Scientific update on COVID-19

Updated on 22nd July 2021
Redaction committee

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Matthieu Mahevas – Inserm, AP-HP Henri-Mondor
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Benoît Visseaux – Inserm, AP-HP Bichat
Question:
- What are the types of vaccines in clinical evaluation?
- Which are the results of immunogenicity safety and efficacy of SARS CoV-2 vaccines?
- Can they protect against arising viral variants?
- Is there any security issues related to authorised vaccines
Vaccines aims: expose the immune system to an antigen that won’t cause disease, provoke an immune response (able to block/kill the virus)

Eight types of vaccines:
- virus (inactivated, weakened),
- viral vector (replicating, non replicating)
- nucleic acid (DNA, RNA)
- protein based (protein subunit, virus like particles)

Callaway E. Nature Apr 2020
**Vaccines**

- **R&D landscape**: WHO lists 184 candidates in preclinical development, 105 candidate vaccines in clinical evaluation (July 22\(^{nd}\) 2021); update available at:

  https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines

5 vaccines abandoned after trials: MSD-IAVI, MSD-Pasteur, Imperial College, University of Queensland, Altimmune

*From WHO COVID19 vaccine tracker*
<table>
<thead>
<tr>
<th>Institutes</th>
<th>Phase</th>
<th>Vaccine</th>
<th>Platform</th>
<th>Location</th>
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## Phase III/IV COVID-19 Vaccines (July 22nd 2021)

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Phase III/IV COVID-19 Vaccines (July 22nd 2021)

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<td>Not yet recruiting</td>
</tr>
<tr>
<td>BioNTech/Pfizer/Fosun Pharma</td>
<td>Phase III</td>
<td>BioNTech BNT162 (O2/b2.B.1.351)</td>
<td>RNA</td>
<td>Hong Kong</td>
<td>08/05/2021</td>
<td>31/08/2025</td>
<td>NCT04800138</td>
<td>Recruiting</td>
</tr>
</tbody>
</table>
# Phase III/IV COVID-19 Vaccines (July 22nd 2021)

<table>
<thead>
<tr>
<th>Institutes</th>
<th>Phase</th>
<th>Vaccine</th>
<th>Platform</th>
<th>Location</th>
<th>Start date</th>
<th>Primary completion date</th>
<th>Trial number</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valneva/Dynavax</td>
<td>Phase III</td>
<td>Valneva VLA2001/VLA2101</td>
<td>Inactivated</td>
<td>Pending</td>
<td>01/07/2021</td>
<td>31/12/2021</td>
<td>NCT04955224</td>
<td>Not yet recruiting</td>
</tr>
<tr>
<td>BioNTech/Pfizer/Fosun Pharma</td>
<td>Phase II/III</td>
<td>BioNTech BNT162 (b2)</td>
<td>RNA</td>
<td>USA, Brazil, South Africa, others</td>
<td>16/02/2021</td>
<td>25/07/2022</td>
<td>NCT04754594</td>
<td>Recruiting</td>
</tr>
<tr>
<td>BioNTech/Pfizer/Fosun Pharma</td>
<td>Phase III</td>
<td>BioNTech BNT162 (lyophilised b2)</td>
<td>RNA</td>
<td>USA</td>
<td>01/04/2021</td>
<td>06/07/2021</td>
<td>NCT48316669</td>
<td>Active, not recruiting</td>
</tr>
<tr>
<td>BioNTech/Pfizer/Fosun Pharma</td>
<td>Phase III</td>
<td>BioNTech BNT162 (b2) +/- 20vPnC</td>
<td>RNA</td>
<td>USA</td>
<td>29/05/2021</td>
<td>29/11/2021</td>
<td>NCT04882948</td>
<td>Recruiting</td>
</tr>
<tr>
<td>Wuxian Institute of Biological Products/Sinopharm</td>
<td>Phase III</td>
<td>WIBP vaccine</td>
<td>Inactivated</td>
<td>Morocco</td>
<td>02/09/2020</td>
<td>31/12/2020</td>
<td>ChiCTR20000390</td>
<td>Recruiting</td>
</tr>
<tr>
<td>Bharat Biotech/ICMR/National Institute of Virology</td>
<td>Phase II/III</td>
<td>Bharat Covaxin</td>
<td>Inactivated</td>
<td>India</td>
<td>26/05/2021</td>
<td>15/08/2021</td>
<td>NCT49318737</td>
<td>Recruiting</td>
</tr>
<tr>
<td>CanSino Biological Inc/Beijing Institute of Biotechnology</td>
<td>Phase III</td>
<td>CanSino Ad5-nCoV</td>
<td>Vector (non-replicating)</td>
<td>Russia</td>
<td>11/09/2020</td>
<td>30/05/2021</td>
<td>NCT04540419</td>
<td>Active, not recruiting</td>
</tr>
<tr>
<td>Osaka University/AnGeS/Takara Bio</td>
<td>Phase II/III</td>
<td>AnGeS AG0302-COVID19</td>
<td>DNA</td>
<td>Japan</td>
<td>23/11/2020</td>
<td>02/04/2021</td>
<td>NCT04655625</td>
<td>Active, not recruiting</td>
</tr>
<tr>
<td>BioNTech/Pfizer/Fosun Pharma/Moderna/NIAID</td>
<td>Phase III</td>
<td>BNT162/mRNA-1273</td>
<td>RNA</td>
<td>Switzerland</td>
<td>19/04/2021</td>
<td>31/07/2022</td>
<td>NCT04905125</td>
<td>Active, not recruiting</td>
</tr>
<tr>
<td>Inovio Pharmaceuticals/International Vaccine Institute</td>
<td>Phase II/III</td>
<td>Inovio INO-4800</td>
<td>DNA</td>
<td>USA</td>
<td>30/11/2020</td>
<td>30/09/2022</td>
<td>NCT04542636</td>
<td>Active, not recruiting</td>
</tr>
<tr>
<td>Gamaleya Research Institute</td>
<td>Phase II/III</td>
<td>Gamaleya Gam-COVID-Vac/Sputnik V</td>
<td>Vector (non-replicating)</td>
<td>Russia</td>
<td>06/07/2021</td>
<td>06/10/2022</td>
<td>NCT04954692</td>
<td>Recruiting</td>
</tr>
<tr>
<td>Moderna/NIAID</td>
<td>Phase III</td>
<td>Moderna mRNA-1273.211</td>
<td>RNA</td>
<td>USA</td>
<td>28/05/2021</td>
<td>05/06/2022</td>
<td>NCT04970765</td>
<td>Active, not recruiting</td>
</tr>
<tr>
<td>Moderna/NIAID</td>
<td>Phase III</td>
<td>Moderna mRNA-1273</td>
<td>RNA</td>
<td>USA</td>
<td>18/02/2021</td>
<td>25/08/2021</td>
<td>NCT04860397</td>
<td>Recruiting</td>
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<tr>
<td>CureVac</td>
<td>Phase III</td>
<td>CureVac CVCOV</td>
<td>RNA</td>
<td>Pending</td>
<td>14/05/2021</td>
<td>31/12/2021</td>
<td>NCT04833847</td>
<td>Not yet recruiting</td>
</tr>
<tr>
<td>Gamaleya Research Institute</td>
<td>Phase III</td>
<td>Gamaleya Gam-COVID-Vac/Sputnik V</td>
<td>Vector (non-replicating)</td>
<td>Belarus</td>
<td>28/09/2021</td>
<td>28/06/2021</td>
<td>NCT04604710</td>
<td>Active, not recruiting</td>
</tr>
<tr>
<td>University of Oxford/AstraZeneca/Gamaley Research Institute</td>
<td>Phase III</td>
<td>Oxford ChAdOx1-S</td>
<td>Vector (non-replicating)</td>
<td>Russia</td>
<td>02/09/2020</td>
<td>11/05/2021</td>
<td>NCT04540393</td>
<td>Suspended</td>
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<tr>
<td>University of Queensland/CSI/Seqirus</td>
<td>Phase II/III</td>
<td>Queensland ScIamp</td>
<td>Protein subunit</td>
<td>Not applicable</td>
<td>15/12/2020</td>
<td>15/12/2020</td>
<td>NCT04808529</td>
<td>Withdrawn</td>
</tr>
</tbody>
</table>
### BioNTech/Pfizer

**Study Design**: Phase I randomized controlled, dose-finding trial

<table>
<thead>
<tr>
<th>Age range</th>
<th>Nb of participants</th>
<th>Nb of doses/route</th>
<th>Vaccine groups</th>
<th>SAE</th>
<th>Local AE</th>
<th>Systemic AE</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 – 55 or 65 – 85</td>
<td>195</td>
<td>2 (days 1/21)-IM</td>
<td>10 μg BNT162b2 (S) 18–55y (n = 12)</td>
<td>None</td>
<td>Injection site pain, swelling</td>
<td>Headache, fatigue, chills, muscle pain, fever, joint pain, diarrhoea</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 μg BNT162b2 (S) 18–55y (n = 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 μg BNT162b2 (S) 18–55y (n = 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 μg BNT162b2 (S) 65–85y (n = 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 μg BNT162b2 (S) 65–85y (n = 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30 μg BNT162b2 (S) 65–85y (n = 12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BNT1621b (not used in Phase III)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Assay**: Luminex immunoassay

**Units**: Geometric mean concentration, U/mL (95% CI)

Antigen-binding IgG and virus-neutralizing responses to vaccination with 10 μg to 30 μg of BNT162b2 **boosted by the second dose** in both the younger adults and the older adults (lower antigen-binding IgG in elderly group)

**Phase I: [NCT04368728](https://clinicaltrials.gov/show/NCT04368728)**
2. Neutralizing responses

Assay: SARS-CoV-2 virus neutralisation test (mNeonGreen reporter strain), 50% inhibitory dilution
Units: Geometric mean response, ID50 (95% CI)

The 50% neutralizing at the 30-μg dose level on day 28 or day 35 ranged from 1.7 to 4.6 times the GMT of the convalescent serum panel among participants 18 to 55 years of age and from 1.1 to 2.2 times the GMT of the convalescent serum panel among those 65 to 85 years of age.
mRNA 1273

IMMUNOGENICITY AND SAFETY DATA

Modern-NIH

Phased I: NCT04283461

Study Design
- Phase I open-label, non-randomised, dose-finding trial

Age range
- 18 – 55

Nb of participants
- 45

Nb of doses/route
- 2 (days 1/29)-IM

Vaccine groups
- 25 μg (n = 15)
- 100 μg (n = 15)
- 250 μg (n = 15)

SAE
- None

Local AE
- Injection site pain (67–100% at ds1, 77–100% at ds 2)

Systemic AE
- Headache (20–47% at ds1, 23–100% at ds2), myalgia (7–27% at ds1, 23–93% at ds2), chills (8–86% at ds2), fatigue (27–33% at ds1, 39–80% at ds2), fever (0–57% at ds2), nausea (0–47% at ds 2)

1. GMHI* assay to spike protein in trial participants.

Assay: ELISA

Units: Geometric mean titre (95% CI)

<table>
<thead>
<tr>
<th>Time Point</th>
<th>25 μg Group</th>
<th>100 μg Group</th>
<th>250 μg Group</th>
<th>Convalescent Serum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>316 (72–187)</td>
<td>131 (65–266)</td>
<td>178 (83–392)</td>
<td>142,140</td>
</tr>
<tr>
<td>Day 43</td>
<td>391,018 (267,402–571,780)</td>
<td>781,999 (600,247–1,007,356)</td>
<td>3,261,975 (973,972–6,139,410)</td>
<td>3,974,629 (804,189–7,227,115)</td>
</tr>
<tr>
<td>Day 57</td>
<td>378,754 (281,587–512,152)</td>
<td>811,119 (656,334–1,002,404)</td>
<td>994,629 (804,189–1,227,115)</td>
<td>1,312,154 (942,878–1,536,669)</td>
</tr>
</tbody>
</table>

Binding antibody IgG geometric mean titers (GMTs) to S protein: seroconversion in all participants by day 15.

A recent study shows that mRNA 1273 vaccine induces specific IgG responses and NAb in adults older than 70 years of age. (Anderson EJ, NEJM 2020)

Jackson LA et al. NEJM. Jul 2020
mRNA 1273

IMMUNOGENICITY 2/2

2. Neutralizing responses
Assay: Plaque-reduction neutralization test (80% inhibitory dilution)
Units: Geometric mean response, ID80 (95% CI)

At day 43, wild-type virus–neutralizing activity capable of reducing SARS-CoV-2 infectivity by 80% or more (PRNT$_{80}$) detected in all participants, with geometric mean PRNT$_{80}$ responses of 339.7 (95% CI, 184.0 to 627.1) in the 25-μg group and 654.3 (95% CI, 460.1 to 930.5) in the 100-μg group.

3. Cellular responses: 25-μg and 100-μg doses elicit CD4 T-cell responses biased toward expression of Th1 cytokines (TNFα > IL2 > IFNγ).
Astrazeneca-Oxford University  Phase II: NCT04400838

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Phase II randomised controlled trial</th>
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</thead>
<tbody>
<tr>
<td>Age range</td>
<td>1: 18–55; 2: 56–69; 3: ≥70</td>
</tr>
<tr>
<td>Nb of participants</td>
<td>560</td>
</tr>
<tr>
<td>Nb of doses/route</td>
<td>1 (day 0) or 2 (days 0/28) - IM</td>
</tr>
<tr>
<td>Vaccine groups</td>
<td>18–55y: 2 x low dose (n = 50)</td>
</tr>
<tr>
<td></td>
<td>18–55y: 2 x std dose (n = 50)</td>
</tr>
<tr>
<td></td>
<td>56–69y: 1 x low dose (n = 30)</td>
</tr>
<tr>
<td></td>
<td>56–69y: 1 x std dose (n = 30)</td>
</tr>
<tr>
<td></td>
<td>56–69y: 2 x low dose (n = 30)</td>
</tr>
<tr>
<td></td>
<td>56–69y: 2 x std dose (n = 30)</td>
</tr>
<tr>
<td></td>
<td>≥70y: 1 x low dose (n = 50)</td>
</tr>
<tr>
<td></td>
<td>≥70y: 1 x std dose (n = 50)</td>
</tr>
<tr>
<td></td>
<td>≥70y: 2 x low dose (n = 50)</td>
</tr>
<tr>
<td></td>
<td>≥70y: 2 x std dose (n = 50)</td>
</tr>
<tr>
<td>Control group:</td>
<td>MenACWY (n = 534)</td>
</tr>
</tbody>
</table>

SAE  13 serious adverse events have occurred none of which are considered related to either study vaccine as assessed by the investigators (Ph III trial suspended and resumed in Sep 2020 due to 2 cases of tranverse myelitis among participants, found not to be related to vaccination)

Local AE  Tenderness, injection site pain; reported for participants who received 2 doses of vaccine; adverse events were less frequent in older adults (≥56y)

Systemic AE  Fatigue, headache, muscle ache, malaise, feverish, chills, joint pain; reported for participants who received 2 doses of vaccine; adverse events were less frequent in older adults (≥56y)

1. SARS-CoV-2 IgG response to spike protein

Assay: ELISA
Units: GMT (95% CI)

Total IgGs against the Spike protein were similar in all age groups regardless the dose.
Responses at day 28 decreased with increasing age (low: 18–55 years, median 6439[AU]/mL; 56–69 years, 4553 AU/mL; ≥70 years, 3565 AU/mL. Std: 18–55 years, median 9807 AU/mL; 56–69 years, 5496 AU/mL; ≥70 years, 4156 AU/mL)
IMMUNOGENICITY 2/2

2. Live SARS-CoV-2 microneutralisation assay (MNA$_{80}$)

**Assay:** Microneutralisation test (80% inhibitory dilution) tition

**Units:** Median titre, ID80 (IQR)

Neutralizing antibody responses: Median titres peaked by day 42 in groups receiving two vaccinations.

There are no significant differences in normalized titers between age groups at day 42 (low: 18–55 years, median 161; 56–69 years, 143; ≥70 years, 150. Std: 18–55 years, median 193; 56–69 years, 144; and ≥70 years, 161.

3. Induction of T cell responses and increase of IFN-γ expression

IFN-γ ELISpot responses against SARS-CoV-2 spike protein peaked 14 days after the prime vaccination
IMMUNOGENICITY 1/2

1. SARS-CoV-2 RBD-specific IgGs

Assay: ELISA
Units: Geometric mean titre (95% CI)

Anti-RBD IgG responses detected from day 14 for both products and in all vaccine administration schemes. At day 21 RBD-specific IgGs were detected in 100% of vaccinated participants. ([GMT] 1629 with the frozen formulation and 951 with the lyophilized one). Heterologous boosting with rAd5-S led to an increase in SARS-CoV-2 RBD specific IgG titres; 7 days after boost.
IMMUNOGENICITY 2/2

2. Neutralizing responses

Assay: Microneutralisation assay (50% inhibitory dilution, Vero E6 cells)
Units: Geometric mean titre, ID50 (95% CI)

Administration of both rAd26-S and rAd5-2 led to production of neutralizing antibodies in 100% of participants, whereas administration of only rAd26-S led to a lower seroconversion rate.

3. T cell response: induction of CD4+ and CD8+ cells and an increase in the concentration of interferon-γ secretion
### Adenoviral vector vaccine

**Ad26COVS1**

### Janssen Pharmaceuticals  
**Phase I/IIa: NCT04436276**

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Phase I/IIa randomised controlled trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age range</td>
<td>18 – 55; ≥65</td>
</tr>
<tr>
<td>Nb of participants</td>
<td>805</td>
</tr>
<tr>
<td>Nb of doses/route</td>
<td>1 (day 1) or 2 (day 1 and 57) ; IM</td>
</tr>
</tbody>
</table>

**Vaccine groups**

| 18–55y : low dose at d1/57 (n = 75) |
| 18–55y : low dose at d1 (n = 75)     |
| 18–55y : high dose at d1/57 (n = 75) |
| 18–55y : high dose at d1 (n = 75)    |
| 18–55y : low dose at d1/57 (n = 5)   |
| 18–55y : low dose at d1 (n = 5)      |
| 18–55y : high dose at d1/57 (n = 5)  |
| 18–55y : high dose at d1 (n = 5)     |
| ≥65y : low dose at d1/57 (n = 75)    |
| ≥65y : low dose at d1 (n = 75)       |
| ≥65y : high dose at d1/57 (n = 75)   |
| ≥65y : high dose at d1 (n = 75)      |

**SAE**

1SAE, participant recovered within 24h

**Local AE**

Injection site pain

**Systemic AE**

Fatigue, headache, myalgia, pyrexia (fever), nausea

### Spike protein and neutralizing responses

A single dose of Ad26.COV2.S elicited a strong humoral response, with the presence of S-binding and neutralizing antibodies in more than 90% of the participants, regardless of either age group or vaccine dose.

At day 71 after the first dose, antibody titers **further increased and stabilized**

Sadoff J et al.; NEJM 2020, Jan 2021
### Immunogenicity and Safety Data

**Phase I: NCT04368988**

<table>
<thead>
<tr>
<th>Study Design</th>
<th>Phase I randomised controlled, dose-finding trial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age range</td>
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<td>Nb of participants</td>
<td>131</td>
</tr>
<tr>
<td>Nb of doses/route</td>
<td>1 (day 0) or 2 (days 0/21) – IM</td>
</tr>
<tr>
<td>Vaccine groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 x 25 μg (n = 25)</td>
</tr>
<tr>
<td></td>
<td>2 x 5 μg + 50 μg Matrix-M1 (n = 28)</td>
</tr>
<tr>
<td></td>
<td>2 x 25 μg + 50 μg Matrix-M1 (n = 28)</td>
</tr>
<tr>
<td></td>
<td>1 x 25 μg + 50 μg Matrix-M1 (n = 25)</td>
</tr>
<tr>
<td></td>
<td>2 x 5 μg and 2 x 25 μg included 3 sentinel</td>
</tr>
<tr>
<td></td>
<td>participants who were vaccinated in an open-</td>
</tr>
<tr>
<td></td>
<td>label manner and observed for reactogenicity</td>
</tr>
<tr>
<td>Control group</td>
<td>0.9% saline placebo (n = 25)</td>
</tr>
<tr>
<td>SAE</td>
<td>None</td>
</tr>
<tr>
<td>Local AE</td>
<td>Tenderness (20–65% at ds1, 12–81% at ds2), injection site pain (24–54% at ds1, 8–63% at ds 2)</td>
</tr>
<tr>
<td>Systemic AE</td>
<td>Headache (23–40% at dose 1, 28–58% at dose 2), muscle pain/myalgia (12–32% at dose 1, 8–54% at dose 2), fatigue (16–40% at dose 1, 12–50% at dose 2), malaise (4–28% at dose 1, 8–38% at dose 2), joint pain (4–27% at dose 2)</td>
</tr>
</tbody>
</table>

**1. SARS-CoV-2 Anti-Spike IgGs**

Assay: ELISA  
Units: Geometric mean titre (95% CI)

By day 21 after 1st vaccination, IgG specific responses occurred for all adjuvant regimens (10-fold of non adjuvant). IgGs concentrations further increased after 2nd dose vaccination (day 29 and day 35).
IMMUNOGENICITY 2/2

2. Neutralizing responses

Assay: Microneutralisation assay (99% inhibitory dilution, Vero E6 cells)
Units: Geometric mean titre, ID99 (95% CI)

Two doses of adjuvant vaccine induced an increase on the concentration of neutralizing antibodies more than 100 times greater than single vaccinations without adjuvant.

3. Induction of T-cell responses: antigen-specific induction of CD4+ T-cell responses A strong bias toward this Th1 phenotype observed

Protein Subunit vaccine

Keech C et al. NEJM. Sep 2020
Heterologous vaccination regimen

Immunogenicity and reactogenicity of BNT162b2 booster in ChAdOx1-S-primed participants (CombiVacS)

Methods:
• Phase 2 open-label, randomised, controlled trial
• Participants: 676 adults aged 18–60 years vaccinated with a single dose of ChAdOx1-S 8–12 weeks before screening, and no history of SARS-CoV-2 infection.
• Participants were randomly assigned (2:1) to receive either BNT162b2 (one single injection) or continue observation (control group).
  • intervention group (n=450)
  • control group (n=226)

Primary outcome: 14-day immunogenicity

SAFETY: Reactions were mild (68%) or moderate (30%), (injection site pain, induration, headache and myalgia) No serious adverse events were reported.

IMMUNOGENICITY
Intervention group: GMT of RBD antibodies increased from 71.46 BAU/mL (95% CI 59·84–85·33) at baseline to 7756.68 BAU/mL (7371·53–8161·96) at day 14.

## Vaccine Summary results on immunogenicity

<table>
<thead>
<tr>
<th>Vaccine &amp; Developer</th>
<th>Phase III regimen</th>
<th>Specific IgG titers (14 - 28 days after 2nd dose) as per Phase I or II published results</th>
<th>NAb titers (14 - 28 days after 2nd dose) as per Phase I or II published results</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNT162b2 BioNTech – Pfizer – Fosun Pharma</td>
<td>2 doses (d1 and d22) 30µg/dose</td>
<td>8147 GMT Test: Luminex anti S1 IgG</td>
<td>163 GMT Test: wtVNA&lt;sub&gt;50&lt;/sub&gt;</td>
</tr>
<tr>
<td>mRNA-1273 Moderna – NIAID</td>
<td>2 doses (d1 and d29) 100µg/dose</td>
<td>782 719 GMT Test: ELISA anti S IgG</td>
<td>654.3 GMT Test: PRNT&lt;sub&gt;80&lt;/sub&gt;</td>
</tr>
<tr>
<td>Ad5-nCoV CanSino Biologics Inc – Beijing Institute of Biotechnology</td>
<td>1 dose 5x10&lt;sup&gt;10&lt;/sup&gt;vp</td>
<td>571.0 GMT Test: ELISA anti RBD IgG</td>
<td>18.3 GMT Test: WT virus neutralization</td>
</tr>
<tr>
<td>SputnikV Gamaleya Research Institute</td>
<td>d1 0,5 mL rAd26 d21 0,5 mL rAd5</td>
<td>14 703 GMT Test: ELISA anti RBD IgG</td>
<td>49.25 GMT Test: MNA&lt;sub&gt;50&lt;/sub&gt;</td>
</tr>
<tr>
<td>Ad26COV1 Janssen Pharmaceutical Companies</td>
<td>1 dose 5x10&lt;sup&gt;10&lt;/sup&gt;vp</td>
<td>478 GMC Test: ELISA anti S IgG</td>
<td>224 GMT Test: MNA&lt;sub&gt;50&lt;/sub&gt;</td>
</tr>
<tr>
<td>ChAdOx1 nCoV-19 University of Oxford – AstraZeneca</td>
<td>2 doses (d1 and d29) 5x10&lt;sup&gt;10&lt;/sup&gt;vp</td>
<td>639 EU Test: ELISA anti S IgG</td>
<td>136 MT Test: MNA&lt;sub&gt;80&lt;/sub&gt;</td>
</tr>
<tr>
<td>NVX COV2373 Novavax</td>
<td>2 doses (d0 and d28) 25µg+Matrix M/ dose</td>
<td>47 521 GMEU Test: ELISA anti S IgG</td>
<td>3305 GMT Test: MNA&lt;sub&gt;99&lt;/sub&gt;</td>
</tr>
<tr>
<td>CoronaVac Sinovac – Institut Butantan</td>
<td>2 doses (d1 and d14)</td>
<td>1094,3 GMT Test: ELISA anti RBD IgG</td>
<td>27.6 GMT Test: Micro cytopathic effect assay</td>
</tr>
<tr>
<td>BIBBP-CorV Beijing Inst. Biological Products – Sinopharm</td>
<td>2 doses (d1 and d14)</td>
<td>Not reported</td>
<td>219.9 GMT Test: MNA&lt;sub&gt;50&lt;/sub&gt;</td>
</tr>
<tr>
<td>SARS-CoV-2 Vaccine Wuhan Inst. Biological products – Sinopharm</td>
<td>2 doses (d0 and d21)</td>
<td>215 GMT Test: ELISA anti S IgG</td>
<td>247 GMT Test: PRNT&lt;sub&gt;50&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

### NOTE:

**Comparisons should not be made as assays are not standardized**
### VACCINE EFFICACY DATA

First data regarding vaccine efficacy has been made public by the means of PRESS RELEASES by pharmaceutical companies.

<table>
<thead>
<tr>
<th>Date of Press release</th>
<th>Company</th>
<th>Vaccine</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 9th 2020</td>
<td>BioNTech/Pfizer</td>
<td>BNT162b2</td>
<td>1st interim analysis; 28 days after 1st dose 94 confirmed cases of COVID19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• &gt; 90% Efficacy</td>
</tr>
<tr>
<td>November 11th 2020</td>
<td>Gamaleya</td>
<td>Sputnik V</td>
<td>1st interim analysis; 21 days after 1st dose 20 confirmed cases of COVID19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• &gt; 92% Efficacy</td>
</tr>
<tr>
<td>November 16th 2020</td>
<td>Moderna</td>
<td>mRNA 1273</td>
<td>1st interim analysis; 42 days after 1st dose 95 confirmed cases of COVID19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 94.5% Efficacy</td>
</tr>
<tr>
<td>November 18th 2020</td>
<td>BioNTech/Pfizer</td>
<td>BNT162b2</td>
<td>Final analysis; 28 days after 1st dose 170 confirmed cases of COVID19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 95% Efficacy</td>
</tr>
<tr>
<td>November 23rd 2020</td>
<td>AstraZeneca/Oxford</td>
<td>AZD1222</td>
<td>1st interim analysis 14 days after 2nd dose 131 confirmed cases of COVID19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 90% Efficacy when given as half dose/full dose</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• 62% Efficacy when given as full dose/full dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Overall 70% efficacy</td>
</tr>
<tr>
<td>November 24th 2020</td>
<td>Gamaleya</td>
<td>Sputnik V</td>
<td>2nd interim analysis; 42 days after 1st dose 39 confirmed cases of COVID19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 95% Efficacy</td>
</tr>
<tr>
<td>November 30th 2020</td>
<td>Moderna</td>
<td>mRNA 1273</td>
<td>Final analysis; 42 days after 1st dose 196 confirmed cases of COVID19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 94.1% Efficacy</td>
</tr>
</tbody>
</table>
First data regarding vaccine efficacy has been made public by the means of **PRESS RELEASES** by pharmaceutical companies.

<table>
<thead>
<tr>
<th>Date of press release</th>
<th>Company</th>
<th>Vaccine</th>
<th>Analysis</th>
</tr>
</thead>
</table>
| January 28th 2021     | NOVAVAX  | NVX-COV2373:             | 1st interim analysis; Onset of COVID 7 days after 2nd dose 28 days after 1st dose (one dose vaccine) 62 confirmed cases of COVID19 (56 on the placebo group)  
  • Efficacy by strain was calculated to be **95.6% against the original COVID-19 strain** and **85.6% against the UK variant strain** |
| January 29th 2021     | Janssen  | Ad26COVS1                | 1st interim analysis 28 days after vaccination (one dose) Etude multinational ENSEMBLE.  
  • **72% Effective** in the US and **66% Effective** Overall at Preventing Moderate to Severe COVID-19  
  • **85% Effective** overall in preventing severe disease.  
  • **Complete protection** against COVID-19 related Hospitalisation and Death  
  • Protection against the SARS-CoV-2 Variant from the B.1.351 Lineage Observed in South Africa |
| February 2nd 2021     | Sinovac  | CoronaVac                | 1st interim analysis; 14 days after 2nd dose vaccination 253 confirmed cases of COVID19 Efficacy rate against diseases caused by COVID-19 for:  
  • **all cases**: 50.65%  
  • cases requiring **medical treatment**: 83.70%  
  • hospitalized, severe and fatal cases: **100%**  
  Efficacy by strain:  
  • **85.6% against the UK variant strain** |
• Efficacy data from ongoing double blind, randomized phase III trial across Argentina, Brazil, South Africa and USA (43,548 participants randomized 1:1)

• Two 30 µg doses of BNT162b2 vaccine, 21 days apart

• **Inclusion criteria:** healthy adults or stable chronic medical conditions, including HIV, HBV or HCV aged of 16y or more.

• **Exclusion criteria:** medical history of Covid-19, treatment with immunosuppressive therapy, or diagnosis with an immunocompromising condition

• Primary **efficacy** endpoint: efficacy of BNT162b2 against confirmed Covid-19 with onset at least 7 days after the second dose

• Primary **safety** end points: solicited, specific local or systemic adverse events and use of antipyretic or pain medication within 7 days after the receipt of each dose

---

**Table 1. Demographic Characteristics of the Participants in the Main Safety Population."**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>BNT162b2 (N=18,806)</th>
<th>Placebo (N=18,846)</th>
<th>Total (N=37,652)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex — no. (%)</td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9,639 (51.1)</td>
<td>9,419 (50.1)</td>
<td>19,058 (50.6)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>9,221 (48.9)</td>
<td>9,419 (49.4)</td>
</tr>
<tr>
<td>Race or ethnic group — no. (%)</td>
<td>White</td>
<td>Black or African American</td>
<td>Asian</td>
</tr>
<tr>
<td></td>
<td>15,632 (82.9)</td>
<td>1,729 (9.2)</td>
<td>801 (4.2)</td>
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</tr>
</tbody>
</table>

* Percentages may not total 100 because of rounding.

† Race or ethnic group was reported by the participants.

The body mass index is the weight in kilograms divided by the square of the height in meters.

Polack FP et al. NEJM Dec 2020
The BNT162b2 vaccine is reactogenic, but the side effects remain acceptable in all populations studied.

- The short-term safety profile of the BNT162b2 vaccine is characterized by mild to moderate pain at the injection site, fatigue and headache. These manifestations disappear after 24 to 48 hours.
- The only grade 3 adverse events with a frequency greater than 2% after the second vaccine administration are fatigue (97/2405 participants; 4.6%) and headache (7/2015; 3.2%).
- No grade 4 adverse side effects observed.

Six deaths were reported during the clinical trials, including four in the placebo group, but no relation with vaccination was found.

Limits:
Just 2 month follow up safety data
Data for over 75 is scarce and absent for children, pregnant women or immunocompromised
TOTAL OF CASES: 170
- 8 in the BNT162b2 group/162 in the Control
- 10 severe cases, 9 within the Placebo group

Vaccine efficacy: 95%

Limits:
Efficacy measured in symptomatic patients
No evidence of an potential effect against viral shedding

Protection occurs as early as the second week after the first vaccine administration, with an increase of protection level up to 95% after the second administration
mRNA 1273

Efficacy and Safety Data

• Efficacy data from Phase III blinded, randomized, controlled trials at 99 US sites
• 2 doses of 100 µg of mRNA 1273 or placebo 28 days apart
  • 30,420 participants randomized (1:1)
  • >96% received 2nd dose
• Inclusion criteria: healthy adults aged of 18y or more with no history of SARS CoV 2 and high risk of severe COVID19

Primary endpoint: efficacy of the mRNA-1273 vaccine in preventing a first occurrence of symptomatic Covid-19 with onset at least 14 days after the second injection (virologically confirmed, symptomatic COVID-19: positive swab combined with at least two qualifying symptom)

Secondary endpoint: efficacy of mRNA-1273 in the prevention of severe Covid-19

Safety assessments: monitoring of solicited local and systemic adverse events for 7 days after each injection; unsolicited adverse reactions for 28 days after each injection
**mRNA 1273**

- **Solicited adverse events at the injection site:** more frequent in the mRNA-1273 group after both the 1st (84.2%, vs. 19.8%) and the 2nd dose (88.6%, vs. 18.8%). Mainly grade 1 or 2

- **Solicited systemic adverse events:** more often in the mRNA-1273 group after both the 1st (54.9%, vs. 42.2%) and the 2nd dose (79.4%, vs. 36.5%). Increase proportions of grade 2 and 3 events after 2nd Dose (from 16.5% vs 38.1% and from 2.9% to 15.8%).

- Both solicited injection-site and systemic adverse events were more common among younger participants (18 to <65y) than among older participants (≥65 y)

- The frequency of unsolicited adverse events, unsolicited severe adverse events, and serious adverse events 28 days after injection similar among age groups

- **Hypersensitivity reactions** reported in 1.5% and 1.1% of participants in the vaccine and placebo groups. 3 Bell’s palsy in the vaccine group and 1 in the placebo group

- 5 deaths, including 3 in the mRNA 1273 group with no link to vaccine

**Key limitations:** short duration of safety and efficacy follow-up
mRNA 1273

Efficacy and Safety Data

TOTAL OF CASES: 196
- 11 in the mRNA 1273 group / 185 in the placebo group
- 30 severe cases all within the placebo group

Vaccine efficacy: 94.1% (100% protection against severe cases)

Data not sufficient to assess asymptomatic infection

Limits: Efficacy tested in a setting of national recommendations for masking and social distancing, which may have translated into lower levels of infectious inoculum.

Baden LR et al. NEJM Dec 2020
Azd1222

- Efficacy data from ongoing blinded, randomized, controlled trials across UK and Brazil
  - COV 002: Phase II/III study in UK. Two dosage groups:
    - LD/SD: prime $2,2 \times 10^{10}$ vp; boost $5 \times 10^{10}$ vp at 28 days
    - SD/SD: prime $5 \times 10^{10}$ vp; boost $5 \times 10^{10}$ vp at 28 days
  - COV 003: Phase III study in Brazil. Dosage:
    - SD/SD: prime/boost $3.5-6.5 \times 10^{10}$ vp up to 12 weeks apart (target 4 weeks)

- Inclusion criteria: healthy adults aged 18y or more.
  - COV 002: healthy adults
  - COV 003: healthy and stable pre-existing health conditions individuals

- Main outcome: virologically confirmed, symptomatic COVID-19 (positive swab combined with at least one qualifying symptom)

- The interim efficacy is assessed by combining data from COV002 and COV003

Limits:
Immunocompromised volunteers not included in the trial
Elderly participants are low represented
Heterogeneity between trials (concentration and schedule)
Primary Efficacy Analysis: 2 weeks after second dose

- 98 cases in the **SD/SD** group (2 trials)
  - 27 within the ChAdOx1 nCov19 group
  - 71 within the Control group
  - **Vaccine Efficacy in SD/SD: 62.1%**
- 33 cases in the **LD/SD** group
  - 3 within the ChAdOx1 nCov19 group
  - 33 within the Control group
  - **Vaccine Efficacy in LD/SD: 90%**

TOTAL OF CASES: 131
30 in the ChAdOx1 nCov19 /101 in the Control
**Vaccine efficacy: 70.4%**

**Limits:**
Is aggregation of SD/LD and SD/SD data for efficacy analysis possible? (different doses, different vaccination schedules schedules)
Primary Efficacy Analysis at more than 21 days after second dose

<table>
<thead>
<tr>
<th>Total number of cases</th>
<th>ChAdOx1 nCoV-19</th>
<th>Control</th>
<th>Vaccine efficacy (55%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/N (%)</td>
<td>n/N (%)</td>
<td></td>
</tr>
<tr>
<td>COVID-19 (EU)</td>
<td>50</td>
<td>28/130 (0.6%)</td>
<td>54/185 (0.7%)</td>
</tr>
<tr>
<td>COVID-19 (SARS)</td>
<td>102</td>
<td>78/273 (0.7%)</td>
<td>92/271 (0.9%)</td>
</tr>
<tr>
<td>Hospitalized COVID-19</td>
<td>122</td>
<td>9/8 (0.8%)</td>
<td>0/0</td>
</tr>
<tr>
<td>None</td>
<td>21</td>
<td>12/12 (1.0%)</td>
<td>0/0</td>
</tr>
</tbody>
</table>

From 21 days after the first dose: there were ten cases hospitalized for COVID-19, all in the control arm; two were classified as severe COVID-19, including one death.

TOTAL OF CASES: 192
(only SD/SD group; two trials, different vaccination schedules)
51 in the ChAdOx1 nCov / 141 in the Control
Vaccine efficacy: 64.1%

Limits: No evidence of an potential effect against viral shedding

Voysey M et al. The Lancet Dec 2020
Sputnik V

- Sputnik vaccine comprises two vector components, rAd26-S and rAd5-S.
- Efficacy data from Phase III blinded, randomized, controlled trials at 25 sites in Moscow-Russia
- 2 doses of $10^{11}$ recombinant vp each at 21 d interval (d26 first, Ad5 later)
  - 21,977 participants randomized (3:1)
  - >90% received 2nd dose
- Inclusion criteria: healthy adults aged of 18y negative for HIV, Hepatitis B and C and no history of SARS CoV 2

**Primary outcome**: proportion of participants with COVID-19 confirmed by PCR from day 21 after receiving the first dose

**Secondary outcomes: end point**: severity of COVID-19; changes in antibody levels against SARS-CoV-2 glycoprotein S; proportion of participants with antibodies against SARS-CoV-2 N-protein; changes in SARS-CoV-2 neutralising antibody titres; changes in antigen-specific cellular immunity level; and incidence and severity of adverse events
Sputnik V

Primary Efficacy Analysis

**From 21 days after the first dose of vaccine (the day of dose 2)**

TOTAL OF CASES: confirmed cases 78
- 16 in the vaccinated group / 62 in the Placebo
- 20 moderate of severe cases all in the Placebo
- 4 deaths unrelated to vaccine

**Vaccine efficacy: 91.6%**
*(greater than 87% for all studied groups including >60)*

**SAFETY:**
- Most of the reported adverse events (7485 [94.0%] of 7966) were grade 1; 451 were grade 2 (5.66%) and 30 were grade 3 (0.38%) *(flu-like illness, injection site reactions, headache, and asthenia).*
- 122 rare adverse events (91 in the vaccine group and 31 in the placebo group)
- 70 episodes of serious adverse events, considered not related to COVID-19 (68 participants, 45 from the vaccine group and 23 from the placebo group)

Limitations of the interim analysis: the small sample sizes within age strata
• **Presence of IgGs** specific to RBD 42 days from the start of vaccination
  - In the vaccine group, detected in 336 (98%) of 342 samples, with a GMT of 8996 (95% CI 7610–10 635). Seroconversion rate: 98·25%.
  - In the placebo group: detected in 17 (15%) of 114 samples, with a GMT of 30,55 (20,18–46,26), and a seroconversion rate of 14·91%
  - 18–30 years group had a significantly higher GMT than the other age groups

• **Presence of neutralizing antibodies** on day 42 after first vaccination
  - In vaccine group: GMT of 44,5 (95% CI 31,8–62,2) and the seroconversion level was 95,83%
  - In the placebo group: GMT 1,6 (1,12–2,19) and the seroconversion rate was 7·14%

• All participants in the vaccine group had significantly higher levels of IFN-γ secretion upon antigen stimulation
**Ad26COVS1**

**Efficacy and Safety Data**

- **Phase 3:** Multicenter, randomized, double-blind, placebo-controlled, in Argentina, Brazil, Chile, Colombia, Mexico, Peru, South Africa, and the United States.

- Randomisation in a 1:1 ratio to receive a single dose of Ad26.COVS2.S (5×10¹⁰ viral particles) or placebo. 43786 participants vaccinated.

**Primary end points:** Vaccine efficacy against moderate to severe–critical Covid-19 with an onset at least 14 days and at least 28 days after administration.

**Safety subpopulation:** 3356 participants in the vaccine group and 3380 in the placebo group.

Reactogenicity higher with Ad26.COVS2.S but mild to moderate and transient.
Adenoviral vector vaccine

**EFFICACY AND SAFETY DATA**

**TOTAL OF CASES: 468**

**28 days after administration** - moderate to severe cases
- > 66 the vaccine group
- > 193 in the placebo group

**Global Vaccine Efficacy:** 66.1 (95% CI 55.0-74.8)

**Vaccine efficacy against severe cases:** 85.4% (95% CI 54.2-96.9)

Efficacy against disease with an onset at least 28 days after administration was similar across age groups

**VOC: 512 RT-PCR–positive samples**
- Prototypic strain in 96% of US samples
- Prototypical strain in 30.6% and Gamma strain in 69.4% of the Brazilian samples.
- Beta strain in 94.5% of South African samples.

VE in south African context: 64.0% against moderate–critical disease and 81.7% against severe–critical disease with onset
Adenoviral vector vaccine

**NVX-CoV2373**

- **Phase 3**: 33 sites in UK. 18-84 years of age. Healthy or stable chronic medical condition.
- 15,187 participants randomly assigned in a 1:1 ratio to receive two 5µg doses of NVX-CoV2373 (+50µg Matrix M) or placebo (normal saline) administered 21 days apart.

**Primary end point**: efficacy of the NVX-CoV2373 vaccine against the first occurrence of virologically confirmed symptomatic mild, moderate, or severe Covid-19 with onset at least 7 days after the second dose.

**SAFETY**: Reactogenicity was generally mild and transient. The incidence of serious adverse events was low and similar in the two groups.

Cases from 7 days after administration - moderate to severe cases
- > 10 in the vaccine group
- > 96 in the placebo group

**Global Vaccine Efficacy**: 89.97% (95% CI 80.2 - 94.6)

100% protection against severe cases

Efficacy of 86.3% (95% CI, 71.3 to 93.5) against the alpha variant
Neutralization of viral variants

Sera of BNT162b2 vaccinated subjects tested against lab generated VSV pseudovirus bearing B.1.1.7 SARS CoV2 mutations

Description of tested sera:
- 40 participants from Phase I
  - 26 younger (23-55 years of age)
  - 14 older (57-73 years of age)
- 7 or 21 days after booster immunization

The 50% neutralization GMT of the sera against the SARS-CoV-2 lineage B.1.1.7 pseudovirus were slightly, statistically significantly reduced compared to the GMTs against the Wuhan reference pseudovirus.

The largely preserved neutralization of pseudoviruses bearing the B.1.1.7 spike by BNT162b2-immune sera makes it unlikely that the UK variant virus will escape BNT162b2-mediated protection.

Limitation of the work: use of a non-replicating pseudovirus system.
Neutralization of viral variants

Serum neutralizing activity against recombinant vesicular stomatitis virus (rVSV)–based SARS-CoV-2 bearing the spike protein from the original Wuhan-Hu-1 isolate, the D614G variant, the B.1.1.7 and B.1.351 variants

Description of tested sera: participants from Phase I trial of the mRNA-1273 vaccine, 7 days after second dose

Full panel of mutations and a subset of mutations affecting the RBD of the B.1.1.7 variant had no significant effect on neutralization by serum from vaccinated patients

Decrease in titers of neutralizing antibodies against the B.1.351 variant and a subset of its mutations affecting the RBD.
**Efficacy of AZD1222 vaccine against SARS-CoV-2 Alpha variant**

**Population:** Volunteers enrolled in the phase 2/3 vaccine efficacy studies in the UK (>18)

**Methods:** Upper airway swabs on a weekly basis and if symptoms of COVID-19 disease. NAAT for SARS-CoV-2 sequencing if positive

Efficacy analysis included symptomatic COVID-19 in seronegative participants with a NAAT positive swab more than 14 days after a second dose of vaccine

**Primary outcome:** symptomatic COVID-19 disease, defined as a positive NAAT from upper airway swab in a participant with at least one symptom, including cough, fever of 37.8°C or higher, shortness of breath, anosmia, or ageusia

TOTAL OF CASES: 520
- 21 caused by B.1.1.7 variant in the vaccinated group;
- 54 caused by B.1.1.7 variant in the control group

**Vaccine efficacy against B1.351:** 61.7%

The viral load among NAAT-positive swab in the AZD 1222 vaccinated group was statistically significantly lower than among those who were in the control group.

> vaccinees showing a NAAT-positive swab could be less likely to transmit the virus than an unvaccinated NAAT
**Population:** Volunteers enrolled in the phase 2 trial in South Africa (>18, HIV-)

**Methods:** Serum samples obtained from 25 participants after the second dose were tested by pseudovirus and live-virus neutralization assays against the original D614G virus and the B.1.351 variant.

**Primary endpoints:** Safety and efficacy of the vaccine against laboratory-confirmed symptomatic cases more than 14 days after the second dose.

**TOTAL OF CASES 42**

39 cases caused by B.1.351 variant;

**Vaccine efficacy against B1.351: 10.4%**

(95% CI, −76.8 to 54.8).

Madhi, S.A. et al. *NEJM.* April 2021
mRNA-1273 vaccine effectiveness against Alpha and Beta variants

- mRNA-1273 (Moderna) vaccine efficacy: 94.1% at preventing symptomatic COVID-19 due to infection with ‘wild-type’ variants

- Real life effectiveness against Alpha and Beta variants in Qatar, a population that comprises mainly working-age adults

- Effectiveness against alpha infection:
  - 88.1% (95% CI 83.7–91.5%) ≥14 days after the first dose but before the second dose,
  - 100% (95% CI: 91.8–100.0%) ≥14 days after the second dose.

- Effectiveness against beta infection:
  - 61.3% after the first dose (95% CI: 56.5–65.5%)
  - 96.4% after the second dose (95% CI: 91.9–98.7%).

- Effectiveness against any severe, critical or fatal COVID-19 disease due to any SARS-CoV-2 infection
  - 81.6% (95% CI: 71.0–88.8%) after the first dose
  - 95.7% (95% CI: 73.4–99.9%) after the second dose

Effectiveness of Covid-19 Vaccines against Delta Variant

- Effectiveness after one dose of vaccine (BNT162b2 or ChAdOx1 nCoV-19) was notably lower among persons with the delta variant (30.7%; 95% confidence interval [CI], 25.2 to 35.7) than among those with the alpha variant (48.7%; 95% CI, 45.5 to 51.7)

- BNT162b2 > the effectiveness of two doses was 93.7% (95% CI, 91.6 to 95.3) among persons with the alpha variant and 88.0% (95% CI, 85.3 to 90.1) among those with the delta variant.

- ChAdOx1 nCoV-19 vaccine > the effectiveness of two doses was 74.5% (95% CI, 68.4 to 79.4) among persons with the alpha variant and 67.0% (95% CI, 61.3 to 71.8) among those with the delta variant.

Negative case control: Vaccine effectiveness estimation against symptomatic disease caused by the delta variant, as compared with the alpha variant
Effectiveness of SARS-CoV-2 vaccination: Real Life Data

Mass vaccination campaigns against COVID19 in Israel

- Estimated **vaccine effectiveness**:
  > 7 days after the second dose: 92% for documented infection, 94% for symptomatic Covid-19, 87% for hospitalization, and 92% for severe Covid-19

  > During days 14 through 20 and days 21 through 27: 46% and 60% for documented infection, 57% and 66% for symptomatic Covid-19, 74% and 78% for hospitalization, 62% and 80% for severe Covid-19, and 72% and 84% for Covid-19–related death, respectively

- BNT162b2 vaccine is effective for a wide range of Covid-19–related outcomes

Dagan, N., et al. NEJM. April 15 2021
## Effectiveness of SARS-CoV-2 vaccination: Real Life Data

### Israel (BNT162b2 mRNA)

<table>
<thead>
<tr>
<th>Week since First Dose</th>
<th>Received a First Dose of Vaccine†</th>
<th>HCWs Tested at HHUMC</th>
<th>HCWs Tested at HHUMC or Community Clinics§</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>5297</td>
<td>32.1</td>
<td>9.4</td>
</tr>
<tr>
<td>Week 2</td>
<td>5247</td>
<td>32.9</td>
<td>9.0</td>
</tr>
<tr>
<td>Week 3</td>
<td>5200</td>
<td>19.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Week 4</td>
<td>5164</td>
<td>16.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Received second dose</td>
<td>4864</td>
<td>11.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Did not receive second dose</td>
<td>300</td>
<td>51.3</td>
<td>13.3</td>
</tr>
<tr>
<td>Week 5</td>
<td>5050</td>
<td>4.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Received second dose</td>
<td>4934</td>
<td>4.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Did not receive second dose</td>
<td>116</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Week 6</td>
<td>4947</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>Received second dose</td>
<td>4793</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>Did not receive second dose</td>
<td>154</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Week 7</td>
<td>4079</td>
<td>19.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Received second dose</td>
<td>4069</td>
<td>19.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Did not receive second dose</td>
<td>10</td>
<td>0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### California (mRNA 1273 & BNT162b2 mRNA)

- **Decrease number of positive test result among vaccinated HCW.**
- **Efficacy of these vaccines is maintained outside the trial settings.**
- **Suggest that widespread and effective vaccination among health care workers provides a safe environment.**

### References

- Benenson S et al. *NEJM.* March 2021
- Keehner J et al. *NEJM.* March 2021
Effect of vaccination on viral load in COVID-19 post-vaccination infections?

Retrospective study – December 21, 2020 to February 11, 2021

Analyse the RT–qPCR test measurements of three SARS-CoV-2 genes, from positive post-vaccination tests (4938 patients) → analysis of the infection cycle threshold (Ct).

Decrease viral load after 12d post-vaccination

Ct values of positive samples collected 12–37 d after were higher than the Ct values of positive samples taken during the first 11 d after vaccination.

Ct values of positive sample of vaccinated patients versus Ct values of positive tests of unvaccinated patients.

A difference of 1 Ct unit is approximately equivalent to a factor of 2 in the number of viral particles per sample,

These Ct differences represent a decrease of 2.8–4.5-fold in viral load in vaccinated individuals

→ Infection occurring 12 d or longer after vaccination have significantly reduced viral loads.

→ affecting viral shedding and contagiousness?

Coefficient for the association of Ct of the RdRp gene with vaccination at different vaccination-to-sample time bins in comparison to unvaccinated patients

Safety of SARS-CoV-2 vaccination: Real Life data

Thrombotic Thrombocytopenia after AZ1222 Vaccination

- Vaccination with ChAdOx1 nCov-19 can result in the rare development of immune thrombotic thrombocytopenia
- This can be mediated by platelet activating antibodies against PF4, which clinically mimics autoimmune heparin-induced thrombocytopenia.

Norway cases:

- five patients with venous thrombosis and thrombocytopenia 7 to 10 days after receiving the first dose of the AZ1222 vaccine (32 to 54 years)
- Four of the patients had severe cerebral venous thrombosis with intracranial hemorrhage, and the outcome was fatal in three.

Germany and Austria cases:

- 11 patients (9 women). Median age of 36 years (22 to 49).
- 10 patients with one or more thrombotic events beginning 5 to 16 days after vaccination
- 1 patients with fatal intracranial hemorrhage

Nina H. Schultz et al. NEJM April 2021

Greinacher, A., et al. NEJM April 2021

Muir, KL., et al. NEJM April 2021
Antibody Responses in Seropositive Persons after a Single Dose of SARS-CoV-2 mRNA Vaccines

- A single dose of mRNA vaccine (either BNT162b2 or mRNA 1273) elicited rapid immune responses in seropositive participants, with postvaccination antibody titers similar to or exceeded titers found in seronegative participants who received two vaccinations.

- Post-vaccine symptoms were more prominent for those with prior infection after the first dose, but symptomology was similar between groups after the second dose.
Population: pregnant (n=84; 13 deliveries); lactating (n=31); or non-pregnant woman of reproductive age (18-45) (n=16)

Type of COVID-19 vaccine received: (BNT162b2 Pfizer/BioNTech or mRNA-1273 Moderna/NIH)
- Mean gestational age at 1st dose: 23.2 weeks
- 13% vaccinated at 1st trimester (1st dose)
- 46% vaccinated at 2nd trimester (1st dose)
- 40% vaccinated at 3rd trimester (1st dose)

Sampling: Blood and breastmilk collected at: V0 (at the time of first dose), V1 (at the time of second vaccine dose) V2 (2-6 weeks following the 2nd dose) and at delivery. Umbilical cord blood was also collected at delivery.

SAFETY: low cumulative symptoms score with no significant differences between groups

MATERNAL VACCINE RESPONSE: significant rise of both S and RBD specific IgGs and IgAs from V0 to V2. Higher levels of SARS-CoV-2 antibodies were observed in all 268 vaccinated women compared to pregnant women with natural infection.

Gray K., et al AJOG March 2021
Vaccination of particular populations

BREASTMILK ANTIBODY TRANSFER
- Anti-S specific antibodies were found in maternal breastmilk.
- Spike and RBD-specific IgG were detectable in 10/10 umbilical cords after maternal vaccination
- NAb titers tending to be lower in umbilical cord than maternal serum
SARS-CoV-2–Specific Antibodies in Breast Milk After COVID-19 Vaccination of Breastfeeding Women

Population: Eighty-four women receiving 2 doses of BNT162b2; 504 breast milk samples

- Anti–SARS-CoV-2-specific IgA antibodies in the breast milk increased rapidly and were significantly elevated at 2 weeks after the first vaccine.
- Mean levels remained elevated for the duration of follow-up, and at week six, 65.7% of samples tested positive.
- Anti–SARS-CoV-2-specific IgG antibodies remained low for the first 3 weeks, with an increase at week 4
Cumulative vaccination doses administered

Share of people who received at least one dose of COVID-19 vaccine, Jul 21, 2021

Share of the total population that received at least one vaccine dose. This may not equal the share that are fully vaccinated if the vaccine requires two doses. This data is only available for countries which report the breakdown of doses administered by first and second doses.

Add country

- United Kingdom: 68.3% (Jul 20, 2021)
- Israel: 66.5%
- Spain: 64.1% (Jul 20, 2021)
- Italy: 61%
- Germany: 61%
- European Union: 60%
- France: 56.7%
- United States: 56% (Jul 19, 2021)
- Brazil: 55.9%
- Upper middle income: 45.3%
- India: 35.9%
- Africa: 3.1%

Source: Official data collated by Our World in Data – Last updated 22 July 2021, 15:20 (London time)

Covidtracker https://covidtracker.fr/vaccintracker/
VACCINES - SUMMARY
(July 2021)

• 88 vaccine candidates are ongoing clinical evaluation. 11 have received authorization from national or international medicines agencies
• Published Phase I/II data suggests that vaccine candidates on trial are immunogenic and mostly well tolerated in young adults. Data is emerging in elderly and children, globally keeping the trend described in young adults
• Induced titers of NAb are variable depending on the vaccine candidate. Comparison of Nab titers among vaccines is not possible. Yet, emerging data suggest that NAb are likely to be considered as correlates of protection.
• Published data do not show increased risk of ADE in vaccinees
• Overall vaccines efficacy results are good and rang between 50% and 95% depending on the vaccine, with mRNA vaccines performing the best.
• Individuals already seropositive for SARS-CoV-2 develop strong humoral responses after one dose of mRNA vaccine
• SARS-COV-2 variants represent a challenge for current vaccines with preliminary results showing variable level of cross-reaction depending on the viral strain. However, protection seems to remain at reasonably high levels.
References


References


References


Draft landscape and tracker of COVID-19 candidate vaccines: https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines-
Covid tracker: https://covidtracker.fr/vaccintracker/
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