

Weekly COVID-19 Vaccine Updates

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Introduction

This document summarises the vaccine efficacy and effectiveness, the vaccine specifications, the vaccine development pipeline and the timeline for World Health Organization (WHO) review of the various COVID-19 vaccines in late phase development. This document is updated weekly.

- Vaccine efficacy refers to the performance of a vaccine in a controlled clinical trial (study) situation
- Vaccine effectiveness refers to the performance of a vaccine in a population under real-world conditions

Key messages

- COVID-19 vaccine efficacy results from different trials cannot be directly compared against each other. They must be interpreted in the context of study designs (including case definitions, clinical endpoints, access to testing), target populations, and COVID-19 epidemiologic conditions (including circulation of variants of concern)
- All COVID-19 vaccines in late phase development report high vaccine efficacy against severe COVID-19 and favourable safety profiles
- Most vaccines have high effectiveness against infection, including with the Delta variant, but lower against Omicron
- The Pfizer/BioNTech vaccine has been authorised in children aged ≥ 5 years by the US FDA, EU EMA, Australian TGA and Health Canada; and in those ≥ 12 years by the UK MHRA and NZ Medsafe, The EMA, MHRA and TGA have authorised the Moderna vaccine in those ≥ 12 years.
- WHO SAGE recommends that boosters should be administered 4-6 months after the primary series in high-priority groups, including older adults and health workers.¹ ATAGI has recommended that immunocompromised persons in Australia receive a third dose as part of the primary series and booster doses of Pfizer/BioNTech be offered to all adults irrespective of the primary COVID-19 vaccine given.^{2,3} Boosters are recommended for all adults ≥ 18 years of age in the US and UK.^{4,5}
- Mixed vaccine schedules (i.e. delivering different types of vaccine for the first and second dose) generally provide good protection against infection and severe disease
- Seven intranasal vaccines are in development (6 live-attenuated viruses or virus-vectored vaccines; 1 protein subunit.⁶ These may be beneficial in preventing transmission (Page 15)
- A very rare clotting disorder with low platelets (Thrombosis with Thrombocytopenia Syndrome – TTS) has been associated with the AstraZeneca and Johnson & Johnson vaccines.⁷⁻⁹ The majority of cases fully recover with adequate treatment. The risk following the first dose of AstraZeneca vaccine has been estimated by the EMA as 1 in 100,000 and by the Australian Technical Advisory Group on Immunisation (ATAGI) as 1 in 50,000.^{10,11} Risk of TTS is much lower following the *second* dose of AstraZeneca vaccine: estimate in the UK is 1 in 1.5 million second doses.¹²
- The risk of TTS following the first dose of Johnson & Johnson vaccine has been estimated as 1 in 319,000 in the USA¹³
- The risk of myocarditis/pericarditis is increased following the second dose of Pfizer/BioNTech and Moderna vaccines, particularly in younger males, occurring in >1 in 20,000 males under 25 years of age.¹⁴ Highest rate in males 16-17 years of age following Pfizer/BioNTech vaccine but no clear difference in risk between Moderna and Pfizer/BioNTech.¹⁵ There is a small increase in risk of myocarditis in females <30 and males >50 years of age. Data from Ontario, Canada, and the UK suggest higher rates following Moderna than Pfizer/BioNTech vaccine. ATAGI in Australia continue to review the data.
- Appropriate communication on the benefit-risk profile of COVID-19 vaccines remains crucial to maintain confidence in immunisation programmes and to avoid vaccine hesitancy.











New updates

Key updates include (also highlighted in yellow text in the document):

- Effectiveness of Pfizer/BioNTech against hospitalisation with Omicron and Delta in USA (Pages 7, 8, 9, 10, 28, 30 and 33):
 - Delta:
 - 2 doses <3 months: 88% (71-95)
 - 2 doses 3-5 months: 77% (62-86)
 - 2 doses ≥ 6 months: 74% (65-80)
 - 3 doses <3 months: 95% (91-97)
 - 3 doses ≥ 3 months: 65% (16-85)
 - Omicron:
 - 2 doses <3 months: 70% (41-84)
 - 2 doses 3-5 months: 67% (44-80)
 - 2 doses ≥ 6 months: 68% (56-76)
 - 3 doses <3 months: 89% (83-92)
 - 3 doses ≥ 3 months: 90% (57-98)
- Effectiveness of Pfizer/BioNTech and Moderna against hospitalisation in USA (Pages 28, 30 and 33):
 - Delta:
 - 2 doses <6 months: 90% (89-90)
 - 2 doses ≥ 6 months: 81% (80-82)
 - 3 doses: 94% (93-95)
 - Omicron:
 - 2 doses <6 months: 81% (65-90)
 - 2 doses ≥ 6 months: 57% (39-70)
 - 3 doses: 90% (80-94)
- Effectiveness of Pfizer/BioNTech and Moderna boosters against symptomatic infection, hospitalisation and death in ≥ 50 years in England (similar effectiveness in younger adults) (Pages 9 and 33):
 - Relative to ≥ 6 months post-dose 2:
 - Symptomatic infection:
 - Pfizer/BioNTech: 85.6% (84.9-86.3)
 - Moderna (after Pfizer/BioNTech primary series): 86.8% (81.5-90.5)
 - Relative to unvaccinated:
 - Symptomatic infection:
 - Pfizer/BioNTech: 94.4% (94.1-94.7)
 - Moderna (after Pfizer/BioNTech primary series): 94.8% (92.7-96.3)
 - Hospitalisation:
 - Pfizer/BioNTech: 98.6% (98.0-99.0)
 - Death:
 - Pfizer/BioNTech: 98.7% (97.4-99.4)
- Effectiveness of Pfizer/BioNTech against infection in Wales (Pages 7 and 28):
 - Single dose: 52% (45-58)
 - 2 doses 2-5 weeks: 86% (79-91)
 - 2 doses ≥ 26 weeks: 45% (39-51)
- Effectiveness of Sinovac, Pfizer/BioNTech and AstraZeneca boosters against mild and severe disease following Sinovac primary series in Chile when Delta was predominant (Pages 9, 15 and 33):
 - Symptomatic infection:
 - Sinovac: 78.8% (76.8-80.6)
 - Pfizer/BioNTech: 96.5% (96.2-96.7)
 - AstraZeneca: 93.2% (92.9-93.6)
 - Hospitalisation:
 - Sinovac: 86.3% (83.7-88.5)
 - Pfizer/BioNTech: 96.1% (95.3-96.9)
 - AstraZeneca: 97.7 (97.3-98.0)
 - Death:
 - Sinovac: 86.7% (80.5-91.0)
 - Pfizer/BioNTech: 96.8% (93.9-98.3)
 - AstraZeneca: 98.1% (97.3-98.6)

- Effectiveness of AstraZeneca and Pfizer/BioNTech against mild and severe disease with Delta in England (Pages 7, 8, 11, 28, 30 and 34):
 - AstraZeneca:
 - Symptomatic infection overall:
 - 2-9 weeks: 67.6% (67.3-67.9)
 - ≥20 weeks: 44.3% (43.2-45.4)
 - Symptomatic infection ≥65 years:
 - 2-9 weeks: 59.1% (55.4-62.6)
 - ≥25 weeks: 27.8% (16.3-37.8)
 - Hospitalisation overall:
 - 2-9 weeks: 95.2% (94.7-95.7)
 - ≥20 weeks: 80.0% (76.8-82.7)
 - Hospitalisation ≥65 years:
 - 2-9 weeks: 91.7% (88.8-93.9)
 - ≥20 weeks: 81.8% (76.6-85.9)
 - Death overall:
 - 2-9 weeks: 95.0% (93.1-96.4)
 - ≥20 weeks: 84.8% (76.2-90.3)
 - Death ≥65 years:
 - 2-9 weeks: 94.1% (89.6-96.7)
 - ≥20 weeks: 82.1% (70.1-89.3)
 - Pfizer/BioNTech:
 - Symptomatic infection:
 - 2-9 weeks: 89.7% (89.5-89.8)
 - ≥20 weeks: 66.3% (65.7-66.9)
 - Symptomatic infection ≥65 years:
 - 2-9 weeks: 79.6% (77.0-81.8)
 - ≥25 weeks: 51.8% (45.4-57.4)
 - Hospitalisation overall:
 - 2-9 weeks: 98.7% (98.3-99.0)
 - ≥20 weeks: 91.7% (90.2-93.0)
 - Hospitalisation ≥65 years:
 - 2-9 weeks: 98.0% (95.9-99.1)
 - ≥20 weeks: 90.5% (87.6-92.7)
 - Death overall:
 - 2-9 weeks: 98.5% (96.5-99.3)
 - ≥20 weeks: 91.9% (88.5-94.3)
 - Death ≥65 years:
 - 2-9 weeks: 97.1% (91.7-99.0)
 - ≥65 years, ≥20 weeks: 90.2% (85.3-93.5)
- Estimated impact of single dose of Pfizer/BioNTech in preventing severe outcomes in children aged 5-11 years with underlying health conditions (Page 12):
 - Per million first doses:
 - Prevented PICU admissions: 105
 - Prevented hospital admissions: 1265
 - Prevented multisystem inflammatory syndrome in children (MIS-C) cases: 16
- WHO recommendations following SAGE meeting 19 January 2022:
 - Pfizer/BioNTech (reduced dose) authorisation for use in children aged 5-11
 - Pfizer/BioNTech boosters should be administered 4-6 months after the primary series in high-priority groups, including older adults and health workers
- Two doses of Pfizer/BioNTech or Sinovac in Hong Kong provided little neutralising immunity against Omicron:
 - Higher levels achieved after boosting with Pfizer/BioNTech than Sinovac
 - Single dose of Pfizer/BioNTech provided protective immunity in those previously infected with SARS-CoV-2
- MIS-C following Pfizer/BioNTech in 12-17 year olds in France (Page 17):
 - 1.1 cases per million doses (post-SARS-CoV-2 MIS-C in the same age group in the same population was 113 per million doses)
- MIS-C following vaccination in 12-20 year olds in USA (18m received Pfizer/BioNTech, 2.6m Moderna, 0.7m Johnson & Johnson) (Page 17):
 - 21 cases all following Pfizer/BioNTech; 1 case per million persons receiving ≥1 dose of COVID-19 vaccine

COVID-19 Vaccine Specifications

| | ASTRAZENECA | GAMALEYA | JOHNSON & JOHNSON | MODERNA | NOVAVAX | PFIZER/ BIONTECH | SINOVAC | SINOPHARM | BHARAT BIOTECH | CLOVER |
|--|---|--|---|---|--|---|---|---|--|--|
| VACCINE TYPE | Viral vector (chimpanzee adenovirus ChAdOx1) | Viral vector (recombinant adenovirus types 5 and 26) | Viral vector (recombinant adenovirus type 26) | mRNA | Protein subunit | mRNA | Inactivated virus | Inactivated virus | Inactivated virus | Protein |
| Available Through COVAX | ✓ | - | ✓ | - | ✓ | ✓ | - | - | - | - |
| Doses Required |  4-12 weeks apart |  3 weeks apart |  2 doses with 2-6 month interval also recommended |  4 weeks apart* |  3 weeks apart |  3-4 weeks apart* |  2-4 weeks apart* |  3-4 weeks apart* |  3 weeks apart |  3 weeks apart |
| Third dose/ boosters | As part of primary series for those with immunocomp. | - | - | As part of primary series for those with immunocomp. USA: at least 6 months after primary series in at-risk groups and ≥65 years | As part of primary series for those with immunocomp. | As part of primary series for those with immunocomp. USA: at least 6 months after primary series in at-risk groups and ≥65 years | As part of primary series for ≥60 years | As part of primary series for ≥60 years | - | - |
| Shipping, Storage & Presentation | Normal cold chain requirements (2-8°C); 10-dose vials | -18,5°C (liquid form); 2-8°C (dry form) | Shipped at -20°C; 2-8°C for up to 3 months; 5-dose vials | -25°C to -15°C; 10-dose vials | 2-8°C; 10-dose vials | -80°C to -60°C; 2-8°C for up to 1 month; 6-dose vials | 2-8°C; Single-dose vials | 2-8°C; Single-dose vials/ pre-filled syringes | 2-8°C; 10-dose or 20-dose vials | 2-8°C |
| Approval by a Stringent Regulatory Authority (SRA) | WHO EUL, EMA, TGA, MHRA | Under review by WHO SAGE | WHO EUL, EMA, FDA, MHRA | WHO EUL, EMA, FDA, TGA | WHO EUL, EMA, TGA | WHO EUL, EMA, FDA, TGA, MHRA | WHO EUL | WHO EUL | WHO EUL | - |

WHO EUL: WHO Emergency Use Listing
 EMA: European Medicines Agency
 FDA: Food and Drug Administration (US)
 TGA: Therapeutic Goods Administration (Australia)
 MHRA: Medicines and Healthcare Products Regulatory Agency (UK)

COVID-19 Vaccine Efficacy

| VACCINE | VACCINE EFFICACY | | | |
|------------------------------|--|--|---|---|
| | SYMPTOMATIC INFECTION | MODERATE-SEVERE | SEVERE | HOSPITALISATION/DEATH |
| AstraZeneca | UK: 66.7% (57.4-74.0) ¹⁶ USA, Chile, Peru: 76% ¹⁷ (not peer-reviewed) Single dose in UK (22-90 days post-vaccination): 76.0% (59.3 to 85.9) ¹⁶ Efficacy with different interval between doses in UK: 12+ weeks: 82.4% (2.7-91.7) <6 weeks: 54.9% (32.7-69.7) ¹⁶ | - | Severe/critical and hospitalisation in USA, Chile, Peru: 100% ¹⁷ (not peer-reviewed) UK: 100% (15 cases in the placebo group) ¹⁶ | Hospitalisation in UK: 100% (9 cases in placebo group) ¹⁶ |
| Bharat Biotech | India: 77.8% (65.2-86.4) ¹⁸ | - | India: 93.4% (57.1-99.8) ¹⁸ | - |
| Clover | Philippines, Colombia, Brazil, South Africa and Belgium: Overall: 67.2% (54.3-76.8); Delta: 78.7% (57.3-90.4) ¹⁹ | Philippines, Colombia, Brazil, South Africa and Belgium: Overall: 83.7% (55.9-95.4); Delta: 81.7% (35.9-96.6) ¹⁹ | - | Hospitalisation in Philippines, Colombia, Brazil, South Africa and Belgium: 100% (42.7-100) ¹⁹ |
| Gamaleya | Russia: 91.6% (85.6-95.2) ²⁰ Single dose (Sputnik Light) in Argentina: 78.6% ²¹ | Moderate-severe: 100% (20 cases in the placebo group) ²⁰ | - | - |
| Johnson & Johnson | USA: 93.2% (91.0-94.8) ²² | Moderate to severe/critical: All sites: 66.1% (55.0-74.8) USA: 72.0% (58.2-81.7) Latin America: 61.0% (46.9-71.8) South Africa: 64.0% (41.2-78.7) ^{23,24} South Africa: 67-71% ²⁵ | 85.4% (54.2-96.9) ²⁴ USA: 98.2% (92.8-99.6) ²² | 100% (5 deaths in placebo group) ²⁴ Death in South Africa: 96% ²⁵ |
| Moderna | USA: 94.1% (89.3-96.8) ²⁶ USA: >90% ²⁷ Efficacy in USA: 12-17 years: Symptomatic: 92.7% (67.8-99.2) Infection: 69.8% (49.9-82.1) Asymptomatic infection: 59.5% (28.4-77.3) ²⁸ | - | USA: 100% (30 cases in placebo group) ²⁶ US: >95% ²⁷ | USA: 100% (1 death in placebo group) ²⁶ |
| Novavax | UK: 89.7% (80.2-94.6) ²⁹ US and Mexico: 90.4% (82.9-94.6) ³⁰ | US and Mexico: 100% (87.0-100) ³⁰ | - | - |
| Pfizer/BioNTech | Argentina, Brazil, Germany, South Africa, Turkey and the USA: 94.6% (89.9-97.3) ³¹ Infection over 6 months: 91.3% (89.0-93.2) ³² Single dose: 100% | - | Argentina, Brazil, Germany, South Africa, Turkey and the USA: 88.9% (20.1-99.7) ³¹ Severe disease: 96.7% (80.3-99.9) ³² | - |
| Sinopharm | UAE, Bahrain, Egypt and Jordan: 78.1% (64.9-86.3) ³³ | - | - | Hospitalisation in UAE, Bahrain, Egypt and Jordan: 78.7% (26.0-93.9) ³³ |
| Sinovac | Brazil: 50.7% (35.9-62.0) Chile: 67% (65-69) Indonesia: 65% (20-85) ³³ Turkey: 83.5% (65.4-92.1) ³⁴ | Requiring medical assistance in Brazil: 83.7% (58.0-93.7) Moderate-severe: 100% (56.4-100.0) ³⁵ | - | Hospitalisation: Brazil: 100% (56-100) Chile: 85% (83-97) Turkey: 100% (20-100) ³³ |
| CanSino Biologics | Pakistan, Mexico, Argentina, Russia and Chile: 57.5% (39.7-70.0) ³⁶ | - | - | - |

Vaccine Effectiveness Summary at-a-glance

Detailed summary available in Appendix 1.

| VACCINE | ANY INFECTION | SYMPTOMATIC INFECTION | HOSPITALISATION/ SEVERE DISEASE | DEATH | EFFECTIVENESS 4 to <6 MONTHS | EFFECTIVENESS ≥6 MONTHS |
|------------------------------|--|---|---|---|--|--|
| AstraZeneca | 45-73% ³⁷⁻⁴³ Single dose 30-67% ^{37,39,42,44} | -39-78% ^{40,45-52*} Single dose: 38-68% ^{45,51,53,54} Moderate-Severe: 82%; Single dose: 79% ⁴² | 84-100% ^{40,43,46-48,51,52,55-58} Single dose: 49-94% ^{51,53,58,59} | 90-100% ^{43,46,47,52,60} | Infection: 44-45% ^{49,51,52} Hospitalisation or death: 42-80% ^{51,52} Death: 85% ⁵² | Infection: 42% ⁴⁹ |
| Bharat Biotech | - | 50% ⁶¹ | - | - | - | - |
| Johnson & Johnson | 50-88% ^{40,62-65} | 54% ⁴⁰ | 71-91% ^{25,40,55,63,66} | - | - | Infection: 13% ⁶⁷ Death: <65 years: 73%; ≥65 years: 52% ⁶⁷ |
| Moderna | 37-92% ^{40,64,68-72} Single dose: 20-72% ^{44,73} | 82-95% ^{40,47,69,70,74} Single dose: 72% ^{74,75} | 92-98% ^{40,47,55,66,68-71,73} Single dose: 69-96% ^{44,73} | 98% ⁶⁹ | - | Infection: 22-58% ^{67,70} Death: <65 years: 82%; ≥65 years: 76% ⁶⁷ Hospitalisation and death: 56% ⁷⁰ |
| Pfizer/BioNTech | 55-95% ^{37,38,40,41,53,64,68,72,76-83} Single dose: 36-57% ^{37,39,44} | -18-97% ^{40,45-47,49,50,52,53,74,79,83-86*} Single dose: 49-61% ^{45,74,75,86} | 85-99% ^{40,46,47,52,53,55,58,66,68,76,79,81,83,84,87-90} Single dose: 85-94% ^{58,59} | 90-100% ^{46,47,52,60,76,79,83,87,88} | Infection: 47-65% ^{49,52,81} Hospitalisation: 92% ⁵² Death 92% ⁵² | Infection: 43-64% ^{49,67,86} Death: <65 years: 84%; ≥65 years: 70% ⁶⁷ Hospitalisation: 68-74% ⁹⁰ |
| Sinopharm | - | 90% ³³ | - | - | - | - |
| Sinovac | 53-60% ^{43,87} | 59% ⁴⁶ | 73-91% ^{43,46,87} | 74-95% ^{43,46,87} | - | - |

* Low/negative values are against the Omicron variant

Vaccine Efficacy/Effectiveness Against Delta at-a-glance

Detailed summary and vaccine efficacy/effectiveness against other variants available in Appendix 2.

| VACCINE | VACCINE EFFECTIVENESS UNLESS OTHERWISE STATED | | | | |
|------------------------------|--|--|--|---|---|
| | ANY INFECTION | SYMPTOMATIC INFECTION | HOSPITALISATION AND DEATH | EFFECTIVENESS 4 to <6 MONTHS | EFFECTIVENESS ≥6 MONTHS |
| AstraZeneca | 60-67% ^{37-39,42} Single dose 30-67% ^{37,39,42,44} | 25-76% ⁴⁷⁻⁵² Moderate-Severe: 82%; Single dose: 38-79% ^{42,51} | 84-95% ^{47,48,51,52,57,58,60} Single dose: 49-88% ^{44,51,58} | Infection: 44-45% ^{49,51,52} Hospitalisation: 64-80% ^{51,52} Death: 82% ⁵² | Infection: 42% ⁴⁹ |
| Bharat Biotech | Efficacy: 65% ¹⁸ | 50% ⁶¹ | - | - | - |
| Clover | - | Efficacy: 79% ¹⁹ | Efficacy (moderate-severe): Delta: 82% ¹⁹ | - | - |
| Johnson & Johnson | 78% ⁶³ | - | 71-85% ^{25,63} | - | Infection: 13% ⁶⁷ Death: <65 years: 73%; ≥65 years: 52% ⁶⁷ |
| Moderna | 76-88% ^{68,71,72} Single dose: 60-72% ^{44,73} | 95% ⁴⁷ | 81-98% ^{47,68,71,73} Single dose: 69-96% ^{44,73} | - | Infection: 22-58% ^{67,70} Death: <65 years: 82%; ≥65 years: 76% ⁶⁷ 56% ⁷⁰ |
| Pfizer/BioNTech | 39-93% ^{37,38,68,72,80,81} Single dose: 36-57% ^{37,39,44} | 56-90% ^{47,49,50,52} Single dose: 33% ⁵⁰ | 75-100% ^{47,52,58,60,68,80,81,90} Single dose: 78-94% ^{44,58} | Infection: 53-66% ^{49,52,81} Hospitalisation: 92% ⁵² Death: 92% ⁵² | Infection: 43-64% ^{47,49,67} Death: <65 years: 84%; ≥65 years: 70% ⁶⁷ Hospitalisation: 74% ⁹⁰ |

Vaccine Efficacy/Effectiveness and Immunogenicity of Boosters Against Delta at-a-glance

Booster refers to an additional dose administered at least 5 months after completion of the primary series.

Booster efficacy/effectiveness reported relative to primary series (not unvaccinated) unless otherwise specified.

Detailed summary available in Appendix 3.

| VACCINE | IMMUNOGENICITY | BOOSTER VACCINE EFFECTIVENESS (UNLESS OTHERWISE STATED) | | | |
|-------------------|--|---|--|--|----------------------------|
| | | ANY INFECTION | SYMPTOMATIC INFECTION | HOSPITALISATION | DEATH |
| Johnson & Johnson | Strong antibody response ⁹¹ | - | - | - | - |
| Moderna | Strong antibody response ⁹¹ | 83-96% ^{*72,73} | 87% ⁹² 95% ^{*92} | - | - |
| Pfizer/BioNTech | Strong antibody response ⁹¹ | 81% ^{*72} | Efficacy: 84-95% ^{93,94} 86% ⁹² 89-94% ^{*49,50,92} After AZ primary series: 90-94% ^{*49,50,92} | 93-99% ^{90,92,95} ≥3 months: 65% ⁹⁰ | 81-99% ^{92,95,96} |
| Sinopharm | Strong antibody response but stronger with a Sinopharm recombinant protein vaccine booster ⁹⁷ | 90% ³³ | - | - | - |
| Sinovac | Strong antibody response ⁹⁸ | - | 79% ⁹⁹ | 86% ⁹⁹ | 87% ⁹⁹ |

*Relative to unvaccinated

Vaccine Efficacy/Effectiveness Against Omicron at-a-glance

Detailed summary available in Appendix 2.

| VACCINE | VACCINE EFFECTIVENESS (AFTER 2 DOSES) UNLESS OTHERWISE STATED | | |
|-------------------|---|---|--|
| | ANY INFECTION | SYMPTOMATIC INFECTION | HOSPITALISATION AND DEATH |
| AstraZeneca | - | No protective effect beyond 15 weeks ⁴⁹ -39% ⁵⁰ | - |
| Johnson & Johnson | Strong antibody response ⁹¹ | - | Booster: Hospitalisation: 85% (54-95) ¹⁰⁰ |
| Moderna | 30-37% ^{72,73} Single dose: 20% ⁷³ Booster: 64% ⁷³ | - | - |
| Pfizer/BioNTech | 55% ⁷² Booster: 55% ⁷² | -18-88% ^{49,50,101} ≥15 weeks: 34-37% ⁴⁹ Booster: 54-76% ^{49,50} Single dose: 34% ⁴⁹ | Hospitalisation: 70% ^{90,101} Hospitalisation >6 months: 68% ⁹⁰ Booster: 89% ⁹⁰ |

Vaccine Efficacy/Effectiveness in High-Risk Groups at-a-glance

Detailed summary available in Appendix 4.

| VACCINE | VACCINE EFFICACY/EFFECTIVENESS | | | |
|-------------------|--|--|---|---|
| | DIABETES | OBESITY | AT RISK FOR SEVERE COVID-19 | ELDERLY* |
| AstraZeneca | - | - | Efficacy against symptomatic infection: 76% ¹⁷ Effectiveness of single dose against: Symptomatic infection: 60% ⁴⁵ Effectiveness against: Symptomatic infection: 80% ⁴⁵ Hospitalisation: 63% ⁵⁶ | Efficacy against infection: 85% ¹⁷ Effectiveness of single dose against: Symptomatic infection: 53-61% ^{45,53} Hospitalisation: 80% ¹⁰² Death: 83% ⁷⁵ Effectiveness against: Symptomatic infection: 39-81% ^{43,45,47,48,52,103} Hospitalisation: 37-94% ^{43,48,52,103,104} Death: 65-94% ^{43,52,80,75} |
| Bharat Biotech | - | - | Efficacy against infection: 66% ¹⁸ | Efficacy against symptomatic infection: 68% ¹⁸ |
| Gamaleya | - | - | - | Symptomatic infection: 92% ²⁰ |
| Johnson & Johnson | Efficacy: 23% ²³ | Efficacy: 66% ²³ | Efficacy: 59% ²³ | Efficacy 66% ²³ |
| Moderna | - | - | Efficacy against symptomatic infection: 84-91% ²⁶ Effectiveness against hospitalisation: 84% (80-87) ⁵⁵ | Efficacy against symptomatic infection: 86% ²⁶ Effectiveness against infection: pre-Omicron: 75-97% ^{69,71,73} ; Omicron: 57% ⁷³ |
| Novavax | | | Efficacy against infection: 91% ³⁰ | |
| Pfizer/BioNTech | Effectiveness against infection: 82% ⁸² 89% ⁸⁸ | Effectiveness against infection: 90% ⁸⁸ | Efficacy against symptomatic infection: 95% ³¹ Effectiveness of single dose against symptomatic infection: 56% ⁴⁵ Effectiveness against: Infection: 71-90% ^{76,88} Symptomatic infection: 89% ⁴⁵ Hospitalisation: 72-81% ⁷⁶ | Efficacy against symptomatic infection: 95-100% ^{31,32} Effectiveness of single dose against: Infection: 76% ⁵³ Symptomatic infection: 40-80% ^{45,52,74} Hospitalisation: 71-91% ^{52,102,104} Death: 77-92% ^{52,75} Effectiveness against: Infection: 70-89% ^{76,82,88,105} Symptomatic infection: 61-93% ^{45,47,74,103} Hospitalisation: 43-93% ¹⁰³⁻¹⁰⁵ Death: 87-98% ^{60,75} |
| Sinopharm | - | 81% ³³ | - | Effectiveness against symptomatic infection 91% ³³ |
| Sinovac | - | Infection: 75% ³³ | Infection: 49% ³³ | Infection: 28% ⁴³ Hospitalisation: 32% ⁴³ Death: 34% ⁴³ |

*Estimates in those ≥60 years to ≥90 years

Vaccine Efficacy/Effectiveness in Children

| VACCINE | VACCINE EFFICACY, EFFECTIVENESS AND OTHER OUTCOMES | | COUNTRIES VACCINATING CHILDREN BY AGE GROUP |
|------------------------|---|---|---|
| | <12 years | 12-18 years | |
| Moderna | Well tolerated and produced strong antibody response in 6-11 year olds in USA (Moderna press release) ¹⁰⁶ | Efficacy in USA, 12-15 years: 96% ¹⁰⁷ | ≥12 years: Authorised by EMA, MHRA, TGA ≥12 years: France, Italy, Japan, Australia, Canada, Guinea, Philippines ≥3 years: Colombia |
| Novavax | 7-12 years trial underway in India | Study in 12-18 years has started recruitment | - |
| Pfizer/BioNTech | 5-11 years: Antibody response and safety profile for reactogenicity similar to 16-25 year-olds ¹⁰⁸ Efficacy against symptomatic infection in 5-11 year olds in USA: 90.9% (68.3-98.3) ¹⁰⁹ <5 years: Evaluation of a 3 dose schedule underway due to low immunogenicity of 2 doses ¹¹⁰ UK JCVI: estimated impact of single dose in 5-11 years with underlying health conditions: Prevented per million first doses: 105 PICU admissions; 1265 hospital admissions; 16 PIMS-TS cases¹¹¹ | Efficacy in USA, 12-15 years: 100% ¹¹² ; Up to 4 months after second dose: 100% (87.5-100) ¹¹³ Effectiveness in Israel 12-18 years: Any infection: 90% (88-92); Symptomatic infection: 93% (88-97) ¹¹⁴ Effectiveness against hospitalisation in USA: 12-18 years: 93% (83-97) ¹¹⁵ Effectiveness: Symptomatic infection 12-15 years: Single dose 2 weeks: 75.4% (73.9-76.9); Single dose 8-9 weeks: 46.8% (14.9-66.7); 16-17 years: Single dose 2 weeks: 75.9% (74.3-77.4); Single dose 8-9 weeks: 34.3 (30.7 to 37.7); 2 doses 2-9 weeks: 94.6% (92.8-95.9); Hospitalisation: 16-17 years: Single dose: 84.5% (64.6-93.2) ¹¹⁶ USA: Effectiveness against MIS-C: 91% (78-97) ¹¹⁷ USA: Effectiveness against: Hospitalisation: 94% (90-96); ICU admission: 98% (88-100) ¹¹⁸ | ≥5 years: Authorised by FDA, EMA, TGA ≥5 years: USA, Israel, Canada, Oman, Saudi Arabia, Bahrain, UAE, Costa Rica ≥12 years: Authorised by EMA, MHRA TGA, Medsafe ≥12 years: USA, Canada, UK Israel, France, Spain, Italy, Netherlands, Germany, South Africa, Singapore, Japan, Australia, Estonia, Denmark, Greece, Ireland, Lithuania, Sweden, Finland, Norway, Switzerland, Jordan, Morocco, Egypt, Guinea, Namibia, South Korea, Philippines, Brazil 12-15 years single dose: South Africa 12-17 years single dose: Hong Kong ≥3 years: Colombia |
| Sinovac | Phase I/II studies complete in 3-17 year olds in China ¹¹⁹ ; Phase 3 studies underway in Chile, Kenya, Malaysia, the Philippines, and South Africa | - | ≥12 years: Indonesia ≥6 years: Chile, El Salvador, Ecuador Indonesia ≥3 years: China, Colombia, Hong Kong |
| Sinopharm | Phase I/II studies in 3-17 year olds in China | | ≥12 years: Morocco ≥3 years: China, UAE, Venezuela, Argentina, Bahrain |
| AstraZeneca | Trials suspended when evidence emerged of the higher risk of TTS in younger adults compared to older adults | | ≥3 years: Colombia |
| Bharat Biotech | Phase 2/3 trial in 2-18 year olds | | - |

Maternal Vaccination

| VACCINE | VACCINE EFFICACY/EFFECTIVENESS IN PREGNANT WOMEN | OTHER OUTCOMES |
|-----------------|---|---|
| AstraZeneca | - | In four clinical trials in the UK, Brazil and South Africa, fertility was unaffected by vaccination and there was no increased risk of miscarriage and no instances of stillbirth in women vaccinated before pregnancy ¹²⁰ |
| Moderna | - | Following maternal vaccination with mRNA vaccines, 100% of neonates (n=36) had protective antibodies at birth ¹²¹ Comparison in USA of 35,691 participants who received an mRNA vaccine in pregnancy and nonpregnant women (v-safe registry and VAERS): Injection-site pain more frequent in pregnancy; headache, myalgia, chills, and fever less frequent. Adverse pregnancy and neonatal outcomes similar in pregnant women to studies conducted before the Covid-19 pandemic ¹²² |
| Novavax | - | - |
| Pfizer/BioNTech | Effectiveness in Israel: Any infection: 96% (89-100); Symptomatic infection: 97% (91-100); Hospitalisation: 89% (43-100) ¹²³ Effectiveness in Israel: Any infection: 78% (57-89) ¹²⁴ | Following maternal vaccination with mRNA vaccines, 100% of neonates (n=36) had protective antibodies at birth ¹²¹ NIH-funded MOMI-VAX study will assess antibody responses in 750 pregnant women and 250 women vaccinated with any US-licensed vaccine within 2 months of birth, and their infants ¹²⁵ Comparison in USA of 35,691 participants who received an mRNA vaccine in pregnancy and nonpregnant women (v-safe registry and VAERS): Injection-site pain more frequent in pregnancy; headache, myalgia, chills, and fever less frequent. Adverse pregnancy and neonatal outcomes similar in pregnant women to studies conducted before the Covid-19 pandemic ¹²² |
| Sinopharm | - | - |
| Sinovac | - | - |

Vaccine Efficacy/Effectiveness Against Asymptomatic Infection at-a-glance

Some of these studies assessed multiple variants, including Delta but none analysed the Delta variant alone.
Detailed summary of vaccine efficacy/effectiveness against transmission available in Appendix 5.

| VACCINE | VACCINE EFFECTIVENESS UNLESS OTHERWISE STATED |
|-------------------|---|
| AstraZeneca | Efficacy: 54% ¹⁶ |
| Bharat Biotech | Efficacy: 64 ¹⁸ |
| Johnson & Johnson | Efficacy: 60% ²³ |
| Moderna | 73% ⁶⁹ |
| Pfizer/BioNTech | 65-92% ^{70,83-85,126,127} |

Mixed Dose Vaccine Safety and Immune Responses

Mixed vaccine schedules (i.e. delivering different types of vaccine for the first and second dose) could be particularly useful to facilitate better protection against variants of concern and enable vaccination programs to continue if a particular vaccine is unavailable.

| SCHEDULE | SAFETY | IMMUNE RESPONSES OR EFFECTIVENESS | COUNTRIES USING SCHEDULE |
|---|--|---|---|
| AZ-PF | <p>Spain: Similar side effects to those receiving 2 doses of the same vaccine; no safety concerns (not peer reviewed)¹²⁸</p> <p>UK: Greater systemic side effects (mild-moderate symptoms) following the booster dose than with 2 doses of the same vaccine; no safety concerns¹²⁹</p> <p>Germany: greater reactogenicity with first dose of AstraZeneca than with the Pfizer/BioNTech booster¹³⁰</p> <p>Increased reactogenicity (54.4%; 49.4-59.5) vs AstraZeneca-AstraZeneca (33.5%; 28.0-39.2)¹³¹</p> <p>Total adverse event reporting in Korea: 0.28% (vs AZ-AZ: 0.22%; and PF-PF: 0.31%)</p> | <p>Spain: ≥8 week dose interval: Stronger immune response following Pfizer/BioNTech than after 2 doses of AstraZeneca vaccine (not peer reviewed)¹²⁸</p> <p>Spain: 8-12 week dose interval: robust antibody response¹³²</p> <p>UK: 4 week dose interval: stronger antibody and cellular response than after 2 doses of AstraZeneca vaccine¹³³</p> <p>Germany: 9-12 week dose interval: Significantly stronger immune response following Pfizer/BioNTech booster than AstraZeneca, and slightly stronger than after 2 doses of Pfizer/BioNTech (not peer reviewed)¹³⁴</p> <p>Germany: 4-fold greater immune response than 2 doses of AstraZeneca¹³⁵</p> <p>South Korea: 6-fold greater neutralising antibody response than 2 doses of AstraZeneca</p> <p>Germany: Higher neutralising antibody response against wild-type, Alpha, Beta, Gamma and Delta variants than AZ-AZ¹³⁶</p> | Canada, Denmark, Finland, France, Germany, Sweden, Norway, Spain and South Korea ¹³⁷ |
| PF-AZ | <p>UK: Greater systemic side effects (mild-moderate symptoms) following the booster dose than with 2 doses of the same vaccine; no safety concerns¹²⁹</p> <p>Greater reactogenicity with first of homologous and heterologous prime-boost immunisation with BNT162b2 and ChAdOx1-nCoV19: a prospective cohort study</p> <p>increased reactogenicity (55.2%; 46.1-64.1) vs Pfizer/BioNTech-Pfizer/BioNTech (33.3%; 23.4-44.5)¹³¹</p> | UK: 4 week dose interval: weaker antibody response than after 2 doses of Pfizer/BioNTech vaccine (but stronger than after 2 doses of AstraZeneca vaccine) ¹³³ | - |
| AZ-mRNA (PF or MO) | - | Effectiveness in Canada: Infection: 90% (89-91); 87% (85-89); Hospitalisation: 99% (98-100); 98% (95-99) ⁴⁸ | - |
| Primary series of PF, J&J or MO followed by PF, J&J or MO booster | Reactogenicity for all combinations similar to primary series ⁹¹ | Homologous boosters increased neutralising antibody titres 4.2 to 20-fold; Heterologous boosters increased neutralising antibody titres 6 to 76-fold ⁹¹ | - |
| AZ, MO and PF | - | Canada: Trial underway mixing and matching all three vaccines with study arms assessing 4 week and 16 week dose intervals ¹³⁸ | AstraZeneca followed by either Moderna or Pfizer/BioNTech: Denmark, Finland, France, Germany, Sweden, Norway and Spain ¹³⁷ |
| Sinovac primary series | - | Chile: Symptomatic infection: Sinovac booster: 78.8% (76.8-80.6); PF booster: 96.5% (96.2-96.7); AZ booster: 93.2% (92.9-93.6); Hospitalisation: Sinovac: 86.3% (83.7-88.5); PF: 96.1% (95.3-96.9); AZ: 97.7 (97.3-98.0); Death: Sinovac: 86.7% (80.5-91.0); PF: 96.8% (93.9-98.3); AZ: 98.1% (97.3-98.6) ⁹⁹ | Sinovac-AZ: Thailand |

Adverse Events Following Immunisation with WHO EUL Vaccines

Adverse events following immunisation (AEFIs) are any reactions occurring after immunisation. They can be either expected or unexpected. The vaccine may not actually cause the AEFI; it may occur coincidentally as millions of people are being vaccinated so some people may get sick after vaccination but this does not necessarily mean that it is due to the vaccine. Special investigations determine whether they are due to the vaccine. Adverse events of special interest (AESIs) are of scientific and medical concern that are found through active surveillance, that have the potential to be causally associated with a vaccine and that need to be carefully monitored and confirmed by further special studies.

For all injectable vaccines, appropriate medical treatment and supervision should always be readily available in case of an anaphylactic event following administration.

| | ASTRAZENECA | MODERNA | PFIZER/BIONTECH | JOHNSON & JOHNSON | SINOPHARM | SINOVAC | CLOVER | BHARAT BIOTECH |
|--|--|---|--|--|--|---|---|---|
| Adverse events following immunisation (AEFIs)* | <p>Very common (more than 1 in 10 people): headache, nausea, muscle pain, joint pain, injection site tenderness/ pain/ warmth/ itch, fatigue, malaise, fever, chills</p> <p>Common (between 1 in 10 and 1 in 100 people): injection site swelling/ redness¹⁴⁰</p> | <p>Injection site pain (92%)/ swelling (15%)/ redness (10%), fatigue (70%), headache (65%), muscle pain (62%), joint pain (46%), fever (16%), chills (45%), nausea/vomiting (23%), axillary swelling/tenderness (20%)¹⁴¹</p> | <p>Very common: headache, muscle pain, joint pain, injection site pain/ swelling, fatigue, fever, chills;</p> <p>Common: nausea, injection site redness¹⁴⁰</p> <p>Uncommon (between 1 in 100 and 1 in 1000 people): lymphadenopathy, insomnia, pain in extremity of vaccinated arm, malaise, injection site itch;</p> <p>Rare: (between 1 in 1000 and 1 in 10,000): acute peripheral facial paralysis¹⁴²</p> | <p>Injection site pain/ redness/ swelling, headache, fatigue, muscle pain, nausea, fever¹⁴³</p> | <p>Injection site pain (16%)/ itch (1%)/ swelling (2%)/ redness (1%), fever (4%), fatigue (3%), nausea (1%), headache (1%), diarrhoea (1%), muscle pain (<1%), itch (non-injection site) (1%)¹⁴⁴</p> | <p>Fatigue (8.3%), fever (3.3%), diarrhoea (0.8%), nausea (1.7%), headache (2.5%), muscle pain (1.7%), injection site pain (10.0%)/ redness (0%)/ swelling (0%)¹⁴⁵</p> | <p>Very common: Injection site pain, fatigue, headache</p> <p>Common: Injection site erythema, myalgia, arthralgia, loss of appetite, nausea, chills</p> <p>Uncommon: Injection site swelling, fever¹⁹</p> | <p>Common: Injection site pain/redness/ itching, headache, fever, malaise, fatigue, body ache</p> |
| Adverse events of special interest (AESIs) | <p>Thrombosis with thrombocytopenia syndrome (TTS) (see page 13 for estimated risk);</p> <p>EMA PRAC: Guillain-Barre syndrome (GBS)¹⁴⁶</p> <p>Australia: Guillain-Barre syndrome: 52 cases (10.4 per million doses)¹⁴⁷</p> <p>Australia: Immune thrombocytopenia (ITP)</p> | <p>Myopericarditis (most common in younger males)</p> <p>USA VAERS: myocarditis cases per million second doses: 18-24 year males 38.5, females: 5.3; 25-29 year males: 17.2, females: 5.7¹⁴⁸</p> <p>ITP**¹⁴⁹</p> | <p>Myopericarditis (most common in younger males)</p> <p>USA VAERS: myocarditis cases per million second doses: 12-15 year males: 39.9, females: 3.9; 16-17 year males: 69.1, females: 7.9;</p> <p>18-24 year males: 36.8, females: 2.5; 25-29 year males 10.8, females: 1.2¹⁴⁸</p> <p>>1 in 20,000 males under 25 years of age¹⁴</p> <p>Israel: 1 to 5 cases of myocarditis per 100,000 persons^{150,151}</p> <p>ITP**¹⁴⁹</p> | <p>TTS (see page 14 for estimated risk)</p> <p>USA: Guillain-Barre Syndrome: 100 preliminary reports of GBS following 12.5 million doses of vaccine administered (mostly males >50 years)¹⁵²</p> | - | - | - | - |

*Details for AstraZeneca, Moderna, Pfizer/BioNTech and Johnson & Johnson from product information sheets in SRA countries, based on data from clinical trials; Sinopharm, Sinovac and Bharat Biotech details from published clinical trials

**The ITP cases are mostly without the thrombotic events characteristic of TTS

Serious Adverse Events

Caution is required when comparing safety profiles as definitions and reporting systems vary in trials and in particular phase IV studies. Risk of TTS in PICs available in Appendix 6.

| VACCINE | VACCINE SAFETY |
|-------------------|--|
| AstraZeneca | <p>108 SAEs in 12,282 (0.9%) vaccine recipients and 127 in 11,962 (1.1%) placebo recipients; 7 deaths all considered unrelated to vaccination (2 vaccine, 5 placebo)¹⁶⁰ US Phase III study: No serious safety concerns involving 32,449 participants¹⁷ (not peer-reviewed) EMA investigation: possible link between the AstraZeneca vaccine and Thrombosis with Thrombocytopenia Syndrome (TTS) Blood clots affected the brain (central venous sinus thrombosis, CVST) and abdomen (splanchnic vein thrombosis) There have been reports of 169 cases of CVST and 53 cases of splanchnic vein thrombosis in ~34 million vaccinated people in Europe The EMA confirmed the overall benefits of the vaccine in preventing COVID-19 outweigh the risks of side effects⁹ UK: Risk factors for death in patients with TTS following the AstraZeneca vaccine: baseline platelet count; and intracranial haemorrhage¹⁵³ TTS reported to occur in ~1 in 50,000 vaccinated adults in Australia¹¹ Several countries introduced age recommendations for the vaccine: >60 years in Germany and Australia; >55 years in France and Canada; >40 years in the UK¹⁵⁴⁻¹⁵⁶ EMA has started a review of reports of capillary leak syndrome following 5 cases of this very rare disorder post vaccination¹⁵⁷ WHO GACVS reports Guillain Barre Syndrome (GBS) rates following adenovirus vector vaccines: EU/EEA: 4.4; AUS: 9.7; KOR: 0.4; PHL: <1¹⁵⁸ Guillain-Barre Syndrome in England: IRR 15-21 days: 2.90 (2.15-3.92); Scotland: IRR 1-28 days: 2.32 (1.08-5.02); following SARS-CoV-2 infection: IRR 1-28 days: 5.25 (3.00-9.18); Bell's Palsy in England: IRR 15-21 days: 1.29 (1.08-1.56); IRR 1-28 days: 1.07 (0.94-1.21)¹⁵⁹ Immune thrombocytopenia (ITP) in Victoria, Australia: 8 cases per million doses (17 cases; 15 after second dose) (Expected background rate: 20-49 years: 1.9; ≥50 years: 4.1)¹⁶⁰</p> |
| Gamaleya | <p>45 SAEs in 16,427 (0.3%) vaccine recipients and 23 in 5,435 (0.4%) placebo recipients; 4 deaths all considered unrelated to vaccination (3 vaccine, 1 placebo)²⁰</p> |
| Johnson & Johnson | <p>83 SAEs in 21,895 (0.4%) vaccine recipients and 96 in 21,888 placebo recipients (0.4%); 19 deaths all considered unrelated to vaccination (3 vaccine, 16 placebo)²³ EMA investigation of 8 reports of TTS. Most cases occurred in women <60 years of age but specific risk factors have not been confirmed⁹ USA: Cases of TTS per million doses: Overall: 3.1; Female: 5.2; Male: 1.5¹⁴⁸ Deaths: 5 (4 female, 1 male) Guillain-Barre Syndrome: 100 preliminary reports of GBS following 12.5 million doses of vaccine administered in USA (mostly males >50 years)¹⁵² WHO GACVS reports Guillain Barre Syndrome (GBS) rates following adenovirus vector vaccines: USA: 7.8; KOR: 0.9; EU/EEA: AZ: 2.1¹⁵⁸</p> |
| Moderna | <p>153 SAEs in 15,166 (1.0%) placebo recipients and 147 in 15,185 (1.0%) vaccine recipients; 5 deaths considered unrelated to vaccine (2 vaccine, 3 placebo)²⁶ Anaphylaxis reported in the US at a rate of 2.5 per million doses¹⁵¹ No obvious safety signals among pregnant women who received mRNA COVID-19 vaccines in USA¹²² USA: Myo/pericarditis reported in 40.6 males and 4.2 females aged 12-29 years per million second doses of mRNA vaccine; and 2.4 males and 1.0 females aged 30+¹⁶² USA VAERS: myocarditis cases per million second doses: 18-24 year old males: 38.5, females: 5.3; 25-29 year old males: 17.2, females: 5.7¹⁴⁸ Ontario, Canada: Myo/pericarditis cases per million second doses in those aged 18-24 years: Males 198.6; Females 59.6¹⁶³ Overall rates in the UK per million second doses: Myocarditis: 28.3; Pericarditis: 17.2¹⁶⁴ EMA PRAC: French study: 57 extra cases of myocarditis per million 16-24-year-old males compared to unexposed; Nordic study: 190 extra cases of myocarditis per million 16-24-year-old males¹⁶⁵ Myo/pericarditis in Ontario, Canada: Rates in males 18-24 years 5.1 (1.9-15.5) times higher following Moderna second dose than Pfizer/BioNTech; Rates higher with shorter dose interval (i.e. ≤30 days)¹⁶⁶ Myocarditis excess cases in people <40 years in the UK: First dose: 8 (4-9) per million; Second dose: 15 (12-16)¹⁶⁷ Myo/pericarditis in Australia: 25 (18-33)¹⁶⁸ Australia: Myo/pericarditis following boosters: 4 cases¹⁶⁹</p> |
| Novavax | <p>SAEs at low levels and similar between vaccine and placebo groups¹⁷⁰</p> |
| Pfizer/BioNTech | <p>SAEs and deaths were low and comparable between vaccine and placebo groups (total 37,586 participants)³¹ Anaphylaxis reported in the US at a rate of 4.7 per million doses¹⁵¹ No obvious safety signals among pregnant women who received mRNA COVID-19 vaccines in USA¹²² Brazil: SAEs: 5.4/100,000 doses USA: Myo/pericarditis reported in 40.6 males and 4.2 females aged 12-29 years per million second doses of mRNA vaccine; and 2.4 males and 1.0 females aged 30+¹⁶² USA VAERS: myocarditis cases per million second doses: 12-15 year males: 39.9, females: 3.9; 16-17 year males: 69.1, females: 7.9; 18-24 year males: 36.8, females: 2.5; 25-29 year males 10.8, females: 1.2¹⁴⁸ Ontario, Canada: Myo/pericarditis cases per million second doses in those aged 18-24 years: Males 35.5; females 39.9¹⁶³ Overall rates in the UK per million second doses: Myocarditis 7.4; Pericarditis 5.6¹⁶⁴ Israel: Myo/pericarditis: 106.9 (69.3-144.6) cases per million in those aged 16-29¹⁷¹; 137.3 (81.1-194.6) cases per million people aged 16-19¹⁷² Haemorrhagic stroke in England: IRR 15-21 days: 1.38 (1.12-1.71) (not replicated in Scotland data)¹⁵⁹ Israel: Myo/pericarditis: 16-19 year old males: Second dose: 161 cases per million; Third dose: 52 cases per million¹⁷³ EMA PRAC: French study: 26 extra cases of myocarditis per million 12-29-year-old males compared to unexposed; Nordic study: 130 extra cases of myocarditis per million 12-29-year-old males¹⁶⁵ Hong Kong: Myo/pericarditis in 12-17 year-olds: After first dose: 34 (11-95) cases per million; Second dose: 212 (138-323); Males, first dose: 56 (24-125); Males, second dose: 373 (270-513)¹⁷⁴ Myo/pericarditis in Ontario, Canada: Rates higher with shorter dose interval (i.e. ≤30 days)¹⁶⁶ Myocarditis excess cases in people <40 years in the UK: First dose: 2 (1-3) per million; Second dose: 3 (2-4)¹⁶⁷ Myo/pericarditis in Australia: 16 (15-17)¹⁶⁸ USA: Myocarditis 5-11 years: 11 confirmed cases following ~8 million doses administered¹⁷⁵ Australia: Myo/pericarditis following boosters: 14 cases¹⁶⁹ France: MIS-C following vaccination in 12-17 year olds: 1.1 cases per million doses (post-SARS-CoV-2 MIS-C in the same age group in the same population was 113 per million doses)¹⁷⁶ USA: MIS-C following vaccination in 12-20 year olds: 21 cases (1 case per million persons vaccinated)¹⁷⁷</p> |
| Sinovac | <p>Brazil: SAEs: 79.7/100,000 doses Safety in Chile 6-11 years: Adverse events following 0.011% of doses administered (most common: vomiting, itching, injection site pain and erythema)¹⁷⁸</p> |

Risk of Myo/Pericarditis in 12-17 Year Olds Following mRNA Vaccines

Estimated number of myo/pericarditis cases that potentially might occur in Pacific Island Countries if all 12-17 year olds received the Pfizer/BioNTech or Moderna vaccine, based on official country population estimates and incidence myo/pericarditis (highest and lowest estimates) in other settings. Nearly all myo/pericarditis cases related to mRNA vaccination are mild and managed conservatively.

| COUNTRY | TOTAL POPULATION | ESTIMATED POPULATION AGED 12-17 YEARS* | POTENTIAL NUMBER OF MYO/PERICARDITIS CASES IF ALL 12-17 YEAR OLDS RECEIVED THE PFIZER/BIONTECH VACCINE** | POTENTIAL NUMBER OF MYO/PERICARDITIS CASES IF ALL 12-17 YEAR OLDS RECEIVED THE MODERNA VACCINE *** |
|-------------------------------------|-------------------|--|--|--|
| American Samoa | 55,519 | 7,217 | 0.3-1.5 | 0.1-1.4 |
| Cook Islands | 15,300 | 1,989 | <1 | <1 |
| Federated States of Micronesia | 102,300 | 13,299 | 0.5-2.8 | 0.3-2.6 |
| Fiji | 867,000 | 112,710 | 4.2-23.9 | 2.3-22.0 |
| French Polynesia | 275,918 | 35,869 | 1.3-7.6 | 0.7-7.0 |
| Guam | 159,358 | 20,717 | 0.8-4.4 | 0.4-4.1 |
| Kiribati | 113,400 | 14,742 | 0.6-3.1 | 0.3-2.9 |
| Marshall Islands | 54,900 | 7,137 | 0.3-1.5 | 0.1-1.4 |
| Nauru | 10,900 | 1,417 | <1 | <1 |
| New Caledonia | 271,407 | 35,283 | 1.3-7.5 | 0.7-6.9 |
| Niue | 1,611 | 209 | <1 | <1 |
| Northern Mariana Islands | 53,883 | 7,005 | 0.3-1.5 | 0.1-1.4 |
| Palau | 18,000 | 2,340 | <1 | <1 |
| Papua New Guinea | 7,744,700 | 1,006,811 | 37.7-213.4 | 20.8-196.8 |
| Samoa | 195,979 | 25,477 | 1.0-5.4 | 0.5-5.0 |
| Solomon Islands | 642,000 | 83,460 | 3.1-17.7 | 1.7-16.3 |
| Tokelau | 1,160 | 151 | <1 | <1 |
| Tonga | 99,419 | 12,924 | 0.5-2.7 | 0.3-2.5 |
| Tuvalu | 10,507 | 1,366 | <1 | <1 |
| Vanuatu | 272,173 | 35,382 | 1.3-7.5 | 0.7-6.9 |
| Wallis and Futuna | 11,558 | 1,503 | <1 | <1 |
| All Pacific Island Countries | 10,976,992 | 1,427,009 | 53.4-302.5 | 29.5-279.0 |

* Based on estimate of 13% of population aged 12-17 years

** Based on estimates of myo/pericarditis occurring in 212 per million second doses of Pfizer/BioNTech in 12-17 year olds in Hong Kong and 37.4 per million second doses in 16-17 year olds in USA (VAERS data)^{148,174}

*** Based on estimates of myo/pericarditis occurring in 195.5 per million doses in 18-24 year olds in Canada (data not available for <18 years) and 20.7 per million second doses in 18-24 year olds in USA (VAERS data; not available for <18 years)^{148,166}

Who Can be Vaccinated Based on WHO SAGE Recommendations?

WHO SAGE have made recommendations for use of AstraZeneca, Moderna, Pfizer/BioNTech, Johnson & Johnson, Sinopharm, Sinovac, Bharat Biotech and Novavax vaccines:

<https://www.who.int/groups/strategic-advisory-group-of-experts-on-immunization/covid-19-materials>

| | ASTRAZENECA | MODERNA | PFIZER/BIONTECH | JOHNSON & JOHNSON | SINOPHARM | SINOVAC | BHARAT BIOTECH | NOVAVAX |
|---|--|--|--|---|--|--|--|--|
| Minimum Age | 18 years | 18 years | 12 years | 18 years | 18 years | 18 years | 18 years | 18 years |
| Maximum Age (SAGE WHO) | None | None | None | None | None | None | None | None |
| Pregnancy | Yes if high priority group & approved by health provider | Yes if high priority group & approved by health provider | Yes if high priority group & approved by health provider | Yes if high priority group & approved by health provider | Yes if high priority group & approved by health provider | Yes if high priority group & approved by health provider | Yes if the benefits outweigh the potential risks | Yes if the benefits outweigh the potential risks |
| Breastfeeding | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| People previously infected with SARS-CoV-2 | May delay 6 months; Within 90 days if VOCs associated with reduced effectiveness are circulating (e.g. Beta) | May delay 6 months; Within 90 days if VOCs associated with reduced effectiveness are circulating (e.g. Beta) | May delay 6 months; Within 90 days if VOCs associated with reduced effectiveness are circulating (e.g. Beta) | May delay 6 months; <6 months may be advisable if VOCs with reduced neutralisation activity are circulating | May delay 6 months; <6 months may be advisable if VOCs associated with reduced effectiveness are circulating | May delay 6 months; <6 months may be advisable if VOCs associated with reduced effectiveness are circulating | May delay 6 months; <6 months may be advisable if VOCs associated with reduced effectiveness are circulating | May delay 6 months; <6 months may be advisable if VOCs associated with reduced effectiveness are circulating |
| Immunocompromised Including HIV | An additional dose at least 1 month, and within 3 months, after completing the primary series | An additional dose at least 1 month, and within 3 months, after completing the primary series | An additional dose at least 1 month, and within 3 months, after completing the primary series | An additional dose at least 1 month, and within 3 months, after completing the primary series | An additional dose at least 1 month, and within 3 months, after completing the primary series | An additional dose at least 1 month, and within 3 months, after completing the primary series | An additional dose at least 1 month, and within 3 months, after completing the primary series | An additional dose at least 1 month, and within 3 months, after completing the primary series |
| History of Anaphylaxis (Severe Allergy) | Yes (unless the allergy is to the vaccine or its components) | Yes (unless the allergy is to the vaccine or its components) | Yes (unless the allergy is to the vaccine or its components) | Yes (unless the allergy is to the vaccine or its components) | Yes (unless the allergy is to the vaccine or its components) | Yes (unless the allergy is to the vaccine or its components) | Yes (unless the allergy is to the vaccine or its components) | Yes (unless the allergy is to the vaccine or its components) |

Vaccine Development Pipeline

WHO has recommended that vaccines adopted by countries have WHO SAGE EUL and/or Stringent Regulatory Approval. Last updated 6 January 2021.

| VACCINE TYPE | NUMBER OF VACCINE CANDIDATES AT EACH PHASE OF DEVELOPMENT | | | | |
|--------------------------|---|------------|-----------|----------|--|
| | PRE-CLINICAL | PHASE I/II | PHASE III | PHASE IV | IN USE* |
| RNA | 25 | 12 | 3 | 2 | 2 (Pfizer/BioNTech, Moderna) |
| DNA | 16 | 9 | 4 | 0 | 1 (Zydus Cadila Healthcare Limited) |
| Vector (non-replicating) | 26 | 8 | 2 | 3 | 4 (CanSino, Gamaleya, Johnson & Johnson, AstraZeneca) |
| Vector (replicating) | 18 | 6 | 1 | 0 | 0 |
| Inactivated | 5 | 8 | 7 | 3 | 9 (Sinopharm/BIBP; Sinopharm/WIBP; Sinovac; Bharat; Chumakov; Research Institute for Biological Safety Problems; Shenzhen Kangtai Biological Products; Shifa Pharmed, Erciyes University) |
| Live-attenuated | 2 | 1 | 0 | 0 | 0 |
| Protein subunit | 72 | 20 | 16 | 1 | 10 (Novavax, Vector institute; Anhui Zhifei Longcom Biopharmaceutical Chinese Academy of sciences; Center for Genetic Engineering and Biotechnology; Instituto Finlay de Vacunas, Cuba [peptides 1 and 2]; Medigen Vaccine Biologics, Taiwan; Vaxine Pty Medytox CinnaGen Co, Biological E Ltd, Razi Vaccine and Serum Research Institute) |
| Virus-like particle | 20 | 4 | 2 | 0 | 0 |
| Other/unknown | 32 | 6 | 0 | 0 | 0 |

*Not all vaccines in use have SRA (as recognised by WHO) approval (see Vaccine specifications table and WHO SAGE Emergency Use Listing and prequalification timeline for approval status of vaccines).

Source: London School of Hygiene and Tropical Medicine COVID-19 vaccine tracker.

WHO SAGE Emergency Use Listing and Prequalification Timeline

| MANUFACTURER | NAME OF VACCINE | PLATFORM | STATUS OF ASSESSMENT | ANTICIPATED DECISION DATE |
|---|---|-------------------|--|---|
| Pfizer/BioNTech | BNT162b2/COMIRNATY Tozinameran (INN) | mRNA | Final decision made | Authorised 31/12/20 |
| AstraZeneca | AZD1222 | Adenoviral vector | Final decision made | SK Bio: Authorised 15/02/21 EU nodes: Authorised 16/04/21 CSL, Australia: Authorised 09/07/21 Daiichi Sankyo, Japan: Authorised 09/07/21 |
| Serum Institute of India | Covishield (ChAdOx1_nCoV19) | Adenoviral vector | Final decision made | Authorised 15/02/21 |
| Sinopharm/Beijing Institute of Biological Products (BIBP) | SARS-CoV-2 Vaccine (Vero Cell), Inactivated (InCoV) | Inactivated | In progress | Authorised: 07/05/2021 |
| Sinovac | SARS-CoV-2 Vaccine (Vero Cell), Inactivated | Inactivated | In progress | Authorised 01/06/2021 |
| Moderna | mRNA-1273 | mRNA | In progress (to use abridged procedure relying on EMA) | Authorised 30/04/2021 |
| Johnson & Johnson | Ad26.COV2.S | Adenoviral vector | Final decision made | Authorised 12/03/21 |
| The Gamaleya National Center | Sputnik V | Adenoviral vector | On hold, awaiting completion of rolling submission | Will be determined when all data are submitted |
| Bharat Biotech | Covaxin; BBV152 | Inactivated | Rolling data assessment started 6 July 2021 | Authorised 03/11/2021 |
| CanSino Biologics | Ad5-nCoV | Adenoviral vector | Rolling data assessment started 9 August 2021 | TBC |
| Novavax | NVX-CoV2373 | Protein subunit | Rolling data assessment started 19 August 2021 | Authorised 20/12/2021 |
| CureVac | Zorecimeran | mRNA | Expression of interest accepted; Application withdrawn by manufacturer | - |
| Clover Biopharmaceuticals | SCB-2019 (CpG 1018/Alum) | Protein subunit | Rolling data starting 20 September | TBC |

Source: WHO Guidance Document: Status of COVID-19 Vaccines within WHO EUL/PQ evaluation process.
Available at: <https://www.who.int/teams/regulation-prequalification/eul/covid-19>

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Other resources on COVID-19 vaccines:

WHO COVID-19 vaccines website: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines>

EMA COVID-19 vaccines website: <https://www.ema.europa.eu/en/human-regulatory/overview/public-health-threats/coronavirus-disease-covid-19/treatments-vaccines/covid-19-vaccines>

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Murdoch Children's Research Institute

50 Flemington Rd, Parkville

Victoria 3052 Australia

ABN 21 006 566 972

<https://www.mcri.edu.au/research/themes/infection-and-immunity/asia-pacific-health>

Weekly COVID-19 Vaccine Updates
Number 42, 27 January 2022



Appendix 1: COVID-19 Vaccine Effectiveness

| VACCINE | SEVERE / HOSPITALISATION / DEATH | INFECTION AND OTHER OUTCOMES |
|------------------------------|---|---|
| AstraZeneca | <p>Single dose in Scotland: 94% (73-99)⁵⁹</p> <p>Risk of death in vaccine failures compared to unvaccinated cases in England reduced by: 55% (41-66)¹⁷⁹ (not peer reviewed)</p> <p>Single dose against hospitalisation in Spain: 92% (46-99)⁵³</p> <p>Pooled analysis of AstraZeneca, Pfizer/BioNTech and Moderna vaccines in Italy: Hospitalisation: 89% (85-91); Death: 93% (89-96)¹⁸⁰</p> <p>Chile: Hospitalisation: 100%; ICU admission: 100%; Death: 100%⁴⁶</p> <p>Scotland: Hospitalisation: 94% (90-99)⁵⁶</p> <p>Netherlands: Hospitalisation: 94% (92-95)⁵⁵</p> <p>Spain: Hospitalisation: 95% (79-99)⁴⁰</p> <p>Scotland: Death: 91% (86-94)⁶⁰</p> <p>British Colombia and Quebec, Canada: Hospitalisation: 94% (90-96); 94% (89-97)⁴⁸</p> <p>Scotland and Brazil, <i>respectively</i> (delta variant dominant in Scotland; gamma variant common in Brazil): Hospitalisation or death: Single dose: 49.3% (43.3-54.6); 57.9% (56.9-58.9); 2 doses: 2-3 weeks: 83.7% (79.7-87.0); 86.4% (85.4-87.3); 2 doses 18-19 weeks: 63.7% (59.6-67.4); 42.2% (32.4-50.6)⁵¹</p> <p>England: Hospitalisation: 2-9 weeks: 95.2% (94.7-95.7); ≥20 weeks: 80.0% (76.8-82.7)</p> <p>Death: 2-9 weeks: 95.0% (93.1-96.4); ≥20 weeks: 84.8% (76.2-90.3)⁵²</p> | <p>Pooled analysis of Pfizer/BioNTech and AstraZeneca vaccines in elderly care home residents in UK: Reduction in risk of infection 4 weeks after single dose: 56% Reduction in risk of infection 5 weeks after single dose: 62%¹⁸¹</p> <p>Pooled analysis of Pfizer/BioNTech and AstraZeneca vaccines: reduced odds of infection post-second dose: 70% (62-77)¹⁸²</p> <p>Single dose in Spain: Any infection: 44% (31-54); Symptomatic infection: 50% (37-61)⁵³</p> <p>Pooled analysis of AstraZeneca, Pfizer/BioNTech and Moderna vaccines in Italy: Infection: 78% (76-79)¹⁸⁰</p> <p>Single dose against symptomatic infection in multiple European countries: 68% (39-83)⁵⁴</p> <p>Symptomatic infection in 16-64 years in UK: single dose: 50.2% (40.8-58.2); 2 doses: 78.0% (69.7-84.0)⁴⁵</p> <p>Symptomatic infection in Chile: 68.7% (39.8-83.7)⁴⁶</p> <p>Spain: Any infection: 54% (48-60); Symptomatic infection: 56% (48-63)⁴⁰</p> <p>British Colombia and Quebec, Canada: Symptomatic infection: 71% (69-74); 73% (69-77)⁴⁸</p> <p>England REACT-1 study: Any infection: 44.8% (22.5-60.7)⁴¹</p> <p>India: Any infection: 2 doses: 63.1% (51.5-72.1); Single dose: 46.2% (31.6-57.7); Moderate-severe disease: 2 doses: 81.5% (9.9-99.0); Single dose: 79.2% (46.1-94.0)⁴²</p> <p>UK: Symptomatic infection: 2-9 weeks: 76.2% (63.7-84.4); 15-19 weeks: 48.5% (44.7-52.0) 20-24 weeks: 45.4% (43.0-47.6); ≥25 weeks: 41.8% (39.4-44.1)⁴⁹</p> <p>Brazil: Infection: 72.9% (71.9-73.8); Hospitalisation: 88.0% (86.8-89.2); Death: 90.2% (88.5-91.5)⁴³</p> <p>England: Omicron: Symptomatic infection: -39% (-50--30); Delta: 25.0% (24.3-25.7)⁵⁰</p> <p>Scotland and Brazil, <i>respectively</i> (delta variant dominant in Scotland; gamma variant common in Brazil): Symptomatic infection: Single dose: 37.6% (34.6-40.5); 37.6% (37.3-37.9); 2 doses 2-3 weeks: 67.9% (65.9-69.8); 69.8% (69.3-70.4); 2 doses 18-19 weeks: 44.6% (41.5-47.6); 57.7% (55.4-60.0)⁵¹</p> <p>England: Symptomatic infection: 2-9 weeks: 67.6% (67.3-67.9); ≥20 weeks: 44.3% (43.2-45.4)⁵²</p> |
| Johnson & Johnson | <p>USA: Hospitalisation: 81% (79-84)⁶³</p> <p>USA: 71% (56-81)⁶⁵</p> <p>Netherlands: Hospitalisation: 91% (88-94)⁵⁵</p> <p>Spain: Hospitalisation: 74% (43-88)⁴⁰</p> <p>Death in veterans in USA: <65 years: 73.0% (52.0-84.8); ≥65 years: 52.2% (37.2-63.6)⁶⁷</p> <p>South Africa: Booster against hospitalisation during Omicron wave: 85% (54-95)¹⁰⁰</p> | <p>USA: Any infection: 76.7% (30.3-95.3)⁶²</p> <p>USA: Infection: 79% (77-80)⁶³</p> <p>Efficacy following booster 2 months after first dose: Moderate-Severe infection in USA: 94% (58-100); worldwide: 75% (55-87)¹⁸³</p> <p>Spain: Any infection: 50% (42-57); Symptomatic infection: 54% (45-62)⁴⁰</p> <p>Symptomatic infection in veterans in USA: 88% (87-89)⁶⁴</p> <p>Any infection in USA: 73.6% (65.9-79.9)⁶⁵</p> <p>Infection in veterans in USA: March: 86.4% (85.2-87.6); September: 13.1% (9.2-16.8)⁶⁷</p> |
| Moderna | <p>Pooled analysis of AstraZeneca, Pfizer/BioNTech and Moderna in Italy: Hospitalisation: 89% (85-91); Death: 93% (89-96)¹⁸⁰</p> <p>Pooled analysis of Pfizer/BioNTech and Moderna against hospitalisation: 2-12 weeks after second dose: 86% (82%-90%) 13-24 weeks after second dose: 84% (77%-90%)¹⁸⁴</p> <p>USA: Hospitalisation: 95.8% (90.7-98.1); Death: 97.9% (66.9-99.9)⁶⁹</p> <p>Pooled Pfizer/BioNTech and Moderna against hospitalisation in Scotland: 92% (85-99)⁵⁶</p> <p>USA: 93% (91-95)⁶⁶</p> <p>Spain: Hospitalisation: 98% (82-100)⁴⁰</p> <p>Qatar: Decline in effectiveness accelerated beyond the fourth month after the second dose; First month after second dose: 96.0% (93.9-97.4); ≥7 months: 55.6% (-44.3-86.3)⁷⁰</p> <p>USA: Hospitalisation: 97.6% (92.8-99.2)⁷¹</p> <p>Moderna and Pfizer/BioNTech in British Colombia and Quebec, Canada: Hospitalisation: 98% (97-98); 97% (96-97)⁴⁸</p> <p>Death in veterans in USA: <65 years: 81.5% (70.7-88.4); ≥65 years: 75.5% (71.8-78.7)⁶⁷</p> <p>USA: Hospitalisation with Delta: Single dose: 68.9% (0.0-99.4); 2 doses Delta: 98.0% (87.2-99.7)⁷³</p> <p>USA: Moderna and Pfizer: Hospitalisation: 2 doses: <6 months: 90% (89-90); ≥6 months: 81% (80-82); 3 doses: 94% (93-95);</p> <p>Omicron: 2 doses: <6 months: 81% (65-90); ≥6 months: 57% (39-70); 3 doses: 90% (80-94)¹⁸⁵</p> | <p>Pooled analysis of Moderna and Pfizer/BioNTech vaccines in USA: Infections in nonvaccinated: 234 of 8969; 2.61% (2.29-2.96) Fully vaccinated: 4/8121; 0.05% (0.01-0.13)¹⁸⁶</p> <p>Pooled analysis of Moderna and Pfizer/BioNTech vaccines against infection in USA: Fully vaccinated: 90% (68-97) Two weeks after first dose: 80% (59-90)¹⁸⁷</p> <p>Pooled analysis of AstraZeneca, Pfizer/BioNTech and Moderna vaccines in Italy: Infection: 78% (76-79)¹⁸⁰</p> <p>Single dose against symptomatic disease in the UK: Age 15-39 years: 72% (46-86)⁵⁵</p> <p>Minnesota, USA: January to July 2021 (Delta variant <0.7% in May): Infection: 86% (81-91); Hospitalisation: 92% (81-97) July (Delta variant >70%): Infection: 76% (58-87); Hospitalisation: 81% (33-96)⁶⁸</p> <p>Infection in USA (98% vaccines used Pfizer/BioNTech and Moderna): Pre-Delta variant predominant: 91% (81-96); Delta variant predominant: 66% (26-84)¹⁸⁸</p> <p>Infection in Canada: 1 dose: 72% (63-80); 2 doses: 94% (86-97)⁷⁴</p> <p>USA: Any infection: 87.4% (84.8-89.6); Symptomatic infection: 88.3% (86.1-90.2)⁶⁹</p> <p>Spain: Any infection: 82% (78-86); Symptomatic infection: 85% (80-89)⁴⁰</p> <p>Qatar: First month after second dose: 77.5% (76.4-78.6); ≥7 months: 22.3% (-1.7-40.7)⁷⁰</p> <p>USA: Any infection: 86.7% (84.3-88.7)⁷¹</p> <p>Moderna and Pfizer/BioNTech in British Colombia and Quebec, Canada: Symptomatic infection: 90% (89-90); 88% (88-89)⁴⁸</p> <p>Infection in veterans in USA: March: 89.2% (88.8-89.6); September: 58.0% (56.9-59.1)⁶⁷</p> <p>Denmark: Effectiveness against infection: Omicron: First month: 36.7% (-69.9-76.4); Third month: 4.2% (-30.8-29.8); Delta: First month: 88.2% (83.1-91.8); Third month: 72.2% (70.4-74.0); Booster first month: 82.8% (58.8-92.9)⁷²</p> <p>USA: Any infection: Single dose: Delta: 60.2% (42.6-72.3); Omicron: 20.3% (0.0-39.8); 2 doses: Delta 14-90 days: 82.8% (69.6-90.3); 181-270 days: 61.4% (56.8-65.5); Omicron 14-90 days: 30.4% (5.0-49.0); 181-270 days: 0.0% (0.0-1.2);</p> |



| | | |
|------------------------|--|--|
| | | 3 doses: Delta ≤2 months: 95.7% (94.2-96.9); >2 months: 90.7% (81.4-95.3); Omicron ≤2 months: 63.6% (57.4-68.9); >2 months: 39.1% (3.8-61.5) ⁷³ |
| Pfizer/BioNTech | <p>Severe in Israel: 92% (75-100)⁸⁴ Severe/critical in Israel: 97.5% (97.1-97.8)⁸³ Single dose against hospitalisation in Scotland: 85% (76-91)⁵⁹ Risk of death in vaccine failures compared to unvaccinated cases in England reduced by: Single dose: 44% (32-53) Fully vaccinated: 69% (31-86)¹⁷⁹ (not peer reviewed) Israel: Hospitalisation: 97.2% (96.8-97.5); Death: 96.7% (96.0-97.3)⁸³ Hospitalisation in Spain: 94% (60-99)⁵³ Priority groups in Denmark: Hospitalisation: 93% (89-96); Death: 94% (90-96)⁷⁶ Pooled analysis of AstraZeneca, Pfizer/BioNTech and Moderna vaccines in Italy: Hospitalisation: 89% (85-91); Death: 93% (89-96)¹⁸⁰ USA care facility: Hospitalisation: 94.4 (73.9-98.8); Death 94.4 (44.6-99.4)⁷⁹ Uruguay: Hospitalisation: 97.8% (96.0-98.8); Death: 96.2 (95.4-96.8)⁸⁷ Israel: Hospitalisation: 93.4% (91.9-94.7); Death: 91.1% (86.5-94.1)⁸⁸ Chile: Hospitalisation: 97.2% (96.6-97.6); ICU admission: 98.3% (97.6-98.8); Death: 100%⁴⁶ Pooled analysis of Pfizer/BioNTech and Moderna against hospitalisation: 2-12 weeks after second dose: 86% (82%-90%) 13-24 weeks after second dose: 84% (77%-90%)¹⁸⁴ Pooled analysis of Moderna and Pfizer/BioNTech against hospitalisation or death: 98% (83-100)⁷⁴ Pooled Pfizer/BioNTech and Moderna against hospitalisation in Scotland: 92% (85-99)⁵⁶ USA: 88% (85-91)⁶⁵ Netherlands: Hospitalisation: 96% (95-96)⁵⁵ USA: Hospitalisation: 93% (84-96)⁸¹ Spain: Hospitalisation: 93% (88-96)⁴⁰ Scotland: Death: 90% (83-94)⁶⁰ Moderna and Pfizer/BioNTech in British Columbia and Quebec, Canada: Hospitalisation: 98% (97-98); 97% (96-97)⁴⁸ Death in veterans in USA: <65 years: 84.3% (76.3-89.7); ≥65 years: 70.1% (66.1-73.6)⁸⁷ Israel: Booster ≥5 months after the primary series: Hospitalisation: 93%; Death 81%⁸⁵ USA: Hospitalisation: Delta: 2 doses <3 months: 88% (71-95); ≥6 months: 74% (65-80); 3 doses <3 months: 95% (91-97); ≥3 months: 65% (16-85) Omicron: 2 doses: <3 months: 70% (41-84); ≥6 months: 68% (56-76); 3 doses: <3 months: 89% (83-92); ≥3 months: 90% (57-98)⁹⁰ USA: Moderna and Pfizer: Hospitalisation: Delta: 2 doses: <6 months: 90% (89-90); ≥6 months: 81% (80-82); 3 doses: 94% (93-95); Omicron: 2 doses: <6 months: 81% (65-90); ≥6 months: 57% (39-70); 3 doses: 90% (80-94)¹⁸⁵ England: Hospitalisation: 2-9 weeks: 98.7% (98.3-99.0); ≥20 weeks: 91.7% (90.2-93.0); Death: 2-9 weeks: 98.5% (96.5-99.3); ≥20 weeks: 91.9% (88.5-94.3)⁵²</p> | <p>Pooled analysis of Moderna and Pfizer/BioNTech vaccines in USA: Infections in nonvaccinated: 234 of 8969; 2.61% (2.29-2.96) Fully vaccinated: 4/8121; 0.05% (0.01-0.13)¹⁸⁶ Pooled analysis of Moderna and Pfizer/BioNTech vaccines in USA: Fully vaccinated: 90% (68-97); Two weeks after first dose: 80% (59-90)¹⁸⁷ Symptomatic infection in Israel: 94% (87-98)⁸⁴ Any infection in Israel: 90% (79-95)⁸² Israel: Any infection: 95.3% (94.9-95.7); Symptomatic infection: 97.0% (96.7-97.2)⁸³ Pooled analysis of Pfizer/BioNTech and AstraZeneca vaccines in elderly care home residents in UK: 4 weeks after first dose: 56%; 5 weeks after first dose: 62%¹⁸¹ Documented infection in Israel: incidence decreased from 9.4 infections per 1,000 HCWs in the week following first dose to <1.0 infection per 1,000 HCWs per week from 1 week after the second dose¹⁸⁹ Pooled analysis of Pfizer/BioNTech and AstraZeneca vaccines: reduced odds of infection post-second dose: 70% (62-77)¹⁸² Spain: Any infection: 65% (56-73); Symptomatic infection: 82% (73-88)⁵³ Infection in priority groups in Denmark: 82% (79-84)⁷⁶ USA: Symptomatic infection: 84% (75-90)⁸⁵ Denmark: Infection in care facility residents: >14 days after first dose: 17% (4-28); >7 days after second dose: 64% (14-84)⁷⁷ USA: Single dose against infection in 2 care facilities: 63% (33-79)⁷⁸ A care facility in USA: Infection 66% (41-81); Symptomatic illness 87% (66-95)⁷⁹ Pooled analysis of AstraZeneca, Pfizer/BioNTech and Moderna vaccines in Italy: Infection: 78% (76-79)¹⁸⁰ Uruguay: Infection: 78.1% (77.0-79.1)⁸⁷ Israel: Infection: 93.0% (92.6-93.4)⁸⁸ Single dose against symptomatic disease in the UK: Age 15-39 years: 61% (56-66)⁷⁵ Symptomatic infection in multiple European countries: single dose: 61% (39-75); 2 doses: 87% (74-93)⁵⁴ Symptomatic infection in 16-64 years in UK: single dose: 48.6% (27.9-63.3); 2 doses: 93.3% (85.8-96.8)⁴⁵ Symptomatic infection in Chile: 87.7% (87.3-88.1)⁴⁶ Minnesota, USA: January to July 2021 (Delta variant <0.7% in May): Infection: 76% (69-81); Hospitalisation: 85% (73-93) July (Delta variant >70%): Infection: 42% (13-62); Hospitalisation: 75% (24-94)⁶⁸ Infection in USA (98% vaccines used Pfizer/BioNTech and Moderna): Pre-Delta variant predominant: 91% (81-96); Delta variant predominant: 66% (26-84)⁸⁸ Infection in Canada: 1 dose: 59% (55-62); 2 doses: 91% (88-93)⁷⁴ Any infection with Delta in USA: 1 month after vaccination: 93% (85-97); 4 months: 53% (39-65)⁸¹ Spain: Any infection: 69% (66-72); Symptomatic infection: 72% (69-75)⁴⁰ Moderna and Pfizer/BioNTech in British Columbia and Quebec, Canada: Symptomatic infection: 90% (89-90); 88% (88-89)⁴⁸ Symptomatic infection in veterans in USA: 91% (91-92) England REACT-1 study: Any infection: 71.3% (56.6-81.0)⁴¹ Infection in veterans in USA: March: 86.9% (86.5-87.3); September: 43.3% (41.9-44.6)⁶⁷ UK: Symptomatic infection: 2-9 weeks: 88.2% (86.7-89.5); 15-19 weeks: 72.2% (71-73.4); 20-24 weeks: 64.8% (62.6-66.9); ≥25 weeks: 63.5% (61.4-65.5)⁴⁹ England: Omicron: Symptomatic infection: Single dose: 2% (-7-11); 2 doses: -18% (-26-11); Delta: Single dose: 33.1% (32.7-33.6); 2 doses: 55.9% (55.5-56.3)⁵⁰ Denmark: Effectiveness against infection: Omicron: First month: 55.2% (23.5-73.7); Third month: 9.8% (-10.0-26.1); Booster first month: 54.6% (30.4-70.4); Delta: First month: 86.7% (84.6-88.6); Third month: 72.8% (71.7-73.8); Booster first month: 81.2% (79.2-82.9)⁷² England: Symptomatic infection: 2-9 weeks: 89.7% (89.5-89.8); ≥20 weeks: 66.3% (65.7-66.9)⁵² Wales: Any infection: Single dose: 52% (45-58); 2 doses: 2-5 weeks: 86% (79-91); ≥26 weeks: 45% (39-51)⁸⁶</p> |
| Sinovac | <p>Uruguay: Hospitalisation: 90.9% (88.6-92.7); Death: 94.7% (93.4-95.7)⁸⁷ Chile: Hospitalisation: 86.0% (85.6-86.5); ICU admission: 89.7% (89.1-90.2); Death: 86.4% (85.6-87.2)⁴⁶</p> | <p>Uruguay: Infection: 59.9% (59.1-60.7)⁸⁷ Symptomatic infection in Chile: 58.5% (58.0-59.0)⁴⁶ Brazil: Infection: 52.7% (52.1-53.4); Hospitalisation: 72.8% (71.8-73.7); Death: 73.7% (72.3-75.0)⁴³</p> |
| Sinopharm | - | Symptomatic infection in Bahrain: 90% (88-91) ³³ |
| Bharat Biotech | - | India: Symptomatic infection: 50% (33-62) ⁸¹ |

Appendix 2: Vaccine Efficacy/Effectiveness Against Variants

Refer to Appendix 1 for vaccine effectiveness results for the Pfizer/BioNTech vaccine in Scotland, England and Israel, where all locations had predominant B.1.1.7 circulation. There are four Variants of Concern listed by WHO.¹⁹⁰ The WHO recommends labelling SARS-CoV-2 variants with letters of the Greek alphabet, as in the tables below.¹⁹¹

| VACCINE | VACCINE EFFICACY/EFFECTIVENESS (EFFECTIVENESS AGAINST INFECTION UNLESS SPECIFIED) | | |
|-------------------|---|--|--|
| | B.1.1.7 (ALPHA) VARIANT | B.1.351 (BETA) VARIANT | P.1 (GAMMA) VARIANT |
| AstraZeneca | UK: 70.4% (43.6-84.5) (vs. 81.5% (67.9-89.4) against wild variant) ¹⁹² England: ≥21 days after one dose: 48.7% (45.2-51.9); ≥14 days after two doses: 74.5% (68.4-79.4) ³⁷ Scotland: 73% (66-78) ³⁸ Canada: Single dose: 64% (60-68) ⁴⁴ UK: Single dose: 63% (55-69); 2 doses: 79% (56-90) ³⁹ Severe disease in Canada: Single dose: 85% (81-88) ⁴⁴ | South Africa: 10.4% (-76.8 to 54.8) ¹⁹³ Study against severe disease underway ²³ | Brazil: Symptomatic infection: Single dose: 37.6% (37.3-37.9); 2 doses 2-3 weeks: 69.8% (69.3-70.4); 2 doses 18-19 weeks: 57.7% (55.4-60.0); Hospitalisation or death: Single dose: 57.9% (56.9-58.9); 2 doses 2-3 weeks: 86.4% (85.4-87.3); 2 doses 18-19 weeks: 42.2% (32.4-50.6) ⁵¹ |
| Johnson & Johnson | - | Moderate to severe/critical: 64.0% (41.2-78.7) Severe/critical: 81.7% (46.2-95.4) ²³ Efficacy against hospitalisation in South Africa: 67% ²⁵ | Moderate to severe/critical: 68.1% (48.8-80.7); Severe/critical: 87.6% (7.8-99.7) ²³ |
| Moderna | Canada: Single dose: 83% (80-86); 2 doses: 92% (86-96) ⁴⁴ Severe disease in Canada: Single dose: 79% (74-83); 2 doses: 94% (89-97) ⁴⁴ | - | - |
| Novavax | UK: 86.3% (71.3-93.5) (vs. 96.4% (73.8-99.5) against wild variant) ³⁹ | South Africa: 51.0% (-0.6 to 76.2) ¹⁹⁴ | - |
| Pfizer/BioNTech | Case-control study in Israel: After one dose, vaccinees were disproportionately infected with B.1.1.7 (OR: 26:10) ¹⁹⁵ Qatar: 89.5% (85.9-92.3) ¹⁹⁶ England: ≥21 days after one dose: 47.5% (41.6 to 52.8) ≥14 days after second dose: 93.7% (91.6-95.3) ³⁷ Scotland: 92% (90-93) ³⁸ Canada: Single dose: 66% (64-68); 2 doses: 89% (86-91) ⁴⁴ UK: Single dose: 59% (52-65); 2 doses: 78% (68-84) ³⁹ Severe disease in Qatar: 100% (81.7-100) ¹⁹⁶ Severe disease in Canada: Single dose: 80% (78-82); 2 doses: 95% (92-97) ⁴⁴ | Israel case-control study: Vaccinees infected at least 1 week after the second dose were disproportionately infected with B.1.351 (odds ratio: 8:1) ¹⁹⁵ Qatar: 75.0% (70.5-78.9) ¹⁹⁶ South Africa: 100% (53.5-100) ³² Severe disease in Qatar: 100% (73.7-100) ¹⁹⁶ | - |
| Sinovac | Chile: 67% (65-69) ³³ | - | Brazil: 1 or 2 doses: 37.9% (-46.4-73.6) ¹⁹⁷ Chile: 67% (65-69) ³³ Brazil: ≥70 years: 41.8% (26.9-53.3); 70-74 years: 61.8% (34.8-77.7); 75-79 years: 48.9% (23.3-66.0); ≥80 years: 28.0% (0.6-47.9) ¹⁹⁸ |

* While it is known P.1. and B.1.1.7 were circulating at the time of the study, the extent is unknown based on available surveillance

| VACCINE | VACCINE EFFICACY/EFFECTIVENESS (EFFECTIVENESS AGAINST INFECTION UNLESS SPECIFIED) | |
|-------------------|--|--|
| | B.1.617.2 (DELTA) VARIANT | OMICRON VARIANT |
| AstraZeneca | <p>England: ≥21 days after one dose: 30.0% (24.3-35.3); ≥14 days after second dose: 67.0% (61.3-71.8)³⁷</p> <p>Scotland: 60% (53-66)³⁸</p> <p>Canada: Single dose: 67% (44-80)⁴⁴</p> <p>UK: Single dose: 46% (35-55); 2 doses: 67% (62-71)³⁹</p> <p>Symptomatic infection in England: 66.7% (66.3-67.0)⁴⁷</p> <p>Hospitalisation in England: 1 dose: 71% (51-83); 2 doses: 92% (75-97)³⁸; 93.9% (91.3-95.7)⁴⁷</p> <p>Death in England: 94.1% (81.8-95.8)⁴⁷</p> <p>Severe disease in Canada: Single dose: 88% (60-96)⁴⁴</p> <p>Hospitalisation and death in Scotland: 88% (85-90)³⁷</p> <p>Scotland: Death: 91% (86-94)³⁰</p> <p>India: Any infection: 2 doses: 63.1% (51.5-72.1); Single dose: 46.2% (31.6-57.7); Moderate-severe: 2 doses: 81.5% (9.9-99.0); Single dose: 79.2% (46.1-94.0)⁴²</p> <p>UK: Symptomatic infection: 2-9 weeks: 76.2% (63.7-84.4); 15-19 weeks: 48.5% (44.7-52.0)</p> <p>20-24 weeks: 45.4% (43.0-47.6); ≥25 weeks: 41.8% (39.4-44.1)⁴⁹</p> <p>England: Symptomatic infection: 25% (24.3-25.7)⁵⁰</p> <p>Scotland: Symptomatic infection: Single dose: 37.6% (34.6-40.5); 2 doses 2-3 weeks: 67.9% (65.9-69.8); 2 doses 18-19 weeks: 44.6% (41.5-47.6); Hospitalisation or death: Single dose: 49.3% (43.3-54.6); 2 doses: 2-3 weeks: 83.7% (79.7-87.0); 2 doses 18-19 weeks: 63.7% (59.6-67.4)⁵¹</p> <p>England: Symptomatic infection: 2-9 weeks: 67.6% (67.3-67.9); ≥20 weeks: 44.3% (43.2-45.4); Hospitalisation: 2-9 weeks: 95.2% (94.7-95.7); ≥20 weeks: 80.0% (76.8-82.7); Death: 2-9 weeks: 95.0% (93.1-96.4); ≥20 weeks: 84.8% (76.2-90.3)⁵²</p> | <p>UK: No protective effect beyond 15 weeks⁴⁹</p> <p>England: Symptomatic infection: -39% (-50--30)⁵⁰</p> <p>England: Hazard ratio for hospitalisation with Omicron relative to primary Delta infection in unvaccinated: Single dose: 0.42; 2 doses: 0.37; 2 doses plus Pfizer booster: 0.21¹⁹⁹</p> |
| Johnson & Johnson | <p>Efficacy against hospitalisation in South Africa: 71%²⁵</p> <p>USA: Infection: 78% (73-82); Hospitalisation: 85% (73-91)⁶³</p> | <p>South Africa: Booster against hospitalisation: 85% (54-95)¹⁰⁰</p> |
| Moderna | <p>Canada: Single dose: 72% (57-82)⁴⁴</p> <p>Minnesota, USA: 76% (58-87)⁶⁸</p> <p>England: 95.2% (94.4-95.9)⁴⁷</p> <p>Severe disease in Canada: Single dose: 96% (72-99)⁴⁴</p> <p>Severe disease in Minnesota: 81% (33-96)⁶⁸</p> <p>Hospitalisation in England: 97.5% (82.3-99.7)⁴⁷</p> <p>Pooled Pfizer/BioNTech and Moderna against hospitalisation and death in Scotland: 91% (88-93)⁵⁷</p> <p>USA: Infection: 86.7% (84.3-88.7); Hospitalisation: 97.6% (92.8-99.2)⁷¹</p> <p>Denmark: First month: 88.2% (83.1-91.8); Third month: 72.2% (70.4-74.0); Booster first month: 82.8% (58.8-92.9)⁷²</p> <p>USA: Infection: Single dose: 60.2% (42.6-72.3); 2 doses: 14-90 days: 82.8% (69.6-90.3); 181-270 days: 61.4% (56.8-65.5); 3 doses: ≤2 months: 95.7% (94.2-96.9); >2 months: 90.7% (81.4-95.3); Hospitalisation: Single dose: 68.9% (0.0-99.4); 2 doses: 98.0% (87.2-99.7)⁷³</p> <p>Moderna and Pfizer in USA: Hospitalisation: 2 doses: <6 months: 90% (89-90); ≥6 months: 81% (80-82); 3 doses: 94% (93-95)¹⁶⁵</p> | <p>Denmark: First month: 36.7% (-69.9-76.4); Third month: 4.2% (-30.8-29.8)⁷²</p> <p>USA: Infection: Single dose: 20.3% (0.0-39.8); 2 doses: 14-90 days: 30.4% (5.0-49.0); 181-270 days: 0.0% (0.0-1.2); 3 doses: ≤2 months: 63.6% (57.4-68.9); >2 months: 39.1% (3.8-61.5)⁷³</p> <p>Moderna and Pfizer in USA: Hospitalisation: 2 doses: <6 months: 81% (65-90); ≥6 months: 57% (39-70); 3 doses: 90% (80-94)¹⁶⁵</p> |
| Pfizer/BioNTech | <p>England: ≥21 days after one dose: 35.6% (22.7-46.4); ≥14 days after second dose: 88.0% (85.3-90.1)³⁷</p> <p>Scotland: 79% (75-82)³⁸</p> <p>Canada: Single dose: 56% (45-64); 2 doses: 87% (64-95)⁴⁴</p> <p>Effectiveness in Israel: Infection: 64%; Symptomatic illness: 64%²⁰⁰</p> <p>Israel 6m after roll out: 39.0% (9.0-59.0)⁸⁰</p> <p>Minnesota, USA: 42% (13-62)⁶⁸</p> <p>UK: Single dose: 57% (50-63); 2 doses: 80% (77-83)³⁹</p> <p>England: 89.8% (89.6-90.0)⁴⁷</p> <p>Hospitalisation in England: 1 dose: 94% (46-99); 2 doses: 96% (86-99)⁵²; 99.7% (97.6-100.0)⁴⁷</p> <p>Death in England: 98.2% (95.9-99.2)⁴⁷</p> <p>Severe disease in Canada: Single dose: 78% (65-86)⁴⁴</p> <p>Hospitalisation in Israel: 93%²⁰⁰</p> <p>Severe disease in Israel: 91.4% (82.5-95.7)⁸⁰</p> <p>Severe disease in Minnesota: 75% (24-94)⁶⁸</p> <p>Pooled Pfizer/BioNTech and Moderna against hospitalisation and death in Scotland: 91% (88-93)⁵⁷</p> <p>Scotland: Death: 90% (83-94)⁸⁰</p> <p>UK: Symptomatic infection: 2-9 weeks: 88.2% (86.7-89.5); 15-19 weeks: 72.2% (71-73.4); 20-24 weeks: 64.8% (62.6-66.9); ≥25 weeks: 63.5% (61.4-65.5)⁴⁹</p> <p>Denmark: First month: 86.7% (84.6-88.6); Third month: 72.8% (71.7-73.8); Booster first month: 81.2% (79.2-82.9)⁷²</p> <p>USA: Hospitalisation: 2 doses: <3 months: 88% (71-95); ≥6 months: 74% (65-80); 3 doses: <3 months: 95% (91-97); ≥3 months: 65% (16-85)⁹⁰</p> <p>Moderna and Pfizer in USA: Hospitalisation: Delta: 2 doses: <6 months: 90% (89-90); ≥6 months: 81% (80-82); 3 doses: 94% (93-95)¹⁶⁵</p> <p>England: Symptomatic infection: 2-9 weeks: 89.7% (89.5-89.8); ≥20 weeks: 66.3% (65.7-66.9); Hospitalisation: 2-9 weeks: 98.7% (98.3-99.0); ≥20 weeks: 91.7% (90.2-93.0); Death: 2-9 weeks: 98.5% (96.5-99.3); ≥20 weeks: 91.9% (88.5-94.3)⁵²</p> | <p>UK: Symptomatic infection: Single dose: 34.2% (-3.5-58.1); 2 doses: 2-9 weeks: 88.0% (65.9-95.8); 15-19 weeks: 34.1% (0.7-52.0); Booster after PF primary series: 75.5% (56.1-86.3); Booster after AZ primary series: 71.4% (41.8-86.0)⁹⁰</p> <p>South Africa: Symptomatic infection: 33%; Hospitalisation: 70% (risk of hospital admission 29% lower for Omicron compared to first wave in mid-2020, adjusted for vaccination status)¹⁰¹</p> <p>England: Hazard ratio for hospitalisation with Omicron relative to primary Delta infection in unvaccinated: Single dose: 0.66; 2 doses: 0.26; 3 doses: 0.37¹⁹⁹</p> <p>Denmark: First month: 55.2% (23.5-73.7); Third month: 9.8% (-10.0-26.1); Booster first month: 54.6% (30.4-70.4)⁷²</p> <p>USA: Effectiveness against hospitalisation: 2 doses: <3 months: 70% (41-84); ≥6 months: 68 (56-76); 3 doses: <3 months: 89% (83-92); ≥3 months: 90% (57-98)⁹⁰</p> <p>Moderna and Pfizer in USA: Hospitalisation: Omicron: 2 doses: <6 months: 81% (65-90); ≥6 months: 57% (39-70); 3 doses: 90% (80-94)¹⁶⁵</p> |

| | | |
|-----------------------|--|---|
| Sinovac | China (combined Sinovac and Sinopharm): Single dose: 13.8% (-60.2-54.8); 2 doses: 59.0% (16.0-81.6) Severe disease: 100% ²⁰¹ | - |
| Sinopharm | China (combined Sinovac and Sinopharm): Single dose: 13.8% (-60.2-54.8); 2 doses: 59.0% (16.0-81.6) Severe disease: 100% ²⁰¹ | - |
| Bharat Biotech | Efficacy against infection in India: 65.2% (33.1-83.0) ¹⁸ India: Symptomatic infection: 50% (33-62) ⁶¹ | - |
| Clover | Efficacy in Philippines, Colombia, Brazil, South Africa and Belgium: Symptomatic infection: 78.7% (57.3-90.4); Mod-Severe: 81.7% (35.9-96.6) ¹⁹ | - |

Appendix 3: Vaccine Efficacy/Effectiveness and Immunogenicity of Boosters Against Delta

Booster refers to an additional dose administered at least 5 months after completion of the primary series.
Booster efficacy/effectiveness reported relative to primary series (not unvaccinated) unless otherwise specified.

| VACCINE | IMMUNOGENICITY | VACCINE EFFECTIVENESS UNLESS OTHERWISE STATED | | | |
|-------------------|--|---|--|---|---|
| | | ANY INFECTION | SYMPTOMATIC INFECTION | HOSPITALISATION | DEATH |
| Johnson & Johnson | Strong antibody response ⁹¹ | - | - | - | - |
| Moderna | Strong antibody response ⁹¹ | USA (relative to unvaccinated): Delta: ≤2 months: 95.7% (94.2-96.9); >2 months: 90.7% (81.4-95.3) ⁷³ | England (after Pfizer primary series): Relative to primary series at least 6 months earlier: 86.8% (81.5-90.5); relative to unvaccinated: 94.8% (92.7-96.3) ⁹² | Moderna and Pfizer in USA: 94% (93-95) ¹⁸⁵ | - |
| Pfizer/BioNTech | Strong antibody response ⁹¹ | Israel; Infection ~10 times lower in boosted group (range across five age groups, 9.0 to 17.2) ⁹⁶ Denmark (relative to unvaccinated): First month: 54.6% (30.4-70.4) ⁷² | Efficacy: ≥6 months (median 10.8 months) in USA, South Africa, Brazil: 95.3 (89.5-98.3) ⁹³ UK: Relative to primary series at least 4.6 months earlier: PF primary: 84.4% (82.8-85.8); AZ primary: 87.4% (84.9-89.4); Relative to unvaccinated: PF primary: 94.0% (93.4-94.6); AZ primary: 93.1% (91.7-94.3) ⁹⁴ UK: relative to unvaccinated: PF primary: 92.6% (92.0-93.1); AZ primary: 93.8% (93.2-94.3) ⁴⁹ England: PF primary: 88.6% (88.1-89.1) AZ primary: 89.7% (88.9-90.4) ⁵³ England: Relative to primary series at least 6 months earlier: 85.6% (84.9-86.3); relative to unvaccinated: 94.4% (94.1-94.7) ⁹² | Israel ≥5 months: 93% (88-97) ⁹⁵ Israel: Severe disease: ≥60 years: 17.9 times lower in boosted group (15.1-21.2); 40-59 years: 21.7 times lower (10.6-44.2) ⁹⁶ USA: <3 months: 95% (91-97); ≥3 months: 65% (16-85) ⁹⁰ Moderna and Pfizer in USA: 94% (93-95) ¹⁸⁵ England: Relative to unvaccinated: 98.6 (98.0 to 99.0) ⁹² | Israel ≥5 months: 81% (59-97) ⁹⁵ Israel ≥5 months: 90% (86-93) ²⁰² Israel ≥60 years: mortality 14.7 times lower in boosted group: (10.0-21.4) ⁹⁸ England: Relative to unvaccinated: 98.7% (97.4-99.4) ⁹² |
| Sinovac | Strong antibody response ⁹⁸ | - | Chile: 78.8% (76.8-80.6) ⁹⁹ | Chile: 86.3% (83.7-88.5) ⁹⁹ | Chile: 86.7% (80.5-91.0) ⁹⁹ |

Appendix 4: Vaccine Efficacy/Effectiveness in High-Risk Groups

| VACCINE | VACCINE EFFICACY UNLESS OTHERWISE STATED | | | |
|-------------------|--|--|--|---|
| | DIABETES | OBESITY | AT RISK FOR SEVERE COVID-19 | ELDERLY |
| AstraZeneca | - | - | 76% against symptomatic infection in a sample where 60% had comorbidities, including diabetes, severe obesity or cardiac disease ¹⁷ (not peer-reviewed) Effectiveness against symptomatic infection in the UK in those with comorbidities and ≥65 years: Single dose: 60.0% (46.5-70.1); 2 doses: 79.7% (61.6-89.3) ⁴⁵ Hospitalisation in Scotland: 63% (46-75) ²⁶ | In ≥65 years: 85% ¹⁷ (not peer-reviewed) Effectiveness against hospitalisation at 28-34 days after a single dose (pooled analysis of AstraZeneca and Pfizer vaccines): 18-64 years: 85% (68-93); 65-79 years: 79% (17-95); ≥80 years: 81% (65-90) ³⁰ Effectiveness of single dose against hospitalisation in England: ≥80 years: 73% (60-81) ¹⁰⁴ Effectiveness in England: Symptomatic infection ≥70 years: 73% (27-90); Hospitalisation ≥80 years: 37% (3-59) ¹⁰³ Hospitalisation following single dose in the UK: ≥80 years: 80.4% (36.4-94.5) ¹⁰² Single dose in Spain: ≥60 years: 53% (19-72) vs. 18-59 years: 50% (34-62) ⁵³ Effectiveness against death in the UK: ≥65 years: Single dose: 83% (78-86); Two doses: 94% (80-98) ⁷⁵ Effectiveness against symptomatic infection in the UK, ≥65 years: single dose: 60.9% (49.0-70.0); 2 doses: 76.4% (58.8-86.5) ⁴⁵ Effectiveness against death in Scotland ≥60 years: 90% (84-94) ⁵⁰ British Columbia and Quebec, Canada: Symptomatic infection ≥70 years: 73% (42-88); 81% (74-86) ⁴⁸ Brazil: Infection: 80-89 years: 73.1% (71.2-74.9); ≥90 years: 39.0% (23.5-51.4); Hospitalisation: 80-89 years: 85.1% (83.0-86.9); ≥90 years: 50.9% (31.3-64.9); Death: 80-89 years: 89.9% (87.7-91.7); ≥90 years: 65.4% (46.1-77.8) ⁴³ England: ≥65 years: Symptomatic infection: 2-9 weeks: 59.1% (55.4-62.6); ≥25 weeks: 27.8% (16.3-37.8); Hospitalisation: 2-9 weeks: 91.7% (88.8-93.9); ≥20 weeks: 81.8% (76.6-85.9); Death: 2-9 weeks: 94.1% (89.6-96.7); ≥20 weeks: 82.1% (70.1-89.3) ⁵² |
| Gamaleya | - | - | - | Symptomatic infection ≥60 years: 91.8% (67.1-98.3) ²⁰ |
| Johnson & Johnson | Moderate to severe/critical: 23.0% (-90.1-69.8) ²³ | Moderate to severe/critical: 65.9% (47.8-78.3) ²³ | Moderate to severe/critical: With any comorbidity: 58.6% (40.6-71.6) ²³ No comorbidity: 68.8% (59.0-76.6) ²³ | Moderate-severe/critical disease ≥28 post vaccination: 18-59 years: 66.1% (53.3-75.8) 60+ years: 66.2% (36.7-83.0) ²³ |
| Moderna | - | - | Symptomatic infection, comorbidities, including diabetes and obesity: In low risk: 95.1% (89.6-97.7) In high risk: 90.9% (74.7-96.7) ²⁸ Pooled Pfizer/BioNTech and Moderna against hospitalisation in Scotland: 72% (51-84) ²⁵ Netherlands: Hospitalisation in a population at high risk for severe COVID-19: 84% (80-87) ⁵⁷ | Symptomatic infection: 18-64 years: 95.6% (90.6-97.9) ≥65 years: 86.4% (61.4-95.2) ²⁵ Pooled Moderna and Pfizer vaccines against hospitalisation ≥65 years: 94% (49-99) ²⁰³ Infection in Canada: 1 dose ≥70 years: 54% (31-69); 2 doses ≥70 years: 95% (83-98) ⁷⁴ Pooled Moderna and Pfizer vaccines in Portugal: Hospitalisation 65-79 years: 94% (88-97); ≥80 years: 82% (72-89); Death 65-79 years: 96% (92-98); Death ≥80 years: 81% (74-87) ²⁵⁴ USA: Hospitalisation: ≥65 years: 75.2% (59.6-84.8) vs 18-64 years: 87.9% (85.5-89.9) ⁷¹ USA: Effectiveness against infection: Delta ≥65 years: 97.2% (94.1-98.7); Omicron ≥65 years: 57.1% (14.2-78.6) ⁷³ |
| Pfizer/BioNTech | Effectiveness in Israel: Diabetes or cardiovascular disease: 82% (62-92) ⁶² Effectiveness against infection in Israel: 88.9% (87.3-90.2) ⁸⁸ | Effectiveness against infection in Israel: (89.7% (88.6-90.7)) ⁸⁸ | Symptomatic infection: With any comorbidity or obesity: 95.3% With no comorbidity: 94.7% ³¹ Denmark: Infection: 71% (58-80); Hospitalisation: 81% (49-93) ⁵⁶ Effectiveness against infection in Israel: Hypertension: (89.7% (88.6-91.7)) ⁸⁸ Effectiveness against symptomatic infection in the UK in those with comorbidities and ≥65 years: Single dose: 56.4% (46.2-64.6) 2 doses: 88.5% (81.5-92.9) ⁴⁵ Pooled Pfizer/BioNTech and Moderna against hospitalisation in Scotland: 72% (51-84) ²⁵ | Efficacy against infection ≥75 years: 96.2% (76.9-99.9) ³² Mympomatic infection: >55 years: 93.7% (80.6-98.8); >65 years: 94.7% (66.7-99.9); >75 years: 100% (-13.1-100) ³¹ Effectiveness against hospitalisation 28-34 days after a single dose (pooled analysis of AstraZeneca and Pfizer vaccines): 18-64 years: 85% (68-93); 65-79 years: 79% (17-95); ≥80 years: 81% (65-90) ³⁰ England 80-83 years: Documented infection: 70.1% (56.1-80.1) Hospital attendance: 78.9% (60.0-89.9); Hospital admission: 75.6% (52.8-87.6) ¹⁰⁵ Reduction in incidence of infection in vaccinated people aged ≥60 years and unvaccinated people aged 20-39 years, respectively: Documented infection: 45% versus 28%; Hospitalisation: 68% versus 22% ²⁰⁵ Pooled Moderna and Pfizer vaccines against hospitalisation ≥65 years: 94% (49-99) ²⁰³ Effectiveness in England: Symptomatic infection ≥70 years: 61% (51-69); Hospitalisation ≥80 years: 43% (33-52); Death ≥80 years (vaccine failure vs non-vaccinated): 51% (37-62) ¹⁰³ Effectiveness against hospitalisation in England ≥80 years: Single dose: 81% (76-85) Fully vaccinated: 93% (89-95) ¹⁰⁴ (not peer reviewed) Effectiveness in Israel: 65-74 years: 82% (63-92); ≥75 years: 82% (61-91) ⁸² Hospitalisation following single dose in the UK: ≥80 years: 71.4% (43.1-86.2) ¹⁰² Single dose in Spain: ≥60 years: 76% (55-87) vs. 18-59 years: 85% (74-91) ⁵³ Effectiveness against infection in Denmark: ≥80 years: 77% (50-89) ⁵⁸ Effectiveness against infection in Israel: ≥70 years: 89.1% (83-93) ⁸⁸ Effectiveness against death in the UK: ≥65 years: Single dose: 77% (72-81); Two doses: 98% (94-99) ⁷⁵ Effectiveness against symptomatic infection in the UK, ≥65 years: single dose: 56.6% (47.6-64.1); 2 doses: 86.7% (80.1-91.1) ⁴⁵ Infection in Canada: 1 dose ≥70 years: 40% (29-50); 2 doses ≥70 years: 93% (82-98) ⁷⁴ Pooled Moderna and Pfizer vaccines in Portugal: Hospitalisation 65-79 years: 94% (88-97); ≥80 years: 82% (72-89); Death 65-79 years: 96% (92-98); Death ≥80 years: 81% (74-87) ²⁵⁴ Effectiveness against death in Scotland ≥60 years: 87% (77-93) ⁵⁰ England: ≥65 years: Symptomatic infection: 2-9 weeks: 79.6% (77.0-81.8); ≥25 weeks: 51.8% (45.4-57.4); Hospitalisation: 2-9 weeks: 98.0% (95.9-99.1); ≥20 weeks: 90.5% (87.6-92.7); Death 2-9 weeks: 97.1% (91.7-99.0); ≥65 years, ≥20 weeks: 90.2% (85.3-93.5) ⁵² |
| Novavax | - | - | Any infection with comorbidity, age ≥65 years or frequent COVID-19 exposure in USA and Mexico: 91.0% (83.6-95.0) ³⁰ | - |
| Sinovac | - | 74.9% (53.7-86.4) ³³ | Any comorbidity: 48.9% (26.6-64.5) ³³ | Brazil: Infection: 80-89 years: 55.6% (53.3-57.8); ≥90 years: 27.6% (20.5-34.0); Hospitalisation: 80-89 years: 63.5% (60.4-66.3); ≥90 years: 31.8% (21.9-40.5); Death: 80-89 years: 67.2% (63.6-70.5); ≥90 years: 33.6% (21.9-43.5) ⁴³ |
| Sinopharm | - | 80.7% (56.7-91.4) ³³ | - | Effectiveness against symptomatic infection in Bahrain: ≥60 years: 91% (87-94) ³³ |
| Bharat Biotech | - | - | Any infection with comorbidity: 66.2% (33.8-84.0) ¹⁸ | Symptomatic infection in India: ≥60 years: 67.8% (8.0-90.0) vs 18-59 years: 79.4% (66.0-88.2) ¹⁸ |



Appendix 5: Vaccine Efficacy/Effectiveness Against Transmission

There are limitations related to the analysis and comparison of transmission data between studies and vaccines. Criteria for testing vary between studies and may include, for example, random testing, testing at defined intervals, or retrospective serology.

| VACCINE | EFFICACY/EFFECTIVENESS AGAINST ASYMPTOMATIC INFECTION | OTHER OUTCOMES |
|-------------------|--|--|
| AstraZeneca | <p>EFFICACY (UK only): 22.2% (-9.9-45.0); Symptomatic and asymptomatic combined (UK, SOUTH AFRICA & BRAZIL): 54.1% (44.7-61.9)¹⁶</p> <p>ENGLAND: Hazard ratio for single dose in vaccinated vs. unvaccinated care facility residents: 0.32 (0.15-0.66)²⁰⁵;</p> <p>Odds ratio for household contacts of vaccinated vs non-vaccinated health workers testing positive: 0.52 (0.43-0.62)²⁰⁷</p> <p>Effectiveness against household transmission of Delta: 42% (14-69); Vaccination of household contacts against infection from a symptomatic household index case: 14% (-5-46)²⁰⁸</p> <p>UK: Regular testing of randomly selected households: 79% (65-88)²⁰⁹; Single dose against symptomatic and asymptomatic infection: 60% (49-68)²¹⁰</p> <p>NETHERLANDS: Effectiveness against transmission (secondary attack rate among household contacts): 58% (-12-84)⁹⁹</p> | <p>SCOTLAND: POOLED ANALYSIS OF PFIZER/BIONTECH AND ASTRAZENECA: Hazard ratio for household contacts of vaccinated vs non-vaccinated health workers testing positive: 0.70 (0.63-0.78)²¹¹</p> <p>PF and AZ: Secondary attack rates in household contacts in the UK: Vaccinated contacts: 25% (18-33); Unvaccinated contacts: 38% (24-53); Unvaccinated index cases: 23% (15-31); Vaccinated index cases: 25% (15-35)²¹²</p> |
| Bharat Biotech | <p>EFFICACY IN INDIA: Asymptomatic: 63.6% (29.0-82.4); Symptomatic and asymptomatic combined: 68.8% (46.7-82.5)¹⁸</p> | - |
| Johnson & Johnson | <p>EFFICACY (multiple countries): Asymptomatic infection: 59.7% (32.8-76.6)⁹³</p> <p>UK: Single dose against symptomatic and asymptomatic infection: 60% (49-68)²¹⁰</p> <p>Netherlands: Effectiveness against transmission (secondary attack rate among household contacts): 77% (6-94)⁹⁹</p> | <p>USA (Kentucky): OR for reinfection in unvaccinated vs vaccinated with Johnson & Johnson, Moderna or Pfizer/BioNTech): 2.34 (1.58-3.47)²¹³</p> |
| Moderna | <p>USA: Asymptomatic infection: 72.7% (53.4-84.0)⁹⁵</p> <p>USA: POOLED ANALYSIS OF PFIZER/BIONTECH AND MODERNA: 88.7% (68.4-97.1)²¹⁴; 90% (68%-97)²¹⁵; single dose: 80% (59-90)²¹⁵;</p> <p>Relative risk of infection in asymptomatic pre-surgical patients >10 days after first dose compared to unvaccinated residents: 0.21 (0.12-0.37)²¹⁶;</p> <p>Incident cases in unvaccinated nursing home residents decreased from 4.3% within 14 days of the first vaccination clinic to 0.3% after 42 days²¹⁷</p> <p>MODELLING: Reduced potential for transmission: at least 61%²¹⁸</p> <p>UK: Single dose against symptomatic and asymptomatic infection: 60% (49-68)²¹⁰</p> <p>Netherlands: Effectiveness against transmission (secondary attack rate among household contacts): 88% (50-97)⁹⁹</p> <p>USA: 63.0% (56.6-68.5)²²</p> <p>Qatar: First month after second dose: 73.1% (70.3-75.5); declining to no evidence of any effect by 4 months post-vaccination⁷⁰</p> | <p>USA (Kentucky): OR for reinfection in unvaccinated vs vaccinated with Johnson & Johnson, Moderna or Pfizer/BioNTech): 2.34 (1.58-3.47)²¹³</p> |
| Pfizer/BioNTech | <p>ENGLAND: 86% (76-97) 7 days after 2 doses; 72% (58-86) 21 days after 1 dose¹²⁶</p> <p>Effectiveness against household transmission of Delta: 31% (-3-61); Vaccination of household contacts against infection from a symptomatic household index case: 24% (-2-64)²⁰⁸</p> <p>ISRAEL: 92% (88-95)⁸⁴; 91.5% (90.7-92.2)⁸³; 65% (45-79%)¹²⁷; single dose: 75% (72-84)²¹⁹;</p> <p>Effectiveness against transmission: 88.5% (82.3-94.8)²²⁰; Effectiveness against infection in the household: 78% (30-94)²²¹</p> <p>USA: Asymptomatic screening: 90% (78-96)⁹⁵</p> <p>USA: POOLED ANALYSIS OF PFIZER/BIONTECH AND MODERNA: 88.7% (68.4-97.1)²¹⁴; 90% (68%-97)²¹⁵; single dose: 80% (59-90)²¹⁵;</p> <p>Relative risk of infection in asymptomatic pre-surgical patients >10 days after first dose compared to unvaccinated residents: 0.21 (0.12-0.37)²¹⁶;</p> <p>Incident cases in unvaccinated nursing home residents decreased from 4.3% within 14 days of the first vaccination clinic to 0.3% after 42 days²¹⁷</p> <p>UK: single dose: 4-fold decrease in risk amongst HCWs ≥12 days post-vaccination²²²; Regular testing of randomly selected households: 80% (73-85)²⁰⁹;</p> <p>Single dose against symptomatic and asymptomatic infection: 72% (63-79)²¹⁰; 60% (49-68)²¹⁰</p> <p>FINLAND: Effectiveness against transmission to unvaccinated household contacts: 2 weeks after first dose: 8.7% (-28.9-35.4); 10 weeks after first dose: 42.9% (22.3-58.1)²²³</p> <p>Netherlands: Effectiveness against transmission (secondary attack rate among household contacts): 70% (61-77)⁹⁹</p> <p>Finland: Effectiveness against transmission to unvaccinated household contacts of vaccinated cases: 42.9% (22.3-58.1)²²³</p> | <p>ISRAEL: Lower viral load in vaccine failure cases 12-37 days after the first dose of vaccine compared to within the first 11 days, indicating potentially lower infectiousness²²⁴;</p> <p>Data from 223 communities: strong correlation between community vaccination rate and a later decline in infection among children under 16 years of age who were unvaccinated²²⁵;</p> <p>Substantially decreased viral load for infections occurring 12-37 days after the first dose of vaccine, indicating likely lower infectiousness²²⁴</p> <p>Detectable transmission in long-term care facilities in Spain reduced by 90% (76-93)²²⁶</p> <p>ENGLAND: Odds ratio for household contacts of vaccinated health workers vs non-vaccinated health workers testing positive: 0.54 (0.47-0.62)²⁰⁷</p> <p>SCOTLAND: POOLED ANALYSIS OF PFIZER/BIONTECH AND ASTRAZENECA: Hazard ratio for single dose in vaccinated vs. unvaccinated care facility residents: 0.35 (0.17-0.71)²⁰⁶</p> <p>USA (Kentucky): OR for reinfection in unvaccinated vs vaccinated with Johnson & Johnson, Moderna or Pfizer/BioNTech): 2.34 (1.58-3.47)²¹³</p> <p>PF and AZ: Secondary attack rates in household contacts in the UK: Vaccinated contacts: 25% (18-33); Unvaccinated contacts: 38% (24-53); Unvaccinated index cases: 23% (15-31); Vaccinated index cases: 25% (15-35)²¹²</p> |

Appendix 6: Risk of Rare Unusual Blood Clotting with Low Platelets (Thrombosis with Thrombocytopenia Syndrome – TTS)

Estimated number of TTS that potentially might occur in Pacific Island Countries if all adults received the AstraZeneca or Johnson & Johnson vaccines, based on most recent official estimate of the adult population in each country and the incidence of these events in Europe and Australia.

| COUNTRY | TOTAL POPULATION | ESTIMATED POPULATION AGED 18 YEARS AND OVER* | POTENTIAL NUMBER OF TTS CASES IF ALL ADULTS IN EACH COUNTRY RECEIVED ASTRAZENECA VACCINE** | POTENTIAL NUMBER OF TTS CASES IF ALL ADULTS IN EACH COUNTRY RECEIVED JOHNSON & JOHNSON VACCINE*** |
|-------------------------------------|-------------------|--|--|---|
| American Samoa | 55,519 | 33,311 | <1 | <1 |
| Cook Islands | 15,300 | 9,180 | <1 | <1 |
| Federated States of Micronesia | 102,300 | 61,380 | 0.6-1.2 | <1 |
| Fiji | 867,000 | 520,200 | 5.2-10.4 | 1.6 |
| French Polynesia | 275,918 | 165,551 | 1.7-3.3 | <1 |
| Guam | 159,358 | 95,615 | 1.0-1.9 | <1 |
| Kiribati | 113,400 | 68,040 | 0.7-1.4 | <1 |
| Marshall Islands | 54,900 | 32,940 | <1 | <1 |
| Nauru | 10,900 | 6,540 | <1 | <1 |
| New Caledonia | 271,407 | 162,844 | 1.6-3.3 | <1 |
| Niue | 1,611 | 967 | <1 | <1 |
| Northern Mariana Islands | 53,883 | 32,330 | <1 | <1 |
| Palau | 18,000 | 10,800 | <1 | <1 |
| Papua New Guinea | 7,744,700 | 4,646,820 | 46.5-92.9 | 14.6 |
| Samoa | 195,979 | 117,587 | 1.2-2.4 | <1 |
| Solomon Islands | 642,000 | 385,200 | 3.9-7.7 | 1.2 |
| Tokelau | 1,160 | 696 | <1 | <1 |
| Tonga | 99,419 | 59,651 | 0.6-1.2 | <1 |
| Tuvalu | 10,507 | 6,304 | <1 | <1 |
| Vanuatu | 272,173 | 163,304 | 1.6-3.3 | <1 |
| Wallis and Futuna | 11,558 | 6,935 | <1 | <1 |
| All Pacific Island Countries | 10,976,992 | 6,586,195 | 65.9-131.7 | 20.8 |

* Based on estimate of 60% of population aged ≥18 years²²⁷

** Based on estimates of TTS occurring in ~1 in 100,000 vaccinated adults by the European Medicines Agency and ~1 in 50,000 in Australia^{10,11}

*** Based on estimates of TTS occurring in ~1 in 319,000 vaccinated adults in USA (may be an underestimate as only cerebral venous sinus thrombosis are reported)¹³