8;	Against SARS- CoV-2 infection: 31.4% (95% Cl, 25.7-36.7; Norway) [Jan- Sep] ⁸ Symptomatic disease: 67% ¹¹ 49% (95% Cl, 32.0-62.0; India) [Apr-Jun] ¹² 41% (95% Cl, 34- 48; Spain) [Apr- Aug] ⁵ 51% (pooled meta-analysis) ⁶	Against SARS- CoV-2 infection: 50.6% (95% CI, 14.0-74.0) [<2 weeks after dose]; 76.7% (95% CI, 30.3-95.3) [>2 weeks after dose] ¹³ ; 79% (95% CI, 77- 80) (when corrected for under-recording, VE was estimated to be 69% (95% CI, 67-71) ¹⁴ .	Partial protection ²⁶ .xvi	 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 death²⁷. 18.6% (95% CI, 17.6-19.6) against SARS-CoV-2 infection, 28.1% (95% CI, 26.3- 	Against symptomatic disease: 45% (95% CI,6.0- 68.0; India) [Apr- Jun] ¹² 40% (95% CI, -21- 71; India) less than 7 days after first dose [April- May] ²⁹ 1% (95% CI, -30- 25); India) at least 7 days after first dose [April-May] ²⁹	Ongoing studies in South Africa ³⁰ and the United Kingdom ³¹

^{iv} COVID-19 vaccine from Pfizer/BioNTech: Swissmedic approves the extension of the booster dose to everyone aged 16 years and over. *Swissmedic.* <u>https://www.swissmedic.ch/swissmedic/en/home/news/coronavirus-covid-19/covid-19-impfstoff-pfizer-biontech-boosterdosis.html</u>

vii Swissmedic approves booster dose of the Moderna COVID-19 vaccine for adults aged 18 and over. Swissmedic. <u>https://www.swissmedic.ch/swissmedic/en/home/news/coronavirus-covid-19/auffrischimpfung-boosterdosis-impfstoff-moderna-ab-18-jahren.html</u>

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



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

^{*} Results do not disaggregate between mRNA vaccines, BNT162b2 and mRNA-1273.



<u> </u>		- · ·					
	States) [May to July 2021] ^{7/iii} 19.6% (95% CI, 17.3-21.9; Norway) [Jan- Sep] ⁸ Against <u>symptomatic</u> <u>disease</u> : 66% (95% CI, 60- 71; Spain) [Apr- Aug] ⁵ <u>Individuals \geq 70:</u> Symptomatic disease: 58% ⁹ .	Norway) [Jan- Sep] ⁸ Against symptomatic disease: 71% (95% CI, 61- 79; Spain) [Apr- Aug] ⁵ Individuals \geq 70: Symptomatic disease: 64% (95% CI, 46-78; >2 weeks after dose) ¹⁰ .xi	46% (95% CI, 37- 54; Spain) [Apr- Aug] ⁵ <u>Individuals ≥70:</u> Symptomatic disease: 58% ⁹ .	71% (95% CI, 56- 81) [11 March – 15 August] ¹⁵ . 61% (95% CI, 29- 84) [January- June] ¹⁶ 50.9% (95% CI, 35.1-63.0) [June- September; Brazil] ¹⁷ 50.0% (95% CI, 42.0-57.0; Spain) [Apr-Aug] ⁵ 73.6% (95% CI, 65.9-79.9; US) [Feb-Jul] ¹⁸ 82.3% (95% CI, 75.1-87.4%; USA) [16 Dec 2020 to 30 Sep 2021] ^{19xii} Among individuals with history of infection, VE against symptomatic infection ≥ 14	29.9) against hospitalization, 28.5% (95% CI, 25.4-31.4) against ICU admission, and 29.4% (95% CI, 26.7.3-31.9) against death [January-April] ²⁸	-1% (95% Cl, -51- 33; India) at least 21 days after first dose [April-May] ²⁹	
				symptomatic			

viii Results do not disaggregate between mRNA vaccines, BNT162b2 and mRNA-1273.

xii Study does not differentiate between Pfizer, Moderna, and Janssen.



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



	Ad26.COV2.S. [Brazil] ²⁰	
	<u>Symptomatic</u> <u>disease</u> : 54% (95% CI, 45- 62; Spain) [Apr- Aug]⁵	
	81% (95% CI, 79- 84) for preventing hospitalization when corrected for under-recording, VE was estimated to be 73% (95% CI, 69-76) ¹⁴ .	
	75% (95% CI, 65- 82) against severe critical COVID- 19 ²¹	
	66.1% against moderate to severe-critical COVID-19 cases after 28 days [ENSEMBLE study; Sep 2020- Nov 2021) ²²	
	85.4% against severe COVID-19 cases after 28 days [ENSEMBLE	



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	study; Sep 2020- Nov 2021) ²²		
	<u>Individuals ≥50:</u> 68% (95% CI, 50- 79) ²³ .		
	VE against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection was 89.1% (95% CI 85.6–92.6%), VE against COVID- 19-related hospitalization was 97.2% (95% CI 96.1–98.3%), and VE against admission to the intensive care unit 97.4% (95% CI 96.0–98.8%), and against death was 99.0% (95% CI 98.5–99.6%).		
	[Overall average from literature review and meta- analysis] ^{24xiii}		

^{xiii} Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.



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VE against infection in the general population aged ≥16 years was 86.1% (95% CI 77.8–94.4%), for the elderly VE was 83.8% (95% CI 77.1–90.6%), and for healthcare workers VE was 95.3% (95% CI 92.0– 98.6%).[Overall average from literature review and meta- analysis] ^{24xiv}	
Adjusted VE was 71% (95% confidence interval, 49%- 83%) among fully vaccinated participants reporting contact with persons with COVID-19 versus 80% (95% CI, 72%-86%) among those without contact.[United	

^{xiv} Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.



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				States; February 2021 to September 2021] ^{25xy}				
Effectiveness of two doses	SARS-Cov-2 infection: 85%2. 94.6%32. 94.5%33. 76% (95% CI, 69- 81) [Jan-Jul] ³⁴ . 88.8% (95% CI, 84.6-91.8) [Dec 2020-May] ³ 74% (95% CI, 72- 76) [Jan-Jun] ¹⁶ 77.5% (95% CI, 43- 51) [5 months after second dose] ⁴ 47% (95% CI, 43- 51) [5 months after second dose] ³⁵ 56% (95% CI, 53- 59) [4 months after second dose] ³⁶ 69% (95% CI, 66- 72; Spain) [Apr- Aug] ⁵	SARS-Cov-2 infection: 100% ³² . 86% (95% CI, 81- 90.6) [January- July] ³⁴ . 96.3% (95% CI, 91.3-98.4) [December-May] ³ 85% (95% CI, 80- 90) [January- June] ¹⁶ 71% (95% CI, 68- 74) [4 months after second dose] ³⁶ 63% (95% CI, 44- 76) [June- August] ⁵⁰	Asymptomatic <u>efficacy:</u> 61.9% ⁵¹ <u>SARS-CoV-2</u> <u>infection</u> : 53% (95% Cl, 12- 84) [January- June] ¹⁶ 27% (95% Cl, 17- 37) [4 months after second dose] ³⁶ 88% (95% Cl, 79.0-94.0; India) [Apr-Jun] ¹² 54.0% (95% Cl, 48-60; Spain) [Apr-Aug] ⁵ 43.4% (95% Cl, 4.4-66.5; Norway) [Jan-Sep] ⁸	Not Applicable (one dose schedule)	Partial protection ²⁶ . ^{xli}	 65.9% for preventing COVID-19; 87.5% for preventing hospitalization; 90.3% for preventing ICU admission; and 86.3% for preventing COVID-19 related death²⁷. 52.7% (95% CI, 52.1-53.4) against SARS-CoV-2 infection, 72.8% (95% CI, 71.8- 73.7) against hospitalization, 73.8% (95% CI, 72.2-75.2) against ICU admission, and 73.7% (95% CI, 72.3-75.0) against death [January-April]²⁸ 	Against symptomatic disease: 71% (95% CI, 41- 85; India) [Apr- Jun] ¹² VE against symptomatic COVID-19 (second dose administered at least 14 days before RT-PCR testing) 50% (95%CI 33.0-62.0; India)[April 15 to May 15 2021] ⁵⁴ <u>Effectiveness of</u> full vaccination: 69% (95% CI; 54- 79; India) [May - July 2021] ⁵² 50% (95% CI, 33- 62; India) 14 days	Ongoing studies in South Africa ³⁰ and the United Kingdom ³¹ 89.7% protection against SARS- CoV-2 infection (95% CI, 80.2- 94.6; United Kingdom) ⁵⁵

^{xv} Study does not differentiate between Pfizer, Moderna, and Janssen

x^{li} Study did not report numerical data on vaccine effectiveness. Further studies are required to validate results. Death reports on fully vaccinated doctors (10 cases during June 2021 in Indonesia). It may be related to new variants [media report]. Indonesian Covid deaths add to questions over Sinovac vaccine. *The Guardian* [press release]. https://www.theguardian.com/world/2021/jun/28/indonesian-covid-deaths-add-to-questions-over-sinovac-vaccine



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^{xvii} Results do not disaggregate between mRNA vaccines, BNT162b2 and mRNA-1273.

^{xviii} Study does not differentiate between Pfizer, Moderna, and Janssen.

^{xxvii} Results do not disaggregate between mRNA vaccines, BNT162b2 and mRNA-1273.

xxviii Study does not differentiate between Pfizer, Moderna, and Janssen.

xxxvi Study does not differentiate between Comirnaty and Vaxrevria



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VE was 49% (95%) G2 20%: (97.7%)[England]VE against severe syndromegeneral population aged >16 years01 20 20%: (97.7%)[England]98.1%, [Overall average from interture reviewacute respiratory connavnus 2ageneral population aged >16 yearsHigher dose two with no-se week interval between scheduleVE against syndrome86.1%, (95%) infection was syndromeCl 77.8-94.4%), infection was schedule87.6-92.6%), VE against 2000Cl 77.8-94.4%), infection was scheduleSyndrome with no-se week interval between scheduleVE against syndromatic syndromatic schedule85.6-92.6%), VE syndromatic infection was schedule87.6-92.6%), VE syndromatic schedule87.6-92.6%), VE syndromatic schedule87.6-92.6%), VE syndromatic schedule87.6-92.6%, VE syndromatic schedule87.6-92.6%, VE syndromatic schedule87.6-92.6%, VE syndromatic schedule98.6%, [Overall schedule14-35 days after cose two are extended vaccine thigher in stored waccine schedule <br< th=""><th></th><th></th><th></th><th></th><th></th></br<>					
Cl 22 0%- 67.0%)[England] ³⁶ average from syndromeacute respiratory syndromeaged 216 years67.0%)[England] ³⁶ average from iterature review connavirus 2Cl 77.8-94.4%), for the elderly VEHigher dose two WE was observed with -6 weekand meta- analysis](SARS-CoV-2) analysis]for the elderly VEHigher dose two WE was observed with -6 weekVE against analysis]86.1% (95% GlCl 77.1-90.6%), elderly VEBNT (62b2 doses compared to the standardVE against interval between80.4% (95% GlCl 77.1-90.6%), elderly VESchedule, etablesverage from against COVID-gainst COVID- vorkers VE was schedule, estimated at 94% was 97.2% (95% Gl96.6% (95% GlSpecifically, (95% GL 68-97%)(96.1-98.3%), vas 97.2% (95% of 96.1-98.3%),98.6%),[Overall average from antibody levelsId-35 days after triched vaccine196.1-98.3%), vas 97.2% (95% of 96.1-98.3%),was 97.9% verage from analysis] ²⁴⁸⁴¹ Id-35 days after triched vaccine196.1-98.3%), vas 97.2% (95% of 96.1-98.3%),VE against severe analysis] ²⁴⁸⁴¹ Id-35 days after triched vaccine25 weeks from a sond on the adainst on to the adainst death as 90.9% (95% Cl cornavirus 2VE against severe analysis] ²⁴⁸⁴¹ Id-96.5%, Cl triched vaccine25 weeks from a sond on the adainst death adainst deat	VE was 49% (95%	vaccine was	VE against severe	general population	
67.0%)[England]**syndromesyndromewas 86.1% (95%)Higher dose two and meta- analysis] **(SARS-CoV-2)C1 77.8-94.4%)), for the elderly VEVE was observed with hos weekand meta- malysis] **(SARS-CoV-2)For the elderly VEWith rose weekVE against85.6-92.6%), VEand for healthcare workers VE wasBNT162b2 doses compared to the scheduleSARS-CoV-219-related99.3% (95% CIstandard infection was schedulesoftware software95.% (95% CI20standard infection was schedule65% (95% (95%)20standard infection was schedule65% (95% (95%)20standard infection was to dow are dose two are estimations from a higher in second dose was are estimations from a interval (95% CI, 86-97%)C1 96.1-98.3%), and the and meta- admission to the meta-social second and was 99.0% (95%VE against severe acute respiratory syndromeBNT162b2VE greater than a dagainst deathand meta- analysis]****30.1% (95% CI acute respiratory was 99.0% (95%VE against severe acute respiratory against severe analysis]acuter application with those dosy bord to even a standard (19-24 covical addis greater evelwed than 26 weeks from a standard (19-24 covical addis greater individuals greater on individuals greater on individuals greater individuals greater individuals greater on individuals greater individuals greater evelwe 6-fold higher at 14-35 dys post dose 2VE against against 1% (95% cICI 96.1-98.3%), coronavirus					
Index Infection was with s6 weekcoronavirus 2 (SARS-CoV-2) infection was b9.1% (95% C1 B9.1% (95% C1 B7.162b2Coronavirus 2 (95% C1 B9.1% (95% C1 B7.162b2Coronavirus 2 (95% C1 B7.162b2BNT162b2 scheduleVE against infection was bospitalizationSARS-CoV-2) (95% C1 B9.1% (95% C1 B9.1% (95% C1 B7.162b2With s6 week scheduleVE against (95% C1 B5.162b2BNT162b2 scheduleSARS-CoV-2 against COVID- scheduleInfection was bospitalization92.0- B7.162b2Specifically, 14-35 days after biper in extinations from scheded vicinationC19.1-9.3%) B7.162b2Infection was bospitalizationBNT162b2 biper in with those corpared to the biper in extinated vicinationC19.5-99.6%) (95% C1.96.0-98.8%)VE against severe and saginst teatth and saginst teatth adainst cotheInterval (65-84 scond dose was corpared to the biper in extinated vicinationC19.5-99.6%), (95% corpared to the corpared to the c	67.0%)[England] ³⁹				
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VE was observed with >6 weekanalysis] 24infection was 89.0% CIwas 83.8% (95%) CI 77.1-90.6%), and for healthcare workers VE was 95.3% (95%) CI and for healthcare workers VE was 95.3% (95%) CI 95.4% CI 95.3% (95%) CI 95.4% CI <th>Higher dose two</th> <th>and meta-</th> <th>(SARS-CoV-2)</th> <th></th> <th></th>	Higher dose two	and meta-	(SARS-CoV-2)		
with >6 weekwith >691% (95% ClCl 77.1-90.6%), and for healthcareinterval betweenVE against85.6-92.6%), VEand for healthcareBNT162b2 dosessymptomaticagainst COVID-workers VE wascompared to theSARS-CoV-219-related95.3% (95% Clstandardinfection wasnospitalization92.0-scheduleestimated at 94%was 97.2% (95%)98.6%).[OverallSpecifically.(95% Cl 86-97%)Cl 96.1-98.3%).average fromantibody levelsfor mRNA-and VE againstliterature review14-35 days after1273.[Based ondomission to theand mission to thehigher inRapid Review!*0unit 97.4% (95%)UUBNT162b2U09.0-98.8%).UUCl 96.0-98.8%).Coronavirus 2SyndromeCl 98.2-99.6%).Coronavirus 2days) compared65% (95% Cl[Overall average](SARS-CoV-2)infection waswith hose65.0-66.0) and VEform iterature89.1% (95% Clagainst classified atdays) intervalhospitalizations for individual spraeterID erature89.1% (95% Clagainst COVID-days) intervalindividual spraeterVE against19-relatedfollowing the infection in the 		analysis] ²⁴	infection was		
interval between BNT162b2 doses symptomaticKE against against COVID- against COVID- specifically absolutionand for healthcare workers VE was gowers VE was ve was very (95% CI 96.0 and VE gowers VE was gowers VE was <th>with >6 week</th> <th></th> <th></th> <th></th> <th></th>	with >6 week				
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schedule.estimated at 94%was 97.2% (95%95%95.6%).[Overall average from average from average from iterature review antibody levels6196.1-98.3%). C1 96.1-98.3%).average from average from average from iterature review and meta- and yes and wission to the intensive care unit 97.4% (95% C1 96.0-98.8%).and VE against severe analysis]244iiBNT 162b2	compared to the	SARS-CoV-2	19-related	<mark>95.3% (95% Cl</mark>	
Specifically antibody levels 14-35 days after toware estimations from a higher in extended vaccine interval (65-84 days corpared schedule, antibody levelsCl 96.1-98.3%), and VE against intensive care unit 97.4% (95% Cl 96.0-98.8%), Cl 96.0-98.8%), Cl 96.0-98.8%),average from literature review and meta- analysis] ^{24kili} Rapid Review] ⁴⁵⁰ WE greater than and against death vaccinated with a standard (19-29 Colv-2 related days) compared days interval, hospitalizations for hospitalizations for intensive care cl 96.0-98.8%),VE against severe acute respiratory syndromedays compared days) compared days interval, bospitalizations for Following the individuals greater textended than 26 weeksDoverall average from literature from literature infection in the schedule, antibody from a second dese was 73% dese was 73% desys bose 2VE against days or poly (95% cl, 71.0-1 was 86.1% (95% cl 217.8-94.4%),Average from and variant days or poly days or to the days or poly days or poly following the individuals greater individuals grea	standard	infection was	hospitalization	92.0-	
antibody levelsfor mRNA- addysignedand VE against admission to the admission to theliterature review and meta- analysis] ²⁴⁸⁰⁰⁰ BNT162b2VE greater than and against deathacute respiratory syndromerecipients with an extended vaccine those26 weeks from a ads 99.0% (95%)VE against severe acute respiratorydays) compared vaccinated with a standard (19–2965% (95% CI, from literature(SARS-CoV-2) imfection was against SARS- review and meta- analysis](2400001vaccinated with a standard (19–29CoV-2 related infection in the infection in the infection in the infection in the schedule, antibodyMeta- against 2000VE against levels were 6-fold hgber at 14–35g6% CI, 71.0- (95% CI, 71.0-Was 86.1% (95% aged >16 yearsCI 96.1–93.3%), admission to the	schedule.	estimated at 94%	was 97.2% (95%	98.6%).[Overall	
14-35 days after dose two are higher in BNT162b21273.[Based on estimations from a higher in Rabi device) ⁴⁵ admission to the intensive care unit 97.4% (95% C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-98.8%), C1 96.0-99.6%), C1 96.0-99.6%), C1 96.0-99.6%), C1 96.0-99.6%), Coronavirus 2 days) compared 65.0-66.0) and VE from literature from literature from literature from literatureand against death second dose was c 198.5-99.6%), C1 98.5-99.6%), Coronavirus 2 (SARS-COV-2) from literature from literatureSyndrome syndrome (SARS-COV-2) infection was s9.1% (95% C1 s5.6-92.6%), VE against SARS- review and meta- against SARS- review and meta- analysis](24xxxii standard (19-29 for V-2 related days) interval, hospitalizations for hospitalizations infection in the infection infection infection infection infection infection infection infection infection infection infection infection infection <th>Specifically,</th> <th><mark>(95% CI, 86–97%)</mark></th> <th><mark>CI 96.1–98.3%),</mark></th> <th>average from</th> <th></th>	Specifically,	<mark>(95% CI, 86–97%)</mark>	<mark>CI 96.1–98.3%),</mark>	average from	
dose two are higher in BNT162b2estimations from a Rapid Review] ⁴⁵ intensive care 	antibody levels	for mRNA-	and VE against	literature review	
higher in BNT162b2Rapid Review]46unit 97.4% (95% Cl 96.0–98.8%), and against death was 99.0% (95% Cl 96.0–98.8%), and against death was 99.0% (95% Cl 96.0–98.8%), and against death was 99.0% (95% Cl 95% Cl 95% Cl, Ioverall average from literature review and meta- analysis](2400001VE against severe acute respiratory syndrome (SARS-CoV-2) infection was 89.1% (95% Cl against SARS- review and meta- analysis](2400001vaccinated with a standard (19–29 cov-2 related tays) interval, hospitalizations for Following the extendedOv-2 related individuals greater individuals greater than 26 weeks general population dose was 73% agade 216 years days post dose 2VE against infection in the general population was 86.1% (95% Cl 96.5%use standard 14–35 covor adainst 14–35 days post dose 2From a second (95% Cl, 71.0– US was 86.1% (95% Cl 96.5%VE against infection in the infection in the<	14–35 days after	1273.[Based on	admission to the	and meta-	
BNT162b2Cl 96.0-98.8%),VE against severerecipients with an extended vaccineVE greater than 26 weeks from a interval (65-84 days) comparedand against death was 99.0% (95%acute respiratory syndromedays) compared65% (95% Cl, 65% (05% Cl, with thoseCl 98.5-99.6%).coronavirus 2 (SARS-CoV-2)with those65.0-66.0) and VE from literature(SARS-CoV-2) individuals greaterfrom literature review and meta- analysis](24xxxvii)89.1% (95% Cl analysis](24xxxvii)days) interval.hospitalizations for individuals greaterVE against from a second general population19-related hospitalizationfollowing the extendedthan 26 weeks infection untheinfection unthe mider and population19-relatedkevels were 6-fold higher at 14-35(95% Cl, 71.0- (95% Cl, 71.0-was 86.1% (95% (95%)cl 96.1-98.3%), and VE againsthigher at 14-35(95% Cl, 71.0- (95% Cl, 71.0-was 86.1% (95% (95%)and VE against admission to the	dose two are	estimations from a	intensive care	analysis] ^{24xiii}	
recipients with an extended vaccineVE greater than 26 weeks from a was 99.0% (95%)acute respiratory syndromeinterval (65–84 days) compared55% (05% Cl (1) (05%)(198.5–90.6%). (05%-Clcoronavirus 2 (SARS-CoV-2)with those650.66.0) and VE from literature(SARS-CoV-2) infection wasinfection was (95% Clwith those65.0-66.0) and VE from literaturereview and meta- analysis](²⁴⁰⁰⁰⁰¹ 85.6–92.6%), VE against COVID-tadays) interval.hospitalizations for infection in the19-relatedFollowing the extendedinfection in the infection in thehospitalizationschedule, antibody levels were 6-fold higher at 14–35gewa 73% (95% Cl, 71.0-aged ≥16 years was 86.1% (95%Cl 96.1–98.3%), admission to the	higher in	Rapid Review]45	unit 97.4% (95%		
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interval (65–84 days) compared with thosesecond dose was 65% (95% CI, 65.0-66.0) and VE from literatureCI 98.5–99.6%). (Overall average from literaturecoronavirus 2 (SARS-COV-2) infection wasvaccinated with a standard (19–29against SARS- COV-2 relatedreview and meta- analysis](240000189.1% (95% CI against COVID- 19-relateddays) interval, Following the extendedhospitalizations for individuals greaterVE against vacion in the schedule, antibody infection in the general population19-related hospitalizationveces were 6-fold higher at 14–35(95% CI, 71.0- (95% CI, 71.0-was 86.1% (95% (95% CI yeas 86.1% (95%)CI 9698.3%), and VE against admission to the	recipients with an	VE greater than	and against death	acute respiratory	
days) compared with those65% (95% CI, 65.0-66.0) and VE from literature[Overall average from literature(SARS-CoV-2) infection wasvaccinated with a standard (19–29against SARS- COV-2 relatedreview and meta- analysis](24xxxvii)89.1% (95% CI 85.6–92.6%), VEdays) interval, Following the extendedhospitalizations for infection in the infection in the schedule, antibody levels were 6-fold higher at 14–35 (95% CI, 71.0-VE against general population19-related was 86.1% (95% general populationhospitalizations for form a second levels were 6-fold higher at 14–35 days post dose 2(SARS-coV-2) form(SARS-coV-2) infection in the general populationcover form days post dose 275.0) forCI 77.8–94.4%),(SARS-coV-2) infection	extended vaccine	26 weeks from a	was 99.0% (95%	syndrome	
with those65.0-66.0) and VE from literaturefrom literatureinfection wasvaccinated with a standard (19–29against SARS- COV-2 relatedreview and meta- analysis](24xxvvii)89.1% (95% CI 85.6–92.6%), VEdays) interval. Following the extendedhospitalizations for individuals greaterVE againstNE against COVID-Following the extendedinfection in the infection in the infection in the19-relatedschedule, antibody levels were 6-fold higher at 14–35from a second (95% CI, 71.0-)general population was 86.1% (95% (95% CICI 96.1–98.3%), and VE against and VE against admission to the	interval (65–84	<mark>second dose was</mark>	<mark>Cl 98.5–99.6%).</mark>	coronavirus 2	
vaccinated with a standard (19–29against SARS- COV-2 relatedreview and meta- analysis](24xxvii)89.1% (95% Cldays) interval.hospitalizations for85.6–92.6%), VEFollowing the extendedindividuals greaterVE againstthan 26 weeksinfection in the19-relatedschedule, antibody levels were 6-fold higher at 14–35general populationwas 86.1% (95%levels were 6-fold days post dose 2(05% Cl, 71.0-)was 86.1% (95%Cldays post dose 275.0) forCl 77.8–94.4%),admission to the					
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higher at 14–35 (95% CI, 71.0- was 86.1% (95% and the second seco		<mark>from a second</mark>			
days post dose 2 75.0) for CI 77.8–94.4%), classing admission to the				n de la companya de l	
		•			
for BNT162b2 for the elderly VE		75.0) for			
	for BNT162b2		for the elderly VE	intensive care	

^{xxxvii} Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen. ^{xii} Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.



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than AZD1222.	Moderna.[United	was 83.8% (95%		<mark>unit 97.4% (95%</mark>	
[England] ⁴⁰	States] ⁴¹	CI 77.1–90.6%),		CI 96.0–98.8%),	
		and for healthcare		and against death	
For BNT162b2	<mark>VE was 69% (95%</mark>	workers VE was		was 99.0% (95%	
and AZD1222, VE	<mark>CI, 67.0% to</mark>	<mark>95.3% (95% Cl</mark>		<mark>CI 98.5–99.6%).</mark>	
was higher across	<mark>70.0%) against</mark>	<mark>92.0–</mark>		[Overall average	
all age-groups	SARS-CoV-2	<mark>98.6%).[Overall</mark>		from literature	
from 14 days after	infection and 86%	average from		review and meta-	
dose two	<mark>(95% CI, 82.0% to</mark>	literature review		<mark>analysis²⁴]^{xliii}</mark>	
compared to one	<mark>89.0%) against</mark>	and meta-			
dose, but the	SARS-CoV-2-	analysis] ^{24xxxviii}			
magnitude varied	related death or			<u>In pregnant</u>	
with dose interval.	more days after	Symptomatic		<u>women</u> :	
[England] ⁴⁰	the second	<u>disease</u> : 90% ¹¹ .		41% (95% Cl,	
	vaccine dose and	56% (95% Cl, 48-		27.1-52.2%;	
VE greater than	was similar when	63; Spain) [Apr-		Brazil) against	
26 weeks from a	follow-up period was extended. VE	Aug] ⁵		symptomatic COVID-19, 85%	
second dose was	against infection	For two doses, VE		(95% Cl, 59.5-	
<mark>45% (95% CI,</mark>	decreased with	against		94.8; Brazil)	
44.0-47.0) for	increasing age	symptomatic		against severe	
Pfizer.[United States] ⁴¹	and comorbidity	SARS-CoV-2		COVID-19, and	
Sidlesj	burden. [United	infection was		75% (95% CI	
For those fully	States, December	73.9% (95% CI,		27.9-91.2;	
vaccinated the	2020 to March	26.2%-90.8%)		Brazil)53	
observed	2021] ⁴² xxix	[Portugal;		,	
<mark>effectiveness of</mark>		December 2020 to			
<mark>the Pfizer-</mark>	VE against severe	November 2021] ⁴⁶			
<mark>BioNTech vaccine</mark>	acute respiratory	xxxix			
was 91.2%.	<mark>syndrome</mark>				
[Overall average	<mark>coronavirus 2</mark>				

^{xxix} Study does not differentiate between Moderna or Pfizer-BioNTech.

xxxviii Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.

xxxix Study does not differentiate between Pfizer and AstraZeneca.

^{xliii} Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.



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	from literature	(SARS-CoV-2)	VE against			
	review and meta-	infection was	symptomatic			
	analysis] ²⁴	<mark>89.1%</mark> (95% <mark>CI</mark>	SARS-CoV-2			
		85.6–92.6%), VE	infection was			
	VE was 69% (95%	against COVID-	estimated at 92%			
	CI, 67.0% to	19-related	(95% CI, 78–97%)			
	70.0%) against	hospitalization	for			
	SARS-CoV-2	was 97.2% (95%	ChAdOx.[Based			
	infection and 86%	CI 96.1–98.3%),	on estimations			
	(95% CI, 82.0% to	and VE against	from a Rapid			
		admission to the	Review] ⁴⁵			
	89.0%) against	intensive care				
	SARS-CoV-2-	unit 97.4% (95%	Among individuals			
	related death or	CI 96.0–98.8%),	with history of			
	more days after	and against death	infection, VE			
	the second	was 99.0% (95%	against			
	vaccine dose and	Cl 98.5–99.6%).	symptomatic			
	was similar when	Overall average	infection ≥ 14			
	follow-up period	from literature	days from vaccine			
	was extended. VE	review and meta-	series completion			
	against infection	analysis] ^{24xxx}	was 56.0% (95%			
	decreased with	analysisj	Cl, 51.4-60.2) for			
	increasing age	VE against	ChAdOx1.			
	and comorbidity	infection in the				
	burden. [United		[Brazil] ²⁰			
	States, December	general population				
	2020 to March	aged ≥16 years	VE was			
	<mark>2021]^{42 xix}</mark>	was 86.1% (95%	approximately			
		<mark>CI 77.8–94.4%),</mark>	<mark>96.7% (95% Cl,</mark>			
	VE was	for the elderly VE	<mark>87.9-99.9) 7 days</mark>			
	approximately	was 83.8% (95%	after the second			
	96.7% (95% CI,	<mark>CI 77.1–90.6%),</mark>	dose [France;			
	87.9-99.9) 7 days	and for healthcare				
	after the second	workers VE was				

xix Study does not differentiate between Moderna or Pfizer-BioNTech.

^{xxx} Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.



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dose [France; December 2020 to		December 2020 to lune 2021] ^{43xl}			
June 2021] ^{43xx}	98.6%).[Overall				
	average from				
VE against severe	literature review				
acute respiratory	and meta-				
syndrome	analysis] ^{24 xxxi}				
coronavirus 2					
(SARS-CoV-2)	Adjusted VE was				
infection was	71% (95%				
<mark>89.1%</mark> (95% Cl 85.6–92.6%), VE	<mark>confidence</mark> interval, 49%-				
against COVID-	83%) among fully				
19-related	vaccinated				
hospitalization	participants				
was 97.2% (95%	reporting contact				
CI 96.1–98.3%),	with persons with				
and VE against	COVID-19 versus				
admission to the	<mark>80% (95% CI,</mark>				
intensive care	72%-86%) among				
unit 97.4% (95%	those without				
<mark>CI 96.0–98.8%),</mark>	contact.[United				
and against death	States; February				
was 99.0% (95% Cl 98.5–99.6%).	2021 to September				
[Overall average	2021] ^{25 xxxii}				
from literature					
	<u>Symptomatic</u>				
	disease: 91%				
	(95% CI, 89-93;				

^{xx} Study does not differentiate between Comirnaty and Vaxrevria.

xxxi Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.

xxxii Study does not differentiate between Pfizer, Moderna, and Janssen.

^{xl} Study does not differentiate between Comirnaty and Vaxrevria.



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review and meta- analysis](^{24xxi} VE against	>2 weeks after dose) ^{10, xxxiii} 85% (95% CI, 80- 89; Spain) [Apr-	
infection in the general population aged ≥16 years was 86.1% (95% Cl 77.8–94.4%), for the elderly VE	Aug] ⁵ Asymptomatic SARS-CoV-2 infection:	
was 83.8% (95% CI 77.1–90.6%), and for healthcare workers VE was 95.3% (95% CI 92.0–	90.6% ⁴⁷ . ^{xxxiv} 71% (95% CI, 61- 78) [January- August] ⁵⁰	
98.6%).[Overall average from literature review and meta- analysis] ^{24xxii}	<u>Hospitalization:</u> 91.6% (95% Cl, 81-97) [January- July] ³⁴ .	
Adjusted VE was 71% (95% confidence interval, 49%- 83%) among fully vaccinated participants	 93% (95% CI, 91- 95) [11 March – 15 August)¹⁵. 89% (95% CI, 87- 91) for individuals ≥50 years [1 January-22 June²³. xxxv 	

xxi Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.

^{xxii} Study does not differentiate between Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, CoronaVac, and Janssen.

xxxiii Results do not disaggregate between BNT162b2 and mRNA-1273.

xxxiv Results do not disaggregate between BNT162b2 and mRNA-1273

xxxv mRNA-aggregated data (results do not disaggregate between BNT162b2 and mRNA-1273).



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reporting contact with persons with COVID-19 versus 80% (95% CI, 72%-86%) among those without contact.[United States; February 2021 to September 2021]				
 25 xxiii <u>Symptomatic</u> <u>disease</u>: 72% (95% CI, 69- 75; Spain) [Apr- Aug]⁵ Adjusted VE was 59% (95% CI 23.0%- 78.0%)[England 				
J ⁴⁴ VE against symptomatic SARS-CoV-2 infection was estimated at 89– 97% BNT162b2.[Based on estimations from a Rapid Review] ⁴⁵				

^{xxiii} Study does not differentiate between Pfizer, Moderna, and Janssen.



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Among individuals with history of infection, VE against symptomatic infection, VE against symptomatic infection, VE against symptomatic infection, VE against symptomatic infection, VE against series completion was 64.95% (05% C), 54.9-72.4) for BNT162b22 Brazil 1 ²⁴ For two doses, VE against symptomatic SARS-CoV-2 infection was 7.3.9% (05% C)[2.6.2%-0.08%) Portugal: December 2020 to November November 2021 [**** Asymptomatic SARS-CoV-2 infection: Hospitalization:					
 with history of infection, VE against series completion was 64.8% (95%) Cl, 54.9-72.4) for was 64.8% (95%) Cl, 54.9-72.4) for BNT162b2. For two doses, VE against symptomatic SARS-CoV-2 infection was protomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection was symptomatic SARS-CoV-2 infection: Symptomatic SARS-CoV-2 infection: Symptomatic SARS-CoV-2 infection: Symptomatic SARS-CoV-2 infection: Symptomatic SARS-CoV-2 infection: Symptomatic SARS-CoV-2 infection: Symptomatic SARS-CoV-2 infection: Symptomatic Symptomati	1	Among individuals			
<pre>intection, VE againsi againsi symptomatic SARS-CoV-2 intection was againsi agains</pre>					
againsi symptomatic infection 2 14 days from vaccine series completion was 64.3% (95% CL 54.9-72.4) for BNT182b2. BNT182b2. BRazil 3° For two doses, VE againsi symptomatic sares-Col-22 infection was 73.9% (95% CL) 26.25%-00-28) infection was 73.9% (95% CL) 26.25%-00-28) Brownbor 2021 [form SARS-Col-22 infection: Source Col-22 infection: Source					
symptomatic series completion was 64.3% (95% C1, 54.9-72.4) for BNT 162b2 [Brazil] 28 For two doses, VE against symptomatic SARS-CoV-2 infection: 2021 [texx] Sons-Soc-V-2 infection: 90.9% (17, 73.9%) 90.9% (21, 73.9%) 90.9%					
Infection 2:14 days from vaccine series completion was 64.8% (95% Cl, 54.97-24) for BNT162b2, [Brazi] ³⁰ Igrazi] ³⁰ Igrazi] ³⁰ SARS-CoV-2 Infection was 73.9% (95% Cl, 26.2%-90.8%) [Portugal; 2021] ^{46er} Asymptomatic SARS-CoV-2 December 2020 to November 2021] ^{46er}					
from vaccine series completion was 64.8% (95% Cl, 54.97.2.4) for BNT162b2. Brazil) 20 For two doses, VE against symptomatic SARS-CoV-2 infection was 73.9% (95% CI, 26.2%-90.8%) Portugal: December 2020 to November 2021 (Mexme Asymptomatic SARS-CoV-2 infection: 0.6%*7.sw 73.1 (95% CI, 70.3-75.5)*		symptomatic			
series completion was 64.8% (95%) Ci, 54.9-72.4) for BNT162b2. [Brazil] ²⁰ For two doses, VE against symptomatic SARS-CoV-2 infection: 26.2%-90.8%) Jortugal: December 2020 to November 2021 Jfease SARS-CoV-2 infection: SARS-CoV-2 SARS-COV-2 Infection: SARS-COV-2 Infection: SARS-COV-2 Infection: SARS-COV-2 Infection: SARS-COV-2 Infectio					
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IBrazil] 24 For two doses, VE against symptomatic SARS-CoV-2 infection was 73.9% (95% Cl, 26.2%-90.3%) (Portugat; December 2020 to November 2021/fessav Asymptomatic SARS-CoV-2; infection; 90.6% ⁴⁷ ;xaw 73.1 (95% Cl, 70.3-75.5) ⁴		BNT162b2			
For two doses, VE against symptomatic SARS-CoV-2 (1ection was r3.9% (95% CI, 26.2%-90.8%) [Portugai; December 2020 to November 2021]480000Image: Comparison of the symptomatic SARS-CoV-2 (1ection regions)Asymptomatic SARS-CoV-2 2011480000Asymptomatic SARS-CoV-2 (1ection regions)Image: Comparison of the symptomatic (1ection regions)Asymptomatic SARS-CoV-2 (1ection regions)Asymptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Asymptomatic SARS-CoV-2 (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Asymptomatic SARS-CoV-2 (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Asymptomatic SARS-CoV-2 (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Asymptomatic SARS-CoV-2 (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Asymptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Asymptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison regions of the symptomatic (1ection regions)Image: Comparison of the symptomatic (1ection regions)Image: Comparison regions of the symptomatic (1ection regio					
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SARS-CoV-2 infection was 73.9% (95% CI, 26.2%—90.8%) [Portugal; December 2020 to November 2021] ^{45xxiv} A <u>symptomatic</u> SARS-CoV-2 infection: 90.6% ⁴⁷ . ^{xxv} 73.1 (95% CI, 73.1 (95% CI, 73.1 (95% CI,		against			
infection was 73.9% (95% CI, 26.2%-90.8%) IPortugal; December 2020 to November 2021] ^{40xxv} Asymptomatic SARS-CoV-2 infection: 90.6% ^{47, xxv} 73.1 (95% CI, 70.3-75.5) ⁴		symptomatic			
73.9% (95% CI, 26.2%-90.8%) [Portugal; December 2020 to November 2021/46xxv Asymptomatic SARS-CoV-2 infection: 90.6%47, xxv 73.1 (95% CI, 73.1 (95% CI, 70.3-75.5) ⁴		SARS-CoV-2			
26.2%-90.8%) [Portugal; December 2020 to November 2021] ^{46xxiv} Asymptomatic SARS-CoV-2 infection: 90.6% ⁴⁷ , xxv 7.3.1 (95% Cl, 7.3.1 (95% Cl, 7.3.5) ⁴					
[Portugal; December 2020 to November 2021] ^{45xxvv} Asymptomatic SARS-CoV-2 infection: 90.6% ^{47, xxv} 90.6% ^{47, xxv} 73.1 (95% Cl, 70.3-75.5) ⁴		73.9% (95% Cl,			
December 2020 to November 2021] ^{46xxiv} A <u>symptomatic</u> SARS-CoV-2 infection: 90.6% ⁴⁷ .xvv 73.1 (95% Cl, 70.3-75.5) ⁴		26.2%–90.8%)			
December 2020 to November 2021] ^{46xxiv} A <u>symptomatic</u> SARS-CoV-2 infection: 90.6% ⁴⁷ .xvv 73.1 (95% Cl, 70.3-75.5) ⁴		[Portugal;			
November 2021] ^{46xxv} Asymptomatic SARS-CoV-2 infection: 90.6% ⁴⁷ .xxv 73.1 (95% Cl, 70.3-75.5) ⁴		December 2020 to			
2021] ^{46xiv} <u>Asymptomatic</u> <u>SARS-CoV-2</u> <u>infection:</u> 90.6% ⁴⁷ .xxv 73.1 (95% CI, 70.3-75.5) ⁴					
Asymptomatic SARS-CoV-2 infection: 90.6% ⁴⁷ .xxv 73.1 (95% Cl, 70.3-75.5) ⁴		2021] ^{46xxiv}			
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90.6% ⁴⁷ .xxv 73.1 (95% CI, 70.3-75.5) ⁴					
73.1 (95% CI, 70.3-75.5) ⁴					
70.3-75.5) ⁴					
Hospitalization:		/0.3-/5.5)⁴			
Hospitalization:					
		Hospitalization:			

xxiv Study does not differentiate between Pfizer and AstraZeneca

^{xxv} Results do not disaggregate between BNT162b2 and mRNA-1273



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3 1		 51 - / - / - / /	 	 	
	85% (95% CI, 73- 93) [January- July] ³⁴ . 88% (95% CI, 85- 91) [11 March – 15 August] ¹⁵ .				
	89% (95% CI, 87- 91) for individuals ≥50 years [1 January-22 June ²³ . xxvi 90% (95% CI, 89- 92) [Dec 2020 – Aug 2021] ³⁵				
	VE against SARS- CoV-2 related hospitalizations for individuals greater than 26 weeks from a second dose was 67% (95% CI, 65.0- 69.0) for Pfizer.[United States] ⁴¹				
	VE against hospitalization or death ≥ 14 days from vaccine series completion was 89.7% (95%				

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



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CI, 54.3-97.7) for BNT162b2. [Brazil] ²⁰

<mark>VE against</mark>

hospitalization 14– 119 days following second Pfizer-BioNTech dose was <mark>86.0% (95% CI =</mark> <mark>77.6%–91.3%); at</mark> <mark>≥120 days VE was</mark> <mark>75.1% (95% CI =</mark> <mark>64.6%–</mark> 82.4%).[United States; February 2021 to September <mark>2021] ⁴⁸</mark> Individuals \geq 65: 61% (95% Cl, 57-65) against SARS-CoV-2 infection and 86% (95% CI, 82-88) against

hospitalizations³⁵ Individuals ≥ 80 : VE of **68.3%** (95%)

Cl, 65.5-70.9) for infections, **73.2%** (95% Cl, 65.3-79.3) for hospitalization,



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Ű				9			,	
	85.1% (95% CI, 80.0-89.0) for mortality [Germany, 09 Jan – 11 Apr 2021] ⁴⁹							
			EFFECTIV	VENESS AGAINST V	ARIANTS ^{×liv}			
	BNT162b2/ COMIRNATY	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield	Janssen COVID- 19 vaccine/Johnson & Johnson	BBIBP-CorV,	CoronaVac	COVAXIN / BBV152	Novavax/ NVX- CoV2373
Alpha (B.1	$\begin{array}{rl} & \underline{Single\ dose:}\\ & \textbf{48.7\%}\ (95\%\\ Cl,\ 45.5\ to\ 51.7)^{56}\\ & \textbf{66\%}\ (95\%\ Cl, 64-\\ & 68)^{57}.\\ & \textbf{54.5\%}\ (95\ Cl,\\ & 50.4-58.3)^{58}\\ \end{array}$	<u>Single dose:</u> 88.1% (95% CI, 83.7 to 91.5) ⁶¹ 83% (95% CI, 80- 86) ⁵⁷ . <u>Two doses:</u> 100% (95% CI, 91.8 to 100) ⁶¹ 92% (95% CI, 86- 96) ⁵⁷ . 98.4% (95% CI, 96.9-99.1) ⁶²	<u>Single dose:</u> 48.7% (95% CI 45.5 to 51.7) ⁵⁶ 6 4% (95% CI, 60- 68) ⁵⁷ . <u>Two doses:</u> 74.5% (95% CI, 68.4 to 79.4) ⁵⁶ 73% (95% CI, 66- 78) ⁵⁹ . 79% (95% CI, 56- 90) ⁶⁰ .	-	No published data	<u>Two doses:</u> Equally effective (~76%) in neutralizing D614G, B.1.1.7 and B.1.429 as the wild-type strain.	No available data	Ongoing studies in South Africa ³⁰ and the United Kingdom ³¹ Post hoc analysis showed efficacy of 86.3% (95% CI, 71.3-93.5; United Kingdom) against B.1.1.7 variants and 96.4% (95% CI, 73.8-99.5; United Kingdom) against non- B.1.1.7 variants. ⁵⁵

xiv Effectiveness data against the latest variant of interest (Mu) will be included in upcoming reports based on data availability.



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Beta (1.351)	Against SARS- CoV-2 infection: Single dose: 60% (95% Cl, 52- 67) ⁵⁷ . <u>Two doses:</u> 84% (95% Cl, 69- 92) ⁵⁷ . 72% (95% Cl, -5- 97; Israel) [Dec 2020-Mar 2021] ⁶³ <u>Against symptomatic infection:</u> 100% (95% Cl, 19-100; Israel) [Dec 2020-Mar 2021] ⁶³	<u>Single dose:</u> 61.3% (95% Cl, 56.5 to 65.5) ⁶¹ 77% (95% Cl, 69- 92) ⁵⁷ . <u>Two doses:</u> 96.4% (95% Cl, 91.9 to 98.7) ⁶¹	<u>Single dose:</u> 48% (95% Cl, 28- 63) ⁵⁷ .	-	No published data	Neutralization capacity was decreased by factor 5.27 ⁶⁴ .	No available data	No available data
Gamma (P.1)	Neutralization activity reduced by 3.3-fold ⁶⁵ .	No available data	No available data	No available data	No published data	Demonstrated 42% vaccine effectiveness in a setting with high P.1 transmission, in individuals aged 70 and above ⁶⁶ . 50.2% against P.1 (>14 days after 2 nd dose) ⁶⁷ .	No available data	No available data



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						Neutralization was decreased by factor 3.92 ⁶⁴ . <u>Against</u> <u>symptomatic</u> <u>COVID-19:</u> 80.5% (95% CI, 75.1-84.7) ⁶⁸		
Delta (1.617.2)	Single dose: 30.7% (95% CI, 25.2 to 35.7) ⁵⁶ ; 57% (95% CI, 50- 63) ⁶⁰ 22.5% (95 CI, 17.0-27.4) ⁵⁸ 22% (95% CI, 10- 32; France) [May- August 2021] ⁶⁹ <i><u>Two doses:</u></i> 88.0% (95% CI, 85.3 to 90.1) ⁵⁶ ; 80% (95% CI, 77- 83) ⁶⁰ 79% (95% CI, 77- 83) ⁶⁰ 79% (95% CI, 77- 83) ⁶⁰ 40.5% (95% CI, 8.7- 61.2) ⁷⁰ . 42% (95% CI, 13- 62) ³⁴ .	Single dose: 72% effective against symptomatic SARS-Cov-2 infection ⁷⁸ . ≥14 days after second dose: 76% (95% CI, 58- 87) ³⁴ . 94.5% (95% CI, 94.1-95) [2-9 weeks after second dose] ⁷¹ . 50.6% (95% CI, 45.0-55.7) [among nursing home residents] ⁷² . 86.7% (95% CI, 84.3-88.7) ⁶² 56.6% (95% CI, 42.0-67.5) against infection ⁷⁹	$\frac{Single \ dose:}{30.7\% \ (95\% \ Cl}{25.2 \ to \ 35.7)^{56}}$ $73\% \ (95\% \ Cl, \ 64-80; \ India) \ [May - July \ 2021]^{52}$ $\frac{Two \ doses:}{67.0\% \ (95\% \ Cl, \ 61.3 \ to \ 71.8)^{56}}$ $67\% \ (95\% \ Cl, \ 62-71)^{60}.$ $60\% \ (95\% \ Cl, \ 62-71)^{60}.$ $60\% \ (95\% \ Cl, \ 62-71)^{60}.$ $66.7\% \ (95\% \ Cl, \ 53-66)^{59}.$ $66.7\% \ (95\% \ Cl, \ 53-66)^{59}.$ $66.7\% \ (95\% \ Cl, \ 53-66)^{59}.$ $66.7\% \ (95\% \ Cl, \ 63-67.0) \ [\geq 20]$ weeks after second dose] ⁷¹ .	78% (95% CI, 73- 82) against SARS- CoV-2 infection ¹⁴ . 3% (95% CI, -7- 12) [August] ⁷³ 76.5% (95% CI, 40.9-90.6; USA) [01 Jul 2021 to 30 Sep 2021] ¹⁹ⁱⁱⁱ <u>Individuals \geq 50:</u> 83% (95% CI, 81- 85) ¹⁴	No available data	<u>Single dose:</u> 13.8% (95% CI, - 60.2-54.8) ⁸¹ . <u><i>Two doses:</i></u> 59% (95% CI, 16- 81.6) against SARS-CoV-2 infection and 70.2% (95% CI, 29.6- 89.3) against moderate COVID- 19 infection ⁸¹ .	<u>Single dose</u> : 44% (95% CI, 0- 71; India) [May – July 2021] ⁵² <u>Two doses:</u> 64% (95% CI, 40- 79; India) [May – July 2021] ⁵²	No available data

^{lii} Study does not differentiate between Pfizer, Moderna, and Janssen.



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	89.8% (95% Cl,	<mark>84.2%</mark> (95% Cl,	81% (95% CI, 71-				
	89.6-90.0) [2-9	<mark>56.4-94.3) against</mark>	88; India) [May –				
	weeks after	<mark>symptomatic</mark>	July 2021] ⁵²				
	second dose]71.	infection ⁷⁹					
	69.7% (95% Cl,	<mark>64%</mark> (95% CI, 62-					
	68.7-70.5) [≥20	66) [August;	Odds ratio of 5.45				
	weeks after	elderly Veteran	(95% CI, 1.39-				
	second dose] ⁷¹ .	population] ⁷³	21.4) to become				
	64.6% (95 CI,	<mark>76.5%</mark> (95% CI,	infected with				
	60.6-68.2) ⁵⁸	<mark>40.9-90.6; USA)</mark>	B.1.167.2				
	52.4% (95% CI,	[01 Jul 2021 to 30	compared to non-				
	48.0-56.4) [among	Sep 2021] ^{19xlviii}	B.1.167.2 ⁸⁰ .				
	nursing home						
	residents] ⁷² .	<u>10-14 weeks after</u>					
	53% (95% Cl, 39-	second dose:	Among individuals				
	65) [4 months	<mark>90.3%</mark> (95% CI,	who received 2				
	after second	<mark>67.2-97.1)⁷¹.</mark>	doses of vaccines				
	dose] ³⁵		(with at least				
	50% (95% Cl, 47-	VE against Delta	1mRNA vaccine)				
	52) [August;	variant-related	VE against Delta				
	elderly Veteran	symptomatic	declined steadily				
	population] ⁷³	infection was	over time from				
	76.5% (95% CI, 40.9-90.6; USA)	67.0% (95% CI, 61.3–71.8%)	84% (95%CI, 81- 86%) 7-59 days				
	[01 Jul 2021 to 30	ChAdOx1 after full	after the second				
	Sep 2021] ^{19xlv}	vaccination.[Base	dose to 71%				
	67% (95% Cl, 63-	d on estimations	(95%Cl, 66-75%)				
	71; France) [May-	from a Rapid	≥240 days after				
	August 2021] ⁶⁹	Review] ⁴⁵	the second dose,				
	VE against Delta		but recovered to				
	variant-related	Among early	93% (95%CI, 92-				
	symptomatic	recipients of	94%) ≥7 days				
	infection was 88%	mRNA-1273, VE	after receiving an				
			<u>_</u>				

xlv Study does not differentiate between Pfizer, Moderna, and Janssen.

xiviii Study does not differentiate between Pfizer, Moderna, and Janssen.



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	÷ ;	÷, , , , ,			
<mark>(95% CI, 85.3–</mark>	decreased an	mRNA vaccine for			
90.1%) by	estimated 10	the third			
BNT162b2 after	percentage when	dose.[Canada;			
full	the Delta variant	November 2021 to			
vaccination.[Base	became dominant.	December 2021]			
d on estimations	<mark>75</mark>	<mark>76 li</mark>			
<mark>from a Rapid</mark>					
Review] ⁴⁵	Among individuals				
	who received 2				
VE against	doses of vaccines				
hospitalization	(with at least				
was 93% (95% CI,	<mark>1mRNA vaccine)</mark>				
90.0-94.0); South	<mark>VE against Delta</mark>				
Africa)[September	declined steadily				
2021 to October	over time from				
<mark>2021] ⁷⁴</mark>	<mark>84% (95%Cl, 81-</mark>				
	86%) 7-59 days				
Among early	after the second				
recipients of	dose to 71%				
BNT162b2, VE	(95%Cl, 66-75%)				
decreased an	≥240 days after				
estimated 15	the second dose, but recovered to				
percentage when	93% (95%CI, 92-				
<mark>the Delta variant</mark>	93% (95%Cl, 92- 94%) ≥7 days				
became dominant.	after receiving an				
<mark>75</mark>	mRNA vaccine for				
	the third				
Among individuals	dose.[Canada;				
who received 2	November 2021 to				
doses of vaccines	December 2021				
(with at least	76 xlix				
1mRNA vaccine)					
VE against Delta					

^{xlix} Study does not differentiate between Pfizer, Moderna, or AstraZeneca.

ⁱⁱ Study does not differentiate between Pfizer, Moderna, or AstraZeneca.



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declined steadily over time from 84% (95%CI, 81- 86%) 7-59 days after the second dose to 71% (95%CI, 66-75%) ≥240 days after the second dose, but recovered to 93% (95%CI, 92- 94%) ≥7 days after receiving an mRNA vaccine for the third dose.[Canada; November 2021 to December 2021] ⁷⁶ xtvi VE was 62.0% (95% CI, 45.6- 73.5) in the first month after complete vaccination and decreased to	VE was 62.0% (95% CI, 45.6- 73.5) in the first month after complete vaccination and decreased to 57.8% (95%CI, 52.5-62.5) by month 3, similar to to results from pre-Delta period. ⁷⁷¹ One dose VE was 77.0% (95% CI, 60.7-86.5%). ⁶² Two dose VE was 86.7% (95% CI 84.3%-88.7%). ⁶² VE against hospitalization was 97.5% (95%			
(95% CI, 45.6- 73.5) in the first month after complete vaccination and	86.7% (95% CI 84.3%-88.7%). ⁶² VE against			

^{xlvi} Study does not differentiate between Pfizer, Moderna, or AstraZeneca.

¹ Study does not differentiate between mRNA vaccines, Pfizer and Moderna.



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	pre-Delta period. ^{77xlvii} <u>Against severe</u> <u>COVID-19:</u> 91.4% (95% CI, 82.5-95.7) ⁷⁰ .	CI 90.5%-96.3%) 14-60 days after vaccination to 80.0%(95% CI, 70.2-86.6%) 151- 180 days after. ⁶² VE against infection was lower for \geq 65 years at 75.2% (95% CI 59.6%- 84.8) than those 18-64 years at 87.9%(95% CI, 85.5%-89.9%). ⁶²						
Mu (B.1.621)	Mu variant is 9.1 times more resistant than the wild type strain when vaccinated with BNT162b2 ⁸²	Two doses: 90.4% (95% Cl, 73.9-96.5) ⁶² (demonstrated similar protective measures as against the Alpha variant)	No available data	No available data	No available data	No available data	No available data	No available data
Omicron (B.1.1.529)	88.0% (95% CI, 65.9-95.8) after 2- 9 weeks following second dose, 48.5% (95% CI, 24.3-65.0) after 10-14 weeks following second dose,	2-dose VE against omicron infection was 30.4% (95% CI, 5.0%-49.0%) at 14-90 days after vaccination and declined quickly thereafter. [United States; December 6 2021	No protective effect of vaccination against symptomatic disease with Omicron from 15 weeks after the second dose ⁸³					

^{xlvii} Study does not differentiate between mRNA vaccines, Pfizer and Moderna.



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<mark>34-37%</mark> from 15	to December 23	<mark>2 doses of</mark>			
weeks after	<mark>2021]⁸⁶</mark>	COVID-19			
<mark>second dose⁸³</mark>		vaccines was not			
	VE against the	protective against			
If assuming a 25-	Omicron variant	Omicron infection			
fold decrease in	<mark>was 36.7% (95%</mark>	at any point in			
<mark>pseudovirus</mark>	<mark>CI: -69.9 to</mark>	time, and VE was			
neutralization 66%	76.4%) for mRNA-	<mark>–38% (95%CI, –</mark>			
<mark>(95% CI, 42-86)⁸⁴</mark>	1273 in the first	<mark>61%, –18%) 120-</mark>			
	month after	179 days and –			
VE against the	primary	<mark>42% (95%CI, </mark>			
Omicron variant	vaccination.	<mark>69%, –19%) 180-</mark>			
<mark>was 55.2% (95%</mark>	[Denmark,	239 days after the			
CI, 23.5 to 73.7%)	November 2021 to	second dose. VE			
for BNT162b2 in	December 2021] ⁸⁵	against Omicron			
the first month		was 37% (95%CI,			
after primary	2 doses of	<mark>19-50%) ≥7 days</mark>			
vaccination.	COVID-19	after receiving an			
However, the VE	vaccines was not	mRNA vaccine for			
is significantly	protective against	the third			
lower than that	Omicron infection	dose.[Canada;			
against Delta	at any point in	November 2021 to			
infection and	time, and VE was	December 2021]			
declines rapidly	<mark>–38% (95%CI, –</mark>	76 lv			
over just a few	<mark>61%, –18%) 120-</mark>				
months.	179 days and –				
[Denmark,	42% (95%CI, –				
November 2021 to	<mark>69%, –19%) 180-</mark>				
December 2021] ⁸⁵	239 days after the				
	second dose. VE				
2 doses of	against Omicron				
COVID-19	was 37% (95%CI,				
vaccines was not	<mark>19-50%) ≥7 days</mark>				
protective against	after receiving an				

^{Iv} Study does not differentiate between Pfizer, Moderna, or AstraZeneca.



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	Omicron infection at any point in time, and VE was -38% (95%Cl, - 61%, -18%) 120- 179 days and - 42% (95%Cl, - 69%, -19%) 180- 239 days after the second dose. VE against Omicron was 37% (95%Cl, 19-50%) ≥7 days after receiving an mRNA vaccine for the third dose.[Canada; November 2021 to December 2021] ⁷⁶ III	mRNA vaccine for the third dose.[Canada; November 2021 to December 2021] ^{76 liv} VE was 30.4% (95% CI, 5.0%- 49.0%) 14-90 days after vaccination and declined thereafter. ⁸⁶						
			EFFECTIVE	NESS AGAINST HOS	PITALIZATION			
	BNT162b2/ COMIRNATY	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield	Janssen COVID- 19 vaccine/Johnson & Johnson	BBIBP-CorV,	CoronaVac	COVAXIN / BBV152	Novavax/ NVX- CoV2373
Any SARS-CoV- 2 infection	Single dose:	<u>Single dose:</u>	Single dose:	VE against hospitalization or	No available data	<u>Against ICU</u> <u>admission</u> :	No available data	No available data

^{liii} Study does not differentiate between Pfizer, Moderna, or AstraZeneca.

^{liv} Study does not differentiate between Pfizer, Moderna, or AstraZeneca.



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			-		
85% (pooled	73% (pooled	56% (pooled	death ≥ 14 days	72.0% (95% CI,	
meta-analysis)6	meta-analysis)6	meta-analysis)6	from vaccine	69.9-73.9;	
			series completion	Malaysia) [Apr-	
Hospitalization risk	Individuals \geq 50:	Hospitalization	was 57.7% (95%	Sep 2021] ⁸⁷	
reduced by 35-	≥14 days after	risk reduced by	Cl, -2.6-82.5) for	000 2021]	
45% ⁹ .	first dose: 54%	35-45% ⁹ .	Ad26.COV2.S.	Against death:	
+J /0°.		JJ-4J /0°.			
Dials of death	(95% CI, 47-61) [1		[Brazil] ²⁰	82.4% (95% Cl,	
Risk of death	Jan-22 Jun ²³ . ^{Ixi}	T		81.0-83.7;	
reduced by 54% ⁹ .		<u>Two doses:</u>		Malaysia) [Apr-	
	<u>Two doses:</u>	91% (pooled		Sep 2021] ⁸⁷	
<u>Individuals ≥50:</u>	88% (pooled	meta-analysis) ⁶		VE against	
≥14 days after	meta-analysis) ⁶			hospitalization or	
first dose: 54%	91% (95% Cl,	92% (95% Cl, 80-		<mark>death ≥ 14 days</mark>	
(95% CI, 47-61) [1	93%-96%; United	97; Sweden) [27		from vaccine	
Jan-22 Jun ²³ . ^{Ivi}	States) [May to	Dec 2020-2 Nov		series completion	
	July 2021] ^{71xii}	2021] ³⁸		was 81.3% (95%	
Two doses:	, ,			Cl, 75.3-85.8) for	
91% (pooled	79% (95% CI, 60-	VE against		CoronaVac.	
meta-analysis)6	89; Sweden) [27	hospitalization or		[Brazil] ²⁰	
91% (95% Cl,	Dec 2020-2 Nov	death ≥ 14 days			
93%-96%; United	2021] ³⁸	from vaccine		Adjusted odds	
States) [May to	2021]	series completion			
July 2021] ^{7/vii}	Adjusted Hazard	was 89.9% (95%		ratios of COVID	
July 202 1]	Ratio for COVID-	Cl, 83.5-93.8) for		hospitalisation or	
89% (95% Cl, 84-	19 hospitalization	ChAdOx1. [Brazil]		death were	
				significantly	
93; Sweden) [27	from day 7 after			increased from 98	
Dec 2020-2 Nov	the second dose			days since series	
2021] ³⁸	was estimated at	1		completion,	
	0.14 (95% CI,	<u>Against ICU</u>		compared to	
<u>Against ICU</u>	<mark>0.11–0.17), for an</mark>	<u>admission</u> :		individuals	
 <u>admission</u> :	estimated 86%			vaccinated 14-41	

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

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

^{lxii} Results do not disaggregate between mRNA vaccines, BNT162b2 and mRNA-1273.



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^{wii} Results do not disaggregate between mRNA vaccines, BNT162b2 and mRNA-1273.



90.3% (95% Cl,	<mark>(95% CI, 83.0%-</mark>	95.6% (95% CI,		days previously:	
88.8-91.6;	88.0%) risk	88.3-98.4;		1.40 (95% CI,	
Malaysia) [Apr-	reduction in	Malaysia) [Apr-		1.09 to 1.79) from	
Sep 2021] ⁸⁷	people aged 75	Sep 2021] ⁸⁷		98-125 days, 1.55	
000 2021]	and older [France]	000 2021]		(1.16 to 2.07) from	
Against death:	88 Ixiii	Against death:		126-153 days,	
92.7% (95% CI,		95.3% (95% CI,		1.56 (1.12 to 2.18)	
91.7-93.6;	Fully vaccinated	91.3-97.4;		from 154-181	
Malaysia) [Apr-	patients had a	Malaysia) [Apr-		days, and 2.12	
Sep 2021] ⁸⁷	shorter overall	Sep 2021] ⁸⁷		(1.39-3.22) from	
0ep 202 1]	length of stay in	0ep 202 1]		182 days. [Brazil;	
Adjusted Hazard	hospitals (aHR for			January 2021 to	
Ratio for COVID-	discharge: 1.61,			September 2021	
19 hospitalization	95%CI: 1.24–			91	
from day 7 after	2.08), shorter LoS				
the second dose	without ICU (aHR:				
was estimated at	1.27, 95%CI:				
	1.07–1.52), and				
0.14 (95% CI,					
0.11–0.17), for an	lower risk of ICU				
estimated 86%	admission (aHR:				
(95% CI, 83.0%-	0.50, 95%CI:				
88.0%) risk	0.37–0.69)				
reduction in	compared to				
people aged 75	unvaccinated				
and older [France]	patients. We				
<mark>88 Iviii</mark>	observed no				
F . B . C . C . C . C . C .	difference in the				
Fully vaccinated	LoS in ICU, nor				
patients had a	risk of in-hospital				
shorter overall	death between				
length of stay in	fully vaccinated				
hospitals (aHR for	and unvaccinated				
 discharge: 1.61,	patients. [Norway,				

^{Iviii} Study does not differentiate between Pfizer/BioNTech and Moderna.

^{kiii} Study does not differentiate between Pfizer/BioNTech and Moderna.



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95%CI: 1.24–	February 2021 to						
2.08), shorter LoS	November 2021]						
without ICU (aHR:	<mark>89 Ixiv</mark>						
1.27, 95%CI:							
<mark>1.07–1.52), and</mark>	VE was observed						
lower risk of ICU	to increase after						
admission (aHR:	the first dose of						
<mark>0.50, 95%Cl:</mark>	mRNA vaccines						
<mark>0.37–0.69)</mark>	with week 6						
compared to	effectiveness						
unvaccinated	approximating						
patients. We	<mark>84% (95% CI</mark>						
observed no	<mark>72.0-91.0)</mark> for						
difference in the	COVID-19						
LoS in ICU, nor	infection and 86%						
risk of in-hospital	<mark>(95% CI, 69.0-</mark>						
death between	<mark>95.0) for COVID-</mark>						
fully vaccinated	19-associated						
and unvaccinated	hospitalization.[Un						
patients. [Norway,	ited States] 90 Ixv						
February 2021 to							
November 2021]							
89lix	<mark>VE against</mark>						
	hospitalization 14–						
VE was observed	119 days following						
to increase after	<mark>second Moderna</mark>						
the first dose of	<mark>vaccine dose was</mark>						
mRNA vaccines	<mark>89.6% (95% CI =</mark>						
with week 6	<mark>80.1%–94.5%) at</mark>						
effectiveness	<mark>≥120 days VE was</mark>						
approximating	<mark>86.1% (95% CI =</mark>						
84% (95% CI	<mark>77.7%–</mark>						

^{lix} Study does not differentiate between mRNA vaccines Pfizer and Moderna.

^{lxiv} Study does not differentiate between mRNA vaccines Pfizer and Moderna.

^{bxv} Study does not differentiate between Pfizer and Moderna.



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	72.0-91.0) for COVID-19 infection and 86% (95% CI, 69.0- 95.0) for COVID- 19-associated hospitalization.[Un ited States] ^{90 lx}	91.3%).[United States; February 2021 to September 2021] ⁴⁸						
Alpha	Single dose: 83% (95% Cl, 62-93) 53% (95% Cl, 7- 83; England) [Feb- Sep 2021] ⁹² Two doses: 95% (95% Cl, 78-99) ⁹³ . 71% (95% Cl, 12- 95; England) [Feb- Sep 2021] ⁹² <u>Against death:</u> 98.2% (95% Cl, 95.9-99.2) [2-9 weeks] ⁷¹ . 90.4% (95% Cl, 85.1-93.8) [≥20 weeks] ⁷¹ .	No available data	Single dose: 76% (95% Cl, 61-85) 3% (95% Cl, -38 – 39; England) [Feb- Sep 2021] ⁹² Two doses: 86% (95% Cl, 53-96) ⁹³ . 26% (95% Cl, -39 – 73; England) [Feb-Sep 2021] ⁹² <u>Against death:</u> 94.1% (95% Cl, 91.8-95.8) [2-9 weeks] ⁷¹ . 78.7% (95% Cl, 52.1-90.4) [\geq 20 weeks] ⁷¹ .	<u>Beta</u> 67% effective at preventing hospitalizations ⁹⁴ . <u>Against death:</u> 96% effective at preventing death ⁹⁴ .	No available data	No available data	No available data	No available data
Gamma	No available data	No available data	No available data	72.9% (95% CI, 35.1-91.1) ¹⁷ <u>Against ICU</u> <u>admission:</u>	No available data	<u>Against</u> <u>hospitalization:</u> 95% (95% CI, 86.9-98.1) ⁶⁸	No available data	No available data

^{Ix} Study does not differentiate between Pfizer and Moderna.



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	<u>Single dose:</u> 94% (95% Cl, 46- 99) ⁹³ . 91% (95% Cl, 90-	<u>Single dose:</u> 81% (95% Cl, 81- 90.6) ³⁴ .	<u>Single dose:</u> 71% (95% CI, 51- 83) ⁹³ 88% (95% CI, 83-	92.5% (95% CI, 54.9-99.6) ¹⁷ <u>Against death:</u> 90.5% (95% CI, 31.5-99.6) ¹⁷ 71% ⁹⁴ 85% (95% CI, 73-		<u>Against death:</u> 94.9% (95% CI, 76.4-98.9) ⁶⁸		
Delta	93) ⁹⁵ 4% (95% CI, -21 – 44; England) [Feb- Sep 2021] ⁹² Two doses: 96% (95% CI, 86- 99) ⁹³ . 88% (95% CI, 86- 99) ⁹³ . 88% (95% CI, 24- 93.9) ³⁴ . 84% (95% CI, 24- 93.9) ³⁴ . 84% (95% CI, 79- 89) ⁹⁶ . 98.4% (95% CI, 97- 98.4% (95% CI, 97- 98.4% (95% CI, 97- 98.4% (95% CI, 97- 92.7% (95% CI, 90.3-94.6) [≥ 20 weeks] ⁷¹ .	Two doses:84% (95% CI, 80-87) 95 95% (95% CI, 92-97) [Jun-Aug2021] 97 96.7% (95% CI,93.9-98.2) ⁸ 97.3% (95% CI,95.9-98.4; NewYork) [Aug 2021] 99 Individuals ≥ 65 :93.7% (95% CI,92.9-94.4; NewYork) [Aug 2021] 99 Against ICUadmission:	1 3 3 3 5 3 5 1 5 3 5 5 5 1 5 3 5 5 1 1 9 1 9 5 2% (95% CI, -19 – 31; England) [Feb-Sep 2021] ⁹² 1 7 1 1 1 1 1 1 1 1 1 1	91) ¹⁴ . 91% (95% CI, 88- 94) ⁹⁵ 93.5% (95% CI, 89.6-96.1; New York) [Aug 2021] ⁹⁹ 85% effective at preventing severe disease and hospitalization ¹⁰⁴ . <i>Individuals</i> \geq 50: 84% (95% CI, 81- 85) ¹⁴ <i>Individuals</i> \geq 65:	Single dose: Does not offer clinically meaningful protection against severe illness 105,lxvi <u>Two doses:</u> 88% (95% CI, 55- 98) adjusted risk reduction in developing severe illness. ^{105,lxvii}	Single dose: Does not offer clinically meaningful protection against severe illness 105,Ixviii <u>Two doses:</u> 88% (95% CI, 55- 98) adjusted risk reduction in developing severe illness. ^{105,Ixix}	No available data	No available data

Ixvi Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.
 Ixvii Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.
 Ixviii Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.
 Ixix Study does not differentiate between the two inactivated vaccines, BBIBP-CorV and CoronaVac.



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) -1		0,	01 / 1	0	,	
	96% (95% CI, 95-	86% (95% CI, 79-	63.1% (95% CI,	81.8% (95% CI,		
	96) ⁹⁵	90) ⁹⁵	51.5-72.1; India)	77.8-85.3; New		
	80% (95% CI, 73-	,	(Apr – May 2021)	York) [Aug 2021]99		
	85) [June-	96% against	103			
	August] ⁹⁷	severe COVID-19		Against ICU		
	93% (95% Cl, 84-	infection ⁷⁸ .	Against moderate	admission:		
	96) ⁹⁸		to severe disease:	94% (95% Cl, 88-		
	96.8% (95% CI,	Estimated risk of	81.5% (95% CI,	98) ⁹⁵		
	93.9-98.3)[2	SARS-CoV-2	9.9-99.0; India)	00)		
	months after the	infection is 4.52	(Apr – May 2021)			
	second dose] ⁴	events per 1000	103			
	93% (95% Cl, 84-	persons (95% CI,				
	96) ³⁵	4.17-4.84) ¹⁰²	<u>Against ICU</u>			
	91.5% (95% Cl,		admission:			
	89.5-93.2) ⁸		Single dose: 92%			
	24% (95% Cl, -2 –		(95% CI, 84-96) ⁹⁵			
	64; England) [Feb-		Two doses: 96%			
	Sep 2021]92		(95% CI, 94-98) ⁹⁵			
	95.2% (95% CI,		· · /			
	93.6-96.5; New		<u>Against death:</u>			
	York) [Aug 2021]99		91% (95% CI, 86-			
	,		94) [≥2 weeks			
	Individuals ≥65:		after second			
	88.6% (95% CI,		dose] ¹⁰⁰			
	87.4-89.6; New		All ages: 91%			
	York) [Aug 2021]99		(95% CI, 86-94) ¹⁰¹			
			<i>40-59</i> : 88% (95%			
	Against death:		CI, 76-93) ¹⁰¹			
	90% (95% CI, 83-		<u>60+:</u> 90% (95%			
	94) [≥2 weeks		CI, 84-94) ¹⁰¹			
	after second					
	dose] ¹⁰⁰					
	<u>All ages</u> : 90%					
	(95% CI, 83-94) ¹⁰¹					
	<u>40-59</u> : 95% (95%					
	CI, 79-99) ¹⁰¹					



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<u>60+</u> CI, 7	<u>-:</u> 87% (95% 77-93) ¹⁰¹				
SAF	imated risk of RS-CoV-2 ection is 5.75 ents per 1000				
pers	sons (95% Cl, 9-6.23) ¹⁰²				
Omicron agai hosp to 5 incr com Delt 84.9 83.0 Omi for r vacc Pfize *No betv vacc VE a hosp was 62.0 Afric 202	imated VE inst ipitalization 4 5-fold reased hpared to ta ^{106*} Estimated VE against hospitalization 0-86.6) against icron variant recently ccinated ter ¹⁰⁶ * No differention ween mRNA ccines against ipitalization 5-fold increased compared to Delta ^{106*} *No differention ween mRNA ccines against ipitalization 5-70% (95% CI, 0-76.0; South ca)[November 21 to December 21] ⁷⁴	n			



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		DURATIC	ON OF PROTECTION	, TRANSMISSION &	BREAKTHROUGH I	NFECTIONS		
	BNT162b2/ COMIRNATY	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield	Janssen COVID- 19 vaccine/Johnson & Johnson	BBIBP-CorV,	CoronaVac	COVAXIN / BBV152	Novavax/ NVX- CoV2373
Duration of protection (antibodies)	Median time between second dose and infection:146 days (IQR, 121-167)107Anti-SARS-CoV-2 Antibodies:Anti-SARS-CoV-2 Antibodies:1 month after 2nd dose: 1762 KU/L (IQR: 933-3761) 3 months after 2nd dose: 1086 KU/L (IQR: 629-2155) 6 months after 2nd dose: 802 KU/L (IQR, 447-1487)108No health worker had antibodies BELOW method- dependent cut-off (0.8 KU/L)Neutralizing antibodies: At peak immunity, NAb titre was	Preliminary phase <u>I results:</u> Antibody activity remained high in all age groups at day 209 (approximately 6 months) GMT were lower in ≥56 years old ¹¹³ <u>Neutralizing</u> <u>antibodies:</u> At peak immunity, NAb titre was 5,848, after 8 months titre was 133 ¹⁰⁹ <u>Pseudovirus</u> neutralizing antibodies: At peak immunity, pseudovirus NAb titre was 1,569, after 8 months titre was 273 ¹⁰⁹	Antibody <u>Response:</u> After single dose, antibody response declined within one year, but remained above baseline levels. Antibody levels after day 180 : 0.54 GMR (Cl, 0.47-0.61). Antibody levels after day 320 : 0.30 GMR (Cl, 0.24-0.39) ¹¹⁴ <u>Cellular Immune</u> <u>Response:</u> Day 182 after first dose: median of 237 SFUx10 ⁶ PBMC (IQR, 109- 520) ¹¹⁴ 6 months after second dose: (median 1240,	Neutralizing antibodies: Remained largely stable for 8-9 months116Remained stable for 8 months; At 4 weeks after immunization NAb titre was 146, after 8 months titre was 629109Pseudovirus neutralizing antibodies: Remained stable for 8 months; At 4 weeks after immunization pseudovirus NAb titre was 391, after 8 months titre was 185109Binding antibodies:	Antibody Response: Unexposed subjects: After 1 st dose: 43.6 IU/mL (95% CI, 30.3-62.8) After 2 nd dose: 377.0 IU/mL (95% CI: 324.3-438.3) 3 months after 2 nd dose: 125.4 IU/mL (95% CI: 88.2- 178.4) ¹¹⁸ Exposed subjects: Before 1 st dose: 203.2 UI/mL (95% CI: 42.9-962.4) After 1 st dose: 761.7 UI/mL (95% CI: 381.1-1522) After 2 nd dose: 719.9 UI/mL (95% CI: 264.6-1959) 3 months after 2 nd dose: 484.4 IU/mL	A phase I/II clinical trial found that NAbs titres dropped below the seropositive cut- off of 8, 6 months after the administration of the first dose ¹²⁰ . 80-90% of anti-S IgG and Nab titers against wild type waned 6 months after second vaccination ¹²¹ <u>Anti-spike Protein</u> <u>RBD IgG</u> <u>Antibodies:</u> Younger age groups (<60): 1 month after 2 nd dose: 97% seropositivity, 11.3 (IQR, 6.2-20.7) 3 months after 2 nd dose: 76% seropositivity, 2.4 (IQR, 1.0-5.0) ¹¹⁰	Median anti-S IgG was 342.7 AU/mL (IQ: 76.1-892.8) which was found to be significantly lower than the Covidshield- induced antibody concentration of 1,299.5 AU/mL (IQ: 517.9- 5,019.07). [India; January to July 2021] ¹¹⁵	No available data



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1.789, after 8 months titre was 53 ¹⁰⁹ Antispike Protein Paceudovirus At peak immunity, pseudovirus NAb titre was 700, after 8 months titre was 154 ⁶⁰⁰ Antispike Protein (100, 8, 2-23.1) ¹⁰⁰ Remained stable groups ¹⁴⁴ (167, 2-3-16) trespective of age groups ¹⁴⁴ Older age groups (260): Antispike Protein Response at last size of a last size of	1		÷ ;		Ţ			
53''9Antibodies: meek interval neutralizing neitralizing neutralizing neutralizi		1,789, after 8	Anti-spike Protein	IQR 432-2002) in	Remained stable	(95% CI: 147.3-		
53''9Antibodies: meek interval neutralizing neitralizing neutralizing neutralizi		months titre was	RBD lgG	groups with 15-25	6 months	1593) ¹¹⁸	Older age groups	
PseudovirusRED litre wasAnti-spike Protein (IQR, 2-513.6)does: 100% (IQR, 2-513.6)does		53 ¹⁰⁹	Antibodies:	week interval	irrespective of age			
PseudovirusRBD itre was anibodries: At peak immunity, pseudovirus NAb titre was 700, after 8 months titre was 160 ¹⁰⁰ RBD lag Antibodies: Younger age groups (<60): 1 month after 2 nd dose: 100%Antibodies: Cellular Immune Response: Antibodies: Younger age groups (<60): 1 month after 2 nd dose: 96%Antibodies: Cellular Immune Response: Antibodies: Younger age (IQR, 25-33) ¹¹⁰ Decreased up to dose: 60% seropositivity, 1.13 (IQR, 05-33) ¹¹⁰ dose: 60% seropositivity, 1.33 (IQR, 05-33) ¹¹⁰ Younger age groups (<60): 1 month after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Older age groups (CBR + T cell response was 0.17% 8 months after 2 nd dose: 96%Anti-spike Protein RBD IgE Anti-spike IgE Anti-spike IgE Decay Ire Anti-spike IgEYounger age groups (c60): 1 month after 2 nd dose: 100%Median anti-SIGE was 1.298.5107Median anti-SIGE was 1.298.5107Anti-spike IgE months ithe was 3 amonths after 2 nd dose: 100%Anti-spike IgE dose 12 nd dose 12 nd (IQR, 8.			At peak immunity,	between doses114	group ¹¹⁶	Anti-RBD lgG:	1 month after 2 nd	
antibodies: At peak immunity, pseudovirus NAb titre was 700, after 8 months titre was 160 ¹⁰⁹ month sitre was 1,545 ¹⁰⁹ <i>FBD IgG</i> Antibodies: Younger age groups (c60): anoth sitre vas <i>Response:</i> <i>CBR</i> + T cell response was 0.017% 8 months after full vaccination ¹⁰⁹ <i>fEB IgG</i> cellular immune Antibodies: (IQR, 9.9-23.6) (IQR, 9.9-23.6)after fall vaccine recipients on day 239 (stable response was 0.017% 8 months after full vaccination ¹⁰⁹ after full (IQR, 9.9-23.6) (IQR, 9.9-23.6) (IQR, 9.9-23.6) <i>Response:</i> response was 0.017% 8 months after full vaccination ¹⁰⁹ <i>Response:</i> (IQR, 9.9-23.6) (IQR, 9.9-23.6) (Stable response was 0.017% 8 months after full vaccination ¹⁰⁹ <i>Anti-spike Protein</i> (IQR, 9.9-23.6) (IQR, 9.9-23.6) (IQR, 9.9-23.6) <i>Anti-spike Protein</i> response was 0.017% 8 months after 2 rd dose to 0.12% 8 months after 2 rd dose to 19.7%160 days after 2 rd dose to 42 days after 2 rd dose: 90% seropositivity, 13.3 (IQR, 2.5-23.1) ¹¹⁰ <i>Anti-spike Protein</i> <i>Response:</i> Anti-spike Protein Remained stable for 8 months after 2 rd dose: 100% seropositivity, 19.2 (IQR, 2.5-23.1) ¹¹⁰ <i>Anti-spike Protein</i> Remained stable for 8 months: after 2 rd dose: 100% seropositivity, 19.2 (IQR, 2.5-23.1) ¹¹⁰ <i>Anti-spike Protein</i> Remained stable for 8 months: after 2 rd dose to 517.9-5,019.07 which is after 2 rd dose to 517.9-5,019.07 <i>Anti-spike Protein</i> Remained stable for 8 months: after 2 rd dose to 50.82% t60 days after 2 rd dose to 50.82% t60 d		<u>Pseudovirus</u>	RBD titre was		- ·	Decreased up to	dose: 88%	
At peak immunity pseudovirus NAb titre was 700, atter 160 ¹⁰⁹ 1,546 ¹⁰⁹ Antibodies: Younger age ose: 100% seropositivity, 12.1 (DR, 9-23.6)Response: to month after 2 nd detected in all vaccination ¹⁰⁹ Antibodies: Younger age seropositivity, 17.1 (DR, 9-23.6)Response: to month after 2 nd dese: 100% seropositivity, 12.1 (IQR, 9-23.6)Response: to month after 2 nd dese: 100% seropositivity, 4.5 (IQR, 3.5-9.3) ¹¹⁰ Antibodies: Neutralizing Antibodies: Decay from seropositivity, 4.5Younger age groups (<60): 1 month after 2 nd dose: 100% seropositivity, 35.3 (IQR, 6.9-27.1)Older age groups (CR, 1.9-8.4) ¹¹⁰ CD8+ T cell response was on that 2 nd dose: 90% seropositivity, 3.5 (IQR, 6.9-27.1)Neutralizing Antibodies: Neutralizing Antibodies: Decay from 95.08% 42 days after 2 nd dose to 10.7% 160 days after 2 nd dose: 90% seropositivity, 3.5 (IQR, 6.9-27.1)Neutralizing Antibodies: CD8+ T cell response was of at least 8 months after 2 nd dose: 90% seropositivity, 3.5 (IQR, 6.9-27.1)Neutralizing Antibodies: CD8+ T cell response was of at least 8 after vaccination ¹⁰⁹ Neutralizing Antibodies: CD8+ T cell response was of a month after 2 nd dose: 90% seropositivity, 3.5 (IQR, 6.9-27.1) Antibodies: Remained stableNeutralizing Antibodies: CD8+ T cell response was of a month after 2 nd dose: 90% seropositivity, 3.5 (IQR, 6.9-27.1) Antibodies: Remained stableAnti-spike fdGi month after 2 nd dose: 100% A seropositivity, 3.5 (IQR, 1.9-8.4) ¹¹⁰ Older age groups (ES0): 1 month after 2 nd Neutralis		neutralizing	25,677, after 8	Anti-spike Protein	<u>Humoral &</u>	41.8% 2 months	seropositivity, 6.4	
pseudovirus NAbYounger age groups (<60):Antibody responses were detected in all vaccine recipients42.9% decrease after 7 months '100'dose: 60% seropositivity, 1.3 (IQR, 0.5-3.3) ¹¹⁰ Anti-spike Protein Response Antibodies: Antibodies: Antibodies: Antibodies: To\$11°DO8+ T cell response was 0.017% 8 months after 21°Inonh after 21° dose: 100% seropositivity, 17.1 (IQR, 9.9-23.6) 3 months after 21° dose: 97%Anti-spike Protein (IQR, 9.9-23.6) 3 months after 21° dose: 97%Meutralizing Antibodies: nonths after 21° dose: 97%Younger age groups (<60): 1 month after 21° dose: 100%Oldr age groups (260): 1 month after 21° dose: 97%CD8+ T cell response was 0.12% 8 months after 21.564, after 8 months titre was r55 ¹⁰⁹ Anti-spike Protein (260): 1 month after 21° dose: 97%Neutralizing Antibodies: Dider age groups (260): 1 month after 21° dose: 90%Anti-spike Protein RBD Infice afterNeutralizing Antibodies: Neutralizing Antibodies: Dider age groups (260): 1 month after 21° dose: 90%Anti-spike Protein RBD Infice vaccination109Neutralizing Anti-spike Protein RBD Infice vaccination109Younger age groups (c40): 1 month after 21° dose: 100% seropositivity, 35.3 (IQR, 7.6-40.0) 3 months after 21° (IQR, 8.2-23.1) ¹¹⁰ Neutralizing Anti-spike Protein RBD Infice Median anti-S Igf was 1,361, after 8 months titre was 843 ¹⁰⁹ Anti-spike Igf: Anti-spike Igf: Neutralizing Anti-spike Igf: Neutralizing Anti-spike Igf: Neutralizing Anti-spike Igf: Neutralizing Anti-spike Igf: Neutralizing 		antibodies:	months titre was	RBD lgG	Cellular Immune	after second dose	(IQR, 2.5-13.6)	
pseudovirus NAb titre was 700, after 8 months titre was 160°°Younger age groups (<60): Response: (D8+ T cell response was 0.017% 8 months after full vaccination ¹⁰⁹ Antibody response was 0.017% 8 months after full vaccination ¹⁰⁹ 42.9% decrease responses were detected in all vaccine recipients and y2394000% Binding Antibodies: Neutralizing Antibodies: 0.017% 8 months after full vaccination ¹⁰⁹ 42.9% decrease response was 0.017% 8 months after full response was 0.017% 8 months after full vaccination ¹⁰⁹ 42.9% decrease response was 0.017% 8 months after full response was 0.017% 8 months after full vaccination ¹⁰⁹ 42.9% decreased activity, 1.3 (IQR, 0.5-3.3) ¹¹⁰ 755 ¹⁰⁹ C08+ T cell response was 0.017% 8 months after full vaccination ¹⁰⁹ C08+ T cell response was 0.12% 8 months after 2 nd dose ¹²⁹ Anti-RBD after 2 nd dose ¹²⁹ 755 ¹⁰⁹ C1der age groups (260): seropositivity, 13.3 (IQR, 0.5-3.2) ¹¹⁰ Older age groups (260, 2000% (IQR, 1.9-8.4) ¹¹⁰ Anti-spike Protein RBD IqC Antibodies: Remained stable for 8 months; after 2 nd dose 128Anti-spike IqC: Decay from dose 128700Get age groups (IQR, 1.9-8.4) ¹¹⁰ Median anti-S IqC was 1.290.5 Mithe is anonth after 2 nd Median anti-S IqC was 1.361, after 8 months titre was 843 ¹⁰⁹ Anti-spike IqC: Decay from was 1.361, after 8 months titre was 843 ¹⁰⁹ 700Older age groups (IQR, 8.2-23.1) ¹¹⁰ Median anti-S IqC was 1.290.5 Mithe is anonths after 2 nd Median anti-S IqC was 1.361, after 8 months titre		At peak immunity,	1,546 ¹⁰⁹	Antibodies:	Response:	and dropped to	3 months after 2 nd	
8 months titre was 100 ¹⁰⁹ Humoral & Cellular Immune Responses: Anti-spike Protein Rabiodes: Antibodies: COB+ T cell response was dose: 97% seropositivity, 6.5 (IQR, 3.5-9.3) ¹¹⁰ I month after 2nd dose: 100% seropositivity, 13.3 a months after 2nd dose: 96% seropositivity, 35.3 (IQR, 27.6-40.0) 3 months after 2nd dose: 100% seropositivity, 19.2 (IQR, 1.9-8.4) ¹¹⁰ I month after 2nd dose: 100% seropositivity, 19.2 (IQR				Younger age	Antibody	42.9% decrease	dose: 60%	
160 ¹⁰⁹ Cellular Immune Response: (DR, 9-23.6) after 101 vaccination ¹⁰⁹ dose: 100% seropositivity, 17.1 or day 23.6) smonths after 2 nd dose: 97% seropositivity, 65 vaccination ¹⁰⁹ vaccine recipients on day 23.9 or at least 8 months) ¹¹⁷ <i>Neutralizing</i> Antibodies: Decreased 82.1% 7 months after 2000 dose 10Anti-spike Protein RBD ltre was 21,564, after 8 months titre was 755 ¹⁰⁹ 0/04r age groups (260): 1 month after 2 nd dose: 90% seropositivity, 35.3 (IQR, 52-32.1) ¹¹⁰ Older age groups (260): 1 month after 2 nd dose: 90% seropositivity, 35.3 (IQR, 6.9-27.7) dose: 100% seropositivity, 19.2 (IQR, 8.2-23.1) ¹¹⁰ dose: 100% wacinately 4-Anti-spike Protein RBD ltre vaccination ¹⁰⁹ Anti-spike IGG: Decay from 42 days after 2 nd dose 122Older age groups (260): 1 month after 2 nd dose: 100%Median anti-S IGG was 1,361, after 8 months itre was 81 ¹⁰⁹ Anti-spike IGG: 100.0%, 42 days after 2 nd dose ¹²² Older age groups (260): 1 month after 2 nd Median anti-S IGG was 1,299.5 Mich is approximately 4-Median anti-S IgG was 1,361, after 8 months itre was 84 ¹⁰⁹ Anti-spike IGG: becay from after 2 nd dose ¹²²		titre was 700 , after		groups (<60):	responses were	after 7 months ¹¹⁹	seropositivity, 1.3	
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Anti-spike Protein RBD IqGResponse: (CD8+ T cell response was 		160 ¹⁰⁹	Cellular Immune	dose: 100%	vaccine recipients	Binding		
RBD lrgG Antibodies: At peak immunity, RBD titre was 				seropositivity, 17.1	on day 239	Antibodies:	<u>Neutralizing</u>	
Antibodies: At peak immunity, RBD titre was 21,564, after 8 months titre was 755 ¹⁰⁹ 0.017% 8 months after full (QR, 3.5-9.3) ¹¹⁰ dose: 97% seropositivity, 6.5 (QR, 3.5-9.3) ¹¹⁰ months) ¹¹⁷ second dose ¹¹⁹ second dose ¹¹⁹ 95.08% 42 days after 2 nd dose to 19.7%160 days after 2 nd dose ¹²² Younger age groups (<60): 1 month after 2 nd dose: 100% seropositivity, 35.3 (QR, 2.7.6-40.0) 3 months after 2 nd dose: 100% seropositivity, 19.2 (QR, 8.2-23.1) ¹¹⁰ Older age groups (GR, 1.9-8.4) ¹¹⁰ months) ¹¹⁷ second dose ¹¹⁹ second dose ¹¹⁹ 95.08% 42 days after 2 nd dose to Anti-RBD Decay from 100% Anti-spike Protein RBD IgG Antibodies: Remained stable for 8 months; At 4 weeks after immunization titre was 1,289.5 AU/mL (IQC: 517.9-5,019.07) which is a prooximately 4-months) ¹¹⁷ second dose ¹¹⁹ 95.08% 42 days after 2 nd dose to 40se ¹²² Older age groups (260): 1 month after 2 nd Median anti-S IgC was 1,289.5 AU/mL (IQC: 517.9-5,019.07) which is a prooximately 4-months ifter 2 nd dose 102 Anti-spike IgG: months after 2 nd dose 102Older age groups (260): 1 month after 2 nd Median anti-S IgC was 1,289.5 AU/mL (IQC: 517.9-5,019.07) which is aproximately 4-Metian anti-S IgC was 1,361, after 8 months after 2 nd dose 102 Metian anti-S IgC was 1,361, after 8 months after 2 nd dose 102 Metian anti-S IgC was 1,361, after 8 months after 2 nd dose 102Older age groups (260): 1 month after 2 nd Metian anti-S IgC was 1,289.5 AU/mL (IQC: 517.9-5,019.07) which is aproximitely 4-Metian anti-S IgC Metian anti-S IgC		<u>Anti-spike Protein</u>	CD8+ T cell	(IQR, 9.9-23.6)	(stable response	Decreased 82.1%	Antibody:	
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RBD titre was 21,564, after 8 months titre was 755 ¹⁰⁹ vaccination ¹⁰⁹ (IQR, 3.5-9.3) ¹¹⁰ CD8+ T cell response was after 2 nd dose ¹²² 75 ¹⁰⁹ Older age groups (260): 1 month after 2 nd dose: 96% groups (c60): 1 month after 2 nd dose: 100% seropositivity, 35.3 (IQR, 27.6-40.0) 3 months after 2 nd dose: 100% seropositivity, 19.2 (IQR, 8.2-23.1) ¹¹⁰ Older age groups (CR, 1.9-8.4) ¹¹⁰ Older age groups (CR, 1.9-8.4) ¹¹⁰ Anti-spike Protein RBD IgGG Anti-spike Protein RBD IgGG Anti-spike 190G dose to 54.10%Older age groups (IQR, 27.6-40.0) 3 months after 2 nd dose: 100% (IQR, 8.2-23.1) ¹¹⁰ (IQR, 1.9-8.4) ¹¹⁰ was 1,299.5 AU/mL (IQ: S17.9-5,019.07) which is 1 month after 2 nd Approximately 4-Decle age from Anti-spike IgG: months titre was after 2 nd dose to after 2 nd		Antibodies:	0.017% 8 months	dose: 97%	months) ¹¹⁷	second dose ¹¹⁹	<mark>95.08%</mark> 42 days	
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months titre was 755 ¹⁰⁹ Older age groups (260): 1 month after 2nd dose: 96%0.12% 8 months after vaccination109Anti-RBD Antibody: Decay from 100%Younger age groups (<60): 1 month after 2nd dose: 96%seropositivity, 13.3 dose: 96%Anti-spike Protein RBD IgG42 days after 2nd dose to 54.10%1 month after 2nd dose: 100%(IQR, 6.9-27.7) dose: 90%Anti-spike Protein RBD IgG42 days after 2nd dose to 54.10%1 month after 2nd dose: 100%(IQR, 1.9-8.4)110Antibodies: remained stable160 days after 2nd dose 1223 months after 2nd dose: 100%(IQR, 1.9-8.4)110remained stable remained stableanti-spike IgG: munization titre3 months after 2nd dose: 100%Median anti-S IgG was 1,299.5 AU/mL (IQ: Seropositivity, 19.2 (IQR, 8.2-23.1)110Median anti-S IgG was 1,299.5 AU/mL (IQ: was 1,299.5 AU/mL (IQ: was 1,361, after 8 months titre was 843109100.0% 42 days after 2nd dose 122Older age groups (260): 1 month after 2ndStropositivity 4.9 approximately 4-Anti-spike IgM:		RBD titre was	vaccination ¹⁰⁹	(IQR, 3.5-9.3) ¹¹⁰	CD8+ T cell			
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Younger age groups (<60): 1 month after 2 nd dose: 96%vaccination ¹⁰⁹ Antibody: Decay from 100% 42 days after 2 nd dose to 54.10%1 month after 2 nd dose: 100%(IQR, 6.9-27.7) 3 months after 2 nd dose: 90%Anti-spike Protein RBD IgG Antibodies: Remained stable for 8 months; At 4 weeks after immunization titre was 1,299.5Anti-spike Irotein RBD IgG Antibodies: Antibodies: At 4 weeks after immunization titre was 1,361, after 8 months titre vas after 2 nd dose to 50.82% 160 days after 2 nd dose 122 (IQR, 8.2-23.1) ¹¹⁰ Older age groups (≥60): 1 month after 2 nd approximately 4-Median anti-S IgG was 1,299.5Wedian anti-S IgG was 1,299.5I month after 2 nd (≥60): 1 month after 2 nd month after 2 nd approximately 4-Anti-spike IgG: At 4 weeks after month after 2 nd dose to At 4 weeks after months titre was after 2 nd dose to after 2 nd dose to At 4 month after 2 nd				Older age groups				
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(≥60): which is approximately 4-					843 ¹⁰⁹			
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							A	
dose: 100%							<u>Anti-spike IgM:</u>	
		dose: 100%		told higher than				



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Immunosuppress negative group ion: comprised of 80% 65% to 70% of the group (268 decrease of 329) with a 8.55 compared to non- anti –RDB IgG immunosuppresse median d ¹¹¹ quantitative titer (IQR 5.5-13.92) (IQR 5.5-13.92)	
ion: 65% to 70% decrease compared to non- immunosuppresse d ¹¹¹ Let a b b b b b b b b b b b b b b b b b b	
to 45-year-old ¹¹¹ Older age (265) AND men: 37% to 46% decrease compared to 18- to 45-year-old	
to 45-year-old ¹¹¹ Older age (265) AND men: 37% to 46% decrease compared to 18- to 45-year-old	
Older age (265) 18.5% (61 of 329) AND men: positive with a 37% to 46% 64.47 BAU/mL decrease anti -RDB IgG compared to 18- median to 45-year-old quantitative titer women ¹¹¹ (IQR 42.87-125.5) obtained. The negative group ion: comprised of 80% 65% to 70% of the group (268) decrease of 329) with a 8.55 compared to non-immunosuppresse median iff median iff iff	
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to 45-year-old women ¹¹¹ Immunosuppress ion: 65% to 70% decrease compared to non- immunosuppresse d ¹¹¹ d	
women ¹¹¹ (IQR 42.87-125.5) obtained. The negative group comprised of 80% of the group (268 decrease compared to non- immunosuppresse d ¹¹¹ due to non- im	
Immunosuppress negative group ion: comprised of 80% 65% to 70% of the group (268 decrease of 329) with a 8.55 compared to non- anti –RDB IgG immunosuppresse median d ¹¹¹ quantitative titer (IQR 5.5-13.92) Immunosuperiod	
ion: 65% to 70% decrease compared to non- immunosuppresse d ¹¹¹ Let a b b b b b b b b b b b b b b b b b b	
65% to 70% decrease compared to non- immunosuppresse d ¹¹¹ of the group (268 of 329) with a 8.55 anti -RDB IgG median quantitative titer (IQR 5.5-13.92)	
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compared to non- immunosuppresse d ¹¹¹ dual to the second	
immunosuppresse d ¹¹¹ d ¹¹¹ quantitative titer (IQR 5.5-13.92)	
d ¹¹¹ quantitative titer (IQR 5.5-13.92)	
(IQR 5.5-13.92)	
Obesity (BMI and the maximum	
≥30): titer was 29.92	
31% increase in BAU/mL (p	
neutralizing actionalized-sciences.com actionalized-sciences.com<td></td>	
antibody	



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	compared with nonobese ¹¹¹ While the mean values of anti- RBD-IgG showed a marked decline at 6 months, high neutralizing bioactivity was maintained at least 6 months after vaccination in almost all study participants (N=57 HCWs) ¹¹² <u>Humoral &</u> <u>Cellular Immune</u> <u>Response:</u> CD8+ T cell response was							
Duration of protection (vaccine effectiveness)	response was 0.016% 8 months after full vaccination ¹⁰⁹ <u>Against any</u> <u>SARS-CoV-2</u> <u>Infection:</u> After reaching peak VE (77.5%) 1 month after 2 nd dose, VE dropped to 20% in months	36.4 (95% CI, 17.1-51.5) reduction of observed incidence rate (SARS-CoV-2 infection) if vaccinated from Dec 2020 – Apr	VE reduced by 7% (95% CI, -18 - 2) for every 30 days from the second dose for those aged 18 to 64 years ⁶⁰ .	A study observed sustained and stable vaccine effectiveness starting 14 days post vaccination to a maximum of 152 days after vaccination ¹⁴ .	No available data	No available data	No available data	No available data



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	5-7 after 2 nd	2021 than Jul	VE reduced from			
	dose ¹²⁴	2021 – Dec	58% (95% CI, 51-	VE decreased		
		2020. ¹³³	65) to 27% (95%	from 89.4% in		
	VE reduced from		CI, 17-37) after 4	May to 51.7% in		
	87% (95% CI, 85-	46.0 (95% Cl, -	months. ³⁶	July ⁵⁰		
	89) to 56% (95%	52.4-83.2)				
	CI, 53-59) after 4	reduction of	VE reduced from	VE decreased		
	months.36	observed	88% (95% CI, 87-	from 86.4% (95%		
		incidence rate	89) in March to	CI, 85.2-87.6) in		
	VE reduced from	(severe SARS-	3% (95% Cl, -7-	March 2021 to		
	91% (95% Cl, 91-	CoV-2 infection) if	12) in August ⁷³	13.1% (95% Cl,		
	92) in March to	vaccinated from		9.2-16.8) in		
	50% (95% Cl, 47-	Dec 2020 – Apr	VE decreased by	September		
	52) in August ⁷³	2021 than Jul	18.5% points	2021 ¹³¹		
		2021 – Dec	(95% CI 8.4-33.4)			
	VE reduced from	2020. ¹³³	among all ages	VE decreased by		
	89.0% (95% Cl,		and 19.9% points	18.5% points		
	84.6-92.1; United	VE against the	among older	(95% CI 8.4-33.4)		
	States) [May to	Delta variant	individuals (95%	among all ages		
	August] to 62.7%	declined from	Cl; 9.2-36.7)	and 19.9% points		
	(95% CI, 62.4-	94.1% (95% CI,	[Overall average	among older		
	63.1; United	90.5-96.3) 14-60	from Systematic	individuals (95%		
	States) [May to	days after	Review and Meta-	Cl; 9.2-36.7)		
	August] ^{125lxx}	vaccination to	Regression] ^{1261xxxvi}	[Overall average		
	\/ F	80.0% (95% CI,		from Systematic		
	VE decreased by	70.2-86.6) 151-	VE reduced from	Review and Meta-		
	18.5% points	180 days after	96.9% (range,	Regression] ^{126xcii}		
	(95% CI 8.4-33.4)	vaccination.62	93.7-98.0) for the	V/E reduced from		
	among all ages	040/ [lanuam/	week of 1 May	VE reduced from		
	and 19.9% points	91% [January-	2021 to 77.8%	86.6% (range,		
	among older	March]	(range, 70.1-86.8)	77.8-89.7) for the		
	individuals (95%			week of 1 May		

^{Ixx} Study does not differentiate between the two mRNA vaccines, Pfizer and Moderna.

^{lxxxvi} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria. ^{xcii} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.



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ining report			e	oublind Houng	ao2 Tolaoquo2, Oubliola Oul220 211, Oullino 2004.100	odia falora, calotto cal	0
	CI; 9.2-36.7) [Overall average from Systematic Review and Meta- Regression] ^{126lxxi} VE reduced from 91.3% (range, 84.1-97) for the week of 1 May 2021 to 72.3% (range, 63.7-77.5) by the week of August 28 2021 ⁹⁹ . VE decreased to 66.3% (95% CI, 65.7-66.9) by 20 weeks after the second dose. Protection against hospitalization decreased less with a VE of 91.7% (95% CI 90.2-93.0) and a	71% (95% CI, 53- 83) [April-May] 63% (95% CI, 44- 76) ⁵⁰ VE reduced from 90% (95% CI, 88- 91) to 71% (95% CI, 68-74) after 4 months ³⁶ VE reduced from 91% (95% CI, 72- 98) in January- March to 71% (95% CI, 53-83) in April-May to 63% (95% CI, 44-76) in June-August ⁵⁰ VE reduced from 92% (95% CI, 92- 93) in March to 64% (95% CI, 62- 66) in August ⁷³	by the week of August 28 2021 ⁹⁹ Estimated results show that vaccine effectiveness significantly wanes from 60 days after the second dose [Japan; February 2020 to December 2021] Ixxxvii VE of first dose 68% (95% CI 67.0.% - 69.%; Canada) and 88% (95% CI 87.0% - 88.0%; Canada) [December 2020 to October 2021] Risk of infection decreased 4-6 months after the second vaccine dose, but markedly	2021 to 69.4% (range, 63.4-77.3) by the week of August 28 2021 ⁹⁹ . VE was 74.8% (95% CI, 72.5- 76.9) at 1 months and decreased to 59.4% (95% CI, 57.2-61.5) at 5 months. [United States; December 2020 to September 2021] ⁷⁵ Waning protection against infections started in month 4 for Ad26.COV2.S (OR [95% CI] in month 5+, 1.31 [1.18, 1.47]). No waning of protection was observed at any			
	hospitalization decreased less with a VE of 91.7% (95% Cl	92% (95% Cl, 92- 93) in March to 64% (95% Cl, 62-	Risk of infection decreased 4-6 months after the second vaccine	month 5+, 1.31 [1.18, 1.47]). No waning of			

^{Ixxi} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.

^{bxxxviii} Study does not differentiate between BNT162b2, mRNA-1273, and ChAdOX-S.



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^{Ixxxvii} Study does not differentiate between Pfizer Moderna, and AstraZeneca.



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	VE was 94.5% (95% CI, 94.1 to 94.9) 2 months after the first dose and decreased to 66.6% (95% CI 65.2-67.8) at 7 months. [United States; December 2020 to September 2021] 75 Waning protection against infections started in month 2 for BNT162b2 (OR [95% CI] in month 6+, 2.93 [2.72, 3.15]). No waning of protection was observed at any time for ICU admissions. [United States, January 2021 to	wane over time and was 63% (95% CI, 55-68) 91-180 days after the second dose [27 Dec 2020 – 26 Oct 2021; Finland] ^{130lxxviii} VE decreased from 89.2% (95% CI, 88.8-89.6) in March 2021 to 58.0% (95% CI, 56.9-59.1) in September 2021 ¹³¹ VE reduced from 89.0% (95% CI, 84.6-92.1; United States) [May to August] to 62.7% (95% CI, 62.4- 63.1; United States) [May to August] ^{125lxxix}	43.2-45.4) by 20 weeks after the second dose. Protection against hospitalization decreased less with a VE of 80.0% (95% CI 76.8-82.7) and a VE against death of 84.8% (95% CI, 76.2-90.3) [England] ¹²⁷ <u>Against</u> <u>symptomatic</u> <u>COVID-19:</u> VE decreased by 25.4% (95% CI, 13.7-42.5) among all ages and 32.0% (95% CI, 11.0-69.0) among older individuals [Overall average from Systematic Review and Meta-	September 2021] ¹²⁸ There was no evidence of waning protection against hospitalization for Ad26.COV2.S (OR [95% CI], 1.25 [0.86, 1.80] in month 5+) [United States, January 2021 to September 2021] ¹²⁸			
	admissions. [United States,	(95% CI, 62.4- 63.1; United States) [May to	older individuals [Overall average from Systematic	<u>Against</u> <u>symptomatic</u> <u>COVID-19:</u> VE decreased by 25.4% (95% CI, 13.7-42.5) among			

^{lxxviii} Study does not differentiate between COMIRNATY/BNT162b2 and SPIKEVAX/ mRNA-1273.

^{Ixxix} Study does not differentiate between the two mRNA vaccines, Pfizer and Moderna.

^{kxxix} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.



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signific from 6 the se [Japar 2020 t 2021] VE of 68% (9 67.0.% Canac (95% 0 88.0% [Decen to Oct Risk o decrea month secon dose, marke increa	50 days after econd dose n; February to December ^{bxii} first dose 95% Cl % - 69.%; da) and 88% Cl 87.0% - 6; Canada) mber 2020 tober 2021] of infection ased 4-6 ns after the d vaccine but edly ased after. ¹²⁹	and 19.9% points among older individuals (95% Cl; 9.2-36.7) [Overall average from Systematic Review and Meta- Regression] ^{126lxxx} VE reduced from 96.9% (range, 93.7-98.0) for the week of 1 May 2021 to 77.8% (range, 70.1-86.8) by the week of August 28 2021 ⁹⁹ . VE was 95.9% (95% Cl, 95.5- 96.2) 2 months after the first dose decreased to 80.3% (95% Cl 79.3-81.2) at 7 months. [United States; December 2020 to	Effectiveness did not fall significantly after longer intervals, however this could be influenced by the study's small number of participants ¹³² <u>Against severe</u> <u>COVID-19:</u> VE decreased by 8.0% (95% CI, 3.6-15.20) among all ages and 9.7% (95% CI; 5.9-14.7) among older individuals [Overall average from Systematic Review and Meta- Regression] ^{126xc} <u>Against variants:</u> <u>Among individuals</u> who received 2	all ages and 32.0% (95% CI, 11.0-69.0) among older individuals [Overall average from Systematic Review and Meta- Regression] ^{126xciii} <u>Against severe</u> <u>COVID-19:</u> VE decreased by 8.0% (95% CI, 3.6-15.20) among all ages and 9.7% (95% CI; 5.9-14.7) among older individuals [Overall average from Systematic Review and Meta- Regression] ^{126xciv}				
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^{lxxii} Study does not differentiate between Pfizer Moderna, and AstraZeneca.

- x^c Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.
- xciii Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.

xciv Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.



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Ixxiii Study does not differentiate between BNT162b2, mRNA-1273, and ChAdOX-S.

xxx Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.



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VE decreased by 25.4% (95% CI, 13.7-42.5) among all ages and 32.0% (95% CI, 11.0-69.0) among older individuals [Overall average from Systematic Review and Meta- Regression ^{126ixxiv} VE reduced by 22% (95% CI, 6- 41) for every 30 days from the second dose for those aged 18 to 64 years ⁶⁰ . VE against infection was 82% (95% CI, 79-85) 14-90 days after the second dose and appeared to wane over time and was 63% (95% CI, 55-68) 91-180 days after the second dose [27 Dec 2020 – 26	September 2021] ⁷⁵ Waning protection against infections started in month 2 for mRNA-1273 (OR [95% CI] in month 6+, 2.76 [2.51, 3.04]). No waning of protection was observed at any time for ICU admissions. [United States, January 2021 to September 2021] ¹²⁸ Evidence of waning protection against hospitalization started in month 3 for mRNA-1273 (OR 95% CI, 1.66 [1.26, 2.19] in month 6+) [United States, January 2021 to	doses of vaccines (with at least 1mRNA vaccine) VE against Delta declined steadily over time from 84% (95%CI, 81- 86%) 7-59 days after the second dose to 71% (95%CI, 66-75%) ≥240 days after the second dose, but recovered to 93% (95%CI, 92- 94%) ≥7 days after receiving an mRNA vaccine for the third dose.[Canada; November 2021 to December 2021] ⁷⁶ xcl			

^{lxxiv} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria. ^{xci} Study does not differentiate between Pfizer, Moderna, or AstraZeneca.



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Oct 2021; Finland]'30xxBestember 2021] LaVE decreased from 86.9% (65%, Cl, 86.547.3) in March 2021 to 43.3% (65% Cl, 43.3% (65% Cl, vames from 60 days after the second dose 12021131Estimated results show that vaccine days after the second dose 12021131VE declined from 81% (95% Cl, 68 69% Cl, 73 days after second dose. 4.66 months after 69% Cl 87.0%, - 69.%i Carada) and 88% remained at 70% (95% Cl, 27.0%, - 69.%i) Carada) and 88% remained at 70% exest after free second dose. 46% (65% Cl, 73.3%)VE of first dose 68% (61% Cl Carada) and 88% second dose. Carada) and 88% second dose. Carada and 88% second dose. Carada and 88% second dose. VE declined from advisiter d ≥6 weeks after frie second dose. Carada and 88% second vaccine weeks after frie second vaccine weeks after frie second vaccine weeks after frie second vaccine second vaccine second vaccine weeks after frie second vaccine second vaccine second vaccine second vaccine second vaccineImage: Carada and the frie second vaccine second vaccine second vaccineVE declined from advisiter d ≥6 second vaccine second vaccineVE declined from advisiter d ≥6 second vaccine second vaccine second vaccineImage: Carada and t	coning roport.		WITO & Emergency Obe Ele	TO THE OLD OUD THAT TO UNG	102 Volaoquo2, Oubilola e	Guza Valera, Gullette Gul	
Finland]130kev128VE decreased from 86.9% (95%) Cl, 86.5-87.3) in March 2021 to asys (95%) Cl, 41.9-44.6) in September 2021133Estimated results show that vaccine effectiveness significantly adys after the second dose (1394), February 2020 to December 2021 133VE declined from 81% (95%) Cl, 68- 68% (95%) Cl (95%) Cl, 62- (95%) Cl, 62-76) and declined to (95%) Cl, 62-76) and declined to (95%) Cl, 62-76) and declined to and declined to becomber 2020 to December		Oct 2021	September 2021				
VE decreased from 86.9% (95% Cl, 86.5-87.3) in March 2021 b 43.3% (95% Cl, 41.9-44.6) in September 2021 ¹³¹ VE declined from 81% (95% Cl, 4-6 months after second dose, VE remaind at 70% Cl, 82-76) and declined from months. [second dose was administered 2-6 weeks after first dose]. ¹³² VE declined from 86% (95% Cl, 22- 63) after six administered 2-6 weeks after first dose]. ¹³²							
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administered ≥6 weeks after first dose]. ¹³² VE declined from 86% (95% CI, 73-		dose was	months after the				
weeks after first dose]. ¹³² dose, but markedly increased after. ¹²⁹ VE declined from 86% (95% CI, 73-		administered ≥ 6					
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VE declined from 86% (95% CI, 73-							
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86% (95% CI, 73-		VE declined from					
93) 14-73 days							
		93) 14-73 days					

^{lxxv} Study does not differentiate between COMIRNATY/BNT162b2 and SPIKEVAX/ mRNA-1273.

^{Ixxxi} Study does not differentiate between Pfizer Moderna, and AstraZeneca.

^{lxxxii} Study does not differentiate between BNT162b2, mRNA-1273, and ChAdOX-S.



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after second dose. 6 months after	<u>Against</u>	
second dose, VE	<u>symptomatic</u> COVID-19:	
declined to 61%	VE decreased by	
(95% Cl, 45-73).	25.4% (95% Cl,	
[second dose was	13.7-42.5) among	
administered ≤ 6	all ages and	
weeks after first	32.0% (95% CI,	
dose] ¹³²	11.0-69.0) among	
0000]	older individuals	
Against severe	Overall average	
COVID-19:	from Systematic	
VE decreased by	Review and Meta-	
8.0% (95% Cl,	Regression) ^{126lxxxiii}	
3.6-15.20) among	5 ,	
all ages and 9.7%	Against severe	
(95% CI; 5.9-14.7)	COVID-19	
among older	<u>disease:</u>	
individuals	VE decreased by	
[Overall average	8.0% (95% Cl,	
from Systematic	3.6-15.20) among	
Review and Meta-	all ages and 9.7%	
Regression] ^{126lxxvi}	(95% CI; 5.9-14.7)	
	among older	
<u>Against</u>	individuals	
Hospitalization	[Overall average	
and Death:	from Systematic	
After reaching	Review and Meta-	
peak VE (96.8%)	Regression] ^{126lxxxiv}	
2 months after 2 nd	Accinctuationts	
dose, VE did not decline over	<u>Against variants:</u>	

^{bxxvi} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria. ^{bxxviii} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria. ^{bxxviv} Study does not differentiate between Pfizer/BioNTech-Comirnaty, Moderna-mRNA-1273, Janssen-Ad26.COV2.S and AstraZeneca-Vaxrevria.



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^{lxxxv} Study does not differentiate between Pfizer, Moderna, or AstraZeneca.



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	the second dose, but recovered to 93% (95%CI, 92- 94%) ≥7 days after receiving an mRNA vaccine for the third dose.[Canada; November 2021 to December 2021] 76 Ixxvii	V/E oggingt	199 ((limited data)					
Transmission prevention	Prior DeltaVariant:Vaccineeffectivenessagainstinfectiousnessgiven infections41.3%134VE againsttransmission88.5%134VE againstonwardstransmission ofAlpha 57% (95%CI, 5-85)92VE againstonwardsonwards	VE against onwards transmission: 52% (95% CI, 33-69) ¹⁶ VE against transmission from vaccinated index case to unvaccinated contact is 63% (95% CI, 46-75) and 40% (95% CI, 20-54) to a vaccinated contact. ^{139xcvi} VE against transmissibility was 31% (95% CI, 26-36) when the	48% (limited data) May not be able to block the transmission of the alpha variant as efficiently as the wild type ¹⁴² . VE against transmission from vaccinated index case to unvaccinated contact is 63% (95% CI, 46-75) and 40% (95% CI, 20-54) to a vaccinated contact. ^{139xcvii}	VE against transmissibility was 31% (95% CI, 26-36) when the secondary case was not vaccinated and 10% (95% CI, 0- 18) when secondary case was fully vaccinated ¹⁴⁰ Estimated SAR to fully vaccinated household contact was 42.7% (95% CI, 13.6-77.9) ¹⁴¹	Unknown	Unknown	No available data	No available data

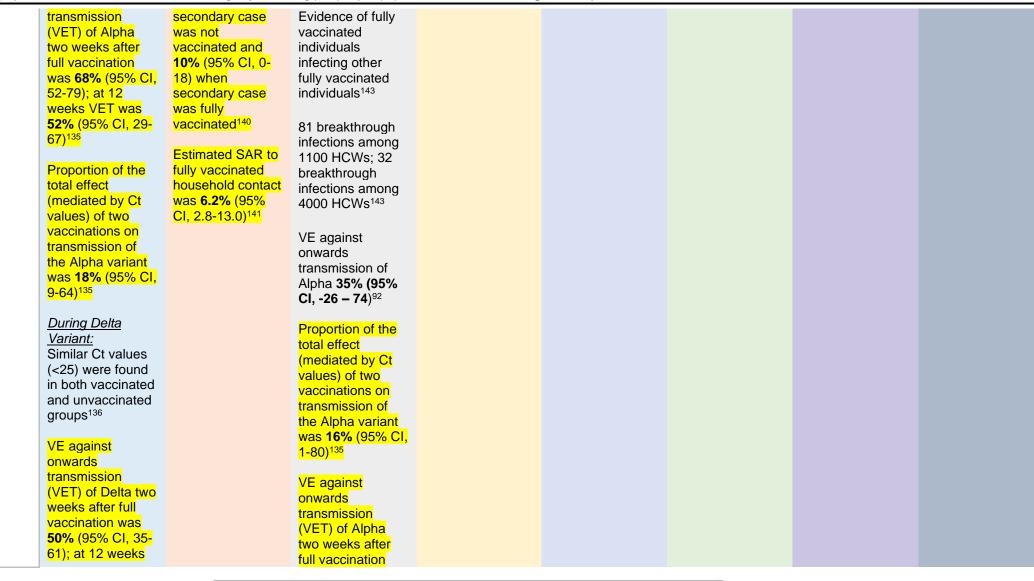
^{Ixxvii} Study does not differentiate between Pfizer, Moderna, or AstraZeneca. ^{xcvi} Study does not differentiate between Comirnaty/BNT162b2, Spikevax/ mRNA-1273, and Vaxzevria/ ChAdOz1 nCOV-19.

xcvii Study does not differentiate between Comirnaty/BNT162b2, Spikevax/ mRNA-1273, and Vaxzevria/ ChAdOz1 nCOV-19.



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0 1	0,	
	VET was 24%	was 24% (95% Cl,
	(95% CI, 20-28) ¹³⁵	18-30); at 12
		weeks VET was
	Proportion of the	2% (95% Cl, -2-
	total effect	6) ¹³⁵
	(mediated by Ct	
	values) of two	VE against
	vaccinations on	onwards
	transmission of	transmission
	the Delta variant	(VET) of Delta two
	was 23% (95% CI,	weeks after full
	17-33) ¹³⁵	vaccination was
		52% (95% Cl, 22-
	Studies from	70); at 12 weeks
	Scotland and	VET was 38%
	England	<mark>(95% CI, -1-62)¹³⁵</mark>
	demonstrated	
	reductions in	Proportion of the second se
	secondary	<mark>total effect</mark> ioned and the second
	infections among	<mark>mediated by Ct</mark> anon and the second
	families of	<mark>values) of two</mark> ng and the second
	vaccinated	<mark>vaccinations on</mark> a second
	individuals	<mark>in a transmission of</mark> the second
	compared to	the Delta variant
	families of	was <mark>7% (95% Cl,</mark>
	unvaccinated	<mark>5-10)¹³⁵</mark>
	individuals ^{137,138} .	
		VE against
	VE against onwards	onwards
	transmission: 62%	transmission of Delta 42% (95%
	(95% Cl, 57-67) ¹⁶	Cl, 14-69) ⁹²
	VE against	
	transmission from	VE against transmissibility
	vaccinated index	transmissibility was 31% (95% Cl,
	case to	



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÷ .		÷ ;	÷, , , , ,			
	unvaccinated		26-36) when the			
	contact is 63%		secondary case			
	(95% CI, 46-75)		was not			
	and 40% (95% CI,		vaccinated and			
	20-54) to a		10% (95% CI, 0-			
	vaccinated		18) when			
	contact. ^{139xcv}		secondary case			
	oonaoa		was fully			
	VE against		vaccinated ¹⁴⁰			
	onwards		Taboniatou			
	transmission of					
	Delta 31% (95%					
	Cl, -3 – 61) ⁹²					
	VE against					
	infection [within a					
	ten-day window]					
	when having a					
	confirmed					
	household					
	exposure 80.4%					
	(95% CI, 73.6-					
	(3578 CI, 73.0- 85.5) ⁶⁹					
	00.0)					
	Additional					
	infections					
	occurred in 49.8%					
	(95% CI, 48-51.6)					
	of homogenously					
	unvaccinated					
	household					
	members and					
	12.5% (95% CI,					
	9.1-17) of					
	9.1-17)01					

xcv Study does not differentiate between Comirnaty/BNT162b2, Spikevax/ mRNA-1273, and Vaxzevria/ ChAdOz1 nCOV-19.



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corooning roport. COME TO Vaconice in the V	inte e Entergentey eee Ele	Tionizozz Gabina Hoang	dez Veldegdez, edollela e	Caza Valora, Callotto Call	
homogenously vaccinated household members [within a ten-day window] ⁶⁹ VE against transmissibility was 31% (95% CI, 26-36) when the secondary case was not vaccinated and 10% (95% CI, 0- 18) when secondary case was fully vaccinated ¹⁴⁰ Estimated SAR					
vaccinated index case was 8.3% (95% CI, 5.6-12.1) and 35.9% (95% CI, 34.1-37.6) for unvaccinated index cases ¹⁴¹ Estimated SAR to fully vaccinated household contact was 15.8% (95% CI, 15.0-16.7) ¹⁴¹					



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	Secondary attack ra		holds infected with th	e Omicron VOC and				
	with the Omicron VC individuals had a se	DC (29%) and the De	rated similar attack ra Ita VOC (28%). Fully f 32% in Omicron infe	vaccinated				
Transmission prevention: Omicron		who had received a th In and 11% for Delta ¹	<mark>ird (booster) shot, se</mark> ⁴⁴ .	condary attack rate				
			of unvaccinated per 1) for boosted individu					
	households had an infected households	estimated OR of 1.17 . For vaccinated and	d individuals in Omicro (95% Cl, 0.99-1.38) boosted individuals, t 95% Cl, 2.65-5.05), re	compared to Delta the estimated OR				
Breakthrough infections	From 6,161 patients with a positive nasopharyngeal SARS-CoV-2 PCR, 1,120 (18%) were breakthrough infections – 97% of these occurred after 2 May (emergence of Delta variant). Of the 1,120 cases, 126 (12%) were hospitalized. Of the 126 breakthrough admissions, 59	From 6,161 patients with a positive nasopharyngeal SARS-CoV-2 PCR, 1,120 (18%) were breakthrough infections – 97% of these occurred after 2 May (emergence of Delta variant). Of the 1,120 cases, 126 (12%) were hospitalized. Of the 126 breakthrough	As of 10 June, 1.5 million individuals have been fully vaccinated with Covishield in Odisha Province, India. Between 1 March to 10 June, 239 breakthrough infections (SARS- CoV-2 positive after having received two doses of Covishield) were identified. Of these, 199 (83.3%) were		No available data	No available data	As of 10 June, 380,000 individuals have been fully vaccinated with Covaxin in Odisha Province, India. Between 1 March to 10 June, 35 breakthrough infections (SARS- CoV-2 positive after having received two doses of Covishield) were identified. Of these, 29 (82.9%)	No available data



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were vaccinated with BNT162D2145.admissions. 36 were vaccinated with mRNA-1273.symptomatic, 24 (10.0%) were were vaccinated individuals had comorbidities153were symptomatic, 3 (8.6%) were hospitalized. 5 individuals had comorbidities153Individuals vaccinated in January and February had a freakthrough infections for breakthrough infections individuals (no timesined under for breakthrough infectionsBreakthrough infections = all differenceBreakthrough time: 647.5 AU/ waccinated fully vaccinated fully vaccinat	0 1		5,	51 / 1 /	0	,	
with BNT-62b2 ⁴⁵ , with mRNA-1273were vaccinated with mRNA-1273were vaccinated hospitalization for hospitalization for h		were vaccinated	admissions, 36	symptomatic, 24	admissions, 10	were symptomatic,	
Individualsindividuals had comorbidities ¹⁵³ Ad26.COV2.S ¹⁴⁵ .individuals had comorbidities ¹⁵³ January and infectionsBreakthrough infectionsAd26.COV2.S ¹⁴⁵ .comorbidities ¹⁵³ January and iffectionsmemained under infectionsMedian antibody titer: 647.5 AU/ breakthrough infections - allMedian antibody titer: 647.5 AU/ breakthrough infections - all4.2% of fully vaccinated HCWs were observed 2.3Median antibody titer: 647.5 AU/ breakthrough infections - all4.2% of fully vaccinated HCWs were observed 2.3Median antibody titer: 647.5 AU/ breakthrough infections - all acres were4.2% of fully vaccinated HCWs were observed 2.3Median antibody titer: 647.5 AU/ breakthrough infections - all cases were4.2% of fully vaccinated HCWs were observed 2.3Median antibody titer: 647.5 AU/ breakthrough infections - all cases were4.2% of fully vaccinated HCWs were observed 2.3Mild only one cases wereWarch and Aprille infectionsmoderna to assured to fold breakthroughModerna to symptomatic but infections wereAss before to symptomatic but infections wereamog 40 to symptomatic but infections wereMarch all (Mild 2) to symptomatic but infections wereMarch all (Mild 2) to symptomatic but infections wereMarch all (Mild 2) to symptomatic but tisMarch all (Mild 2) to symptomatic but<		with BNT162b2 ¹⁴⁵ .	were vaccinated	(10.0%) were	were vaccinated		
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		<mark>10,412</mark>	vaccinated.	measured for 10	vaccines).125	Covaxin	
		participants, of	[United States;	breakthrough		recipients. [India;	
		which 8,554 were	December 2020 to	cases, all 10			

^{ciii} Study does not differentiate between Covishield (n=62.4%) and Covaxin (n=37%). ^{cvi} Study does not differentiate between Covishield (n=62.4%) and Covaxin (n=37%).



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vaccinated, breakthrough infections were reported by 74 (1.0%) among fully vaccinated individuals and 198 (2.3%) among partially vaccinated. [United States; December 2020 to September 2020 to September 2021] 147 xcviii In a case series of 20 HCWs, 90% (18 of 20) had confirmed infection after the first dose (47.1% within the first week, 41.2% within the second week, and 11.8% within the third week. 2 HCWs (10.0%) had	September 2021] (¹⁴⁷ c From 126,586 vaccine recipients, 492 (0.39%) were found to have breakthrough infections during the 10-month observational period. 97.2% of the identified breakthrough cases (478 of 492) were asymptomatic or mild and 2.8% (14 of 492) required hospitalization. [Switzerland; December 2021 to October 2021] ^{ci} Of 23,697 vaccinated HCPs, 0.58% tested positive for COVID	cases had lower NAbs at day 14 and 90 post second vaccination compared to controls ¹⁵⁴ From 126,586 vaccine recipients, 492 (0.39%) were found to have breakthrough infections during the 10-month observational period. 97.2% of the identified breakthrough cases (478 of 492) were asymptomatic or mild and 2.8% (14 of 492) required hospitalization. [Switzerland; December 2021 to	In a study of 10,412 participants, of which 8,554 were vaccinated, breakthrough infections were reported by 74 (1.0%) among fully vaccinated individuals and 198 (2.3%) among partially vaccinated. [United States; December 2020 to September 2020 to September 2020 to September 2021] ¹⁴⁷ civ From 126,586 vaccine recipients, 492 (0.39%) were found to have breakthrough infections during the 10-month observational period. 97.2% of		January to July 2021] ¹¹⁵	
week. 2 HCWs	0.58% tested		observational			

xcviii Study does not differentiate between Pfizer, Moderna, or Johnson & Johnson.

^c Study does not differentiate between Pfizer, Moderna, or Johnson & Johnson.

^{ci} Study does not differentiate between Pfizer, Moderna, AstraZeneca, or Janssen.

^{civ} Study does not differentiate between Pfizer, Moderna, or Johnson & Johnson.



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dose. [Saudi	received at least	October 2021] 149	cases (478 of 492)		
Arabia; December	one dose of an	cii	were		
2020 to March	<mark>mRNA vaccine) –</mark>		asymptomatic or		
2021] ¹⁴⁸	105 of which only	In a study of 614	mild and 2.8% (14		
	received one dose	of HCW, 13% (81	of 492) required		
From 126,586	<mark>and 33 (0.15% 33</mark>	<mark>of 614) had</mark>	hospitalization.		
vaccine recipients,	of 22,458 cases	breakthrough	[Switzerland;		
492 (0.39%) were	who received both	<mark>infections – within</mark>	December 2021 to		
found to have	vaccine doses)	breakthrough	October 2021] ¹⁴⁹		
breakthrough	were among those	infections, 37%	<mark>cv</mark>		
infections during	who completed	<mark>(30 of 81) were</mark>			
the 10-month	vaccination.	Covishield	Among HCW		
observational	Among the 138	<mark>recipients. [India;</mark>	participating in the		
period. 97.2% of	postvaccination	January to July	Sisonke clinical		
<mark>the identified</mark>	<mark>cases, 64 were</mark>	2021] ¹¹⁵	trial, 40,538		
breakthrough	vaccinated with		breakthrough		
<mark>cases (478 of 492)</mark>	Moderna. ¹⁵⁰		infections were		
were	4 400		<mark>confirmed – 609 of</mark>		
asymptomatic or	Among 1,128		which occurred		
mild and 2.8% (14	cluster-associated		during Beta		
<mark>of 492) required</mark>	cases of COVID,		variant		
hospitalization.	918 (81%) were		predominance,		
[Switzerland;	identified as		22,279 cases		
December 2021 to	breakthrough		during Delta, and		
October 2021]	infections. Of these, 293 (32%)		17,650 during Omicron. There		
149xcix	received the		were a total of		
01 00 007	Moderna vaccine.		1,914		
Of 23,697	Characteristics of		hospitalizations		
vaccinated HCPs,	breakthrough		(77 in the Beta,		
0.58% tested	infection cases		1,429 in the Delta,		
positive for COVID	were similar		and 408 in the		
(138 of 23,697	were on man				

^{xcix} Study does not differentiate between Pfizer, Moderna, AstraZeneca, or Janssen).

^{cii} ***Study does not differentiate between Pfizer, Moderna, AstraZeneca, or Janssen.

^{cv} Study does not differentiate between Pfizer, Moderna, AstraZeneca, or Janssen.



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cases that received at least one dose of an mRNA vaccine) – 105 of which only received one dose and 33 (0.15% 33 of 22,458 cases who received both vaccine doses) were among those who completed vaccination. Among the 138 postvacciantion cases, 74 were vaccinated with Pfizer. ¹⁵⁰ Among 1,128 cluster-associated cases of COVID, 918 (81%) were identified as breakthrough infections. Of these, 504 (55%) received the Pfizer vaccine. Characteristics of breakthrough infection cases were similar across Pfizer, Moderna, and Johnson &	across Pfizer, Moderna, and Johnson & Johnson vaccines. ¹⁵¹	Omicron periods). During Omicron, 91% hospitalized HCWs required general ward care, 6% high care, and 3% intensive care which were significantly different from the Delta (89% general, 4% high, 7% intensive care) and Beta (78% general, 7% high, 16% intensive care) periods. [South Africa; March 2021 to December 2021] ¹⁵⁶ Among 1,128 cluster-associated cases of COVID, 918 (81%) were identified as breakthrough infections. Of these, 121 (13%) received the Johnson & Johnson vaccine. Characteristics of breakthrough infection cases were similar			
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Johnson vaccines. ¹⁵¹ Overall test positivity rate was 6.4% during the period of Delta dominance and 24.4% during a proxy Omicron period.[South Africa] ⁷⁴ <u>Omicron</u> (<u>B.1.1529):</u> Breakthrough cases described symptoms as mild or moderate, had viral loads ranging from 15,011.2 to over 40,000 AU.mL ¹⁵²			across Pfizer, Moderna, and Johnson & Johnson vaccines. ¹⁵¹				
		SAFE	TY AND ADVERSE E	VENTS			
BNT162b2/ COMIRNATY	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield	Janssen COVID- 19 vaccine/Johnson & Johnson	BBIBP-CorV,	CoronaVac	COVAXIN / BBV152	Novavax/ NVX- CoV2373 (Awaiting approval from WHO EUL)



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Common side effects	Pain at the injection site, fatigue, headache, myalgia, chills and fever, arthralgia Optimal safety for asthma patients. The vaccine is considered safe for cancer patients undergoing treatments.	Pain at injection site, headache, fatigue, myalgia, arthralgia, Covid arm (cutaneous hypersensitivity). The vaccine is considered safe for cancer patients undergoing treatments.	Fatigue, myalgia, arthralgia, headache, lethargy, fever, & nausea.	Headache, fever, chills, fatigue, myalgia, and nausea.	Pain at the injection site, dizziness, fever, headache, fatigue, nausea, vomiting, & allergic dermatitis.	Pain at injection site, headache, fatigue, tremors, & flushing, inflammatory reaction, urticaria, myalgia	Pain at injection site, headache, pyrexia, fatigue, myalgia	Pain at injection- site, headache, muscle pain, fatigue
Rare adverse events	Myocarditis & myopericarditis, anaphylaxis and swelling of the lips, face, and tongue related to anaphylaxis (11 anaphylaxis cases per million doses administered), axillary aadenopathy, paroxysmal ventricular arrhythmia, leg paresthesia, pityriasis rosea (lesions improved completely after ~8 weeks), lymphocytic vasculitis,	Myocarditis & myopericarditis, orofacial swelling & anaphylaxis. Potential risk factor for Bell's palsy (most improve upon follow-up), herpes zoster reactivation, varicella zoster reactivation, herpes zoster ophtalmicus, eczema & urticaria, transverse myelitis, Guillain- Barré syndrome, acute generalized exanthematous	Transverse myelitis, high fever, cutaneous hypersensitivity, vasculitis, thromboembolism, vaccine induced immune thrombotic thrombocytopenia, intracerebral haemorrhage, small vessel vasculitis, psoriasis, rosacea, raynaud's phenomenon, Ischaemic stroke, anaphylaxis, recurrent herpes zoster,	Thrombosis, thrombocytopenia, increased risk of developing Guillain-Barré syndrome post vaccination, herpes zoster ophtalmicus, pseudothrombocyt openia, vaccine induced thrombocytopic thrombosis, cutaneous reactions, optic neuritis, subacute thyroiditis, CNS demyelination ¹⁶³	Cutaneous reactions, herpes zoster ¹⁶⁹ , CNS demyelination ¹⁶³ Rare adverse events were similar among the vaccine groups and control group within 7 days. Pityriasis rosea, uveitis	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, Guillain-Barré syndrome, subacute thyroiditis, erythema multiforme, uveitis, vaccine induced thrombotic thrombocytopenia,	Subacute thyroiditis, herpes zoster ¹⁷⁰	Cutaneous reactions Myocarditis was reported in one vaccine recipient, occurring 3 days after second dose



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	varicella-zoster	pustulosis,	generalized	vaccine	serum sickness-		
	reactivation,	rhabdomyolysis,	bullous fixed drug	administration	like reaction,		
	Kikuchi-Fujimoto	herpes zoster	eruption, Guillain-	were non-serious.	cutaneous		
	disease,	ophtalmicus,	Barré syndrome,		reactions,		
	thrombotic	eczema &	pityriasis rosea.		neuromyelitis		
	thrombocytopenic	urticaria,	Vaccination in		optica spectrum		
	purpura, IgA	transverse	individuals with		disorders		
	nephropathy flare-	myelitis, Guillain-	adrenal		(transverse		
	up, Guillain-Barré	Barré syndrome,	insufficiency can		myelitis or optic		
	syndrome,	acute generalized	lead to adrenal		neuritis), bullous		
	pustural psoriasis,	exanthematous	crises, Dariers		pemphigoid, CNS		
	immunoglobulin A	pustulosis,	disease, vaccine		demyelination ¹⁶³		
	vasculitis, immune	rhabdomyolysis,	induced acute				
	complex vasculitis,	cervical	localized				
	Rhabdomyolysis,	lymphadenopathy,	exanthematous				
	subacute	glomerulonephritis	pustulosis,				
	thyroiditis, Bell's	, Behçet's	Henoch-Schönlein				
	Palsy, erythema	disease,	Purpura,				
	multiforme,	neurological	rhabdomyolysis,				
	vaccine induced	autoimmune	Grave's disease,				
	interstitial lung	disease, axillary	acute				
	disease, macular	adenopathy,	demyelinating				
	neuroretinopathy,	multiple sclerosis,	polyradiculoneuro				
	brachial neuritis,	cutaneous	pathy, erythema				
	thyroid eye	reactions,	nodosum,				
	disease,	Löfgren's	polyarthralgia,				
	exacerbation of	syndrome,	recurrence of				
	subclinical	erythema	cutaneous T-cell				
	hyperthyroidism,	multiforme,	lymphoma,				
	rhabdomyolysis,	pemphigus	neurological				
	internal jugular	vulgaris, graft	autoimmune				
	vein thrombosis,	rejection (corneal),	disease, multiple				
	herpes simplex,	thrombotic	sclerosis, sudden				
	herpes zoster,	thrombocytopenic	sensorineural				
	virus keratitis,	purpura,	hearing loss ¹⁶⁵ ,				
	cervical	reactivation of	acute-onset				
	lymphadenopathy,	BCG scars ¹⁶² ,	polyradiculoneuro				



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glomerulonephritis , Ramsay-Hunt syndrome, Sweet's syndrome, neurological autoimmune disease, axillary	urticarial vasculitis ¹⁶⁴ , CNS demyelination ¹⁶³	pathy ¹⁶⁶ , cutaneous reactions, leukocytoclastic vasculitis, Löfgren's syndrome, acute eosinophilic				
adenopathy,		pneumonia,				
multiple sclerosis,		bullous sweet				
meningoencephali		syndrome,				
tis, intracerebral		neuralgic				
haemorrhage due		amyotrophy of the				
to vasculitis,		lumbosacral				
cutaneous		plexus, sudden				
reactions,		sensorineural				
pigmented		hearing loss, graft				
purpuric		rejection (corneal),				
dermatosis, graft		erythema				
rejection (corneal), flexural		annulare centrfugum, <mark>graft</mark>				
exanthema,		rejection				
severe non-		(stromal) ¹⁶⁷ ,				
anaphylatic		leukocytoclastic				
allergic reaction,		vasculitis ¹⁶⁸				
uveitis,						
erythroderma,						
Behçet's disease						
¹⁵⁷ , <mark>brachial plexus</mark>						
neuritis ¹⁵⁸ ,						
systemic capillary						
leak syndrome ¹⁵⁹ ,						
chronic graft-						
versus-host-						
disease flare						
up ¹⁶⁰ , <mark>vaccine-</mark> induced						
 Induced						



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	pneumonitis ¹⁶¹ , reactivation of BCG scars ¹⁶² , CNS demyelination ¹⁶³							
	Systemic allergic symptoms were more common in BNT162b2 than mRNA-1273, however, anaphylaxis rates were similar for both mRNA vaccines, could potentially worsen migraines in people who already suffer from migraines							
	Having adverse reactions is associated with enhanced SARS- CoV-2 IgG antibody response							
Potential associated adverse events (causal links not yet proven)	Cerebral venous sinus thrombosis and intracranial haemorrhage, aseptic meningitis, autoimmune hepatitis, multiple	Cerebral venous sinus, Autoimmune hepatitis, myocardial infarction, autoimmune haemolytic	Autoimmune hepatitis, Acute hyperglycaemic crisis, Facial nerve palsy, cervical myelitis, alopecia areata, takotsubo (stress)	Facial Diplegia, acute macular neurotinopathy, cerebral venous sinus thrombosis, oral lichen planus	Longitudinally extensive transverse myelitis	Likely vaccine associated disease enhancement (VADE), autoimmune hepatitis	No available data	No available data



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sclerosis relapse myeloperoxidase anti-neutrophil cytoplasmic antibody-positive optic perineuritis central retinal ve occlusion, paracentral acut middle maculopathy & acute macular neurotinopathy, Stevens-Johnso syndrome/ toxic epidermal necrolysis, lichenoid cutaneous skin eruption, acute mania and psychotic feature acute psychosis due to anti-N- methyl-D- aspartate recept (anti-NMDAR) encephalitis, alopecia areata, rhombencephaliti , multisystem inflammation ane organ dysfunctio aplastic anaemia bullous pemphigoid, minimal change	 hypophysitis & panhypopituitaris m, erythema nodosum-like rash, pulmonary embolism, minimal change disease, encephalomyelitis, lupus nephritis, retinal vein occlusion, takotsubo syndrome¹⁷⁵ One case developed IgA Nephropathy after receiving the second dose of mRNA-1273. es, or 	women),					
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	disease, miller fisher syndrome, unilateral acute foveolitis, encephalomyelitis, acute posterior multifocal placoid pigment epitheliopathy, trigeminal neuralgia, vestibular neuritis ¹⁷¹ , autoimmune acquired factor XIII/13 deficiency ¹⁷² , Still's disease ¹⁷³ , ¹⁷¹ , autoimmune acquired factor XIII/13 deficiency ¹⁷² , Still's disease ¹⁷³ , cranial nerve palsy							
Myocarditis data	174 Mainly reported in young adults and adolescents <u>First dose (1-28</u> <u>days post</u> <u>vaccination):</u> Incidence rate ratio of 1.37 (95% CI, 1.12-1.67) ¹⁷⁶	Mainly reported in young adults and adolescents <u>First dose (1-28</u> <u>days post</u> <u>vaccination):</u> No association ¹⁷⁶ <u>Second dose:</u>	First dose (1-28 days post vaccination): Incidence rate ratio of 1.27 (95% CI, 1.05-1.55) ¹⁷⁶ Second dose: No association ¹⁷⁶ Third dose:	No available data	No available data	No available data	No available data	Myocarditis was reported as viral myocarditis. Participant fully recovered after 2 days of hospitalisation. No episode of anaphylaxis or vaccine- associated



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Second dose:	Incidence rate	No association ¹⁷⁶			enhanced COVID-
Incidence rate ratio of 1.60 (95%	ratio of 13.71 (95% CI, 8.46-	(small sample size)			19 was reported
CI, 1.31-1.97) ¹⁷⁶	(95% CI, 0.40- 22.20) ¹⁷⁶	SIZE)			
$O_1, 1.51^{-1.57}$	22.20)	Males <40 years:			
Third dose:	Third dose:	Second dose [1-			
Incidence rate	No association ¹⁷⁶	28 days post			
ratio of 2.02 (95%	(small sample	vaccination]:			
CI, 1.40-2.91) ¹⁷⁶	size)	Incidence rate			
		<mark>ratio of 2.57 (95%</mark>			
<u>Males <40 years:</u>	<u>Males <40 years:</u>	CI, 1.52-4.35) ¹⁷⁶			
First dose [1-28	First dose [1-28				
days post	days post				
vaccination]:	vaccination]:				
Incidence rate ratio of 1.66 (95%	Incidence rate ratio of 2.34 (95%				
CI, 1.14-2.41) ¹⁷⁶	CI, 1.03-5.34) ¹⁷⁶				
$\mathbf{O}(, 1.1 + 2.1)$	0, 1.00 0.04)				
Second dose [1-	Second dose [1-				
28 days post	28 days post				
vaccination]:	vaccination]:				
Incidence rate	Incidence rate				
ratio of 3.41 (95%	ratio of 16.52				
<mark>CI, 2.44-4.78)¹⁷⁶</mark>	<mark>(95% CI, 9.10-</mark>				
Third dose [1-28	<mark>30.0)¹⁷⁶</mark>				
days post					
vaccination]:	Females <40				
Incidence rate	years				
ratio of 7.60 (95%	Second dose [1-				
<mark>CI, 2.44-4.78)¹⁷⁶</mark>	28 days post				
	vaccination]:				
Israeli study:	Incidence rate				
Estimated	ratio of 7.55 (95%				
incidence within 42 days after	CI, 1.67-34.12) ¹⁷⁶				
receipt of first					



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dose per 100,000 vaccinated persons was 2.13 cases (95% CI, 1.56-2.7)	5.8 cases per 1 million second dose administrations 95.4 (95% CI,	
<u>Male patients</u> Incidence of 4.12 (95% CI, 2.99- 5.26) per 100,000 vaccinated 3.19 cases (95% CI, 2.37-4.02) per 100,000 vaccinated Female patients	52.1-160.0) cases per 1 million second dose administrations in patients aged 12- 39 ¹⁷⁸ <u>12–39-year-olds</u> <u>(within 28 days of</u> <u>vaccination:</u>	
Incidence of 0.23 (95% CI, 0-0.49) per 100,000 vaccinated ¹⁷⁷	Female patients 2.0 (95% CI, 0.7- 4.8) per 100,000 vaccinated ¹⁷⁹	
0.39 cases (95% CI, 0.10-0.68) per 100,000 vaccinated	<u>Male patients</u> 6.3 (95% CI, 3.6- 10.2) per 100,000 vaccinated ¹⁷⁹	
 ≥30 years Incidence of 1.13 (95% CI, 0.66- 1.60) per 100,00 vaccinated 		
5.8 cases per 1 million second dose administrations		



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95.4 (95% CI, 52.1-160.0) cases per 1 million second dose administrations in patients aged 12- 39 ¹⁷⁸				
5.07 cases per 100,000				
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)				
Risk per 100,000 persons 1 st dose (male): 0.64 2 nd dose (male); 3.83 1 st dose (female):				
0.07 2 nd dose (female): 0.46 1 st dose (male 16- 19): 1.34 2 nd dose (male 16- 19): 15.07				



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	<u>12–39-year-olds</u> (within 28 days of vaccination: <u>Female patients</u> 1.3 (95% CI, 0.8- 1.9) per 100,000 vaccinated ¹⁷⁹ <u>Male patients</u> 1.5 (95% CI, 1.0- 2.2) per 100,000 vaccinated ¹⁷⁹							
			Cł	IILDREN VACCINAT	ION			
	BNT162b2/ COMIRNATY	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield	Janssen COVID- 19 vaccine/Johnson & Johnson	BBIBP-CorV,	CoronaVac	COVAXIN / BBV152	Novavax/ NVX- CoV2373
Efficacy	<u>Adolescents (12- 15):</u> After one dose had efficacy of 75% (CI, 7.6-95.5) After second dose efficacy of 100% (CI, 78.1-100) ¹⁸⁰ . <u>Children (5-11):</u>	Adolescents (12- 17): 14 days after one dose had efficacy of 92.7% (Cl, 67.8-99.2) After second dose efficacy of 93.3% (Cl, 47.9-99.9) ¹⁸³ Against SARS- CoV-2 Infection:	No available data Paused ongoing trials in children aged 6-17 due to concerns over rare blood clots reported in adult population ¹⁸⁵ .	No available data Announced at beginning of April ongoing study in adolescents but paused to investigate blood clots in adult population ¹⁸⁵ .	Children (3-17): Unknown. Ongoing clinical trial only looked at safety, tolerability, and immunogenicity ^{cvii} *	<u>Children (3-17):</u> Unknown. Clinical trial only looked at safety, tolerability and immunogenicity ¹⁸⁶ .	No available data	Adolescents (16- <u>17):</u> PREVENT-19 clinical trial ^{cviii} expanded to assess efficacy, safety, and immunogenicity in 12–17-year-old adolescents ¹⁸⁷

cvii Safety and immunogenicity of an inactivated COVID-19 vaccine, BBIBP-CorV, in people younger than 18 years: a randomised, double-blind, controlled, phase 1/2 trial. The Lancet Infectious Diseases.

https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(21)00462-X/fulltext

cviii A Study to Evaluate the Efficacy, Immune Response, and Safety of a COVID-19 Vaccine in Adults ≥18 Years With a Pediatric Expansion in Adolescents (12 to <18 Years) at Risk for SARS-CoV-2. *ClinicalTrials.gov*. ClinicalTrials.gov Identifier: NCT04611802. <u>https://clinicaltrials.gov/ct2/show/NCT04611802?term=Novavax&cond=Covid19&draw=2</u>



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	After second dose efficacy of 90.7% (CI , 67.7-98.3) ¹⁸¹ <u><i>Children (Under 5</i></u> <u>years):</u> Ongoing trials ¹⁸²	14 days after first dose efficacy of 68.9% (95% CI, 49.9-82.1) 14 days after second dose efficacy of 55.7% (95% CI, 16.8,82.1) ¹⁸³			* The study design administered three doses of 2 μg, 4 μg, or 8 μg of vaccine			
		Against asymptomatic: 14 days after first dose efficacy of 59.5% (95% CI, 28.4-77.3) 14 days after second dose efficacy of 39.2 (95% CI, -24.7- 69.7) ¹⁸³ <u>Children (6month- 11):</u>						
	Adolescents	Ongoing trials ¹⁸⁴						
Effectiveness	<u>Against SARS-</u> <u>CoV-2 infection:</u> 91.5% (95% CI, 88.2-93.9) ¹⁸⁸ 91% (95% CI, 88- 93) ¹⁸⁹	No available data	No available data	No available data	No available data	No available data	No available data	No available data
	<u>Adolescents</u> <u>Against</u> hospitalisation:							



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0 1		0,	0		
	81% (95% CI, -55- 98) ¹⁸⁹				
	98) ¹⁰⁰ 93% (95% Cl,83-				
	97) ¹⁹⁰				
	97) ¹⁹⁰ <mark>94% (95% Cl, 91 to 97)</mark>				
	Adolescents against				
	ICU care:				
	<mark>98%</mark> (95% Cl, 93 to				
	<mark>99)191</mark>				
	<u>Waning VE in</u>				
	Adolescents 12-16:				
	<mark>VE against</mark>				
	breakthrough infection				
	reduced to 75% (95%				
	CI: 71%, 79%) after				
	90-149 days after				
	second dose and <mark>58%</mark>				
	<mark>(95% CI: 52%, 64%)</mark>				
	<mark>150-180 days after</mark>				
	second dose				
	VE against				
	symptomatic infection				
	was 78% (95% CI:				
	<mark>73%, 82%)</mark> after 90-				
	140 days and 65%				
	<mark>(95% CI: 58%, 71%)</mark>				
	after 150-180 days192				



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Immunogenicity	Adolescents (12- 15) serum- neutralizing titer: 1 month after 2nd dose had 1283.0GMN50 (CI, 1095.5-1402.5)180.Adolescents/youn g adult (16-25) serum-neutralizing titer: 1 month after 2nd dose had 705.1GMN50 (CI, 621.4- 800.2)180.Children (5-11): 1 month after 2nd dose had 1,197.6GMT (95% CI, 1106.1-1296.6)SARS-CoV-2- neutralizing antibody181Children (Under 5): Ongoing trials182	<u>Adolescents (12- 17):</u> Neutralizing antibody titer after 2 nd dose was 1401.7 GMN ₅₀ (CI, 1276.3- 1539.4) Serological response was 98.8% (CI, 97.0- 99.7) ¹⁸³ <u>Children (6-11):</u> Seroreponse of 99.3% ¹⁹³ <u>Children (6month- 11):</u> Ongoing trials ¹⁸⁴	No available data	No available data	Children (3-17): Neutralizing antibodies after 28 days after 2 nd 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 Neutralizing antibodies after 28 days after 3 rd 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 ¹⁹⁴ GMC of anti-RBD antibody in adolescent cohort aged 12-17 was 102.9 BAU/mL (95%CI ; 91.0- 116.4) after 4 weeks since 2nd dose ¹⁹⁵	<u>Children (3-17):</u> Neutralizing antibody response after 2 nd dose (100%) with GMT ranging from 45.9-212.6 ¹⁸⁶	Ongoing clinical trial ¹⁹⁶ Neutralizing antibodies after 56 days after 2nd dose was 358.6 GMT (95% CI, 287.2-447.8) in 2- 6 years group, 366.9 (95% CI, 297.0-453.3) in 6- 12 years group, and 317.4 (95% CI, 224.4-449.2) in 12-18 years group ¹⁹⁷	Ongoing clinical trial ¹⁹⁸
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Safety and Adverse events	Rare possibility of developing multisystem inflammatory syndrome ¹⁹⁹ <u>Adolescents (12- 15):</u> Local and systemic events were generally mild to moderate Severe injection- site pain (1.5%) Fever (20%) High Fever (0.1%) Adverse events (6%) Severe adverse events (0.6%) ¹⁸⁰ . <u>Adolescent/young</u> <u>adults (16-25):</u> 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%) ¹⁸⁰ .	Rare possibility of developing multisystem inflammatory syndrome ¹⁹⁹ <u>Adolescents (12- 17):</u> Solicited local reactions after 2nd dose (93.4%) Most common solicited adverse reactions were Injection-site pain (92.7%) Headache (70.2%) Fatigue (67.8%) Grade 3 adverse events (6.8%)) ²⁰² Most common solicited local reaction: injection- site pain after first injection (93.1%) and second injection (92.4%) Most common systemic reactions: fatigue, myalgia, and chills ¹⁸³	No available data	Rare possibility of developing multisystem inflammatory syndrome ¹⁹⁹	Children (3-17): Most common adverse reaction was pain at injection site in 3– 5-year group (4%), 6-12-year group (1.2%), and 13-17-year group (7.9%) Most common systemic reactions in all three age cohorts were mild to moderate fever and cough Adverse events were mostly mild to moderate in severity ¹⁹⁴ 18.1% reactogenicity reported on day 1 in adolescents 12- 17, most common immediate local events were mild pain and tenderness at injection site, No serious adverse events ¹⁹⁵	<u>Children (3-17):</u> 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%) ¹⁸⁶	Ongoing clinical trial ¹⁹⁶ most common local reaction of mild injection site pain in no more than 35% of all age groups Most frequent solicited systemic adverse event was mild-to-moderate fever- 5% of 12-18 group, 10% of 6-12 group, and 13% of 2-6 group197	Ongoing clinical trial ¹⁹⁸	
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	Pain at injection site, fatigue, headache, chills were reported. Overall, the vaccine is safe and tolerable ¹⁸¹	Vaccine was generally well tolerated ¹⁹³ <u>Children (6month- 11):</u> Ongoing trials ¹⁸⁴						
	<u>Children (Under</u> <u>5):</u> Ongoing trials ¹⁸²							
	Multisystem inflammatory syndrome (causal link not yet proven) ²⁰⁰							
	Additional reports of rare cases of multisystem inflammatory syndrome ¹⁹⁹							
	<u>Adverse events</u> <u>cases:</u> 15-year old boy developed nephrotic syndrome ²⁰¹							
Myocarditis Data	Few reported cases of acute myocarditis and pericarditis in 16-	Few reported cases of acute myocarditis and pericarditis	No available data					



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25 year olds (mainly in	(mainly in males) ²⁰²			
males) ²⁰²	<u>16-17 year old</u>			
Male patients 12- 17 years	boys in US: Second dose:			
97 cases per million (1 in	31.2 cases per million doses			
10,000 males) ²⁰³	administered ²⁰⁵			
Female patients <u>12-17 years</u>				
16 cases per million (1 in				
63,000 females) ²⁰³				
<u>16-29 years</u> Incidence of 5.49				
(95% CI, 3.59- 7.39) per 100,00 vaccinated ¹⁷⁷				
Male patients (16- 29 years) Incidence of 10.69				
(95% CI, 6.93- 14.46) per				
100,000 vaccinated ¹⁷⁷				
Incidence of 13.6				
cases (95% Cl, 9.30-19.20) per				
100,000 vaccinated ²⁰⁴				
vaccinated				



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		0	,	
<u>12-15 year old</u>				
boys in US:				
First dose: 4.8				
cases per million				
doses				
administered ²⁰⁵				
Second dose: 42.6				
cases per million				
doses				
administered ²⁰⁵				
auministereu				
<u>12-15 year old</u>				
<u>girls in US</u> : First dose: 0.5				
cases per million				
doses				
administered ²⁰⁵				
Second dose: 4.3				
cases per million				
doses				
administered ²⁰⁵				
<u>16-17 year old</u>				
<u>boys in US</u> :				
First dose: 5.2				
cases per million				
doses				
administered ²⁰⁵				
Second dose: 71.5				
cases per million				
doses				
administered ²⁰⁵				
<u>16-17 year old</u>				
<u>girls in US</u> :				
First dose: 0.0				
cases per million				



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	doses administered ²⁰⁵ <i>Second dose</i> : 8.1 cases per million doses administered ²⁰⁵		HETE	ROLOGOUS VACCIN	NATION			
Vaccine Schedule	BNT162b2/ChAd Ox1 Administration of ChAdOx1 as second/booster dose	ChAdOx1/mRNA- 1273 Administration of mRNA-1273 as second/booster dose	ChAdOx1/BNT16 2b2 Administration of BNT162b2 as second/booster dose	Not Applicable (one dose schedule) For more information refer to booster section	BBIBP/BNT162b2	CoronaVac/ChAd Ox1 Press releases have confirmed that Thailand will use the AstraZeneca vaccine as the second dose for individuals whose first dose was Sinovac ^{cix} CoronaVac/Conv idecia	ChAdOx1/BBV15 2 Administration of Covaxin as second/booster dose	Ongoing trial ²⁰⁶ (Com-Cov2) ^{cx}
Immunogenicity	<u>GMCs of SARS-</u> <u>CoV-2 anti-spike</u> <u>IgG at 28 days</u> post booster:	<u>*Spike-specific</u> <u>IgG antibodies:</u> Heterologous (3602 BAU/mL) Vs.	<u>RBD antibody</u> <u>titres:</u> Heterologous (7756.68 BAU/mL, Cl	Not Applicable (one dose schedule)	Unknown (on- going clinical trial) ⁴⁹	CoronaVac/ChAd Ox1 : <u>Anti-S Antibodies:</u>	<u>RBD antibody</u> <u>titres:</u> Heterologous (1866 GMT; 95% Cl, 1003-3472)	No available data Ongoing trial ²⁰⁶

cix Malaysia to stop using Sinovac vaccine after supply ends - minister. *Reuters* [press release]. https://www.reuters.com/world/asia-pacific/malaysia-stop-using-sinovac-vaccine-after-supply-ends-minister-2021-07-15/

^{cx} Comparing COVID-19 Vaccine Schedule Combinations. University of Oxford. <u>https://comcovstudy.org.uk/about-com-cov2</u>



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(7133 ELU/mL, Cl (14080 ELU/mL, Cl (14080 ELU/mL, Cl (14080 ELU/mL, Cl (100%) vs.(7133 ELU/mL, vs.(7133 ELU/mL, vs.(7133 ELU/mL, vs.Homologous (99.84 BAU/mL, Cl (16.93.120.59) at day 14209.Uml; 95% Cl, (16.93.120.59) at day 14209.Homologous (99.84 BAU/mL, Cl (100%) vs.Homologous (16.93.120.59) at day 14209.Uml; 95% Cl, (17.62 ELU/mL, (100%) vs.Homologous (100%) vs.Homologous (100%) vs.Homologous (100%) vs.Homologous (100%) vs.Homologous (16.93.120.59) at day 14209.Jag antibode (17.62 ELU/mL)Jag antibode (17.62 ELU/mL) <th< th=""><th>Heterologous</th><th>Homologous</th><th>7371.53-8161.96)</th><th>For more</th><th>Heterologous (797</th><th>VS.</th><th></th></th<>	Heterologous	Homologous	7371.53-8161.96)	For more	Heterologous (797	VS.	
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(14080 čLU/mL, C1 12491- 15871)***Intibodies: Heterologous (100%) vs. HomologousC 76.132.01 CoronaVac (94.4) VmL 195% C1: Homologous Covaxin (710 Covaxin (710 Vs. Homologous B61.125.001: Heterologous(100%) vs. Heterologous(100%) vs. Heterologous(100%) vs. Heterologous(100%) vs. Heterologous SFC/10 ⁶ PBMCs) Vs. Homologous (80.4)Homologous (10.2.864 BAU/mL) vs. B64.7% effectiveness (95% C1, 83.1- 86.1)*Homologous (10.2.8AU/mL) at day 14 ²⁰⁰ .Homologous (10.2.8AU/mL) at day 14 ²⁰⁰ .Homologous (10.2.8AU/mL) at day 14 ²⁰⁰ .Homologous (10.2.8AU/mL) (10.2.8AU/mL) at day 14 ²⁰⁰ .Homologous (10.2.8AU/mL) (10.2.8AU/mL) at day 14 ²⁰⁰ .Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL)Homologous (10.2.8AU/mL) (10.2.8AU/mL)Homologous (2.3.2.7AU/m)Homologous (2.3.2.7AU/M)Homologous (2.3.2.3AU/M)Homologous (2.3.2.3AU/M)Homologous (2.3.2.3AU/M)Homologous (2.3.2.3AU/M)Homologous (2.3.2.3AU/M)Homologous (2.3.2.3AU/	6415-7932) vs.		Homologous	to booster section	598.7-1062)	Covishield (2260	
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SFC frequency (TOcell ELISpot): Heterologous (90 SFC/10* PBMCs) vs. Homologus (80 SFC/10* PBMCs) vs. Heterologus Heterologus mRNA: 84.7% effectiveness effectiveness (101.2 BAU/mL) (101.2 BAU/mL) s. (101.2 BAU/mL) (101.2 BAU/mL) (101.4 day 14 ^{20,9} . Neutralizing antibodies: Heterologous (100%) at day 14 vs. Homologous (30%) at day 14 vs. Homologous (30%) at day 14 vs. Heterologous (30%) at day 14 vs. Heterologous (12.8 GMT (95%) (1, 37.9-78) Vs. Heterologous (12.8 GMT (95%) (1, 9.3-17.5) ²¹² Neutralizing (C), 9.3-17.5) ²¹² Neutralizing (AMT; 95% CI, 485.8-1134) ²¹³ Heterologous (12.8 GMT (95%) (1, 21.3-242.3) (rmedian 62%) ²¹⁰ Heterologous (12.8 GMT (95%) (1, 21.3-242.3) (Vs. Homologous (C), 9.3-17.5) ²¹² Neutralizing (MT; 95% CI, 485.8-1134) ²¹³ Heterologous (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1 (BNT162D2/BNT1	CI 12491-	Heterologous	at day 14 ²⁰⁹ .		CoronaVac (94.4	VS.	
SFC frequency (TOcell ELISpot):(100%) ²⁰⁸ .itres: theterologous (3684 BAU/mL)vs.GMT, 95% Cl, 40mologous (ChAdOx1 (818 Heterologous) (101.2 BAU/mL)GMT, 95% Cl, 40mologous (101.2 BAU/mL)Homologous (80 SFC/10° PBMCs)Heterologus (101.2 BAU/mL)Vs.U/mcl; 95% Cl: (62.5-1010) ²¹¹ Heterologous (1145 GMT; 95% (1145 GMT; 95%)Heterologous mRMA: mRMA: B4.7%(100%) at day 14 ²⁰⁸ .CoronaVac/Corv (decia antibodies; antibodies; (Covishield (333.7 Covishield (333.7 (Covishield (333.7 Covishield (333.7 (21.9-568.9)GMT; 95% Cl, (21.9-568.9)84.7% effectiveness (95% Cl, 83.1- 86.1)°Neutralizing antibodies; (100%) at day 14 vs.Neutralizing (100%) at day 14 vs.Neutralizing (Covishield (333.7 Covishield (333.7 Covishiel	15871) ²⁰⁷ .	(100%) vs.	·		U/mL; 95% CI :	Homologous	
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Heterologous (99 SFC/10° PBMCs) vs.Heterologous mRNA: 84.7% effectiveness (95% CI, 83.1- 86.1)°Heterologous (101.2 BAU/mL) (95% CI, 83.1- 86.1)°ChadOx1 (818 U/mL; 95% CI, 83.1- (95% CI, 83.1- 86.1)°N-protein IgG: Heterologous (101.2 BAU/mL) (95% CI, 83.1- antibodies: Heterologous (100%) at day 14200.N-protein IgG: (100%) at day 14200.Heterologous (95% CI, 83.1- 86.1)°Neutralizing antibodies: Heterologous (100%) at day 14 (100%) at day (140%).Neutralizing antibodies: (100%) at day 14 (100%) at day 14 (100%) at day (140%).Neutralizing (100%) at day 14 (100%) at day (140%).CoronaVac/Conv (130%) at day (140%).86.1)°"emunosuppressed poulation"emunosuppressed (100%) at day 14 (140%).Vs. (140%).CoronaVac (100%) at day 14 (140%).14000 (100%) at day 14 (140%).CoronaVac (140%).CoronaVac (130%) at day (140%).CoronaVac (100%) at day (140%).14000 (140%).(140%).Vs. (140%).Homologous (130%) at day (140%).CoronaVac (12.8 GMT (95%).14000 (111.3 GMT; 95%).(1145 GMT; 95%).Meterologous (130%).CoronaVac (130%).14000 (111.3 GMT; 95%).(111.3 GMT; 95%).Meterologous (171.4 GMT; 95%).1411 (111.4 GMT; 95%).(111.3 GMT; 95%).Meterologous (171.4 GMT; 95%).1411 (111.4 GMT; 95%).(111.3 GMT; 95%).Meterologous (171.4 GMT; 95%).1411 (111.3 GMT; 95%).(111.3 GMT; 95%). </td <td>SFC frequency</td> <td>(100%)²⁰⁸.</td> <td>titres:</td> <td></td> <td>VS.</td> <td></td> <td></td>	SFC frequency	(100%) ²⁰⁸ .	titres:		VS.		
SFC/10 ⁶ PBMCs) vs. Homologous (80 SFC/10 ⁶ PBMCs) ²⁰⁷ .mRNA: 44.7% effectiveness (95% CI, 83.1- 86.1) ⁶ vs. Homologous (101.2 BAU/mL) at day 14 ²⁰⁹ .U/mL; 95% CI: 662.5-1010) ²¹¹ lidecia Meutralizing antibodies: Ar7% effectiveness (95% CI, 83.1- 86.1) ⁸ Meutralizing antibodies: Heterologous (100, at day 14 vs. Homologous (30%, at day 14 ²⁰⁹ .Neutralizing antibodies: Heterologous vs. Heterologous (100, at day 14 vs. Homologous (30%) at day 14 ²⁰⁹ .U/mL; 95% CI: 662.5-1010) ²¹¹ Lifecia Meutralizing antibodies: CoronaVac/Conv dideciaNeutraliging antibodies: Covishield (353.7 Cl, 321.8Heterologous (95% CI, 83.1- 86.1) ⁸ "Results based on immunosuppressed ppulationNeutralizing antibodies: Heterologous (100%) at day 14 vs. Homologous CoronaVacNeutralizing antibodies: Covasin (742.4 CoronaVac Covasin (742.4 CoronaVac Cl, 93.17.5) ²¹² Meutralizing antibodies: Momologous Covasin (742.4 CoronaVac Cl, 93.17.5) ²¹² Heterologous (median 99%) vs. Homologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Meutralizing antibodies: Vs. Homologous Cl, 93.17.5) ²¹² Neutralizing antibodies: Neutralizing antibodies: Cl, 93.17.5) ²¹² Heterologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Weither and the second covasin field (111 GMT; 95% CI, 98.59-124.9)Neutralizing antibodies: Covasin field (111 GMT; 95% CI, 98.59-124.9)	(T0cell ELISpot):		Heterologous		Homolougous	461-1092) ²¹³	
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SFC/10 ⁶ PBMCs) ²⁰⁷ . (95% Cl, 83.1- 86.1) ⁸ at day 14 ²⁰⁹ . CoronaVac/Conv idecia Cl, 520.7-2520) vs. Heterologous mRNA: 84.7% effectiveness (95% Cl, 83.1- 86.1) ⁸ Neutralizing antibodies: Heterologous (100%) at day 14 vs. Neutralizing antibodies: Heterologous (2, 9.7-2520) Homologous (2, 520.7-2520) VS. Neutralizing antibodies: Heterologous (100%) at day 14 vs. S4.4 GMT (95% Cl, 37.9-78) 219.9-568.9) (95% Cl, 83.1- 86.1) ⁸ 'Results based on immunosuppressed poulation Vs. Homologous (30%) at day 14 ²⁰⁹ . vs. Heterologous (95% Cl, 83.1- 86.1) ⁸ Heterologous (30%) at day 14 ²⁰⁹ . vs. Homologous (30%) at day 14 ²⁰⁹ . CoronaVac (12.8 GMT (95% Cl, 93.917.5) ²¹² Meutralizing antibody titres : Heterologous (171.4 GMT; 95% Cl, 121.3-242.3) Heterologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Imman 62%) ²¹⁰ Neutralizing (171.4 GMT; 95% Cl, 121.3-242.9) vs. Homologous Covishield (111 GMT; 95% Cl, 121.3-242.9)	VS.	84.7%	Homologous		662.5-1010) ²¹¹	Heterologous	
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effectiveness (95% Cl, 83.1- 86.1) ⁸ Vs. Homologous (30%) at day 14 ²⁰⁹ . Heterologous (median 99%) vs. Homologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Vs. Homologous (DV) (median 62%) ²¹⁰ Vs. Homologous (DV) (MC) (MC) (MC) (MC) (MC) (MC) (MC) (MC			Heterologous		Heterologous	GMT; 95% CI,	
(95% CI, 83.1- 86.1) ⁸ yo yo Yo Yo Homologous (30%) at day 14 ²⁰⁹ . 14 ²⁰⁹ . Homologous CoronaVac CoronaVac GMT; 95% CI, 12.8 GMT (95% VS. Heterologous Cl, 9.3-17.5) ²¹² Neutralizing antibody titres : Heterologous VS. Homologous Cl, 9.3-17.5) ²¹² Neutralizing antibody titres : Heterologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Vs. Heterologous (GMT; 95% CI, 98.59-124.9)	84.7%		(100%) at day 14		54.4 GMT (95%	219.9-568.9)	
(95% Cl, 83.1- Homologous Covaxin (742.4 86.1)8 (30%) at day CoronaVac GMT; 95% Cl, 14 ²⁰⁹ . 12.8 GMT (95%) 485.8-1134) ²¹³ Heterologous Cl, 9.3-17.5) ²¹² Neutralizing (median 99%) vs. Homologous Cl, 9.3-17.5) ²¹² Noncologous (Interview) Neutralizing antibody titres : Homologous (BNT162b2/BNT1 (171.4 GMT; 95%) (171.4 GMT; 95%) 62b2) (median 62%) ²¹⁰ vs. Homologous (median 62%) ²¹⁰ Vs. Homologous Covishield (111) GMT; 95% Cl, 98.59-124.9) 98.59-124.9) 98.59-124.9)			-		CI, 37.9-78)		
14209. CoronaVac 12.8 GMT (95% Cl, 9.3-17.5) ²¹² GMT; 95% Cl, 485.8-1134) ²¹³ Heterologous (median 99%) vs. Neutralizing antibody titres : Homologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Neutralizing antibody titres : Heterologous (171.4 GMT; 95% Cl, 121.3-242.3) vs. Momologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Neutralizing antibody titres : Heterologous Cl, 121.3-242.3) vs. Homologous (BNT162b2/BNT1 62b2) Cl, 121.3-242.3) vs. Homologous (median 62%) ²¹⁰ vs.	(95% CI, 83.1-	population			VS.	Homologous	
12.8 GMT (95% Cl, 9.3-17.5) ²¹² 485.8-1134) ²¹³ Neutralizing antibody titres : Homologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Neutralizing antibody titres : Heterologous (171.4 GMT; 95% Cl, 121.3-242.3) Vs. Heterologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Vs. Median 62%) ²¹⁰ Vs.	86.1) ⁸				Homologous	Covaxin (742.4	
Heterologous Cl, 9.3-17.5) ²¹² (median 99%) Neutralizing vs. Homologous (BNT162b2/BNT1 (171.4 GMT; 95% 62b2) Cl, 9.3-17.5) (median 62%) ²¹⁰ Vs. Homologous Vs. Homologous Cl, 121.3-242.3) Covishield (111) GMT; 95% Cl, 98.59-124.9)			14 ²⁰⁹ .				
Image: Sector of the sector						485.8-1134) ²¹³	
vs. antibody titres : Homologous Heterologous (BNT162b2/BNT1 (171.4 GMT; 95% 62b2) Cl, 121.3-242.3) (median 62%) ²¹⁰ vs. Homologous Covishield (111 GMT; 95% Cl, 98.59-124.9)			Heterologous		CI, 9.3-17.5) ²¹²		
Heterologous (BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ Homologous (median 62%) ²¹⁰ Homologous Covishield (111 GMT; 95% Cl, 98.59-124.9)			(median 99%)				
(BNT162b2/BNT1 62b2) (median 62%) ²¹⁰ (median 6			VS.				
(2011) 0252 2011 CI, 121.3-242.3) 62b2) VS. (median 62%) ²¹⁰ Homologous Covishield (111 GMT; 95% CI, 98.59-124.9)			Homologous				
(median 62%) ²¹⁰ Konstantion			(BNT162b2/BNT1				
Homologous Covishield (111 GMT; 95% CI, 98.59-124.9)			62b2)				
Covishield (111 GMT; 95% Cl, 98.59-124.9)			(median 62%) ²¹⁰				
GMT; 95% Cl, 98.59-124.9)							
98.59-124.9)							
VS.						•	
						VS.	



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							Homologous Covaxin (86 GMT; 95% Cl, 138.2- 252.0) ²¹³	
Immunogenicity against variants	No available data	No available data	<u>Neutralizing</u> <u>Antibodies for</u> <u>Alpha, Beta,</u> <u>Gamma, and</u> <u>Delta:</u> Heterologous 2.3-fold to 3.6- fold higher neutralizing antibodies than homologous ²¹⁰ <u>Omicron</u> (<u>B.1.1.529):</u> 13/20 seropositive against Omicron ²¹⁴	No available data	No available data	No available data	Neutralizing antibody titres B.1: 539.4 GMT (95% Cl, 263.9-1103) ²¹³ Neutralizing antibody titres Alpha: 396.1 GMT (95% Cl, 199.1-788) ²¹³ Neutralizing antibody titres <u>Beta:</u> 151 GMT (95% Cl, 80.21-284.3) ²¹³ Neutralizing antibody titres <u>Delta:</u> 241.2 GMT (95% Cl, 74.99-775.9) ²¹³	No available data
Reactogenicity	Observed increase in systemic reactogenicity after boost in heterologous schedules in	*Adverse events in heterologous and homologous vaccination groups were very similar ²⁰⁸ .	<u>Adverse events in</u> <u>heterologous:</u> Headache (44%), Myalgia (43%), Malaise (42%), Fever (2%), Injection site pain	Not Applicable (one dose schedule) For more information refer to booster section	Unknown (on- going clinical trial) ²¹⁵	CoronaVac/ChAd Ox1: Unknown CoronaVac/Conv idecia:	<u>Most common</u> <u>local adverse</u> <u>events:</u> Pain at injection site (11.1%) ²¹³	No available data Ongoing trial ²⁰⁶



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	comparison with homologous schedules ²⁰⁷ <u>Adverse events in</u> <u>heterologous:</u> Adverse events (90) Grade 1 (54.4%) Grade 2 (37.8%) Grade 2 (37.8%) Grade 3 (7.8%) Grade 3 (7.8%) Grade 4 (0%) Arthralgia, Migraine, Back Pain ²⁰⁷ . <u>Adverse events in</u> <u>homologous:</u> Adverse events (81) Grade 1 (59.3%) Grade 2 (39.5%)	*Majority of adverse events self-reported were Pain at injection site, Swelling at injection site, Fever, Headaches, Fatigue, Chills, GI effects, Myalgia, Arthralgia ²⁰⁸ . *Results based on immunosuppressed population	(88%), Induration (35%), Erythema (31%) ²⁰⁹ . <u>Severity of</u> <u>adverse events in</u> <u>heterologous:</u> Mild (68%), Moderate (30%), Severe (2%) ²⁰⁹ .			Convidecia recipients reported more adverse reactions and reported higher occurrence of solicited injection- site pain) ²¹²	Most common systemic adverse events: Pyrexia (27.77%, 11.1%) after 1 st and 2 nd dose Malaise (33.3%, 5.5%) after 1 st and 2 nd dose ²¹³	
	Grade 3 (1.2%) Grade 4 (0%) ²⁰⁷ .							
	Grade 4 (076)-**.			BOOSTER DOSES				
				BOUSTER DUSES				
Vaccine Schedule	BNT162b2/BNT16 2b2	mRNA- 1273/mRNA-1273	ChAdOx1/ChAdO X1	Ad26.CoV.2.S/ Ad26.CoV.2.S	SinoPharm/Sino Pharm	CoronaVac/Coro naVac	Covaxin/Covaxin	NVX- CoV2373/NVX- CoV2373
Approved Administration	<u>Israel:</u> 12-year-old and over can received homologous booster shot 5	Phase II booster trial of three booster doses are ongoing ²¹⁶	Preliminary results on tolerability and immunogenicity of third dose of ChAdOx1 vaccines showed	Johnson & Johnson has said it will submit all of their new data to the FDA for potential	<u>UAE:</u> Offering booster doses of Pfizer and Sinopharm to people who received full	Turkey and the United Arab Emirates began homologous booster shots	India has started administering homologous booster doses	Ongoing phase II trials ²¹⁸



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months after full jab ^{cxi} <u>United States:</u> Starting September, adult who received mRNA vaccine 8 months ago are eligible for booste <u>Europe:</u> Starting in fall, most European countries are planning on rolling out booster shots to immunocomprom sed and elder populations with some countries administering to overall population ^{cxii}	Starting September, adults who received mRNA vaccine 8 months ago are eligible for booster.	strong boost to the immune response ²¹⁷	consideration for adding a booster dose and consideration to authorize two- dose regimen ^{cxiv}	Sinopharm jab ≥6 months ago	Indonesia and Thailand are considering giving homologous booster shot to HCW ^{exv}		Results below are based on ongoing phase II trial	
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cxii A country-by-country guide to coronavirus vaccine booster plans. POLITICO [press reléase]. https://www.politico.eu/article/vaccine-booster-coronavirus-covid-19-europe-delta-varian-who/

^{cxiv} Two dose version of Johnson & Johnson shot 94% effective against Covid-19, study finds. *CNN*. <u>https://edition.cnn.com/2021/09/21/health/johnson-vaccine-two-doses-booster/index.html</u> ^{cxv} Indonesia and Thailand consider booster shots amid doubts over Sinovac vaccine. *Reuters* [press release]. <u>https://www.reuters.com/world/china/indonesia-thailand-consider-booster-shots-</u>

amid-doubts-over-sinovac-vaccine-2021-07-08/



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^{cxi} Israel offers COVID-19 booster to all vaccinated people. *Reuters* [press release]. <u>https://www.reuters.com/world/middle-east/israel-offers-covid-19-booster-shots-all-vaccinated-people-2021-08-29/</u>

cxiii Moderna seeks U.S. authorization for COVID-19 vaccine booster. *Reuters* [press release]. <u>https://www.reuters.com/business/healthcare-pharmaceuticals/moderna-submits-initial-data-covid-19-vaccine-booster-us-fda-2021-09-01/</u>



Time-to-booste dose	 6 months to 8 months after initial two-dose regimen Israel offers up to 5 months after initial two-dose regimen UK has shortened time interval up to 3 months after initial two-dose regimen due to new Omicron variant^{cxvi} 	6 months to 8 months after initial two-dose regimen	6-9 months after initial two-dose regimen	6 months after one dose regimen ¹¹⁶	6 months after initial two-dose regimen	6 months to 12 monthsAfter primary vaccination8 months after the primary vaccination to healthy adults \geq 60 years	6 months after initial two-dose regimen	6 months after initial two-dose regimen (189 days) ²¹⁸
Efficacy	Symptomatic COVID-19: 95.6% during Delta prevalent period ²¹⁹ 95.3% (95% Cl, 89.5-98.3) ²²⁰ 96.5% (95% Cl, 89.3-99.3) in <u>16-55 year old²²⁰</u> 93.1% (95% Cl, 78.4-98.6) in ≥ 55 year old ²²⁰	No available data	No available data	No available data	No available data	No available data	Ongoing clinical trials ^{xxxvii}	No available data

^{cxvi} UK's minimum gap for Covid-19 booster jabs to be halved to three months. *The Guardian* [press release]. Accessed on 12 December 2021. <u>https://www.theguardian.com/world/2021/nov/29/covid-booster-jabs-to-be-offered-to-all-uk-adults-after-three-month-gap</u>

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Effectiveness	Effectiveness against testing positive: 12% (95% Cl, 8- 17) in first 7 days after booster 58% (95% Cl, 56- 61) 14 days after booster 85% (95% Cl, 83- 86) 28 days after booster ²²¹ Effectiveness against symptomatic infection: 92% (95% Cl, 91- 92% (95% Cl, 91- 92) ²²² 85.6% (95% Cl, 79.2-90.1) relative to two doses ²²³ 88% (95% Cl, 87- 88) ²²³ 82% (95% Cl, 79- 85) ²²³ Effectiveness in ≥ 50 : 84.4% (95% Cl, 82.8-85.8) against symptomatic COVID-19 ²²⁴ 94.0% (93.4-94.6) against symptomatic	Effectiveness against infection: 94% (95% Cl, 91- 95) ²²² 91% (95% Cl, 90- 92) ²²³ 87% (95% Cl, 83- 91) ²²³ Effectiveness against hospitalization: 86% (95% Cl, 82- 89) ²²³	No available data	No available data	No available data	Effectiveness against symptomatic infection: 78.8% (95% CI, 76.8-80.6) ²²⁵ Effectiveness against hospitalization: 86.3% ²²⁵ Effectiveness against ICU admission: 92.2% ²²⁵ Effectiveness against COVID-19 related death: 86.7% ²²⁵	No available data	No available data	
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	COVID-19 compared with unvaccinated ²²⁴ <u>Effectiveness</u> <u>against</u> <u>hospitalization:</u> 87% 0-6 days after receiving booster dose 92% to 97% Iower than those who received 2 doses ²²¹ 88% (95% CI, 86- 90)				
Effectiveness against Variants	Omicron (B.1.1.529): 75.5% (95% Cl, 56.1-86.3) effectiveness against symptomatic infection ⁸³ If assuming 25- fold decrease compared to wild- type, 81% (95% Cl, 59-95) 54.6% (95% Cl, 30.4-70.4) effectiveness	Delta (1.617.2): 95.2% (93.4%- 96.4%) ⁸⁶ Omicron (B1.1.529): 62.5% (95% Cl 56.2-67.9%) ⁸⁶	<u>Omicron</u> (B.1.1.529): 63% (95% Cl, 31- 81) against hospitalization 0- 13 days post booster 84% (95% Cl, 67- 92) against hospitalization 14- 27 days post booster 85% (95% Cl, 54- 95) against hospitalization 1-2		



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	against symptomatic infection in ≥60- year-old ⁸⁵			<mark>months post</mark> booster ²²⁶				
Immunogenicity	Neutralizing titers:Elicits >5-8 morefor wild type after6 months after 2^{nd} dose 6.1-fold increase (95% CI, 5.5-6.8)following boostercompared to 2-initial doses ²²³ IgG Antibodies: 1.7-fold increase (95% CI, 1.6-1.9)following boostercompared to 2-initial doses ²²³ 260 years:Neutralizingantibody:9.34 times higherthan second doseIgG Antibodies in97%seroconversionwith increase inIgG antibodytiters ²²⁷	Booster doses (mRNA1273 or mRNA1273.351) increased neutralizing antibody titers against wild-type	Antibody Levels: Higher levels after third dose (tIgG EU 3746 ; IQR: 2047-6420) Spike Cellular Immune Response: Increased from 200 SFUx10 ⁶ PBMC (IQR, 127- 389) after the second dose to 399 SFUx10 ⁶ PBMC (IQR, 314- 662) after the third one	5X10 ¹⁰ vp booster dose elicited 9- fold increase at day 7 compared to first dose after 29 days in 18-55- year-olds 1.25X10 ¹⁰ vp booster dose elicited 6-7.7-fold increase at day 28 compared to first dose after 29 days in 18-55 and ≥65- year-old	Specific Antibodies: 99.66% participants had detectable antibodies 28 days after the booster ²²⁸ I <u>gG</u> Seroconversion: 175/176 vaccinees were seropositive for IgG 14 days after receiving third dose Mean IgG value increased 8.00- fold compared to before third vaccination 6.1-fold increase 28 days after booster dose compared to 28 days after second dose ²²⁸	Neutralizing Antibodies: 60% higher NAbs activity against wild-type compared to 2- doses Anti-S IgG and NAbs: 20-fold increase 4 weeks post booster vaccination NAbs were maintained 60 to 180 days post booster	Neutralizing Antibodies (PRNT ₅₀): 30-fold increase with 746 GMT (95% CI, 515- 1081) 4 weeks after booster ²²⁹ S-protein IgG: Increase of IgG to 11,119 GMT (95% CI, 8,689-14,229) 4 weeks after booster dose ²²⁹ Anti-RBD & Anti- nucleocapsid IgG: Increase in IgG antibodies 4 weeks after booster dose ²²⁹	Anti-spike IgG: Increase of 4.6- fold compared to peak response after 2 nd dose (Day 217 GMEU = 200408; 95% CI: 159796-251342) Wild-type <u>Neutralizing</u> <u>Response</u> : Increase of 4.3- fold compared to peak response after 2 nd dose (IC50 = 6231; 95% CI: 4738- 8195) ²¹⁸ <u>Serum IgG</u> : 4.7-fold increase from 43,905 EU following primary vaccination to 204,367 EU following booster ²³⁰ <u>Older Participants</u> (60-84):



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	33-fold increase in IgG after booster dose				Anti-RBD IgG: Increased by 8.14- fold higher than before third vaccine <u>Memory B cells:</u> Third dose increased the percentage of RBD-specific memory B cells (0.96%)		Alnha (B 1 1 7):	5.4-fold increase in antibody response ²¹⁸ 5.1-fold increase in serum IgG ²³⁰ <u>Younger</u> <u>Participants (18- 59):</u> 3.7-fold increase in antibody response 4.1-fold increase in serum IgG ²³⁰ High levels of
Immunogenicit against variant		Preliminary results of booster doses of mRNA-1273 vaccine show robust antibody response against Delta variant Beta (B.1.351): 6.7-fold increase in neutralization against Beta compared to 2- initial doses ²³² Omicron (B.1.1.529): 12-fold increase in neutralization titer (GMT) against Omicron	Third dose provided higher antibody titters against Alpha, Beta, and Delta variants	No available data	Beta (B.1.351):71.6% plasmainhibitions againstBeta variantDelta (B.1.671.2):83.4%% plasmainhibitions againstDelta variantLambda:89.0% plasmainhibitions againstLambda variantOmicron:4-fold increase inneutralization titeragainst Omicroncompared to 2-	Beta (B.1.351):3.0-fold decreasein neutralizingantibodiescompared to wildtypeGamma (P.1):3.1-fold decreasein neutralizingantibodiescompared to wildtypeDelta (B.1.671.2):2.3-fold decreasein neutralizingantibodiescompared to wildtype	Alpha (B.1.1.7): 161-fold increase with 338 GMT (95% Cl, 188-607) 4 weeks after booster dose ²²⁹ Beta (B.1.351): 265-fold increase with 147.3 GMT (95% Cl, 75-289) 4 weeks after booster dose ²²⁹ Delta (B.1.671.2): 32.6-fold increase with 252 GMT (95% Cl, 133-482) 4 weeks after booster dose ²²⁹	High levels of functional antibodies against Alpha (B.1.1.7), Beta (B.1.351), and Delta (B.1.671.2) Alpha (B.1.1.7): 21.9-fold increase in anti-S IgG compared to 2-initial doses ²³⁰ Beta (B.1.351): 40.6-fold increase in serum IgG ²³⁰ 24.5-fold increase in anti-S IgG compared to 2-initial doses ²³⁰



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		Omicron (B.1.1.529): 37.0-fold decrease in neutralization compared to Delta after 0.5 months after booster 24.5-fold decrease in neutralization compared to Delta after 3 months after booster 17-fold increase in neutralization titer compared to 2-initial doses ²³¹	compared to 2- initial doses ²³²			dose vaccination ²³² 11-fold decrease in neutralization titer 14 days after booster dose compared to wild type ²³² 3.3-fold increase in neutralizing activity 28 days after booster compared to 2- initial doses against Omicron ²²⁸	2.5-fold higher neutralizing potency than 2- dose vaccination	Delta Plus: 174-fold increase with 174 GMT (95% CI, 64-474) 4 weeks after booster dose ²²⁹	Delta (B.1.671.2):Increase of 6.6-fold in antibodyresponsecompared to Deltaresponseobserved withprimaryvaccination24.4-foldincrease in anti-SIgG compared to2-initial doses ²³⁰ Omicron(B.1.1.529):20.1-foldincrease in anti-SIgG compared to2-initial doses ²³⁰
F	Reactogenicity	Preliminary results show consistent tolerability 25% reported at least one adverse event ²²⁰ <u>Common solicited</u> <u>AE:</u> Injection site pain, injection site redness, injection	Similar safety and tolerability compared to second dose <u>Common solicited</u> <u>local adverse</u> <u>events:</u> Injection-site pain (68.4% for mRNA-1273.351, 90% for mRNA- 1273)	Lower reactogenicity after third dose compared to first dose	No available data	Ongoing trial	The third shot is considered to be safe <u>Common side</u> <u>effects:</u> Pain at the injection site. <u>Adverse events:</u> Unrelated to the vaccination	Most reported adverse events were mild and resolved within 24 hours ²²⁹ Solicited Adverse <u>Events:</u> 8 solicited adverse events were reported 5.4% care of pain, 2.1% itching 1% redness ²²⁹	Booster dose was well tolerated Local and systemic reactogenicity increased between Dose 1, Dose 2, and Dose 3 90% of symptoms were rated as mild or moderate



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	site swelling, fatigure, muscle pain, fever <u>≥Grade 3 AE:</u> 6.6% reported grade 3 or higher reactogenicity with 0.7% being local reactions and 5.9% systemic events	fatigue (36.8% for mRNA-1273.351, 70% for mRNA- 1273) headache (36.8% for mRNA1273.351, 55.0% for mRNA- 1273) myalgia (31.6% for mRNA- 1273.351, 45.0% for mRNA-1273) arthralgia (21.1% for mRNA-1273, 50.0% for mRNA- 1273)						
Protection against COVID-19	Confirmed Infection: Youngest age group (16-29): 17.2 (95% Cl, 15.4-19.2) lower rate in booster group 30-39 age group: 9.0 (95% Cl, 8.4- 9.7) lower rate in booster group 40-49 age group: 9.7 (95% Cl, 9.2- 10.3) lower rate in booster group	No available information	No available information	No available information	No available information	No available information	Ongoing clinical trials ^{xxxvii}	No available information



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50-59 age group: 12.2 (95% CI, 11.4-13.0) lower rate in booster group				
<u>Oldest age group</u> (≥60): 12.3 (95% CI, 10.4-12.3) lower rate in booster group ²³³ 12.3 (95% CI, 11.8-12.8) lower rate in booster group				
<u>Severe Illness:</u> <u>40-59 age group:</u> 21.7 (95% CI, 10.6-44.2) lower rate in booster group				
Older population (≥60): 19.5 (95% CI, 12.9-29.5) lower rate in booster group ²³³ 17.9 (95% CI, 15.1-21.2) lower rate in booster group ²³⁴				



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	<u>Mortality:</u> ≥60 years old: 14.7 (95% CI, 10.0-21.4) lower rate in booster group ²³⁴							
	≥50 years old: Adjusted hazard ratio for death due to COVID-19 in booster compared to non-booster was 0.10 (95% Cl, 0.07 to 0.14) or 90% lower mortality rate ²³⁵							
Duration of Protection	≥60 years old: 3 months after booster dose, neutralizing antibody levels remained adequate although significant decrease is reported (25,429 AU/mL to 8306 AU/mL) ²³⁶ Viral Load: 52% decrease in Ct-reduction post the booster shot	No available data						



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	over time (decline in reducing viral loads over time) ²³⁷ Detailed report from Pfizer				
	regarding booster doses can be found here: <u>https://www.fda.go</u> <u>v/media/152161/d</u> <u>ownload</u>				
Other	14-20 days after booster, marginal effectiveness increases to 70- 84%			For more detailed information regarding	
	Incidence Rate: Infection in individuals <60: 0.22 (95% Cl, 0.22-0.23)			immunogenicity of third dose refer to study ^{cxvii}	
	incidence rate in booster compared to non-booster ²³⁸ <u>Infection in</u> individuals ≥60:				
	0.16 (95% Cl, 0.15-0.17)				

cxvii A third dose of inactivated vaccine augments the potency, breadth, and duration of anamnestic responses against SARS-CoV-2. *medRxiv.* <u>https://www.medrxiv.org/content/10.1101/2021.09.02.21261735v1</u>



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	incidence rate in booster compared to non-booster ²³⁸							
	Severe illness in individuals <60: 0.33 (95% CI, 0.21-0.52) incidence rate in booster compared to non-booster ²³⁸							
	Severe illness in individuals ≥60: 0.12 (95% CI, 0.10-0.14) incidence rate in booster compared to non-booster ²³⁸							
			HETER	OLOGOUS BOOSTE	R DOSES			
	<u>Heterologous 1:</u> mRNA1273/BNT1 62b2	<u>Heterologous 1:</u> BNT162b2/mRNA 1273		<u>Heterologous 1:</u> BNT162b2/Ad26. CoV.2.S		<u>Heterologous 1:</u> CoronaVac/ChAd Ox1		<u>Heterologous 1:</u> BNT162b2/NVX- CoV2373
Vaccine Schedule	<u>Heterologous 2:</u> Ad26.CoV.2.S/BN T162b2	<u>Heterologous 2:</u> Ad26.CoV.2.S/m RNA1273	<u>Heterologous 1:</u> BNT162b2/ChAd Ox1*	<u>Heterologous 2:</u> mRNA1273/Ad26. CoV.2.S	<u>Heterologous:</u> SinoPharm/BNT1 62b2	<u>Heterologous 2 :</u> CoronaVac/BNT1 62b2	No available data	<u>Heterologous 2:</u> ChAdOx1/NVX- CoV2373
	Heterologous 3: ChAdOx1/BNT16 2b2 *Received BNT162b2 as booster dose	Heterologous 3: ChAdOx1/mRNA 1273 *Received mRNA1273 as booster dose	*Received ChAdOx1 as booster dose	Heterologous 3: ChAdOx1/Ad26.C oV.2.S. *Received Ad26.CoV.2 as booster dose		<u>Heterologous 3 :</u> CoronaVac/Sino Pharm <u>Heterologous 4:</u>		*Received NVX- CoV2373 as booster dose



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Time-to-booster dose	At least 3 months after receiving two dose regimen	At least 3 months after receiving two dose regimen	6 months after initial two-dose regimen	4 months after initial two-dose BNT162b2 regimen ²³⁹ At least 3 months after receiving two dose regimen	6 months after initial two-dose regimen	CoronaVac/mRN A1273 *Received CoronaVac as initial regimen <i>Heterologous 1:</i> 21 to 26 days after full jab of CoronaVac <i>Heterologous 2:</i> 6 months after primary vaccination of CoronaVac <i>Heterologous 3:</i> 6 months after primary vaccination of CoronaVac <i>Heterologous 4:</i> 6 months after primary vaccination of CoronaVac	No available data	6 months after initial two-dose regimen
Effectiveness	<u>Heterologous 1:</u> 94% (95% CI, 91- 96) effectiveness against infection ²²² <u>Heterologous 2 –</u> <u>Effectiveness in</u> ≥50:	<u>Heterologous 1:</u> 92% (95% CI, 88- 95) effectiveness against infection ²²² <u>Heterologous 3:</u>	No available data	No available data	No available data	Heterologous 1:93.2% (95% CI,92.9-93.6) againstsymptomaticinfections ²²⁵ 97.7% againsthospitalization ²²⁵	No available data	No available data



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	87.4% (95% CI, 84.9-89.4) against symptomatic COVID-19 ²²⁴ 93.1% (95% CI, 91.7-94.3) against symptomatic COVID-19	91% (95% CI, 63- 98) effectiveness against infection ²²²				98.9% against ICU admission ²²⁵ 98.1% against COVID-19 related death ²²⁵		
	COVID-19 compared to unvaccinated ²²⁴ <u>Heterologous 3:</u> 82% (95% CI, 68- 90) effectiveness against infection ²²²					<u>Heterologous 2:</u> 96.5% (95% CI, 96.2-96.7) against symptomatic infections ²²⁵		
						96.1% against hospitalization ²²⁵ 96.2% against ICU admission ²²⁵ 96.8% against		
			<u>Omicron</u> (B.1.1.529):			COVID-19 related death ²²⁵		
Effectiveness against Variants	No available data	No available data	Heterologous 1: 71.4% (95% CI, 41.8-86.0) against symptomatic infection ⁸³	No available data	No available data	No available data	No available data	No available data



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107/147



Immunogenicity	Binding Antibody Responses:2-fold or greater rise in bAb noted in 98-100% of BNT162b2 recipients240Neutralizing Antibody Responses:341.3-677.9 IU50/mL 15 days after booster with BNT162b2240Participants who received mRNA- based booster vaccination had four-fold increase compared to Ad26.COV2.S.Heterologous 3: Anti-spike IgG: In individuals <70: 22479 ELU/mL (95% CI, 18276- 27648) Individuals ≥70: 19091 EUL/mL (95% CI, 15554- 23432)	Binding Antibody Responses: 2-fold or greater rise in bAb noted in 96-100% of mRNA1273 recipients ²⁴⁰ Neutralizing Antibody Responses: 676.1-901.8 IU50/mL 15 days after booster with mRNA1273 ²⁴⁰ Participants who received mRNA- based booster vaccination had four-fold increase compared to Ad26.COV2.S. Heterologous 1: Anti-spike IgG: In individuals <70: Hata Y ELU/mL (95% CI, 38424- 51645) In individuals ≥70: 25118 ELU/mL (95% CI, 17698- 35650)	Heterologous 1: Anti-spike lqG: In individuals <70: 12440 ELU/mL (95% CI, 10420- 14852) In individuals ≥70: 14961 ELU/mL (95% CI, 12065- 18551) ²⁴¹ Cellular Response : In individuals <70 : 105 (95% CI, 67- 164) In individuals ≥70: 84 (95% CI, 45- 156) ²⁴¹	Heterologous 1:14.8 to 32.4-fold increase in neutralization titers against wild- type virus239Binding Antibody Responses (bAb):2-fold or greater rise in bAb noted in 98-100% of Ad26.COV2.S. recipients240Neutralizing Antibody Responses: 31.2-382.2IU50/mL 15 days after booster with Ad26.COV2.S.Anti-spike IgG: In individuals >70: 17312 ELU/mL (95% CI, 13678- 21911) In individuals ≥70: 16855 ELU/mL (95% CI, 13360- 21264)Cellular Response:	No available data	Heterologous 1: Heterologous vaccination had a 9-fold greater GMT (7,947 U/mL) than fully patients fully vaccinated with AZD1222 and the highest antibody response, IgA, and neutralizing antibodies than other groups ²⁴² <u>Anti-RBD</u> <u>Antibody</u> : 9865 U/mL 14- days after booster ²⁴³ <u>Heterologous 2:</u> Median values of IgG-S titers were higher in group that received BNT162b2 as booster than CoronaVac BNT162b2 boosted IgG-S median titers by factor of 46.6 but IgG-N titers	No available data	Heterologous 1: $Anti-spike IgG:$ In individuals <70: $14961 ELU/mL$ (95% CI, 12065- 18551) In individuals ≥70: $9130 EUL/mL$ (95% CI, 6783- 12289)241 $Cellular$ $Response:$ In individuals <70: $69 (95% CI, 45-$ $156)In individuals ≥70:45 (95% CI, 22-92)^{241}Heterologous 2:Anti-spike IgG:In individuals <70:8389 ELU/mL(95% CI, 6599-10665)In individuals ≥70:5822 ELU/mL(95% CI, 4495-7541)CellularResponse:$
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Cellular In individuals <70: decreased by In individuals <70: Response: 114 (95% CI, 55: factor of 6.5 127 (95% CI, 82: 119 (95%, CI, 81: In individuals <70: Ani:spike RBD: In individuals <70: 131 (95%, CI, 82: 109 (95%, CI, 64: Single booster 55 (95% CI, 35: 230 In individuals <70: Ani:spike RBD: In individuals <70: 131 (95%, CI, 64: Single booster 55 (95% CI, 35: 89) 200 sport forming In individuals <70: Individuals <70: Individuals <70: 131 (95%, CI, 64: Single booster 89) 55 (95% CI, 35: 89) 200 sport forming In individuals <70: Individuals <70: Individuals <70: Individuals <70: 131 (95%, CI, 64: Individuals <70: Individuals <70: Individuals <70: Individuals <70: 200 sport forming Cellular Finder IG2: Individuals <70: Individuals <70: Individuals <70: 131 (95%, CI, 2205: G8%, CI, 4415: Corona Vac Individuals <70: Individuals <70: Individuals <70: 2700 CE LUMIL G9%, CI, 4266: G980 Individuals <70:
In individuals <70:
In individuals <70:
119 (95%, Cl, 82- 169) sport forming cells per 10° perpheral blood in individuals 270: 131 (95%, Cl, 46- 200) sport forming cells per 10° perpheral blood mononuclear cells In individuals 270: 250 Heterologous 3: 187) ⁵⁴¹ In individuals 270: 187) ⁵⁴¹ In individuals 270: 100 (95%, Cl, 46- 105) 200) sport forming cells per 10° peripheral blood mononuclear cells Anti-spike IgG: 10 individuals 270: 10 indi
169) sport forming cells per 10° peripheral blood mononuclear cells 143 (95% Cl, 82- 250) 100 (95% Cl, 64- 187) ²⁵¹¹ Single booster dose of BNT162b2 55 (95% Cl, 35- 89) 113 (95% Cl, 64- 10 individuals ≥70: 113 (95% Cl, 64- 10 individuals ≥70: 113 (95% Cl, 64- 10 individuals ≥70: 113 (95% Cl, 64- 10 individuals ≥70: 116) Anti-spike IgG: 116) IgG antibody 116 (95% Cl, 4415- 10 individuals <70: 10 individuals <70: 10 individuals <70: 10 individuals >70: 10 individuals >70: 116 individuals >70: 10 individuals >70: 10 individuals >70: 10 individuals >70: 110 individuals >70: 122 (95% Cl, 177- 224) Anti-spike IgB: 100 individuals >70: 123 (95% Cl, 177- 224) Individuals >70: 101 (95% Cl, 54- 187) Heterologous 4: 124) Individuals >70: 101 (95% Cl, 54- 187) Individuals >70: 124) Individuals >70: 123 BAUmL) ²⁴ Individuals >70: 101 (95% Cl, 54- 187) Individuals >70: 124) Individuals >70: 101 (95% Cl, 54- 187) Individuals >70: 101 (95% Cl, 54- 187) Individuals >70: 124) Individuals >70: 124) Individuals >70: 101 (95% Cl, 54- 187) Individuals >70: 101 (95% Cl, 54- 187) Individuals >70: 124) Individuals >70: 101 (95% Cl, 54- 187) Individuals >70: 101 (95%
celis per 10 ⁶ 250) 187 ³²¹ dos of BNT162b2 89) peripheral blood mononuclear cells 160 ³ Anti-spike IgG: 168) individuals 270: 168) BNT162b2 2000 sport forming cells per 10 ⁶ peripheral blood mononuclear cells Anti-spike IgG: 168) Anti-spike IgG: 168) Individuals 270: 168) 4eterologous 3: 5582 ELU/mL (95% C1, 4415- dose of mononuclear cells CoronaVac CoronaVac 75522 ELU/mL (95% C1, 29205- 6998) 161 individuals 270: 1698) 20,787 U/mL 14 (95% C1, 29205- 10 individuals 270: 1702 ELU/mL (95% C1, 2137- 35966) 20,787 U/mL 14 (95% C1, 1237- 35966) 20,787 U/mL 14 (95% C1, 1237- 35966) 14 (195% C1, 100- 493 after booster 414 (195% C1, 100- 493 after booster 161 individuals 270: 101 individuals 270: 110 individuals 270: 128 (95% C1, 177- 294) 124) 9.3-fold increase 10 individuals 270: 101 individuals 270: 101 individuals 270: 110 inditab
peripheral blocd mononuclear cells In individuals 270: 113 (95% Cl, 46- 188) Heterologous 3: Anti-spike IgG: 188) BNT 162b2 individuals 270: 193 anti-spike RBD anti-spike RBD anti-spike RBD 195 Cl, 4415- dose of 7057) Peripheral blocd mononuclear cells Heterologous 3: 9582 ELUML 10 single booster 96% Cl, 4415- dose of 7057) Individuals 270: 10 individuals 270: 3552 ELUML 10 single booster 998) Anti-spike IgG: mononuclear cells 10 individuals 270: 10 individuals 270: 3552 ELUML 10 (95% Cl, 21337- 35966) 7057) Cellular (95% Cl, 21337- 35966) Cellular Response: 10 individuals 270: 10 individuals 270: 11 individuals 270: 128 (95% Cl, 177- 294) Anti-spike RBD: 10 individuals 270: 10 individuals 270: 128 (95% Cl, 177- 294) 28 (95% Cl, 177- 294) 124) Individuals 270: 10 individuals 2
morinoruclear cells 88 (95%, Cl, 46- 168) Heterologous 3: Anti-spike IgG: In individuals <70: Peripheral blood mononuclear cells induced higher anti-spike RBD IgG antibody In individuals <70: IsSS2 ELU/mL (95%, Cl, 4415- dose of Anti-spike IgG: In individuals <70: 33522 ELU/mL (95%, Cl, 2205- 43204) 20,787 U/mL 14 dose of Anti-spike RBD: In individuals <70: TOT3 U/mL 14 (95%, Cl, 21337- Segeonse: In individuals <70: In individuals <
In individuals ≥70: 168) anti-spike RBD 113 (95% C), 64- Anti-spike IgC; IgG antibody 200) sport forming in individuals <70:
113 (95% Cl, 64- 200) sport forming cells per 10° peripheral blood mononuclear cells Heterologous 3: hindividuals <70: 2002 Anti-spike IgG: (95% Cl, 2415- 0 corona Vac IgG antibody levels, compared dose of corona Vac Heterologous 3: peripheral blood mononuclear cells Heterologous 3: (95% Cl, 29205- 43204) To57) Corona Vac In individuals <70: 3592 ELU/mL (95% Cl, 29205- 43204) In individuals <70: (95% Cl, 29205- 43204) Heterologous 3: 27702 ELU/mL (95% Cl, 21337- 35966) Heterologous 3: 1073 U/mL 14 days after booster 27702 ELU/mL (95% Cl, 21337- 35966) Cellular (95% Cl, 21337- 35966) Cellular (95% Cl, 177- 228 (95% Cl, 177- 228 (95% Cl, 177- 294) Anti-spike RBD: 1073 U/mL 14 days after booster In individuals <70: 11 individuals <70: 28 (95% Cl, 177- 294) In individuals <70: 124) Heterologous 4: 107 In individuals <70: 195% Cl, 54- 1877 In individuals <70: 124) Heterologous 4: 1073 U/mL 14 days after booster In individuals <70: 195% Cl, 54- 1877 In individuals <70: 124) Heterologous 4: 1073 U/mL 14 days after booster
200) sport forming cells per 10 ⁶ peripheral block mononuclear cells Heterologous 3: 5582 ELU/mL to single booster to single boost
cells per 10° Heterologous 3: 5582 ELU/mL dose of mononuclear cells Anti-spike IgG; 7057) CoronaVac in individuals <70:
peripheral blood mononuclear cells (95% Cl, 4415- In individuals ≥70: 35522 ELU/mL (95% Cl, 29205- 43204) (95% Cl, 4415- In individuals ≥70: 27702 ELU/mL (95% Cl, 29205- 43204) 20,787 U/mL 14 (95% Cl, 29205- 43204) In individuals ≥70: 27702 ELU/mL (95% Cl, 21337- 35966) Cellular Heterologous 3: 27702 ELU/mL (95% Cl, 21337- 35966) In individuals ≥70: 141 (95% Cl, 100- 288 (95% Cl, 177- 228 (95% Cl, 177- 228 (95% Cl, 177- 228 (95% Cl, 177- 2124) Heterologous 4: 101 (95% Cl, 54- 187) In individuals ≥70: In individuals ≥70: 187) In individuals ≥70: 124) Heterologous 4: 162: 3.34504 increase in median IgG titer compared to 2- initial doses (250 to 2313 BAU/mL) ²⁴⁴
mononuclear cells Anti-spike IaG: In individuals <70: St522 ELU/mL 7057) In individuals >70: St62E ELU/mL CoronaVac 95% Cl, 104266- 43204) 0998) 20,787 U/mL 14 days after booster 10 in individuals >70: 27702 ELU/mL Cellular (95% Cl, 21337- 35966) Heterologous 3: 27702 ELU/mL 095% Cl, 11337- 35966) Cellular 11 individuals <70: 1073 U/mL 14 days after booster 200 141 (95% Cl, 100- 200) days after booster 201 141 (95% Cl, 100- 228 (95% Cl, 177- 228 (95% Cl, 177- 228 (95% Cl, 177- 228 (95% Cl, 177- 228 (95% Cl, 177- 294) Heterologous 4: 101 (95% Cl, 54- 187) 101 (95% Cl, 54- 187) 124) 9.3-fold increase in median IgG titef compared to 2- 187)
In individuals <70:
35522 ELU/mL 5464 ELU/mL 20,787 U/mL 14 (95% C1, 2200- 699 In individuals ≥70: Heterologous 3: 277702 ELU/mL Cellular (95% C1, 21337- Response: In individuals <70:
(95% Cl, 29205- 43204) (95% Cl, 4266- 6998) days after booster (43204) 6998) Heterologous 3: 27702 ELU/mL (95% Cl, 21337- 35966) Cellular Response: In individuals <70: 200) Anti-spike RBD: 1073 U/mL 14 141 (95% Cl, 100- days after booster 200) Response: In individuals <70: 228 (95% Cl, 177- 294) Batter booster 101 (95% Cl, 54- 197) 124) IgG: 33-fold increase in medial [gG titer compared to 2- initial doses (250 to 2313 BAU/mL) ²⁴⁴ 187) Seropositivity: Increase from
43204) 6998) In individuals ≥70: 27702 ELU/IL 27702 ELU/IL Cellular (95% CI, 21337- Response: 35966) In individuals <70:
In individuals ≥70: Cellular 27702 ELU/mL Cellular (95% Cl, 21337- 35966) In individuals <70:
27702 ELU/mLCellular Response: In individuals <70: 141 (95% Cl, 21337- 35966)Anti-spike RBD: 1073 U/mL 14 days after boosterCellular200)Response: In individuals <70: In individuals <70: 282 (95% Cl, 54- 294)In individuals <70: 124)In individuals <70: In individuals <70: 101 (95% Cl, 54- 187)In individuals <70: 124)In individuals <70: In individuals <70: In individuals <70: In individuals <70: 124)In individuals <70: 124)Seropositivity: In individuals <70: In individuals <70: In individuals <70: In individuals <70: In individuals <70: IN median IgG titer In individuals <70: In individuals <70: In individuals <70: IN median IgG titer In median IgG titer In median IgG titer In median IgG titer In individuals <70: In individuals <7
(95% Cl, 21337- 35966) Response: In individuals <70: 141 (95% Cl, 100- 200) 1073 U/mL 14 days after booster Cellular Response: In individuals <70: 228 (95% Cl, 177- 294) In individuals ≥70: 124) Heterologous 4: 124) In individuals ≥70: 101 (95% Cl, 54- 187) 124) IgG: 9.3-fold increase in median IgG titer compared to 2- initial doses (250) to 2313 BAU/mL) ²⁴⁴ Seropositivity: Increase from Seropositivity: Increase from
35966) In individuals <70:
Image: Cellular Cellular Response: 141 (95% Cl, 100-200) Response: In individuals ≥70: In individuals <70:
Cellular 200) Response: In individuals ≥70: In individuals <70:
Response: In individuals ≥70: Heterologous 4: In individuals <70:
In individuals <70:
228 (95% CI, 177- 294) In individuals ≥70: 101 (95% CI, 54- 187)124)In individuals ≥70: in median IgG titer compared to 2- initial doses (250) to 2313 BAU/mL)244Seropositivity: Increase from
294) In individuals ≥70: 101 (95% CI, 54- 187)
In individuals ≥70: 101 (95% CI, 54- 187) 197)
101 (95% Cl, 54- 187) compared to 2- initial doses (250 to 2313 BAU/mL) ²⁴⁴ Seropositivity: Increase from
187) 187)
to 2313 BAU/mL) ²⁴⁴ Seropositivity: Increase from
BAU/mL) ²⁴⁴
Seropositivity: Increase from
Increase from
Increase from



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						after booster dose ²⁴⁴		
Immunogenicity against variants	Binding Antibody Responses: Baseline bAb levels for Delta were 34-45% lower compared to Wa-1 strainFollowing boost, 	Binding Antibody Responses: Baseline bAb levels for Delta were 34-45% lower compared to Wa-1 strainFollowing boost, bAB levels for Delta were 15- 36% lower compared to Wa-1 strainNeutralizing Antibody Responses: Delta and Beta variants were only available in those boosted with mRNA-1273Heterologous 1: Pseudotype virus neutralizing antibody NT50:	AZD1222/ BNT162b2 Demonstrated 80% response rate against Omicron serum sample & 14.7 - fold decrease in GMT ²⁴⁵ AZD1222/ mRNA- <u>1273</u> Demonstrated 82% response rate against Omicron serum sample & 17.5 - fold decrease in GMT ²⁴⁵ Pseudovirus neutralizing antibody NT ₅₀ : 260 GMT (95% Cl, 217-313) against Delta	Heterologous 1:10.9 to 21.2-foldincrease inpseudo virusneutralizationassay (onevolunteer did nothave any againstB.1.351)Binding AntibodyResponses:Baseline bAblevels for Deltawere 34-45%lower comparedto Wa-1 strainFollowing boost,bAB levels forDelta were 15-36% lowercompared to Wa-1strainPseudotype virusneutralizingantibody NT ₅₀ :418 GMT (95%)CI, 330-530)against Delta	No available data	 Heterologous 1: Neutralizing activity against the wild type and variant strains showed higher neutralizing activity in the following order: wild type > B.1.617.2 > B.1.1.7 > B.1.351 Heterologous 2: 6.3-fold increase in neutralization titers against Delta 28 days after booster dose compared to 2- initial doses²⁴⁶ 6.3-fold decrease in neutralization titers against Omicron 28 days after booster dose compared to wild type²⁴⁶ 	No available data	Heterologous 1: Pseudotype neutralizing antibody NT ₅₀ : 165 GMT (95% CI, 131-209) against Delta Heterologous 2: Pseudotype neutralizing antibody NT ₅₀ : 124 GMT (95% CI, 99-156) against Delta



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	315 GMT (95% CI, 1314–1998) against Delta	508.7 GMT (95% CI, 408.6-633.4) against Delta ²⁴¹ <u>Heterologous 3:</u> <u>Pseudotype virus</u> <u>neutralizing</u> <u>antibody NT₅₀: 559.7 GMT (95% CI, 441.3-709.9) against Delta <u>Adverse Events:</u></u>		41-fold increase against Omicron compared to 2- initial doses ²³¹ <u>Heterologous 3:</u> <u>Pseudotype virus</u> <u>antibody NT₅₀:</u> 125 GMT (95% CI, 99-159) against Delta				
Reactogenicity	 Adverse Events: 72-92% participants reported local pain or tenderness Malaise, myalgias, and headaches were commonly reported 14.4% of the participants reported unsolicited adverse events 	 75-86% participants reported local pain or tenderness Malaise, myalgias, and headaches were commonly reported 15.6% of participants reported unsolicited adverse events 	No available data	Adverse Events: 71-84% participants reported local pain or tenderness Malaise, myalgias, and headaches were commonly reported 12% of participants reported unsolicited adverse events	No available data	Similar results to homologous booster administration Reactogenicity of mRNA1273 booster was acceptable and better tolerated with increasing age and shorter time since booster dose ²⁴⁴	No available data	No available data



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Other						Ongoing clinical trial examining immunogenicity and safety of third dose vaccination with ChAdOx1 or BNT162b2 vaccine among adults who received full jab of CoronaVac ^{cxviii}			
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cxviii 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



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ANNEXES

	BNT162b2/ COMIRNATY (Pfizer- BioNTech, USA)	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273 (Moderna, USA)	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield (AstraZeneca/Ox ford, UK, India)	Janssen COVID- 19 vaccine/Johnson & Johnson (Janssen, USA)	Sinopharm/BBIB P-CorV, China	Sinovac CoronaVac, China	COVAXIN/ BBV152 (Bharat Biotech, India)	Novavax/ NVX- CoV2373	
				FURTHER INFORM	IATION				
Storage conditions	2°C to 8 °C (for 1 month)	2°C to 8 °C (for 1 month)	2°C until 8 °C	2°C to 8 °C (for 3 months)	2°C until 8 °C	2°C until 8 °C	2°C until 8 °C	2°C to 8 °C	
Approving authorities	FDA (11.12.20) ^{cxix} ; EMA (21.12.20); WHO EUL (31.12.20); and list of countries (including Switzerland – approved on 20.12.20)	FDA (18.12.20); EMA (06.01.21); WHO EUL (30.04.21); and list of 51 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 (Switzerland awaiting on approval)	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)	WHO EUL (03.11.21) and list of 9 countries (Guyana, Inidia, Iran, Mauritius, Mexico, Nepal, Paraguay, Philippines & Zimbabwe)	Waiting on approval (Not-yet- approved by countries or WHO for emergency use)	
IMMUNOGENICITY									

cxix Pfizer-BioNTech's Comirnaty Vaccine received full FDA approval on 23 August 2021 for people age 16 and above, moving it beyond emergency use status. <u>https://www.fda.gov/news-events/press-announcements/fda-approves-first-covid-19-vaccine</u>



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Immunogenicity	Single Dose (\geq 4weeks):79.4% IgGseropositivity(95% CI, 75.7-83.1) ²⁴⁷ Second dose (\geq 4weeks):96.5% IgGseropositivity(95% CI, 94.9-98.1) to 92% IgGseropositivityonwards ²⁴⁷ 7-14 days aftersecond dose:18-55 years:GMT ranged from1.7 to 4.6 timesthe GMT of theconvalescentserum.65-85 years:GMT ranged from1.1 to 2.2 timesthe GMT of theconvalescentserum.	14 days after second dose: 18-55 years: PRNT ₈₀ GMT 654.3 (95% CI, 460.1-930.5). 56-70 years: PRNT ₈₀ GMT 878 (95% CI, 516- 1494). ≥71 years: PRNT ₈₀ GMT 317 (95% CI, 181- 557).	28 days after second dose median antibody titres: 18–55 years: 20,713 AU/mL [IQR 13,898 - 33,550] 56–69 years: 16,170 AU/mL [IQR 10,233 - 40,353]. ≥70 years: 17,561 AU/mL [IQR 9,705 - 37,796].	IgG Antibodies: 1299.5 AU/mL highest median ¹¹⁵ 29 days after vaccination: 18-55 years: GMC 586 (95% CI, 445-771); GMT 224 (95% CI, 168-298). ≥ 65 years: GMC 312 (95% CI, 246-396); GMT 212 (95% CI, 163-266). 57 days after vaccination: 18-55 years: 754 (95% CI, 221-376).	<u>14 days after</u> <u>second dose:</u> 18-55 years: GMT 211.2 (95% CI, 158.9-280.6). ≥60 years: GMT 131.5 (95% CI, 108.2-159.7).	Single dose (\geq 4 weeks): 37.7±57.08 IU/mI (min: 0, max: 317.25); 57.02% of participants did not develop sufficient antibody titres (<25.6 IU ml) 28.1% IgG seropositivity (95% CI, 25.0- 31.2) ²⁴⁷ <u>Two doses (2</u> weeks): 164.4 BAU/ mL <u>Two doses (\geq4 weeks)</u> : 194.61±174.88 IU/mI (min: 0, max: 677.82); 11.48% of participants did not develop sufficient antibody titres (<25.6 IU ml) 94.8 BAU/ mL	IgG Antibodies:342.7 AU/mLhighest median115Single dose (≥4weeks:43.8%seropositive foranti-spikeantibody > 15AU/mLGMT 16.8 (95%CI, 15.80-17.88)for SARS-CoV-2spike antibodytitreTwo doses (≥4weeks):80.0%seropositive foranti-spikeantibody > 15AU/mLGMT 48.3 (95%CI, 47.46-48.92)for SARS-CoV-2spike antibodytitre	
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				77.4% IgG seropositivity (95% CI, 75.5- 79.3) ²⁴⁷ <u>Two doses (8-12</u> <u>weeks):</u> 34.7 BAU/ mL	
	7.77-fold reduction in neutralization titres for Delta (B.1.617.1) when compared with wild-type ²⁴⁸				
Immunogenicity against Delta variant	11.30-fold reduction in neutralization titres for Delta (B.1.617.2) when compared with wild-type ²⁴⁸				
	157 PRNT₅₀ neutralization against Delta (B.1.617.1) ²⁴⁹				
	355 PRNT₅₀ neutralization against Delta (B.1.617.2) ²⁴⁹				



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Immunogenicity against the Mu variant	6.8-fold decrease in neutralizing titres when compared to convalescent sera	Neutralizing titre similar to that of BNT162b2 sera	Neutralizing titre similar to that of BNT162b2 sera	No available data	No available data	No available data	No available data	No available data
Immunogenicity against Omicron variant (not specific to vaccines)	Boosted (3-dose scl	hedule)	at Omicron when com Omicron when comp					
Immunogenicity against Omicron variant	29.8-fold decrease in mean neutralizing titres compared to wild- type, 10.3-fold decrease compared to Beta, 25.1-fold decrease compared to Delta ²⁵¹ Plasma specimens one month after full mRNA vaccination, NT ₅₀ values were 127±66 times lower for Omicron than the wild type (Wuhan) strain. After 5 months, the neutralization	 20-fold decrease in neutralization 6 months after vaccination compared to Delta²⁵¹ 1/10 seropositive against Omicron²¹⁴ Plasma specimens one month after full mRNA vaccination, NT₅₀ values were 127±66 times lower for Omicron than the wild type (Wuhan) strain. After 5 months, the neutralization potency was 	Mean neutralizing titres drop to below the detectable threshold in all but one participant ²⁵¹ 0/20 seropositive against Omicron ²¹⁴ The mean Omicron titre estimate in the infected + double vaccinated group suggests protection against symptomatic Omicron disease is 80% ²⁵⁰	Vaccine lacked detectable neutralizing activity against Omicron. ²⁵² Demonstrated 9% response rate against Omicron serum sample ²⁴⁵		Not a single serum sample demonstrated neutralizing antibodies against the Omicron VOC among 25 blood samples ²⁵⁷	Only 5/20 live virus samples exhibited neutralization titres above the lower limit of quantification. ²⁵⁶	



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potency was 27±17 lower for Omicron. ²⁵²	27±17 lower for Omicron. ²⁵² Persons who had	rate against Omicron serum sample & 12.8 - fold decrease in			
Persons who had	prior SARS-CoV-2	GMT ²⁴⁵			
prior SARS-CoV-2	infections and	Only 5/20 live			
infections and then were fully	then were fully (two-dose)	virus samples			
(two-dose)	vaccinated had	exhibited			
vaccinated had	NT ₅₀ values 154	neutralization			
NT ₅₀ values 154	times greater than	titres above the			
times greater than	the pre-	lower limit of			
the pre-	vaccination	quantification. ²⁵⁶			
vaccination	<mark>convalescent</mark>				
convalescent	phase titres ²⁵²	No neutralizing			
phase titres ²⁵²	A (1) 11 (antibodies were			
A third booster	A third booster dose increased	observed in serum samples obtained			
dose increased	the neutralization	1 months after the			
the neutralization	capacity against	receipt of the			
capacity against	Omicron by 38	second dose ²⁵⁵			
Omicron by 38	times. ²⁵²				
times. ²⁵²					
	The mean				
11.4-fold	Omicron titre				
decrease in	estimate in the				
neutralization 6 months after	infected + double				
vaccination	vaccinated group suggests				
compared to Delta	protection against				
compared to Dolla	symptomatic				
25-fold decrease	Omicron disease				
in neutralization	is 91%²⁵⁰				
titers against					
Omicron variant	Demonstrated				
	100% response				



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	 compared to wild- type²⁵³ 41-fold decrease in neutralization level against Omicron²⁵⁴ 9/20 seropositive against Omicron ²¹⁴ Demonstrated 33% response rate against Omicron serum sample²⁴⁵ 9/20 participants neutralized Omicron variant 1 month after 2nd dose²⁵⁵ 	rate against Omicron serum sample & 15.8 - fold decrease in GMT ²⁴⁵ No neutralizing antibodies were observed in serum samples obtained 4-6 months after the receipt of the second dose ²⁵⁵						
				EFFICACY				
Single dose ^{cxx}	52% (95% CI, 29.5 to 68.4; starting at 12 days) or 82.2% (75.1 to 87.3; starting at ≥14 days).	95.2% (95% Cl, 91.2.8 to 97.4; starting at >14 days) ²⁵⁸ .	 72.8% (starting at 22 days up to 60 days). 88% (95% CI, 75-94).^{cxxii} 	Single dose vaccine	Unknown	35.1% (95% CI, - 6.6 to -60.5) [conducted in a setting with high P.1 transmission].	No available data	83.4% (95% CI, 73.6-89.5) starting at ≥14 days

^{cxx} Against SARS-COV-2 infection

^{cxxii} Conducted between 8 December 2020 and 8 February 2021. Study sample = ≤ 1 million participants.



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	91% (95% CI, 85- 94). ≥80 years : 71.4% (95% CI, 46.5-90.6) vaccine efficacy for symptomatic disease 14 days after one dose [United Kingdom, 18 Dec 2020 – 26 Feb 2021] ≥65 years : 56% (95% CI 19- 76) at 28-34 days and 62% (95% CI 23-81) at 35-48 days post- vaccination [United Kingdom, 8 Dec 2020 – 15 Mar 2021] ^{cxxi}		≥80 years : 80.4% (95% CI, 36.4-94.5) vaccine efficacy for symptomatic disease 14 days after one dose [United Kingdom, 18 Dec 2020 – 26 Feb 2021 ≥65 years : 56% (95% CI 19- 76) at 28-34 days and 62% (95% CI 23-81) at 35-48 days post- vaccination [United Kingdom, 8 Dec 2020 – 15 Mar 2021] ^{cxxiii}					
Two doses ^{cxxiv}	95.0% (95% CI, 90.3-97.6) starting at ≥7 days in population without prior SARS-CoV-2 infection	94.1% (95% CI, 89.3-96.8) after median follow-up of less than 63 days	63.1% (95% CI, 51.8-71.7) starting at ≥14 days for two standard doses	66.9% (95% Cl 59.0-73.4) after 14 days and 66.1% (95% Cl 55.0-89.1) after 28 days for VE against moderate-	After 14 days, efficacy against symptomatic cases was 72.8% (95% CI 58.1- 82.4; in WIV04 vaccine) or 78.1%	After 14 days, efficacy against symptomatic cases was 50.7% (95% CI 35.9 to 0- 62.0).	<u>Symptomatic</u> <u>SARS-CoV-2</u> <u>infection:</u> 77.8% (95% CI, 65.2-86.4)	89.7% (95% CI, 80.2-94.6) starting at ≥7 days 90.4% (95% CI, 82.9-94.6)

^{cxxi} Does not differentiate between BNT162b2 and ChAdOx1 nCoV-19.

cxxiii Does not differentiate between BNT162b2 and ChAdOx1 nCoV-19.

^{cxxiv} Against SARS-CoV-2 infection.



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	94.6% (95% CI, 89.9-97.3) starting at ≥7 days in population with or without prior infection	93.2% (95% Cl, 91.0-94.8) Against severe disease: 98.2% (95% Cl, 92.8-99.6) Prevention against COVID-19 illness: 93.2% (95% Cl, 91.0-94.8; United States) ²⁵⁹ Prevention against severe disease: 98.2% (95% Cl, 92.8-99.6; United States) ²⁵⁹ Prevention against asymptomatic infection starting 14 days after second infection: 63.0% (95% Cl, 56.6-68.5; United States) ²⁵⁹	80.7% (95% CI, 62.1-90.2) starting at \geq 14 days for first low dose and standard second dose 66.7% (95% CI, 57.4-74.0) starting at \geq 14 days for pooled analysis efficacy <u>Against mild-to- moderate</u> <u>symptomatic</u> <u>COVID-19 > 14</u> <u>days after second</u> <u>injection</u> : 21.9% (95% CI, - 49.9 to 59.8; South Africa) [24 June – 09 November 2020] ²⁶⁰	severe-critical COVID-19 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	(95% CI 64.8 to 86.3; in HBO2 vaccine).	99.17% of NAb titres were above or equal to the Nab positivity cut- off (20 units) against wild-type.	Severe symptomatic SARS-CoV-2 infection: 93.4 (95% CI, 57.1-99.8) Symptomatic COVID-19 in ≥ 60 years old: 67.8% (95% CI, 65.2-86.4) against symptomatic COVID-19 Symptomatic COVID-19 in 18- 59 years old: 79.4% (95% CI, 66.0-88.2) against symptomatic COVID-19	100% (95% CI, 87-100) against moderate-to- severe COVID-19 100% (95% CI, 34.6-100) against severe COVID-19 90% (95% CI, 80- 95) (≥7 days after second dose)
Against asymptomatic infection	90% (starting at 14 days) regardless of symptom status	63.0% (95% Cl, 56.6-68.5) ²⁵⁹	Statistically non- significant reduction of 22.2% (95% CI -	At day 71, vaccine efficacy against asymptomatic infections was	Efficacy against symptomatic and asymptomatic cases was 64%	Unknown	63.6 (95% CI, 29.0-82.4) efficacy against	Unknown



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			9.9 to 45.0) for asymptomatic cases 61.9% efficacy ⁵¹	65.5% (95% Cl 39.9 to 81.1).	(95% CI 48.8 to 74.7; in WIV04 vaccine) or 73.5% (95% CI 60.6 to 82.2; in HBO2 vaccine).		asymptomatic cases	
			E	FFICACY AGAINST	VARIANTS			
Alpha (B.1.1.7)	Two doses of the vaccine effectively neutralize the B.1.1.7 variant and the D614G substitution.	NAbs remained high and consistent with titres of the wildtype for the B.1.1.7 variant.	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.	3.6-fold reduction in neutralization capacity when compared to wild- type.	Demonstrated reduced neutralizing capacity. However, there were no differences in the NAbs titres against B.1.351 in vaccinated individuals vs. those naturally infected, suggesting the vaccine has a similar level of protection against infection as natural infections.	 10.4-fold reduction in neutralization capacity when compared to natural infection sera²⁶¹. 85.83% of NAb titres were above or equal to the Nab positivity cut- off (20 units) against wild-type. Neutralization decreased by 4.1- fold when compared to wild- type. 	PRNT ₅₀ 0.8 when compared with wild type against Alpha (no significant difference in neutralization capacity)	Two dose efficac against the B.1.1.7 variant 86.3% (95% Cl, 71.3-93.5) ⁵⁵ 93.6% (95% Cl, 81.7-97.8) agains the Alpha variant <u>Against non- B.1.1.7 variant</u> 96% (95% Cl, 74 99.5) (≥7 days after second dose) <u>Against B.1.1.7</u> <u>variant</u> 86% (95% Cl, 71 94) (≥7 days after second dose)
Beta (B.1.351)	Neutralization was diminished by a factor of 5. Despite this, the BNT162b2 mRNA vaccine still	NAbs were 6-fold lower. Nevertheless, NAbs were still found to be protective.	Two doses of the vaccine had no efficacy against the B.1.351 (VE = 21.9%; 95% CI, - 49.9 to 59.8).	Efficacy against moderate-severe- critical Covid-19 due to the variant was 52.0% (>14 days) and 64.0%		NT _{GM} 35.03 (95% CI, 27.46-44.68); 8.75-fold reduction in neutralization capacity when	GMT 61.57 (95% Cl, 36.34-104.3) against Beta variant with significant	51.0% (95% CI, - 0.6-76.2) efficacy against B.1.351 variant



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	provides some protection against B.1.351 100% (95% CI, 53.5-100).		Against mild-to- moderate symptomatic COVID-19 associated with B.1.351 variant >14 days after second injection: 10.4% (95% -76.8 to 54.8; South Africa) [24 June – 09 November 2020]	(>28 days). Efficacy against severe-critical COVID-19 was 73.1% (>14 days) and 81.7% (>28 days). Demonstrated 3.6-fold reduction in neutralization sensitivity. Neutralization titres were decreased by 6.7- fold .	No published data	compared to natural infection sera. 82.5% of NAb titres were above or equal to the Nab positivity cut- off (20 units) against wild-type.	reduction in neutralization titre	
Gamma (P.1)	Single dose: ≥21 days: 83% against hospitalization and death. Two doses: ≥14 days: 98% against hospitalization and death.	3.2-fold reduction in neutralization capacity when compared to wild- type.	Single dose: ≥ 21 days: 94% against hospitalization and death ²⁶² . <u>Two doses:</u> 64% (95% CI, -2-87) [n=18] Efficacy against Zeta (P.2) [2 doses]: 69% (95% CI, 55-78) ²⁶³	Demonstrated 3.4-fold reduction in neutralization sensitivity.	No published data	49.6% against P.1 (>14 days after 1st dose). Neutralization decreased by 7.5- fold when compared to wild- type.	No available data	No available data
Delta (B. 1.671.2)	Reduced NAb activity relative to B.1.1.7 strain.	2.1-fold reduction in neutralization capacity when compared to wild- type.	Single dose: ≥21 days: 90% against hospitalization and death.	Demonstrated 1.6-fold reduction in neutralization sensitivity.	Demonstrated reduced neutralizing capacity. However, there	NT _{GM} 24.48 (95% CI,19.2-31.2). 69.17% of NAb titres were above	65.2 (95% CI, 33.1-83.0) estimated efficacy	No available data



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	22 5% (95% CI			Neutralization titres were decreased by 5.4- fold .	were no differences in the NAbs 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 natural infections.	or equal to the Nab positivity cut- off (20 units) against wild-type.	GMT 68.97 (95% CI, 24.72-192.4) against Delta variant with significant reduction in neutralization titre	
Omicron (B.1.1.529)	22.5% (95% CI, 8.5-40.7) against symptomatic infection							
			P	HASE III TRIALS RE	SULTS ^{cxxv}			
Number of participants (vaccine/ placebo)	43,448 (21,720/ 21,728)	30,420 (15,210/15,210)	17,178 (8597/8581)	39,321 (19,630/19,691)	26,917 (13,459/13458); or 26,914 (13,465/13,458)	9,823 (4,953/4,870)	25,798 (12,899/12899)	14,039 (7,020/7,019)

CXXV 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, 16 November 2020 and 7 January 2021 for the COVAXIN 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.



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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)	130 (24/106)	106(10/96)
Efficacy estimates in Phase III trials	Starting from 7 days after 2nd dose: 95.0% (95% Cl, 90.3 to 97.6) in population without prior SARS-CoV-2 infection. Efficacy of 94.6% (95% Cl, 89.9 to 97.3) in population with or without prior infection. 100% among adolescents (12- 15 years old).	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; \geq 14 days) while those with first low dose and standard 2nd dose the efficacy was 80.7% (95% CI 62.1 to 90.2). 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).	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% CI 55.0 to 89.1) after 28 days. VE against severe- critical 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. SII-ChAdOx1 nCoV-19 has a non-inferior immune response compared to AZD1222 and an acceptable safety/ reactogenicity profile ²⁶⁴	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 86.3; in HBO2 vaccine).	After 14 days, efficacy against symptomatic cases was 50.7% (95% CI 35.9 to 0- 62.0).	77.8% (95% CI, 65.2-86.4) against symptomatic COVID-19 starting at ≥14 days after second dose	83.4% (95% Cl, 73.6-89.5) starting at \geq 14 days after first dose 89.7% (95% Cl, 80.2-94.6) starting at \geq 7 days after second dose
Efficacy against	100% (after 7 days)	100% (≥14 days)	100% (after 21 days)	76.7% (≥14 days) or 85.4% (≥28 days)	100% (>14 days)	100% (>14 days)	93.4% (>14 days) against severe COVID-19	100% (after 7 days).

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hospitalization and death								
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.	The 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 occurred 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): transverse myelitis, haemolytic anaemia and a case of fever higher than 40°C.	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), hypersensitivity (1), Bell's Palsy (2), & severe generalized weakness, fever & headache (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.	Rates of local and systemic AEs reported in the BBV152 group as mild (11·2%), moderate (0·8%), or severe (0·3%) were comparable to the placebo group 15 deaths, none considered related to the vaccine or placebo	Phase II: Nine serious adverse events were reported, only one of which was assessed as related to the vaccine: acute colitis.
				PHASE III TH	RIAL OTHER			
Comments	Specific populations were excluded (HIV and immunocompromi sed patients, and pregnant women).	Calculation of efficacy were not based on the total number of confirmed Covid- 19 cases.		2-DOSE EFFICACY Efficacy against symptomatic (moderate to severe/ critical) SARS-CoV-2 infection	Only 2 severe cases occurred in the control group and none in the vaccine group (very few cases to	-	-	Novavax is currently awaiting FDA, EMA, and WHO EUL approval. Upcoming information



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94% (95% CI, 58- 100) in the US.get a reliable estimate).75% (95% CI, 55- 87) globally.	regarding results of clinical trials or approval will be updated in upcoming reports
Efficacy against severe/ critical SARS-CoV-2 infection 100% (95% CI,	
<u>33-100</u>)	

	VACCINE PRODUCTION SITES										
BNT162b2/ COMIRNATY (Pfizer- BioNTech, USA) ^{cxxvi}	Spikevax/ Moderna COVID- 19 Vaccine/ mRNA-1273 (Moderna, USA) ^{cxxvii}	Vaxzevria/ ChAdOx1 nCoV- 19/ AZD1222/ Covishield (AstraZeneca/Oxf ord, UK, India) ^{cxxviii}	Janssen COVID- 19 vaccine/Johnson & Johnson (Janssen, USA) ^{cxxix}	Sinopharm/BBIB P-CorV, China ^{cxxx}	Sinovac CoronaVac, China ^{cxxxi}	COVAXIN / BBV152 (Bharat Biotech, India)	Novavax/ NVX- CoV2373				

cxxvi WHO recommendation BioNTech Tozinameran – COVID-19 mRNA vaccine (nucleoside modified) – COMIRNATY. WHO. https://extranet.who.int/pqweb/vaccines/who-recommendation-covid-19-mrna-vaccine-nucleoside-modified-comirnaty

cxvii 1. WHO recommendation ModernaTX, Inc/USFDA COVID-19 mRNA vaccine (nucleoside modified). WHO. <u>https://extranet.who.int/pqweb/vaccines/who-recommendation-modernatx-incusfda-covid-19-mrna-vaccine-nucleoside-modified</u>
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cxviii WHO recommendation AstraZeneca/ EU approved sites COVID-19 vaccine (ChAdOx1-S) [recombinant]. WHO. https://extranet.who.int/pgweb/vaccines/covid-19-vaccine-chadox1-s-recombinant-0

cvxix WHO recommendation Janssen-Cilag International NV (Belgium) COVID-19 Vaccine (Ad26.COV2-S [recombinant]). WHO. https://extranet.who.int/pqweb/vaccines/who-recommendation-janssen-cilag-international-nv-belgium-covid-19-vaccine-ad26cov2-s

^{cxxx} WHO recommendation COVID-19 vaccine BIBP/Sinopharm. WHO. <u>https://extranet.who.int/pgweb/vaccines/who-recommendation-covid-19-vaccine-bibp</u>

^{cxxxi} WHO recommendation of Sinovac COVID-19 vaccine (Vero Cell [Inactivated]) – CoronaVac. WHO. <u>https://extranet.who.int/pgweb/vaccines/who-recommendation-sinovac-covid-19-vaccine-vero-cell-inactivated-coronavac</u>



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EUL holder	BioNTech Manufacturing GmbH (Germany)	ModernaTX, Inc. (USA) ¹ Moderna Biotech (Spain) ²	AstraZeneca AB (Sweden)	Janssen-Cilag International NV (Belgium)	Beijing Institute of Biological Products Co., Ltd. (BIBP) (China)	Sinovac Life Sciences Co., Ltd. (China)	Bharat Biotech International Limited (India)	Novavax (USA)
Production sites (Drug substance)	BioNTech Manufacturing GmbH (Mainz, Germany) BioNTech Manufacturing Marburg (Marburg, Germany) Rentschler Biopharma SE (Laupheim, Germany) Wyeth BioPharma Division of Wyeth Pharmaceuticals (USA)	Lonza Biologics, Inc., (USA) ¹ Moderna TX, Inc. (USA) ¹ Lonza AG (Switzerland) ²	Henogen S.A (Belgium) Catalent Maryland, Inc. (USA) Oxford Biomedica (UK) Ltd. (United Kingdom) SK Bioscience (Republic of Korea) Halix B.V (Netherlands) WuXi Biologics (China)	Janssen Vaccines & Prevention B.V. (The Netherlands) Janssen Biologics B.V. (The Netherlands) Emergent Manufacturing Operations Baltimore LLC (USA)	Beijing Institute of Biological Products Co., Ltd. (China)	Sinovac Life Sciences Co., Ltd. (China)	-	Novavax (Bohumil, Czech Republic)
Production sites (Drug product)	Baxter Oncology GmbH (Halle/ Westfallen, Germany) BioNTech Manufacturing GmbH (Mainz, Germany)	Baxter Pharmaceutical Solutions, LLC. (USA) ¹ Catalent Indiana, LLC. (USA) ¹ Rovi Pharma Industrial	Catalent Anagni (Italy) CP Pharmaceuticals (United Kingdom) IDT Biologika (Germany)	Janssen Biologics B.V. (The Netherlands) Janssen Pharmaceutica NV (Belgium) Aspen SVP. (South Africa)	Beijing Institute of Biological Products Co., Ltd. (China)	Sinovac Life Sciences Co., Ltd. (China)	-	Novavax (Bohumil, Czech Republic)



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	Pfizer Manufacturing Belgium NV (Belgium)Novartis Pharma Stein AG (Switzerland)Mibe GmbH Arzneimittel (Brehna, Germany)Delpharm Saint- Remy (France)Sanofi-Aventis Deutschland GmbH (Germany)	Services, S.A. (Spain) ²	SK Bioscience (Republic of Korea) Universal Farma, S.L. ("Chemo") (Spain) Amylin Ohio LLC (USA)	Catalent Indiana LLC. (USA) Grand River Aseptic Manufacturing Inc. (USA) Catalent Anagni S.R.L. (Italy)				
Diluent suppliers	Pfizer Perth, Australia Fresenius Kabi, USA	-	-	-	-	-	-	-



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