



## COVID-19 Living Evidence Synthesis #6

(Version 38: 22 June 2022)

### Question

What is the effectiveness of available COVID-19 vaccines for adults, including variants of concern and over time frames up to 120 days?

### Findings

For vaccine effectiveness in variants of concern (VOC), we present a visual summary of evidence in Table 1 and Table 2 and details in Table 3.

Methods are presented in Box 1 and in the following appendices:

- 1) [reference list](#)
- 2) [glossary](#)
- 3) [data-extraction template](#)
- 4) [process for assigning variant of concern to studies](#)
- 5) [research question and critical appraisal process](#)
- 6) [detailed description of the narrative summary statement](#).

Overall, 526 studies were appraised and 182 used to complete this summary. The [reasons for excluding](#) the remaining 344 studies are reported in the second section of Appendix 2. (this section has not been updated since version 6.37 due to technical issues: it will be updated by next version)

Two new studies have been added since the previous edition of this living evidence synthesis, all of which are signaled by a last-updated date of 22 June 2022 (highlighted in yellow). The new studies included results for: VOC Omicron (2) - 0 reporting results by sub-lineage.

Studies examining effectiveness of vaccines in children and adolescents, including those covering periods beyond 120 days, are captured in a third synthesis, COVID-END

### **Box 1: Our approach**

We retrieved candidate studies and updates to living evidence syntheses on vaccine effectiveness using the following mechanisms: 1) PubMed via COVID-19+ Evidence Alerts; 2) systematic scanning of pre-print servers; 3) updates to the COVID-END inventory of best evidence syntheses; and 4) cross-check with updates from the VESPa team. We included studies and updates to living evidence syntheses identified up to two days before the version release date. We did not include press releases unless a preprint was available. A full list of included and excluded studies is provided in **Appendix 1**. A glossary is provided in **Appendix 2**.

**Prioritized outcome measures:** Infection, severe disease (as defined by the study investigators), death, and transmission.

**Data extraction:** We prioritized variant-confirmed and vaccine-specific data over total study population data (variant assumed and/or vaccine unspecified). We extracted data from each study in duplicate using the template provided in **Appendix 3**. Relevance to VOC is determined directly, when reported by study authors, or indirectly where reasonable assumptions can be made about the variant prevalent in the jurisdiction at the time of the study as described in **Appendix 4**.

**Critical appraisal:** We assessed risk of bias, direction of effect, and certainty of evidence. **Risk of bias:** assessed in duplicate for individual studies using an adapted version of ROBINS-I. **Direction of vaccine effect:** “prevented” or “protects” was applied to mean estimates or range of mean estimates of effect that are greater than or equal to 50% (the lowest acceptable limit for vaccine effectiveness as determined by WHO). **Certainty of evidence:** assessed for the collection of studies for each vaccine according to variant of concern using a modified version of GRADE. Details of the research question for this synopsis and the critical appraisal process are provided in **Appendix 5**.

**Summaries:** We summarized the evidence by presenting narrative evidence profiles across studies, with or without pooling, as appropriate. A template for the summary statements used on page 1 under “Findings” and in Table 1 under each VOC is provided in **Appendix 6**.

We update this document every Wednesday and post it on the COVID-END website.

living evidence synthesis 8. The most recent version of all three syntheses (6,8,10) can always be found on the [COVID-END website](#).

### Highlights of changes this week

- Threshold for protection has been adjusted as per WHO guidance resulting in revisions to statements below
- Several VOC Omicron studies have been updated because newer versions of preprints or published versions with different results for VE have been reported

### VOC Omicron

\*new definition for threshold for protection added June 22, 2022: For infection – point estimate of 70% with lower limit of 95% CI of 50% or higher; For severe disease or death – point estimate of 90% with lower limit of 95% CI of 70% or higher\*

### 3 Doses

We have low certainty evidence that **3 doses of BNT162b2 [Pfizer]** reached threshold for protection against infection from VOC **Omicron** up to 60 days after 3<sup>rd</sup> dose (58 to 74% – range of means), but dropped below threshold at or before 90 days after 3<sup>rd</sup> dose (35.7% [95% CI, 29.8 to 41.2] – 1 Obs).

We have low certainty evidence that **3 doses of BNT162b2 [Pfizer]** reached threshold for protection against symptomatic infection from VOC **Omicron** up to 14 days after 3<sup>rd</sup> dose (75.5% [95% CI, 56.1 to 86.3] – 1 Obs), but dropped below threshold at or before 35 days after 3<sup>rd</sup> dose (54 to 69% – range of means).

We have low certainty evidence that **3 doses of BNT162b2 [Pfizer]** reached threshold for protection against severe, critical, or fatal disease from VOC **Omicron** up to 49 days after 3<sup>rd</sup> dose (90.8% [95% CI, 81.5 to 95.5] – 1 Obs) and remained above threshold up to 63 days after 3<sup>rd</sup> dose (75 to 91% - range of means).

We have low certainty evidence that **3 doses of BNT162b2 [Pfizer]** reached threshold for protection against death from VOC **Omicron** up to 30 days after 3<sup>rd</sup> dose (82% [95% CI, 72 to 92] – 1 Obs); and remained above threshold up to 60 days after 3<sup>rd</sup> dose (85% [95% CI, 79 to 90]- 1 Obs) and at up to 90 days after 3<sup>rd</sup> dose (86% [95% CI, 80 to 92] – 1 Obs).

We have low certainty evidence that **3 doses of mRNA-1273 [Moderna]** did not reach threshold for protection against infection by VOC **Omicron** up to 30 days after 3<sup>rd</sup> dose (46 to 64% - range of means) and remained below threshold up to 60 days after 3<sup>rd</sup> dose (60 to 61% - range of means).

We have low certainty evidence that **3 doses of mRNA-1273 [Moderna]** reached threshold for protection against symptomatic infection by VOC **Omicron** up to 35 days after 3<sup>rd</sup> dose (55 to 71% - range of means) but dropped below threshold at or before 42 days after 3<sup>rd</sup> dose (38.6% [95% CI, 19.4 to 53.1] – 1 Obs).

We have low certainty evidence that **3 doses of mRNA-1273 [Moderna]** did not reach threshold for protection against severe, critical, or fatal disease from VOC **Omicron** up to 42 days after 3<sup>rd</sup> dose (80.8% [95% CI, -51.9 to 97.6] – 1 Obs).

We have low certainty evidence that **3 doses of ChAdOx1** did not reach threshold for protection against symptomatic infection from VOC **Omicron** at 30 days after 3<sup>rd</sup> dose (52 to 56% - range of means) and remained below threshold at 60 days after 3<sup>rd</sup> dose (44 to 47% - range of means).

We have low certainty evidence that **2 doses of ChAdOx1 followed by BNT162b2** did not reach threshold for protection against symptomatic infection from VOC **Omicron** at 60 days after 3<sup>rd</sup> dose (**16 to 53%** - range of means).

We have low certainty evidence that **2 doses of ChAdOx1 followed by BNT162b2** did not reach threshold for protection against severe disease from VOC **Omicron** up to 60 days after 3<sup>rd</sup> dose (66.7% [95% CI, 61 to 71.6] – 1 Obs).

We have low certainty evidence that **2 doses of ChAdOx1 followed by mRNA-1273** did not reach threshold for protection against symptomatic infection from VOC **Omicron** at 60 days after 3<sup>rd</sup> dose (**18 to 61%** - range of means).

We have low certainty evidence that **3 doses of CoronaVac** did not reach threshold for protection against symptomatic infection from VOC **Omicron** up to 59 days after 3<sup>rd</sup> dose (15.0% [95% CI, 2.0 to 18.0] – 1 Obs) and low certainty evidence that **3 doses of CoronaVac** did not reach threshold for protection against severe disease from VOC **Omicron** up to 59 days after 3<sup>rd</sup> dose (71.3% [95% CI, 60.3 to 79.2]- 1 Obs).

We have low certainty evidence that **2 doses of CoronaVac followed by BNT162b2 [Pfizer]** reached threshold for protection against symptomatic infection from VOC **Omicron** at 59 days after 3<sup>rd</sup> dose (87.1% [95% CI, 80.1 to 91.6] – 1 Obs) and low certainty evidence that **2 doses of CoronaVac followed by BNT162b2 [Pfizer]** reached threshold for protection against severe disease from VOC **Omicron** at 59 days after 3<sup>rd</sup> dose 85.5% [95% CI, 83.3 to 87.0]- 1 Obs).

## 2 Doses

We have low certainty evidence that **2 doses of BNT162b2 [Pfizer]** did not reach threshold for protection against infection from VOC **Omicron** up to 44 days after 2<sup>nd</sup> dose (26 to 55% - range of means) and remained below threshold up to 60 days after 2<sup>nd</sup> dose (6 to 49% - range of means).

We have low certainty evidence that **2 doses of BNT162b2 [Pfizer]** did not reach threshold for protection against symptomatic infection from VOC **Omicron** up to 60 days after 2<sup>nd</sup> dose (32 to **49%** – range of means) and remained below threshold up to 90 days after 2<sup>nd</sup> dose (**27 to 36%** - range of means).

We have low certainty evidence that **2 doses of BNT162b2 [Pfizer]** did not reach threshold for protection against death from VOC **Omicron** at 60 days after 2<sup>nd</sup> dose (62% [95% CI, 33 to 90] – 1 Obs) and remained below threshold at 90 days after 2<sup>nd</sup> dose (88% [95% CI, 71 to 105] – 1 Obs).

We have low certainty evidence that **2 doses of mRNA-1273 [Moderna]** did not reach threshold for protection against infection from VOC **Omicron** up to 30 days after 2<sup>nd</sup> dose (37.9% [95% CI, 34.4 to 41.2] – 1 Obs) and remained below threshold up to 60 days after 2<sup>nd</sup> dose (48% [95% CI, 44 to 52] – 1 Obs).

We have low certainty evidence that **2 doses of mRNA-1273 [Moderna]** did not reach threshold for protection against symptomatic infection from VOC **Omicron** up to 30 days after 2<sup>nd</sup> dose (44.8% [95% CI, 16 to 63.8] – 1 Obs) and remained below threshold up to 60 days after 2<sup>nd</sup> dose (**52.8%** [95% CI, 48.2 to 57.1]).

We have low certainty evidence that **2 doses of ChAdOx1** did not reach threshold for protection against infection from VOC **Omicron** up to 60 days after 2<sup>nd</sup> dose (51% [95% CI, 23 to 69] – 1 Obs).

We have low certainty evidence that **2 doses of ChAdOx1** did not reach threshold for protection against symptomatic infection from VOC **Omicron** up to 60 days after 2<sup>nd</sup> dose (33.7% [95% CI, 25 to 41.5] – 1 Obs) and remained below threshold up to 90 days after 2<sup>nd</sup> dose (28.6% [95% CI, 20.9 to 35.6]).

We have low certainty evidence that **one dose of Ad26.COV2.S followed by one dose of BNT162b2** did not reach threshold for protection against symptomatic infection from VOC **Omicron** up to 30 days after 2<sup>nd</sup> dose (58.9% [95% CI, 54.6 to 62.8] – 1 Obs) and low certainty evidence that **one dose of Ad26.COV2.S followed by one dose of mRNA-1273** did not reach threshold for protection against symptomatic infection from VOC **Omicron** up to 30 days after 2<sup>nd</sup> dose (63.7% [95% CI, 59.7 to 67.3] – 1 Obs).

We have low certainty evidence that **one dose of Ad26.COV2.S** did not reach threshold for protection against infection from VOC **Omicron** up to 60 days after dose (47% [95% CI, 45 to 49] – 1 Obs).

**Table 1a: Visual summary of evidence for COVID-19 vaccines for Variant of Concern – Omicron [2 doses: 30 to 120 days since last dose; 3 doses: 1 to 90 days since last dose]**

Percentages indicate level of effectiveness from 0% (no effect) to 100% (full protection): ranges of estimated means are provided when ≥ 1 study is available; estimated mean value is provided for single studies

Colour indicates **Level of Certainty** based on the evidence.

*Please note: prior to LES 6.34 moderate certainty evidence was coloured orange and low certainty evidence was coloured yellow*

High certainty evidence	Moderate certainty evidence	Low certainty evidence
pooling of low to moderate risk of bias RCTs or pooling of observational studies with low risk of bias and consistent findings	single RCT with low to moderate risk of bias or >one observational study with low to moderate risk of bias and at least partially consistent findings	single RCT or observational study with serious risk of bias or multiple low to serious risk of bias observational studies with inconsistent findings

  

Outcome (vaccine)	Variant	Number of Doses	Time since Last Dose* (days)	Vaccine Effectiveness
<b>Infection – Omicron (3 doses: up to 90 days after 3<sup>rd</sup> dose)</b>				
AZ followed by mRNA vaccine	Omicron	2/1	at least 7	58.6% (55.5 to 61.6)
Pfizer or Moderna		3	30	57.6% (55.8 to 59.4)
Pfizer		3	30	34 to 55%
Moderna		3	30	46 to 64%
Pfizer		3	60	58 to 74%
Moderna		3	60	60 to 61%
Pfizer or Moderna		3	60	55.3% (53.6 to 56.9)
Pfizer		3	90	35.7% (29.8 to 41.2)
Pfizer or Moderna		3	90	58.3% (56.5 to 60)
<b>Infection – Omicron (2 doses: 30 to 120 days after 2<sup>nd</sup> dose)</b>				
Pfizer	Omicron	2	44	26 to 55%
Moderna		2	44	36.7% (-70 to 76.4)
Pfizer		2	60	6 to 49%
Moderna		2	60	48% (44 to 52)
Pfizer or Moderna		2	60	6 to 39%
AstraZeneca		2	60	51% (23 to 69)
Johnson & Johnson		1	60	47% (45 to 49)
Moderna		2	90	24 to 30%
Pfizer or Moderna		2	120	13 to 26%
<b>Symptomatic Infection – Omicron (3 doses: up to 90 days after 3<sup>rd</sup> dose)</b>				
Pfizer	Omicron	3	14	75.5% (56.1 to 86.3)
Pfizer		3	30	54 to 69%
Moderna		3	30	55 to 71%
AstraZeneca		3	30	52 to 56%
Johnson & Johnson		2	30	28% (18.3 to 36/5)
Pfizer		3	30 to 60	37 to 59%
AstraZeneca		3	30 to 60	44 to 47%

Outcome (vaccine)	Variant	Number of Doses	Time since Last Dose* (days)	Vaccine Effectiveness
AZ followed by Pfizer		2/1	60	16 to 53%
AZ followed by Moderna		2/1	60	18 to 61%
CoronaVac		3	60	15.0% (12.0 to 18.0)
CoronaVac followed by BNT162b2		2/1	60	87.1% (80.1 to 91.6)
Pfizer or Moderna		3	14 to 63	43.7% (37.3 to 49.5)
Pfizer		3	up to 104	40 to 60%
Johnson & Johnson		2	60 to 120	29.3% (23.2 to 34.9)
Moderna		3	42 to 120	39 to 67%
<b>Symptomatic Infection - Omicron (2 doses: 30 to 120 days after 2<sup>nd</sup> dose)</b>				
Moderna	Omicron	2	30	44.8% (16 to 63.8)
Johnson & Johnson		1	30	17.9% (4.3 to 29.5)
J&J followed by Pfizer		1/1	30	58.9% (54.6 to 62.8)
J&J followed by Moderna		1/1	30	63.7% (59.7 to 67.3)
Pfizer		2	60	32 to 49%
Moderna		2	60	52.8% (48.2 to 57.1)
AstraZeneca		2	60	33.7% (25 to 41.5)
Pfizer		2	90	27 to 36%
Moderna		2	90	35.6% (32.7 to 38.4)
AstraZeneca		2	90	28.6% (20.9 to 35.6)
Pfizer		2	120	26 to 34%
Pfizer or Moderna		2	14 to 149	45% (14 to 66)
<b>Severe Disease – Omicron (2 or 3 doses)</b>				
Pfizer	Omicron	3	7 to 42	90.6% (77.8 to 96)
Moderna		3	7 to 42	80.5% (-51.9 to 97.6)
Pfizer		3	60	75 to 91%
Pfizer or Moderna		3	60	68.8% (-87 to 94.8)
AZ followed by Pfizer		2/1	60	66.7% (61 to 71.6)
CoronaVac		3	8-59	71.3% (60.3 to 79.2)
CoronaVac followed by BNT162b2		2/1	8-59	85.5% (83.3 to 87.0)
<b>Death – Omicron (2 or 3 doses)</b>				
Pfizer	Omicron	2	30 to 60	62% (33 to 90)
Pfizer		2	60 to 90	88% (71 to 105)
Pfizer		2	90 to 120	57% (35 to 78)
Pfizer		3	14 to 30	82% (72 to 92)
Pfizer		3	30 to 60	85% (79 to 90)
Pfizer		3	60 to 90	86% (80 to 92)

**Table 1b: Visual summary of evidence for COVID-19 vaccines for Variant of Concern – Delta [2 doses: 30 to 120 days since last dose; 3 doses: 1 to 90 days since last dose] – Last Updated April 29, 2022 and will not further updated)**

Percentages indicate level of effectiveness from 0% (no effect) to 100% (full protection): ranges of estimated means are provided when ≥ 1 study is available; estimated mean value is provided for single studies

Colour indicates **Level of Certainty** based on the evidence.

High certainty evidence	Moderate certainty evidence	Low certainty evidence
pooling of low to moderate risk of bias RCTs or pooling of observational studies with low risk of bias and consistent findings	single RCT with low to moderate risk of bias or >one observational study with low to moderate risk of bias and at least partially consistent findings	single RCT or observational study with serious risk of bias or multiple low to serious risk of bias observational studies with inconsistent findings

Outcome (vaccine)	Variant	Number of Doses	Time since Last Dose* (days)	Vaccine Effectiveness	
<b>Infection – Delta (3 doses: up to 90 days after 3<sup>rd</sup> dose)</b>					
AZ followed by Pfizer	Delta	2/1	7	82% (68 to 90)	
Sinovac followed by Pfizer		2/1	7	93 to 98%	
Sinovac followed by AZ		2/1	7	86% (74 to 93)	
Pfizer		3	>7	75% (72.5 to 77.8)	
Moderna		3	>7	85% (71.8 to 91.9)	
Moderna, followed by Pfizer		2/1	>7	87.1% (80.1 to 91.6)	
Pfizer followed by Moderna		2/1	>7	68.2% (57.6 to 76.1)	
Pfizer or Moderna		3	>14	91 to 95%	
Pfizer		3	30	81 to 93%	
Moderna		3	30	83 to 96%	
Pfizer		3	60	90% (89 to 90)	
Moderna		3	60	92% (91 to 93)	
<b>Infection – Delta (2 doses: 30 to 120 days after 2<sup>nd</sup> dose)</b>					
Pfizer		2	60	73 to 87%	
Moderna		2	60	71 to 94%	
AstraZeneca		2	60	60% (57 to 62)	
Pfizer		2	90	67 to 74%	
Moderna		2	90	79 to 83%	
Pfizer		2	120	53 to 85%	
Moderna		2	120	81 to 88%	
AstraZeneca		2	120	65 to 72%	
AZ followed by mRNA vaccine		1/1	120	86% (81 to 89)	
Pfizer or Moderna		2	>14	63 to 70%	
<b>Symptomatic Infection – Delta (3 doses: up to 90 days after 3<sup>rd</sup> dose)</b>					
Sinovac			3	14	78.8% (76.8 to 80.6)

AZ followed by Pfizer	Delta	2/1	14	93 to 94%
Sinovac followed by Pfizer		2/1	14	96.5% (96.2 to 96.7)
Sinovac followed by AZ		2/1	14	93.2% (92.9 to 93.6)
Pfizer or Moderna		3	>7	96% (93 to 98)
<b>Symptomatic Infection – Delta (2 doses: 30 to 120 days after 2<sup>nd</sup> dose)</b>				
Pfizer	Delta	2	30 to 60	74 to 76%
Pfizer		2	60 to 90	69 to 72%
AstraZeneca		1	60 to 90	65% (48 to 76)
Johnson & Johnson		1	60 to 90	52% (33 to 66)
Moderna		2	70 to 98	90%
AstraZeneca		2	119	41 to 49%
AZ followed by mRNA vaccine		1/1	120	66% (41 to 80)
Pfizer or Moderna		2	14 to 149	80 to 89%
<b>Severe Disease – Delta (2 or 3 doses)</b>				
Pfizer	Delta	2	44 to 98	91.1% (90 to 92)
Moderna		2	60	97.8% (83.7 to 99.7)
Moderna		2	90	75 to 93%
Pfizer		2	120	68 to 72%
Moderna		2	120	91.5% (60.8 to 98.1)
AstraZeneca			120	70.5% (67 to 73.7)
Sinovac followed by Pfizer		2/1	14	96 to 97%
Sinovac followed by AZ		2/1	14	98.9% (98.5 to 99.2)
Pfizer or Moderna		2	>7	99% (97 to 99)
<b>Death – Delta (2 or 3 doses)</b>				
Johnson & Johnson	Delta	1	120	89.4% (52.3 to 97.6)
Pfizer or Moderna		2	>14	58 to 88%
Sinovac followed by Pfizer		2/1	14	96.8% (93.9 to 98.3)
Sinovac followed by AZ		2/1	14	98.1% (97.3 to 98.6)

\*approximate because studies did not use the same s frames

**Table 2: Visual summary of evidence for COVID-19 vaccines for variants of concern (up to 30 days after 2 doses)**

**Percentages** indicate level of effectiveness from 0% (no effect) to 100% (full protection): ranges of estimated means are provided when  $\geq 1$  study is available; estimated mean value is provided for single studies

**Colour** indicates **Level of Certainty** based on the evidence

*Please note: prior to LES 6.34 moderate certainty evidence was coloured orange and low certainty evidence was coloured yellow*

High certainty evidence	Moderate certainty evidence	Low certainty evidence			
pooling of low to moderate risk of bias RCTs or pooling of observational studies with low risk of bias and consistent findings	single RCT with low to moderate risk of bias or >one observational study with low to moderate risk of bias and at least partially consistent findings	single RCT or observational study with serious risk of bias or multiple low to serious risk of bias observational studies with inconsistent findings			

  

Outcome (and vaccine)	Vaccine Effectiveness (2 doses unless otherwise stated) up to 30 days after last dose for each combination of vaccine, variant, and outcome				
	Alpha	Beta	Gamma	Delta	Omicron
<b>Any Infection</b>					
Pfizer	78 to 95%		93%	42 to 93%	
Moderna	86 to 100%	96%	95%	59 to 91%	38%
Pfizer or Moderna (2 doses)					40%
AstraZeneca (AZ)	62 to 79%		90%	45 to 83%	11%
Johnson & Johnson				3 to 71%*	
JnJ followed by an mRNA vaccine					48%
Novavax					
Sinovac			66%	60 to 74%	
AZ followed by Pfizer or Moderna	82 to 91%		96%	88%	
Sinovac followed by AZ				74% (43 to 99)	
<b>Symptomatic Infection</b> (reported when data on “any infection” is limited)					
Pfizer		84 to 88%	84 to 88%	63 to 94%	
Moderna			88%	87%	
AstraZeneca		10%**	65%	61 to 92%	
Johnson & Johnson				51%*	
Novavax	86%	43%**			
Sinovac				59%	
Covaxin				50%	
AZ followed by Pfizer or Moderna				67 to 79%	
<b>Transmission</b>					
Pfizer	70 to 82%			31 to 63% (unvacc contact) 10 to 40%	

<b>Outcome (and vaccine)</b>	<b>Vaccine Effectiveness (2 doses unless otherwise stated) up to 30 days after last dose for each combination of vaccine, variant, and outcome</b>			
				(vacc contact)
Moderna	88%			62 to 77%
AstraZeneca	58 to 63%			36%
Johnson & Johnson	77%*			
Novavax				
Sinovac				
AZ followed by Pfizer or Moderna				86%
<b>Severe Disease (may include death for some studies)</b>				
Pfizer	92 to 100%			82 to 98%
Moderna	96%	96%		93 to 100%
AstraZeneca			76%	
Johnson & Johnson		82%*		93%
Novavax				
Sinovac				46 to 89%
<b>Death</b>				
Pfizer	91 to 97%			90%
Moderna				
AstraZeneca				91%*
Johnson & Johnson				90%
Novavax				
Sinovac			86%	77%

\*single dose

\*\*mean estimate of effect less than the lowest acceptable limit for vaccine effectiveness as determined by WHO

AZ, AstraZeneca; unvacc, unvaccinated; vacc, vaccinated; JnJ, Johnson & Johnson

Table 3a: Key findings about vaccine effectiveness for VOC Omicron (revised 25 May 2022)

VOC	Vaccine	Findings
<b>3 Doses – VOC Omicron</b>		
<b>Omicron</b>  <b>(3 doses)</b>  <b>(any time frame)</b>	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	<p>BNT162b2 (3 doses) provided protection against infection by VOC Omicron at the following number of days after the 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 34 to 54.6% up to 30 days (RME)</li> <li>• 58 to 74% up to 60 days (RME)</li> <li>• 35.7% (95% CI, 29.8 to 41.2) up to 90 days (8 Obs) [<a href="#">137</a>][<a href="#">147</a>][<a href="#">160</a>][<a href="#">167</a>][<a href="#">168</a>][<a href="#">169</a>][<a href="#">187</a>][<a href="#">205</a>]; <i>last update 2022-05-25</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 67.2% (95% CI, 66.5 to 67.8) at 14 to 30 days</li> <li>• 54 to 69% at 28 to 35 days (RME)</li> <li>• 37 to 59% at 30 to 60 days (RME)</li> <li>• 40 to 60% at up to 104 days (RME) (6 Obs) [<a href="#">136</a>][<a href="#">162</a>][<a href="#">199</a>][<a href="#">200</a>][<a href="#">201</a>][<a href="#">208</a>]; <i>last update 2022-06-22</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against severe, critical, or fatal disease by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 90.6% (95% CI, 77.8 to 96) at 7 to 42 days</li> <li>• 75 to 91% up to 63 days (RME) (2 Obs) [<a href="#">162</a>][<a href="#">199</a>]; <i>last update 2022-05-12</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against <b>death</b> by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 82% (95% CI, 72 to 92) at 14 to 30 days</li> <li>• 85% (95% CI, 79 to 90) at 30 to 60 days</li> <li>• 86% (95% CI, 80 to 92) at 60 to 90 days (1 Obs) [<a href="#">199</a>]; <i>last update 2022-05-12</i></li> </ul> <p>BNT162b2 (3 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 70% (95% CI, 68.4 to 71.6) at 14 to 63 days (1 Obs)[<a href="#">191</a>]; <i>last update 2022-06-22</i></li> </ul> <p>BNT162b2 (3 doses + prior infection) provided protection against <b>severe disease</b> by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 95.7% (95% CI, 90.6 to 98) at 14 to 63 days (1 Obs)[<a href="#">191</a>]; <i>last update 2022-06-22</i></li> </ul> <p><b>BA.1</b></p> <p>BNT162b2 (3 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.1 the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 59.9% (95% CI, 51.2 to 67.0) up to 30 days (1 Obs) [<a href="#">175</a>]; <i>last update 2022-03-30</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against <b>severe disease</b> by VOC Omicron BA.1 the following number of days after 3<sup>rd</sup> dose:</p>

VOC	Vaccine	Findings
		<ul style="list-style-type: none"> <li>94% (95% CI, 76 to 98) up to 90 days (1 Obs)[<a href="#">197</a>]; <i>last update 2022-05-12</i></li> </ul> <p>BNT162b2 (3 doses + prior infection) provided protection against symptomatic infection by VOC Omicron BA.1:</p> <ul style="list-style-type: none"> <li>74.4% (95% CI, 63.4 to 82.2) median 42 days after 3<sup>rd</sup> dose (1 Obs) [<a href="#">176</a>]; <i>last update 2022-03-30</i></li> </ul> <p><b>BA.2</b></p> <p>BNT162b2 (3 doses) provided protection against symptomatic infection by VOC Omicron BA.2 the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>43.7% (95% CI, 36.5 to 50.0) up to 30 days (1 Obs) [<a href="#">175</a>]; <i>last update 2022-03-30</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against mild/moderate infection by VOC Omicron BA.2 the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>71.6% (95% CI, 43.5 to 85.7) at median of 35 days (1 Obs) [<a href="#">182</a>]; <i>last update 2022-03-30</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against severe disease by VOC Omicron BA.2 the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>82% (95% CI, 56 to 93) up to 90 days (1 Obs)[<a href="#">197</a>]; <i>last update 2022-05-12</i></li> </ul> <p>BNT162b2 (3 doses + prior infection) provided protection against symptomatic infection by VOC Omicron BA.2:</p> <ul style="list-style-type: none"> <li>77.3% (95% CI, 72.4 to 81.4) median 42 days after 3<sup>rd</sup> dose (1 Obs) [<a href="#">176</a>]; <i>last update 2022-03-30</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against death by VOC Omicron BA.2 at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>98.9% (95% CI, 95.3 to 99.7) at median of 35 days (1 Obs) [<a href="#">182</a>]; <i>last update 2022-03-30</i></li> </ul>
<p><b>Omicron</b></p> <p><b>(3 doses)</b></p> <p><b>(any time frame)</b></p>	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p>mRNA-1273 (3 doses) provided protection against infection by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>46.4 to 64% at 7 to 30 days (RME)</li> <li>60 to 61% up to 60 days (RME)</li> </ul> <p>(7 Obs) [<a href="#">147</a>][<a href="#">148</a>][<a href="#">160</a>][<a href="#">167</a>][<a href="#">169</a>][<a href="#">187</a>][<a href="#">205</a>]; <i>last update 2022-05-25</i></p> <p>mRNA-1273 (3 doses) provided protection against symptomatic infection by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>55% to 71% at 28 to 35 days (RME)</li> <li>39% to 67% at 42 to 120 days (RME)</li> </ul> <p>(3 Obs) [<a href="#">136</a>][<a href="#">162</a>][<a href="#">208</a>]; <i>last update 2022-06-22</i></p> <p>mRNA-1273 (3 doses) provided protection against severe, critical, or fatal disease by VOC Omicron at the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>80.8% (95% CI, -51.9 to 97.6) at 7 to 42 days (1 Obs) [<a href="#">162</a>]; <i>last update 2022-03-02</i></li> </ul>

VOC	Vaccine	Findings
		<p><b>BA.1</b> mRNA-1273 (3 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.1 the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>51.5% (95% CI, 32.3 to 65.2) up to 30 days (1 Obs) [175]; last update 2022-03-30</li> </ul> <p>mRNA-1273 (3 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.1:</p> <ul style="list-style-type: none"> <li>77.2% (95% CI, 38.5 to 91.5) unknown median days after 3<sup>rd</sup> dose (1 Obs) [176]; last update 2022-03-30</li> </ul> <p><b>BA.2</b> mRNA-1273 (3 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.2 the following number of days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>39.4% (95% CI, 24.8 to 51.2) up to 30 days (1 Obs) [175]; last update 2022-03-30</li> </ul> <p>mRNA-1273 (3 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.2:</p> <ul style="list-style-type: none"> <li>69.8% (95% CI, 50.1 to 81.7) unknown median days after 3<sup>rd</sup> dose (1 Obs) [176]; last update 2022-03-30</li> </ul>
<p><b>Omicron</b> <b>(3 doses)</b>  <b>(any time frame)</b></p>	<p><b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>  <b>OR</b>  <b>Moderna Spikevax [mRNA-1723]</b></p>	<p><b>BNT162b2 or mRNA-1273 (3 doses)</b> provided protection against VOC Omicron for the following outcomes after the 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>57.6% (95% CI, 55.8 to 59.4) from infection at 14 to 30 days</li> <li>55.3% (95% CI, 53.6 to 56.9) from infection at 31 to 60 days</li> <li>58.3% (95% CI, 56.5 to 60.0) from infection at 61 to 90 days</li> <li>65 to 94% from infection at 14 to 179 days (RME)</li> <li>62% (95% CI, 48 to 72) from <b>symptomatic infection</b> &gt;7 days</li> <li>43.7% (95% CI, 37.3 to 49.5) from <b>symptomatic infection</b> 14 to 63 days</li> <li>68.8% (95% CI, -87 to 94.8) from severe disease 14 to 63 days</li> <li>85% (95% CI, 60 to 94) from <b>death</b> at 14 to 179 days</li> </ul> <p>(5 Obs)[184][188][193][196][200]; last update 2022-05-12</p> <p><b>BA.1</b> <b>BNT162b2 or mRNA-1273 (3 doses)</b> provided protection against VOC Omicron for the following outcomes after the 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>38.1% (95% CI, 18.6 to 52.9) from infection up to 14 days (1 Obs) [204]; last update 2022-05-12</li> </ul>
<p><b>Omicron</b> <b>(3 doses)</b>  <b>(any time frame)</b></p>	<p><b>AstraZeneca [ChAdOx1] Vaxzevria Serum Institute of India [Covishield]</b></p>	<p>ChAdOx1 (3 doses) provided protection against VOC Omicron for the following outcomes after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>52 to 56% from <b>symptomatic infection</b> 14 to 30 days (RME)</li> <li>44 to 47% from <b>symptomatic infection</b> 30 to 69 days (RME)</li> <li>-27.2% (95% CI, -131.6 to 30.1) from <b>symptomatic infection</b> 70 to 104 days</li> </ul> <p>(2 Obs) [136][201]; last update 2022-06-22</p> <p>ChAdOx1 (3 doses + prior infection) provided protection against VOC Omicron for the following outcomes after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>72.9% (95% CI, 72.2 to 73.5) from <b>symptomatic infection</b> at 14 to 63 days</li> <li>97.5% (95% CI, 96.6 to 98.1) from <b>severe disease</b> at 14 to 63 days</li> </ul>

VOC	Vaccine	Findings
		(1 Obs) [191]; last update 2022-06-22
<b>Omicron</b> <b>(2 doses)</b> <b>(any time frame)</b>	<b>Johnson &amp; Johnson</b> <b>[AD26.COV 2.S]</b>	Ad26.COV2.S provided minimal protection against <b>symptomatic infection</b> by VOC Omicron at the following number of days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 28% (95% CI, 18.3 to 36.5) at 14 to 30 days</li> <li>• 29.3% (95% CI, 23.2 to 34.9) at 60 to 120 days</li> </ul> (1 Obs) [208]; last update 2022-06-22
<b>Omicron</b> <b>(3 doses)</b> <b>(any time frame)</b>	<b>Sinovac</b> <b>[CoronaVac]</b>	CoronaVac (3 doses) provided protection against <b>mild/moderate</b> infection by VOC Omicron BA.2 the following number of days after 3 <sup>rd</sup> dose: <ul style="list-style-type: none"> <li>• 50.7% (95% CI, 12.9 to 72.1) at median of 35 days</li> </ul> (1 Obs) [182]; last update 2022-03-30  CoronaVac (3 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron the following number of days after 3 <sup>rd</sup> dose: <ul style="list-style-type: none"> <li>• 15.0% (95% CI, 12.0 to 18.0) at 8-59 days</li> </ul> (1 Obs) [189]; last update 2022-04-13  CoronaVac (3 doses) provided protection against <b>severe disease</b> by VOC Omicron the following number of days after 3 <sup>rd</sup> dose: <ul style="list-style-type: none"> <li>• 71.3% (95% CI, 60.3 to 79.2) at 8-59 days</li> </ul> (1 Obs) [189]; last update 2022-04-13  CoronaVac (3 doses) provided protection against <b>death</b> by VOC Omicron BA.2 at the following number of days after 3 <sup>rd</sup> dose: <ul style="list-style-type: none"> <li>• 98.5% (95% CI, 95.3 to 99.6) at median of 35 days</li> </ul> (1 Obs) [182]; last update 2022-03-30
<b>Omicron</b> <b>(2 doses followed by mRNA vaccine)</b> <b>(any time frame)</b>	<b>AstraZeneca</b> <b>[ChAd0x1</b> <b>Vaxzevria</b> <b>Serum</b> <b>Institute of</b> <b>India</b> <b>[Covishield]</b>	ChAdOx1 (2 doses) followed by BNT162b2 provided protection against VOC Omicron for the following outcomes after 3 <sup>rd</sup> dose: <ul style="list-style-type: none"> <li>• 58.6% (95% CI, 55.5 to 61.6) from infection at least 7 days</li> <li>• 16 to 53% from <b>symptomatic infection</b> at 14 to 63 days (RME)</li> <li>• 66.7% (95% CI, 61 to 71.6) from <b>severe disease</b> 14 to 63 days</li> </ul> (3 Obs) [136][167][200]; last update 2022-06-22  ChAdOx1 (2 doses) followed by mRNA-1273 provided protection against VOC Omicron for the following outcomes after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 18 to 61% (95% CI, -6.7 to 37.2) from <b>symptomatic infection</b> at 14 to 63 days</li> </ul> (2 Obs) [136][200]; last update 2022-06-22
<b>Omicron</b> <b>(2 doses followed by mRNA vaccine)</b> <b>(any time frame)</b>	<b>Sinovac</b> <b>[CoronaVac]</b>	CoronaVac (2 doses), followed by BNT162b2 provided protection against VOC Omicron for the following outcomes after 3 <sup>rd</sup> dose: <ul style="list-style-type: none"> <li>• 87.1% (95% CI, 80.1 to 91.6) from symptomatic infection at 8-59 days</li> <li>• 85.5% (95% CI, 83.3% to 87.0%) from severe disease at 8-59 days</li> </ul> (1 Obs) [189]; last update 2022-04-13
<b>2 Doses – VOC Omicron</b>		
<b>Omicron</b>	<b>Pfizer/</b> <b>BioNTech</b>	BNT162b2 (2 doses) provided protection against infection by VOC Omicron at the following number of days after 2 <sup>nd</sup> dose:

VOC	Vaccine	Findings
(2 doses)  (any time frame)	Comirnaty [BNT162b2]	<ul style="list-style-type: none"> <li>• 26 to 55% up to 44 days (RME)</li> <li>• 6 to 49% up to 60 days (RME)</li> <li>• -77 to 30% up to 164 days (RME)</li> </ul> <p>(6 Obs) [<a href="#">137</a>][<a href="#">147</a>][<a href="#">160</a>][<a href="#">169</a>][<a href="#">187</a>][<a href="#">205</a>]; <i>last update 2022-05-25</i></p> <p>BNT162b2 (2 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron at the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 61.9% (95% CI, 49.9 to 71.1) up to 30 days</li> <li>• 32 to 49% at 30 to 60 days (RME)</li> <li>• 27 to 36% at 60 to 90 days (RME)</li> <li>• 26 to 34% up to 120 days (RME)</li> </ul> <p>(3 Obs) [<a href="#">136</a>][<a href="#">162</a>][<a href="#">199</a>]; <i>last update 2022-06-22</i></p> <p>BNT162b2 (2 doses) provided protection against <b>death</b> by VOC Omicron at the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 62% (95% CI, 33 to 90) at 30 to 60 days</li> <li>• 88% (95% CI, 71 to 105) at 60 to 90 days</li> <li>• 57% (95% CI, 35 to 78) at 90 to 120 days</li> </ul> <p>(1 Obs) [<a href="#">199</a>]; <i>last update 2022-05-12</i></p> <p>BNT162b2 (2 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron at the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 66.5% (95% CI, 65.5 to 67.5) at 14 to 63 days</li> </ul> <p>(1 Obs)[<a href="#">191</a>]; <i>last update 2022-06-22</i></p> <p>BNT162b2 (2 doses + prior infection) provided protection against <b>severe disease</b> by VOC Omicron at the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 90.9% (95% CI, 84 to 94.8) at 14 to 63 days</li> </ul> <p>(1 Obs)[<a href="#">191</a>]; <i>last update 2022-06-22</i></p> <p><b>BA.1</b></p> <p>BNT162b2 (2 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.1 the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 46.6% (95% CI, 33.4 to 57.2) at 30 to 90 days</li> </ul> <p>(1 Obs) [<a href="#">175</a>]; <i>last update 2022-03-30</i></p> <p>BNT162b2 (2 doses) provided protection against <b>severe disease</b> by VOC Omicron BA.1 the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 84% (95% CI, 37 to 96) up to 90 days</li> </ul> <p>(1 Obs)[<a href="#">197</a>]; <i>last update 2022-05-12</i></p> <p>BNT162b2 (2 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.1:</p> <ul style="list-style-type: none"> <li>• 51.7% (95% CI, 43.5 to 58.7) median 268 days after 2<sup>nd</sup> dose</li> </ul> <p>(1 Obs) [<a href="#">176</a>]; <i>last update 2022-03-30</i></p> <p><b>BA.2</b></p> <p>BNT162b2 (2 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.2 the following number of days after 2<sup>nd</sup> dose:</p>

VOC	Vaccine	Findings
		<ul style="list-style-type: none"> <li>51.7% (95% CI, 43.2 to 58.9) at 30 to 90 days (1 Obs) [<a href="#">175</a>]; <i>last update 2022-03-30</i></li> </ul> <p>BNT162b2 (2 doses) provided protection against <b>severe disease</b> by VOC Omicron BA.2 the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>43% (95% CI, 0 to 79) up to 90 days (1 Obs)[<a href="#">197</a>]; <i>last update 2022-05-12</i></li> </ul> <p>BNT162b2 (2 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.2:</p> <ul style="list-style-type: none"> <li>55.1% (95% CI, 50.9 to 58.9) median 268 days after 2<sup>nd</sup> dose (1 Obs) [<a href="#">176</a>]; <i>last update 2022-03-30</i></li> </ul>
<p><b>Omicron</b> <b>(2 doses)</b>  <b>(any time frame)</b></p>	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p>mRNA-1273 (2 doses) provided protection against infection by VOC Omicron at the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>37.9% (95% CI, 34.4 to 41.2) up to 30 days</li> <li>36.7% (95% CI, -69.9 to 76.4) up to 44 days</li> <li>48% (95% CI, 44 to 52) up to 60 days</li> <li>23.7 to 30.4% up to 90 days (RME)</li> <li>-39% to 14% up to 164 days (RME)</li> <li>15.2% (95% CI, 0 to 30.7) at 91 to 180 days</li> <li>0% (95% CI, 0 to 1.2) at 181 to 270 days</li> </ul> <p>(6 Obs) [<a href="#">137</a>][<a href="#">148</a>][<a href="#">160</a>][<a href="#">169</a>][<a href="#">187</a>][<a href="#">205</a>]; <i>last update 2022-05-25</i></p> <p>mRNA-1273 (2 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron at the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>44.8% (95% CI, 16 to 63.8) at 28 to 35 days</li> <li>52.8% (95% CI, 48.2 to 57.1) at 35 to 63 days</li> <li>35.6% (95% CI, 32.7 to 38.4) at 70 to 98 days</li> </ul> <p>(2 Obs) [<a href="#">136</a>][<a href="#">162</a>]; <i>last update 2022-06-22</i></p> <p><b>BA.1</b></p> <p>mRNA-1273 (2 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.1 the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>71.0% (95% CI, 24.0 to 89.0) at 30 to 90 days (1 Obs) [<a href="#">175</a>]; <i>last update 2022-03-30</i></li> </ul> <p>mRNA-1273 (2 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.1:</p> <ul style="list-style-type: none"> <li>44.3% (95% CI, 30.4 to 55.4) unknown median days after 2<sup>nd</sup> dose (1 Obs) [<a href="#">176</a>]; <i>last update 2022-03-30</i></li> </ul> <p><b>BA.2</b></p> <p>mRNA-1273 (2 doses) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.2 the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>35.9% (95% CI, -5.9 to 61.2) at 30 to 90 days (1 Obs) [<a href="#">175</a>]; <i>last update 2022-03-30</i></li> </ul> <p>mRNA-1273 (2 doses + prior infection) provided protection against <b>symptomatic</b> infection by VOC Omicron BA.2:</p> <ul style="list-style-type: none"> <li>47.9% (95% CI, 40.8 to 54.1) unknown median days after 2<sup>nd</sup> dose</li> </ul>

VOC	Vaccine	Findings
		(1 Obs) [ <a href="#">176</a> ]; <i>last update 2022-03-30</i>
<b>Omicron</b>  (2 doses)  (any time frame)	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>  <b>OR</b>  <b>Moderna Spikevax [mRNA-1723]</b>	<b>BNT162b2 or mRNA-1273 (2 doses)</b> provided protection against VOC Omicron for the following outcomes after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 39.9% (95% CI, 26.4 to 50.9) from infection 14 to 30 days</li> <li>• 6 to 39% from infection up to 60 days (RME)</li> <li>• 13 to 26% from infection 60 to 119 days (RME)</li> <li>• -38% to 26% from infection up to 179 days (RME)</li> <li>• -16% (95% CI, -62 to 17) from infection ≥240 days</li> <li>• 45% (95% CI, 14 to 66) from <b>symptomatic infection</b> 14-149 days</li> <li>• 60% (95% CI, 49 to 68) from <b>death</b> 14 to 179 days</li> </ul> (4 Obs) [ <a href="#">147</a> ][ <a href="#">184</a> ][ <a href="#">193</a> ][ <a href="#">196</a> ]; <i>last update 2022-05-12</i>  <b>BA.1</b> <b>BNT162b2 or mRNA-1273 (2 doses)</b> provided protection against VOC Omicron BA.1 for the following outcomes after the 3 <sup>rd</sup> dose: <ul style="list-style-type: none"> <li>• 28.5% (95% CI, 20 to 36.2) from infection up to 14 days</li> </ul> (1 Obs) [ <a href="#">204</a> ]; <i>last update 2022-05-12</i>
<b>Omicron</b>  (2 doses)  (any time frame)	<b>AstraZeneca [ChAdOx1] Vaxzevria Serum Institute of India [Covishield]</b>	ChAdOx1 (2 doses) provided protection against VOC Omicron for the following outcomes after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 11.4% (95% CI, -18.8 to 34.6) from infection at 14 days</li> <li>• 51% (95% CI, 23 to 69) from infection up to 60 days</li> <li>• 33.7% (95% CI, 25 to 41.5) from <b>symptomatic infection</b> at 35 to 63 days</li> <li>• 28.6% (95% CI, 20.9 to 35.6) from <b>symptomatic infection</b> at 70 to 98 days</li> </ul> (3 Obs) [ <a href="#">136</a> ][ <a href="#">160</a> ][ <a href="#">169</a> ]; <i>last update 2022-02-22</i>  ChAdOx1 (2 doses + prior infection) provided protection against VOC Omicron for the following outcomes after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 49% (95% CI, 46.6 to 51.3) from <b>symptomatic infection</b> at 14 to 63 days</li> <li>• 90.2% (95% CI, 77.4 to 95.8) from <b>severe disease</b> at 14 to 63 days</li> </ul> (1 Obs) [ <a href="#">191</a> ]; <i>last update 2022-06-22</i>
<b>Omicron</b>  (2 doses)  (any time frame)	<b>Sinovac [CoronaVac]</b>	CoronaVac (2 doses + prior infection) provided protection against VOC Omicron for the following outcomes after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 49.3% (95% CI, 46.5 to 52) from <b>symptomatic infection</b> at 14 to 63 days</li> <li>• 78.4% (95% CI, 48.29 to 91) from <b>severe disease</b> at 14 to 63 days</li> </ul> (1 Obs) [ <a href="#">191</a> ]; <i>last update 2022-06-22</i>
<b>Omicron</b>  (2 doses)  (any time frame)	<b>Johnson &amp; Johnson [AD26.COV 2.S]</b>	<b>Ad26.COVS (2 doses + prior infection)</b> provided protection against VOC Omicron for the following outcomes after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 47.2% (95% CI, 45.2 to 49.2) from <b>symptomatic infection</b> 14 to 63 days</li> <li>• 97.5% (95% CI, 91.3 to 99.3) from <b>severe disease</b> at least 14 to 63 days</li> </ul> (1 Obs) [ <a href="#">191</a> ]; <i>last update 2022-06-22</i>
<b>Omicron</b>  (1 dose followed by mRNA vaccine)	<b>Johnson &amp; Johnson [AD26.COV 2.S]</b>	Ad26.COVS followed by BNT162b2 provided protection against <b>symptomatic infection</b> by VOC Omicron at the following number of days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 58.9% (95% CI, 54.6 to 62.8) at 14 to 30 days</li> <li>• 51.5% (95% CI, 48.3 to 54.5) at 60 to 120 days</li> </ul> (1 Obs) [ <a href="#">208</a> ]; <i>last update 2022-06-22</i>

VOC	Vaccine	Findings
(any time frame)		<p>Ad26.COVS followed by mRNA-1273 provided protection against <b>symptomatic infection</b> by VOC Omicron at the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>63.7% (95% CI, 59.7 to 67.3) at 14 to 30 days</li> <li>56.7% (95% CI, 53.9 to 59.3) at 60 to 120 days</li> </ul> <p>(1 Obs) [<a href="#">208</a>]; <i>last update</i> 2022-06-22</p> <p>Ad26.COVS followed by an mRNA vaccine provided protection against VOC Omicron for the following outcomes after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>48% (95% CI, 42.5 to 53.7) from infection at least 7 days</li> </ul> <p>(1 Obs) [<a href="#">167</a>]; <i>last update</i> 2022-03-16</p>
Omicron  (1 dose)  (any time frame)	Johnson & Johnson [AD26.COV 2.S]	<p>Ad26.COVS provided protection against VOC Omicron for the following outcomes after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>47% (95% CI, 45 to 49) from infection up to 60 days</li> <li>17.9% (95% CI, 4.3 to 29.5) from <b>symptomatic</b> infection 14 to 30 days after dose</li> <li>8.4% (95% CI, 1.5 to 14.8) from <b>symptomatic</b> infection 60 to 120 days after dose</li> </ul> <p>(2 Obs) [<a href="#">169</a>][<a href="#">208</a>]; <i>last update</i> 2022-06-22</p>

Relative VE - VOC Omicron		
Omicron  Relative VE for primary series vaccine doses compared to primary series plus booster vaccine doses (instead of an unvaccinated group)	Any vaccine	<p><b>The results in this section should be reviewed with caution. Study populations that received booster doses are commonly very different from populations who did not receive or were not yet eligible for booster doses which increases the risk of bias</b></p> <p>BNT162b2 (4 doses) showed relative VE for the following outcomes compared to BNT162b2 (3 doses):</p> <ul style="list-style-type: none"> <li>45 to 63% from infection 21 to 27 days after 4<sup>th</sup> dose (RME)</li> <li>56% (95% CI, 53.4 to 58.5) from infection 35 to 41 days after 4<sup>th</sup> dose</li> <li>27.1% (95% CI, 4.2 to 44.5) from infection 63 to 69 days after 4<sup>th</sup> dose</li> <li>55% (95% CI, 53 to 58) from symptomatic infection 7 to 30 days after 4<sup>th</sup> dose</li> <li>62 to 83% from severe disease 7 to 27 days after 4<sup>th</sup> dose (RME)</li> <li>70.3% (95% CI, 37.4 to 85.9) from severe disease 28 to 48 days after 4<sup>th</sup> dose</li> <li>87.1% (95% CI, 0 to 98.4) from severe disease 49 to 69 days after 4<sup>th</sup> dose</li> <li>74 to 78% from death 7 to 40 days after 4<sup>th</sup> dose (RME)</li> </ul> <p>(3 Obs) [<a href="#">178</a>][<a href="#">183</a>][<a href="#">190</a>]; <i>last update</i> 2022-05-25</p> <p>BNT162b2 (3 doses) showed relative VE for the following outcomes compared to BNT162b2 (2 doses):</p> <ul style="list-style-type: none"> <li>51.1% (95% CI, 50.3 to 51.9) from infection up to 90 days after 3<sup>rd</sup> dose</li> <li>11% (95% CI, 7 to 14) from infection up to 120 days after 3<sup>rd</sup> dose</li> <li>70% (95% CI, 51 to 81) from symptomatic infection median 30 days after 3<sup>rd</sup> dose</li> </ul>

		<ul style="list-style-type: none"> <li>88% (95% CI, 68 to 96) from severe disease or death up to 120 days after 3<sup>rd</sup> dose (3 Obs) [<a href="#">195</a>][<a href="#">202</a>][<a href="#">207</a>]; last update 2022-05-25</li> </ul> <p>mRNA-1273 (3 doses) showed relative VE for the following outcomes compared to mRNA-1273 (2 doses):</p> <ul style="list-style-type: none"> <li>27% (95% CI, 24 to 30) from infection up to 120 days after 3<sup>rd</sup> dose</li> <li>72% (95% CI, 24 to 90) from severe disease or death up to 120 days after 3<sup>rd</sup> dose (1 Obs) [<a href="#">207</a>]; last update 2022-05-25</li> </ul> <p><b>BNT162b2 (majority) or mRNA-1273 (3 doses)</b> showed relative VE for the following outcomes compared to 2 doses of BNT162b2 or mRNA-1273:</p> <ul style="list-style-type: none"> <li>56% (95% CI, 39 to 67) from infection 14 days after 3<sup>rd</sup> dose</li> <li>54% (95% CI, 48 to 60) from infection 14 to 59 days after 3<sup>rd</sup> dose</li> <li>47% (95% CI, 37 to 56) from infection 60 to 89 days after 3<sup>rd</sup> dose</li> <li>70% (95% CI, 51 to 81) from symptomatic infection (3 Obs) [<a href="#">174</a>][<a href="#">195</a>][<a href="#">204</a>]; last update 2022-05-25</li> </ul> <p>ChAdOx1 (3 doses) showed relative VE for the following outcomes compared to BNT162b2 (2 doses):</p> <ul style="list-style-type: none"> <li>30.1% (95% CI, 28.4 to 31.8) from infection up to 90 days (1 Obs) [<a href="#">202</a>]; last update 2022-05-12</li> </ul> <p><b>ChAdOx1 (2 doses) + BNT162b2</b> showed relative VE for the following outcomes compared to BNT162b2 (2 doses):</p> <ul style="list-style-type: none"> <li>53.0% (95% CI, 51.6 to 54.3) from infection up to 90 days (1 Obs) [<a href="#">202</a>]; last update 2022-05-12</li> </ul> <p>CoronaVac (3 doses) showed relative VE for the following outcomes compared to BNT162b2 (2 doses):</p> <ul style="list-style-type: none"> <li>33.4% (95% CI, 31.9 to 34.9) from infection up to 90 days (1 Obs) [<a href="#">202</a>]; last update 2022-05-12</li> </ul> <p><b>CoronaVac (2 doses) + BNT162b2</b> showed relative VE for the following outcomes compared to BNT162b2 (2 doses):</p> <ul style="list-style-type: none"> <li>47.6% (95% CI, 46.9 to 48.3) from infection up to 90 days (1 Obs) [<a href="#">202</a>]; last update 2022-05-12</li> </ul> <p><b>CoronaVac (2 doses) + ChAdOx1</b> showed relative VE for the following outcomes compared to BNT162b2 (2 doses):</p> <ul style="list-style-type: none"> <li>49.0% (95% CI, 46.7 to 51.3) from infection up to 90 days (1 Obs) [<a href="#">202</a>]; last update 2022-05-12</li> </ul>
<b>Transmission – VOC Omicron</b>		
<b>Omicron</b>  <b>Transmission Household or close contacts of index case</b>	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	<b>BNT162b2 or mRNA-1273 (2 doses)</b> hh contacts showed <b>VES</b> : <ul style="list-style-type: none"> <li>16% (95% CI, 0 to 37) at least 7 days after 2<sup>nd</sup> dose</li> </ul> <b>BNT162b2 or mRNA-1273 (3 doses)</b> hh contacts showed <b>VES</b> : <ul style="list-style-type: none"> <li>47% (95% CI, 17 to 64) at least 7 days after 3<sup>rd</sup> dose (1 Obs) [<a href="#">161</a>]; last update 2022-03-02</li> </ul>
<b>Omicron</b>	<b>Moderna</b>	<b>BNT162b2 or mRNA-1273 (2 doses)</b> hh contacts showed <b>VES</b> :

Transmission Household or close contacts of index case	Spikevax [mRNA-1723]	<ul style="list-style-type: none"> <li>• 16% (95% CI, 0 to 37) at least 7 days after 2<sup>nd</sup> dose</li> </ul> <p><b>BNT162b2 or mRNA-1273 (3 doses)</b> hh contacts showed <b>VES</b>:</p> <ul style="list-style-type: none"> <li>• 47% (95% CI, 17 to 64) at least 7 days after 3<sup>rd</sup> dose (1 Obs) [<a href="#">161</a>]; <i>last update 2022-03-02</i></li> </ul>
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**Table 3b: Key findings about vaccine effectiveness for VOC Delta (revised 25 May 2022)**  
 (Last updated [27 April 2022](#) – will not be updated further)

3 Doses - VOC Delta		
Delta (3 doses) (any time frame)	Pfizer/ BioNTech Comirnaty [BNT162b2]	<p>BNT162b2 (3 doses) provided protection against the following outcomes <b>compared to unvaccinated</b>:</p> <ul style="list-style-type: none"> <li>• 81 to 93% from infection up to 30 days after 3<sup>rd</sup> dose (RME)</li> <li>• 90% (95% CI, 89 to 90) up to 60 days after 3<sup>rd</sup> dose</li> <li>• 75% (95% CI, 72.5 to 77.8) from infection from 7 days after 3<sup>rd</sup> dose (6 Obs) [<a href="#">137</a>][<a href="#">139</a>][<a href="#">147</a>][<a href="#">160</a>][<a href="#">169</a>] [<a href="#">186</a>]; <i>last update 2022-04-13</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against <b>symptomatic</b> infection <b>compared to unvaccinated</b>:</p> <ul style="list-style-type: none"> <li>• 94% (95% CI, 93.4 to 94.6) – at least 14 days after 3<sup>rd</sup> dose (age 50+) (1 Obs) [<a href="#">126</a>]; <i>last update 2021-12-15</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against <b>infection</b> by VOC Delta <b>compared to 2 doses</b>:</p> <ul style="list-style-type: none"> <li>• 84.0% (95% CI, 79 to 88) at 14 to 20 days after 3<sup>rd</sup> dose</li> <li>• 45.7% (95% CI, 37.9 to 53.5) median of 30 days after 3<sup>rd</sup> dose (2 Obs) [<a href="#">93</a>][<a href="#">132</a>]; <i>last update 2021-12-15</i></li> </ul> <p>BNT162b2 (3 doses) provided protection against the following outcomes by VOC Delta <b>compared to 2 doses</b>:</p> <ul style="list-style-type: none"> <li>• Rate ratio 11.3 to 12.3 from infection at least 12 days after 3<sup>rd</sup> dose</li> <li>• Rate ratio 17.9 to 19.5 from severe illness at least 12 days after 3<sup>rd</sup> dose</li> <li>• Rate ratio 14.7 (95% CI, 10 to 21.4) from death at least 12 days after 3<sup>rd</sup> dose</li> <li>• 90% (95% CI, 86 to 93) from death unclear number of days after 3<sup>rd</sup> dose (3 Obs)[<a href="#">100</a>][<a href="#">134</a>][<a href="#">135</a>]; <i>last update 2022-01-05</i></li> </ul> <p><b>BNT162b2 or mRNA-1273 (3 doses)</b> provided protection against VOC Delta for the following outcomes after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 91 to 95% against <b>infection</b> &gt;14 days (RME)</li> <li>• 96% (95% CI, 93 to 98) against <b>symptomatic infection</b> &gt;7 days</li> <li>• 76% (95% CI, 46 to 89) against death 14 to 179 days (3 Obs)[<a href="#">184</a>][<a href="#">188</a>][<a href="#">193</a>]; <i>last update 2022-05-12</i></li> </ul>
Delta (3 doses) (any time frame)	Moderna Spikevax [mRNA-1723]	<p>mRNA-1273 (3 doses) provided protection against <b>infection</b> by VOC Delta <b>compared to unvaccinated</b>:</p> <ul style="list-style-type: none"> <li>• 83 to 95.7% up to 30 days after 3<sup>rd</sup> dose (RME)</li> <li>• 92% (95% CI, 91 to 93) up to 60 days after 3<sup>rd</sup> dose</li> <li>• 85% (95% CI, 71.8 to 91.9) from 7 days after 3<sup>rd</sup> dose (7 Obs) [<a href="#">137</a>][<a href="#">139</a>][<a href="#">147</a>][<a href="#">148</a>][<a href="#">160</a>][<a href="#">169</a>][<a href="#">186</a>]; <i>last update 2022-04-13</i></li> </ul>

		<p>mRNA-1273 (3 doses) provided protection against <b>infection</b> by VOC Delta compared to 2 doses:</p> <ul style="list-style-type: none"> <li>46.6% (95% CI, 36.4 to 55.3) median of 16 days after 3<sup>rd</sup> dose (1 Obs) [<a href="#">132</a>]; <i>last update 2021-12-15</i></li> </ul>
<p><b>Delta</b></p> <p>2 doses followed by 1 dose of another vaccine</p> <p>(any time frame)</p>	<p><b>AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]</b></p>	<p><b>ChAdOx1 (2 doses) followed by BNT162b2</b> provided protection against VOC Delta for the following outcomes:</p> <ul style="list-style-type: none"> <li>82% (95% CI, 68 to 90) from infection at least 7 days after 3<sup>rd</sup> dose</li> <li>93.1 to 93.8% from <b>symptomatic infection</b> at least 14 days after 3<sup>rd</sup> dose (RME)</li> </ul> <p>(3 Obs) [<a href="#">126</a>][<a href="#">136</a>][<a href="#">139</a>]; <i>last update 2022-01-18</i></p> <p><b>ChAdOx1 (2 doses) followed by mRNA-1273</b> provided protection against VOC Delta for the following outcomes:</p> <ul style="list-style-type: none"> <li>91% (95% CI, 63 to 98) from infection at least 7 days after 3<sup>rd</sup> dose (1 Obs) [<a href="#">139</a>]; <i>last update 2022-01-05</i></li> </ul>
<p><b>Delta</b></p> <p>(3 doses)</p> <p>(any time frame)</p>	<p><b>Sinovac [CoronaVac]</b></p>	<p>CoronaVac (<b>3 doses</b>) provided protection against VOC Delta for the following outcome <math>\geq 14</math> days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>78.8% (95% CI, 76.8 to 80.6) from symptomatic infection</li> </ul> <p>(1 Obs) [<a href="#">154</a>]; <i>last update 2022-02-02</i></p>
<p><b>Delta</b></p> <p>2 doses followed by 1 dose of another vaccine</p> <p>(any time frame)</p>	<p><b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b></p>	<p><b>BNT162b2 (2 doses), followed by mRNA-1273</b> provided protection against VOC Delta for the following outcomes:</p> <ul style="list-style-type: none"> <li>68.2% (95% CI, 57.6 to 76.1) against infection at <math>&gt;1</math> week compared to no vaccination</li> </ul> <p>(1 Obs) [<a href="#">18</a>]; <i>last update 2022-04-13</i></p>
<p><b>Delta</b></p> <p>2 doses followed by 1 dose of another vaccine</p> <p>(any time frame)</p>	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p><b>mRNA-1273 (2 doses), followed by BNT162b2</b> provided protection against VOC Delta for the following outcomes:</p> <ul style="list-style-type: none"> <li>87.1% (95% CI, 80.1 to 91.6) against infection at <math>&gt;1</math> week compared to no vaccination</li> </ul> <p>(1 Obs) [<a href="#">186</a>]; <i>last update 2022-04-13</i></p>
<p><b>Delta</b></p> <p>2 doses followed by 1 dose of another vaccine</p> <p>(anytime frame)</p>	<p><b>Sinovac [CoronaVac]</b></p>	<p>CoronaVac (2 doses) followed by <b>BNT162b2</b> provided protection against VOC Delta for the following outcomes at least 7 days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>92.7 to 98% from infection (RME)</li> <li>96.5% (95% CI, 96.2 to 96.7) from symptomatic infection</li> <li>97.3% (95% CI, 96.1 to 98.1) from severe disease (hospitalization or death)</li> <li>96.2% (95% CI, 94.6 to 97.3) from ICU admission</li> <li>96.8% (95% CI, 93.9 to 98.3) from death</li> </ul> <p>(3 Obs) [<a href="#">155</a>][<a href="#">164</a>][<a href="#">165</a>]; <i>last update 2022-03-02</i></p>

		<p>CoronaVac (2 doses) followed by <b>ChAdOx1</b> provided protection against VOC Delta for the following outcomes at least 7 days after 3<sup>rd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 86% (95% CI, 74 to 93) from infection</li> <li>• 93.2% (95% CI, 92.9 to 93.6) from symptomatic infection</li> <li>• 98.9% (95% CI, 98.5 to 99.2) from ICU admission</li> <li>• 98.1% (95% CI, 97.3 to 98.6) from death</li> </ul> <p>(2 Obs) <a href="#">[155]</a><a href="#">[164]</a>; <i>last update 2022-03-02</i></p>
<b>1 to 2 Doses – VOC Delta</b>		
<b>Delta (1-2 doses)</b>  <b>(up to 30 days)</b>	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	<p>BNT162b2 provided protection against VOC Delta for the following outcome at least 14 to 21 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 30 to 65% from infection (RME)</li> <li>• 33 to 47.5% from symptomatic infection (RME)</li> <li>• 87 to 94% from hospitalization (RME)</li> <li>• 100% (95% CI, not reported) against severe, critical, or fatal disease</li> </ul> <p>BNT162b2 provided protection against VOC Delta for the following outcome at least 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 42 to 93% from infection (RME)</li> <li>• 63 to 94% from symptomatic infection (RME)</li> <li>• 82 to 98% from severe, critical, or fatal disease (RME)</li> <li>• 90% from death (RME)</li> </ul> <p>(27 Obs) <a href="#">[29]</a><a href="#">[38]</a><a href="#">[42]</a><a href="#">[47]</a><a href="#">[57]</a><a href="#">[63]</a><a href="#">[64]</a><a href="#">[71]</a><a href="#">[74]</a><a href="#">[76]</a><a href="#">[84]</a><a href="#">[88]</a><a href="#">[92]</a><a href="#">[97]</a><a href="#">[102]</a><a href="#">[109]</a><a href="#">[110]</a><a href="#">[111]</a><a href="#">[118]</a><a href="#">[119]</a><a href="#">[121]</a><a href="#">[123]</a><a href="#">[133]</a><a href="#">[138]</a><a href="#">[156]</a><a href="#">[160]</a><a href="#">[163]</a><a href="#">[168]</a>; <i>last update 2022-04-13</i></p>
<b>Delta (1-2 doses)</b>  <b>(up to 30 days)</b>	<b>Moderna Spikevax [mRNA-1723]</b>	<p>mRNA-1273 provided protection against VOC Delta for the following outcomes at least 14 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 75 to 86.7% from infection (RME)</li> <li>• 72% (95% CI, 57 to 82) from symptomatic infection</li> <li>• 96% (95% CI, 72 to 99) from hospitalization</li> <li>• 93 to 100% from severe, critical, or fatal disease (RME)</li> </ul> <p>mRNA-1273 provided protection against VOC Delta for the following outcomes 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 59 to 91% from infection (RME)</li> <li>• 87% (95% CI, 84 to 88) from symptomatic infection</li> <li>• 93 to 100% from severe, critical, or fatal disease (RME)</li> </ul> <p>(20 Obs) <a href="#">[47]</a><a href="#">[57]</a><a href="#">[63]</a><a href="#">[64]</a><a href="#">[71]</a><a href="#">[74]</a><a href="#">[97]</a><a href="#">[101]</a><a href="#">[102]</a><a href="#">[109]</a><a href="#">[110]</a><a href="#">[111]</a><a href="#">[118]</a><a href="#">[121]</a><a href="#">[123]</a><a href="#">[133]</a><a href="#">[138]</a><a href="#">[140]</a><a href="#">[160]</a><a href="#">[186]</a>; <i>last update 2022-04-13</i></p>
<b>Delta (1-2 doses)</b>  <b>(up to 30 days)</b>	<b>AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]</b>	<p>ChAdOx1 provided protection against VOC Delta for the following outcome at least 21 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 18 to 46% from infection (RME)</li> <li>• 33 to 58% from symptomatic infection (RME)</li> <li>• 71% (95% CI, 51 to 83) from hospitalization</li> </ul> <p>ChAdOx1 provided protection against VOC Delta for the following outcome at least 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 44.8 to 83% from infection (RME)</li> <li>• 61 to 92% from symptomatic infection (RME)</li> <li>• 92% (95% CI, 75 to 97) from hospitalization</li> <li>• 91% (95% CI, 83 to 94) from death</li> </ul>

		(13 Obs) <a href="#">[29]</a> <a href="#">[38]</a> <a href="#">[42]</a> <a href="#">[47]</a> <a href="#">[71]</a> <a href="#">[92]</a> <a href="#">[118]</a> <a href="#">[119]</a> <a href="#">[123]</a> <a href="#">[131]</a> <a href="#">[141]</a> <a href="#">[160]</a> <a href="#">[164]</a> ; <i>last update 2022-03-02</i>
<b>Delta (1 dose) (up to 30 days)</b>	<b>Johnson &amp; Johnson [AD26.COV 2.S]</b>	Ad26.COV2.S provided protection against VOC Delta for the following outcomes $\geq 14$ days after dose: <ul style="list-style-type: none"> <li>• 3% to 71% against infection (RME)</li> <li>• 50.9% (95% CI, 35.5 to 63.0) from symptomatic infection</li> <li>• 92.5% (95% CI, 54.9 to 99.6) from ICU admission</li> <li>• 90.5% (95% CI, 31.5 to 99.6) from death</li> </ul> (6 Obs) <a href="#">[97]</a> <a href="#">[109]</a> <a href="#">[110]</a> <a href="#">[111]</a> <a href="#">[117]</a> <a href="#">[133]</a> ; <i>last update 2021-12-15</i>
<b>Delta (1-2 doses) (up to 30 days)</b>	<b>Sinovac [CoronaVac]</b>	CoronaVac provided protection against VOC Delta for the following outcome at least 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 60 to 74% from infection (RME)</li> <li>• 59% (95% CI, 16 to 81.6) from symptomatic infection</li> <li>• 46 to 89% from severe disease (RME)</li> <li>• 76.5% (95% CI, 72.9 to 79.6) from death</li> </ul> (3 Obs) <a href="#">[91]</a> <a href="#">[156]</a> <a href="#">[164]</a> ; <i>last update 2022-03-02</i>  <b>CoronaVac followed by ChAdOx1</b> provided protection against VOC Delta for the following outcomes at least 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 74% (95% CI, 43 to 99) from infection</li> </ul> (1 Obs) <a href="#">[164]</a> ; <i>last update 2022-03-02</i>
<b>Delta 1 dose followed by an mRNA vaccine (up to 30 days)</b>	<b>AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]</b>	ChAdOx1 followed by BNT162b2 at least 14 days after 2 <sup>nd</sup> dose provided protection against VOC Delta for the following outcomes: <ul style="list-style-type: none"> <li>• 67% (95% CI, 59 to 73) against symptomatic infection</li> </ul> (1 Obs) <a href="#">[121]</a> ; <i>last update 2021-12-01</i>  ChAdOx1 followed by mRNA-1273 at least 14 days after 2 <sup>nd</sup> dose provided protection against VOC Delta for the following outcomes: <ul style="list-style-type: none"> <li>• 79% (95% CI, 62 to 88) against symptomatic infection</li> </ul> (1 Obs) <a href="#">[121]</a> ; <i>last update 2021-12-01</i>  ChAdOx1 followed by either BNT162b2 or mRNA-1273 at least 14 days after 2 <sup>nd</sup> dose provided protection against VOC Delta for the following outcomes: <ul style="list-style-type: none"> <li>• 88% (95% CI, 85 to 89) against infection</li> </ul> (1 Obs) <a href="#">[123]</a> ; <i>last update 2021-12-01</i>  ChAdOx1 followed by BNT162b2 provided protection against infection by VOC Delta compared to ChAdOx1 (homologous): <ul style="list-style-type: none"> <li>• HR 0.61 (95% CI, 0.52 to 0.71) unreported number of days after 2<sup>nd</sup> dose</li> </ul> (1 Obs) <a href="#">[128]</a> ; <i>last update 2021-12-01</i>
<b>Delta (2 doses) (&gt;30 days)</b>	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	BNT162b2 showed a higher risk of infection by VOC Delta in participants <u>fully vaccinated (<math>\geq 14</math> days after 2<sup>nd</sup> dose) longer than or equal to 146 days ago vs fully vaccinated less than 146 days ago</u> [OR 2.06 (95% CI, 1.69 to 2.51)] (1 Obs) <a href="#">[69]</a> ; <i>last update 2021-08-25</i>  BNT162b2 provided protection against <b>infection</b> by VOC Delta for the following number of days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 73 to 87% up to 60 days (RME)</li> <li>• 67 to 74% from 21 to 98 days (RME)</li> <li>• 53 to 85% up to 120 days (RME)</li> <li>• 57 to 84% up to 150 days (RME)</li> </ul>

		<p>(10 Obs) <a href="#">[76]</a><a href="#">[84]</a><a href="#">[123]</a><a href="#">[137]</a><a href="#">[152]</a><a href="#">[156]</a> <a href="#">[158]</a><a href="#">[163]</a><a href="#">[169]</a><a href="#">[185]</a>; <i>last update 2022-05-12</i></p> <p>BNT162b2 provided protection against <b>symptomatic infection</b> by VOC Delta for the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 74 to 76% at 30 to 60 days (RME)</li> <li>• 69 to 72% at 60 to 89 days (RME)</li> <li>• 47% (95% CI, 39 to 55) – at 121 to 180 days</li> <li>• 70.1% (95% CI, 68.9 to 71.2) – at 7 months (210 days)</li> </ul> <p>(5 Obs) <a href="#">[92]</a><a href="#">[114]</a><a href="#">[124]</a><a href="#">[141]</a><a href="#">[181]</a>; <i>last update 2022-03-30</i></p> <p>BNT162b2 provided protection against <b>severe, critical, or fatal disease</b> by VOC Delta for the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 91.1% (95% CI, 90 to 92) at 44 to 98 days</li> <li>• 68 to 72% up to 120 days</li> <li>• 92 to 94% - age 40 to 59 up to 150 days (RME)</li> <li>• 57 to 86% - age 60+ up to 150 days (RME)</li> </ul> <p>(5 Obs) <a href="#">[76]</a><a href="#">[125]</a><a href="#">[156]</a> <a href="#">[158]</a><a href="#">[163]</a>; <i>last update 2022-03-02</i></p> <p>BNT162b2 provided protection against <b>death</b> by VOC Delta for the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 81 to 89% up to 150 days (RME)</li> </ul> <p>(3 Obs) <a href="#">[124]</a><a href="#">[125]</a><a href="#">[156]</a>; <i>last update 2022-02-02</i></p> <p>BNT162b2 provided protection against <b>infection</b> by VOC Delta at the following <b>intervals between doses</b>:</p> <ul style="list-style-type: none"> <li>• 92% (95% CI, 91 to 93) at 14 to 27 days after 2<sup>nd</sup> dose (interval 7+ weeks)</li> <li>• 90% (95% CI, 88 to 91) at 4 months after 2<sup>nd</sup> dose (interval 7+ weeks)</li> </ul> <p>(1 Obs) <a href="#">[123]</a>; <i>last update 2021-11-17</i></p> <p><b>BNT162b2 or mRNA-1273 (2 doses)</b> provided protection against VOC Delta for the following outcomes after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 63% to 70% against <b>infection</b> &gt;14 days (RME)</li> <li>• 80 to 89% against <b>symptomatic infection</b> 14-149 days (RME)</li> <li>• 99% (95% CI, 97 to 99) against <b>severe disease</b> &gt;7 days</li> <li>• 58 to 88% against <b>death</b> &gt;14 days (RME)</li> </ul> <p>(4 Obs)<a href="#">[184]</a><a href="#">[192]</a><a href="#">[193]</a><a href="#">[194]</a>; <i>last update 2022-05-12</i></p>
<p><b>Delta (2 doses) (&gt;30 days)</b></p>	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p>mRNA-1273 provided protection against <b>infection</b> by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 71 to 94% up to 60 days (RME)</li> <li>• 79 to 83% up to 90 days (RME)</li> <li>• 81 to 88% at 120 days (RME)</li> <li>• 63.6% (95% CI, 51.8 to 72.5) at 91 to 180 days</li> <li>• 65 to 88% at 151 to 180 days (RME)</li> <li>• 61.4% (95% CI, 56.8 to 65.5) at 181 to 270 days</li> <li>• 52.9% (95% CI, 43.7 to 60.5) at &gt;270 days</li> </ul> <p>(8 Obs) <a href="#">[101]</a><a href="#">[123]</a><a href="#">[137]</a><a href="#">[143]</a><a href="#">[152]</a><a href="#">[157]</a><a href="#">[158]</a><a href="#">[169]</a>; <i>last update 2022-03-16</i></p> <p>mRNA-1273 provided protection against <b>symptomatic infection</b> by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 91% (95% CI, 85 to 95) – at 30 to 59 days (age 30-59)</li> </ul>

		<ul style="list-style-type: none"> <li>• 90% – at 70 to 98 days (RME)</li> <li>• 71% (95% CI, 56 to 81) – at 121 to 180 days</li> <li>• 81.9% (95% CI, 81 to 82.7) – at 7 months (210 days) (4 Obs) <a href="#">[92]</a><a href="#">[114]</a><a href="#">[124]</a><a href="#">[141]</a>; <i>last update 2022-01-05</i></li> </ul> <p>mRNA-1273 provided protection against <b>severe disease</b> by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 97.8% (95% CI, 83.7 to 99.7) at 60 days</li> <li>• 74.5 to 93.4% up to 90 days (RME)</li> <li>• 91.5% (95% CI, 60.8 to 98.1) up to 120 days (RME)</li> <li>• 85.2% (95% CI, 82.7 to 87.7) at 150 days (3 Obs)<a href="#">[143]</a><a href="#">[157]</a><a href="#">[158]</a>; <i>last update 2022-02-16</i></li> </ul> <p>mRNA-1273 provided protection against <b>death</b> by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 96% (95% CI, 91.9 to 98) at 60 days</li> <li>• 93.7% (95% CI, 90.2 to 95.9) at 210 days (1 Obs) <a href="#">[124]</a>; <i>last update 2022-02-02</i></li> </ul> <p>mRNA-1273 provided protection against <b>infection</b> by VOC Delta at the following <b>intervals between doses</b>:</p> <ul style="list-style-type: none"> <li>• 92% (95% CI, 90 to 94) at 14 to 27 days after 2<sup>nd</sup> dose (interval 7+ weeks)</li> <li>• 91% (95% CI, 87 to 94) at 4 months after 2<sup>nd</sup> dose (interval 7+ weeks) (1 Obs) <a href="#">[123]</a>; <i>last update 2021-11-17</i></li> </ul>
<b>Delta</b> <b>(2 doses)</b> <b>(&gt;30 days)</b>	<b>AstraZeneca</b> <b>[ChAd0x1]</b> <b>Vaxzevria</b> <b>Serum</b> <b>Institute of</b> <b>India</b> <b>[Covishield]</b>	<p>ChAdOx1 provided protection against <b>infection</b> by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 21% (95% CI, 18 to 24) at 21 to 42 days</li> <li>• 65 to 72% (95% CI, 66 to 77) at 120 days (RME) (3 Obs) <a href="#">[123]</a><a href="#">[169]</a><a href="#">[185]</a>; <i>last update 2022-05-12</i></li> </ul> <p>ChAdOx1 provided protection against <b>symptomatic</b> infection by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 63 to 67% – at 30 to 59 days (RME)</li> <li>• 65% (95% CI, 48 to 76) – at 60 to 89 days</li> <li>• 41 to 49% – at 120 days (17 weeks) (RME)</li> <li>• 69.7% (95% CI, 68.7 to 70.5) – at 140 days (4 Obs) <a href="#">[92]</a><a href="#">[114]</a><a href="#">[141]</a><a href="#">[142]</a>; <i>last update 2022-01-05</i></li> </ul> <p>ChAdOx1 provided protection against <b>severe disease</b> by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 79.0% (95% CI, 75.9 to 81.7) at 56 to 63 days</li> <li>• 70.5% (95% CI, 67 to 73.7) at 112 to 119 (1 Obs)<a href="#">[142]</a>; <i>last update 2022-01-05</i></li> </ul> <p>ChAdOx1 provided protection against <b>infection</b> by VOC Delta at the <b>following intervals</b> between doses:</p> <ul style="list-style-type: none"> <li>• 85% (95% CI, 60 to 94) at 14 to 27 days after 2<sup>nd</sup> dose (interval 7+ weeks)</li> <li>• 72% (95% CI, 66 to 77) at 84+ days after 2<sup>nd</sup> dose (interval 7+ weeks) (1 Obs) <a href="#">[123]</a>; <i>last update 2021-11-17</i></li> </ul>
<b>Delta</b> <b>(1 dose)</b>	<b>Johnson &amp;</b> <b>Johnson</b>	<p>Ad26.COVS.S provided protection against the following outcomes by VOC Delta the following number of days after dose:</p>

(>30 days)	[AD26.COV 2.S]	<ul style="list-style-type: none"> <li>60% (95% CI, 57 to 62) from infection up to 60 days</li> <li>74% (95% CI, 70 to 76) from infection at <math>\geq 150</math> days</li> <li>89.4% (95% CI, 52.3 to 97.6) from death at 120 days (3 Obs) [124][152][169]; <i>last update 2022-03-16</i></li> </ul> <p>Ad26.COV2.S provided protection against <b>symptomatic</b> infection by VOC Delta the following number of days after dose:</p> <ul style="list-style-type: none"> <li>50% (95% CI, 36 to 62) – at 30 to 59 days</li> <li>52% (95% CI, 33 to 66) – at 60 to 89 days</li> <li>64.3% (95% CI, 62.3 to 66.1) – at 150 days (2 Obs) [124][141]; <i>last update 2022-01-05</i></li> </ul>
Delta (2 doses) (>30 days)	Sinovac [CoronaVac]	<p>CoronaVac provided protection against the following outcomes by VOC Delta the following number of days after the 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>30% (95% CI, 18.4 to 39.9) from infection up to 150 days</li> <li>30.2% (95% CI, 7.6 to 47.3) from ICU admission up to 150 days</li> <li>75.7% (95% CI, 67.0 to 82.1) from death up to 150 days (1 Obs) [156]; <i>last update 2022-02-02</i></li> </ul>
Delta ChAdOx1 (1 dose) followed by mRNA vaccine	AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]	<p>ChAdOx1 followed by an mRNA provided protection against infection by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>86% (95% CI, 81 to 89) at 120 days (1 Obs) [123]; <i>last update 2021-11-17</i></li> </ul> <p>ChAdOx1 followed by an mRNA provided protection against <b>symptomatic</b> infection by VOC Delta the following number of days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>67% (95% CI, 59 to 73) at least 14 days (BNT162b2)</li> <li>79% (95% CI, 62 to 88) at least 14 days (mRNA-1273)</li> <li>66% (95% CI, 41 to 80) – &gt; 120 days (17 weeks) (2 Obs) [114][121]; <i>last update 2022-01-05</i></li> </ul>
<b>Transmission – VOC Delta</b>		
Delta Transmission Household or close contacts of index case	Pfizer/ BioNTech Comirnaty [BNT162b2]	<p><u>Fully vaccinated index cases by BNT162b</u> showed <b>VET</b> to unvaccinated (hh contact):</p> <ul style="list-style-type: none"> <li>31 to 63% (RME)</li> </ul> <p><u>Fully vaccinated index cases by BNT162b</u> showed <b>VET</b> to fully vaccinated household contacts:</p> <ul style="list-style-type: none"> <li>10 to 40% (RME)</li> </ul> <p><u>Fully vaccinated index cases by BNT162b</u> showed <b>VET</b> to hh contacts (unclear status):</p> <ul style="list-style-type: none"> <li>65% (95% CI, 52 to 74)</li> </ul> <p><u>Fully vaccinated hh contacts by BNT162b</u> showed <b>VES</b>:</p> <ul style="list-style-type: none"> <li>46% (95% CI, 40 to 52) (vaccinated index case)</li> <li>61% (95% CI, 59 to 63) (unvaccinated index case)</li> <li>62 to 90% from infection (unclear status of index case) (RME)</li> <li>100% (95% CI, not reported) from severe disease (5 Obs) [105][107][108][129][149]; <i>last update 2021-01-18</i></li> </ul> <p>BNT162b2 or mRNA-1273 (2 doses) hh contacts showed <b>VES</b>:</p> <ul style="list-style-type: none"> <li>46% (95% CI, 28 to 58) at least 7 days after 2<sup>nd</sup> dose</li> </ul>

		BNT162b2 or mRNA-1273 (3 doses) hh contacts showed VES: <ul style="list-style-type: none"> <li>62% (95% CI, 38 to 78) at least 7 days after 3<sup>rd</sup> dose (1 Obs) [161]; last update 2022-03-02</li> </ul>
Delta Transmission Household or close contacts of index case	Moderna Spikevax [mRNA-1723]	Fully vaccinated household contacts by mRNA-1273 showed VES (unclear status of index): <ul style="list-style-type: none"> <li>62 to 77% from infection (RME) (2 Obs) [108][129]; last update 2021-12-01</li> </ul> BNT162b2 or mRNA-1273 (2 doses) hh contacts showed VES: <ul style="list-style-type: none"> <li>46% (95% CI, 28 to 58) at least 7 days after 2<sup>nd</sup> dose</li> </ul> BNT162b2 or mRNA-1273 (3 doses) hh contacts showed VES: <ul style="list-style-type: none"> <li>62% (95% CI, 38 to 78) at least 7 days after 3<sup>rd</sup> dose (1 Obs) [161]; last update 2022-03-02</li> </ul>
Delta Transmission Household or close contacts of index case	AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]	Fully vaccinated index cases by ChAdOx1 showed VET for household contacts (unclear status): <ul style="list-style-type: none"> <li>36% (95% CI, 28 to 43) from infection</li> </ul> Fully vaccinated household contacts by ChAdOx1 showed VES (unclear status of index): <ul style="list-style-type: none"> <li>55 to 72% from infection (RME) (2 Obs)[107][108]; last update 2021-11-03</li> </ul>
Delta Transmission Household or close contacts of index case	ChAdOx1 followed by mRNA vaccine	Fully vaccinated household contacts by ChAdOx1 followed by mRNA showed VES (unclear status of index): <ul style="list-style-type: none"> <li>86% (95% CI, 45 to 97) from infection (1 Obs)[108]; last update 2021-11-03</li> </ul>

**Table 3c: Key findings about vaccine effectiveness for VOC Delta**  
(Last updated [30 March 2022](#))

1 to 2 Doses – VOC Gamma or VOC Beta		
Gamma/Beta	Pfizer/BioNTech Comirnaty [BNT162b2]	BNT162b2 provided protection against VOC Gamma/Beta for the following outcomes: <ul style="list-style-type: none"> <li>84.2% (95% CI, 78.2 to 90.3) from symptomatic infection 15 to 30 days after 2<sup>nd</sup> dose</li> <li>68% (95% CI, 59.1 to 76.9) from symptomatic infection 30 to 60 days after 2<sup>nd</sup> dose</li> <li>61.2% (95% CI, 45.7 to 76.8) from symptomatic infection 60 to 90 days after 2<sup>nd</sup> dose</li> </ul> (1 Obs) [181]; last update 2022-03-30
Gamma	Moderna Spikevax [mRNA-1723]	mRNA-1273 provided protection against VOC Gamma for the following outcomes 14 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>85% (95% CI, 71 to 92) from infection</li> <li>77% (95% CI, 63 to 86) from symptomatic infection</li> <li>89% (95% CI, 73 to 95) from hospitalization</li> </ul> mRNA-1273 provided protection against VOC Gamma (or Beta) for the following outcomes 35-41 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>43% (95% CI, 22 to 59) from symptomatic infection</li> </ul> mRNA-1273 provided protection against VOC Gamma for the following outcome at least 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>95% from infection (RME)</li> </ul>

		<ul style="list-style-type: none"> <li>• 88% (95% CI, 61 to 96) from symptomatic infection (4 Obs – 5 refs) <a href="#">[23]</a><a href="#">[47]</a><a href="#">[101]</a><a href="#">[122]</a><a href="#">[123]</a>; <i>last update 2021-12-01</i></li> </ul>
<b>Gamma</b>	<b>AstraZeneca [ChAdOx1] Vaxzevria Serum Institute of India [Covishield]</b>	<p>ChAdOx1 provided protection against VOC Gamma for the following outcomes at least 14 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 60% (95% CI, 48 to 69) from infection</li> <li>• 39.9% (95% CI, 39 to 41) from infection up to 126 days</li> <li>• 42 to 48% from symptomatic infection (RME)</li> <li>• 83% (95% CI, 66 to 92) from hospitalization</li> <li>• 71.8% (95% CI, 71 to 73) from death up to 126 days</li> </ul> <p>ChAdOx1 provided protection against VOC Gamma for the following outcomes at least 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 90% (95% CI, 61 to 98) from infection</li> <li>• 68.5% (95% CI, 67 to 71) from infection up to 126 days</li> <li>• 65.4% (95% CI, 64.6 to 66.2) from symptomatic infection at 56 to 63 days after 2<sup>nd</sup> dose</li> <li>• 58.7% (95% CI, 56.7 to 60.5) from symptomatic infection at 112 to 119 days after 2<sup>nd</sup> dose</li> <li>• 75.6% (95% CI, 73.4 to 77.6) from severe disease at 56 to 63 days after 2<sup>nd</sup> dose</li> <li>• 50.5% (95% CI, 43.4 to 56.6) from severe disease at 112 to 119 days after 2<sup>nd</sup> dose</li> <li>• 80.1% (95% CI, 78 to 82) from death up to 126 days after 2<sup>nd</sup> dose (6 Obs)<a href="#">[47]</a><a href="#">[116]</a><a href="#">[122]</a><a href="#">[123]</a><a href="#">[142]</a><a href="#">[179]</a>; <i>last update 2022-03-30</i></li> </ul>
<b>Gamma</b>	<b>Johnson &amp; Johnson [AD26.COV 2.S]</b>	<p>Ad26.COVS provided protection against VOC Gamma for the following outcomes 28 days after dose:</p> <ul style="list-style-type: none"> <li>• 50.9% (95% CI, 35.5 to 63.0) from symptomatic infection</li> <li>• 92.5% (95% CI, 54.9 to 99.6) from ICU admission</li> <li>• 90.5% (95% CI, 31.5 to 99.6) from death (1 Obs) <a href="#">[117]</a>; <i>last update 2021-11-17</i></li> </ul>
<b>Gamma</b>	<b>Sinovac [CoronaVac]</b>	<p>CoronaVac provided protection against VOC Gamma for the following outcome <math>\geq</math> 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 65.9% (95% CI, 65.2 to 66.6) from infection</li> </ul> <p>CoronaVac provided protection against VOC Gamma for the following outcome <math>\geq</math> 14 days after 2<sup>nd</sup> dose for people over age 70:</p> <ul style="list-style-type: none"> <li>• 41.6% (95% CI, 26.9 to 63.3) from symptomatic infection (2 Obs) <a href="#">[30]</a><a href="#">[49]</a>; <i>last update 2021-07-14</i></li> </ul>
<b>Gamma</b>	<b>ChAdOx1 followed by mRNA vaccine</b>	<p>ChAdOx1 followed by either BNT162b2 or mRNA-1273 at least 14 days after 2<sup>nd</sup> dose provided protection against VOC Gamma for the following outcomes:</p> <ul style="list-style-type: none"> <li>• 96% (95% CI, 70 to 99) against infection (1 Obs) <a href="#">[123]</a>; <i>last update 2021-11-17</i></li> </ul>
<b>Gamma</b>	<b>Sputnik V Gam-Covid-Vac [rAd26-rAd5]</b>	<p>rAd26-rAd5 provided protection against VOC Gamma for the following outcomes:</p> <ul style="list-style-type: none"> <li>• 39.5% (95% CI, 39 to 40) from infection up to 126 days after 1<sup>st</sup> dose</li> <li>• 68.8% (95% CI, 68 to 70) from death up to 126 days after 1<sup>st</sup> dose</li> <li>• 64% (95% CI, 63 to 65) from infection up to 126 days after 2<sup>nd</sup> dose</li> <li>• 80.7% (95% CI, 79 to 82) from death up to 126 days after 2<sup>nd</sup> dose (1 Obs) <a href="#">[179]</a>; <i>last update 2022-03-30</i></li> </ul>

<b>Gamma</b>	<b>Sinopharm [BBIBP-CorV]</b>	<p>BBIBP-CorV provided protection against VOC Gamma for the following outcomes:</p> <ul style="list-style-type: none"> <li>• 22.6% (95% CI, 20 to 25) from infection up to 126 days after 1<sup>st</sup> dose</li> <li>• 61.8% (95% CI, 59 to 64) from death up to 126 days after 1<sup>st</sup> dose</li> <li>• 43.6% (95% CI, 42 to 45) from infection up to 126 days after 2<sup>nd</sup> dose</li> <li>• 73.4% (95% CI, 71 to 75) from death up to 126 days after 2<sup>nd</sup> dose</li> </ul> <p>(1 Obs) [<a href="#">179</a>]; <i>last update 2022-03-30</i></p>
<b>Beta</b>	<b>Moderna Spikevax [mRNA-1273]</b>	<p>mRNA-1273 provided protection against VOC Beta for the following outcomes 14 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 61.3% (95% CI, 56.5 to 65.5) from infection</li> <li>• 77% (95% CI, 63 to 86) from symptomatic infection</li> <li>• 89% (95% CI, 73 to 95) from hospitalization</li> <li>• 81.6% (95% CI, 71.0 to 88.8) from severe, critical, or fatal disease (combined with Alpha)</li> </ul> <p>mRNA-1273 provided protection against VOC Beta for the following outcomes 35-41 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 43% (95 CI, 22 to 59) from symptomatic infection</li> </ul> <p>mRNA-1273 provided protection against VOC Beta for the following outcome 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 96.4% (95% CI, 91.9 to 98.7) from infection</li> <li>• 88% (95% CI, 61 to 96) from symptomatic infection</li> <li>• 95.7% (95% CI, 73.4 to 99.9) from severe, critical, or fatal disease (combined with Alpha)</li> </ul> <p>(2 Obs – 3 refs) [<a href="#">23</a>][<a href="#">47</a>][<a href="#">50</a>]; <i>last update 2021-07-14</i></p>
<b>Beta</b>	<b>AstraZeneca [ChAdOx1] Vaxzevria Serum Institute of India [Covishield]</b>	<p>ChAdOx1 provided protection against VOC Beta for the following outcome 14 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 48% (95% CI, 28 to 63) from symptomatic infection</li> <li>• 83% (95% CI, 66 to 92) from hospitalization</li> </ul> <p>ChAdOx1 provided protection against VOC Beta for the following outcome after 2 doses:</p> <ul style="list-style-type: none"> <li>• 10.4% (95% CI, -76.8 to 54.8) from mild to moderate disease</li> </ul> <p>(1 RCT, moderate quality; 1 Obs) [<a href="#">4</a>][<a href="#">47</a>]; <i>last update 2021-07-07</i></p>
<b>Beta</b>	<b>Novavax [NVX-CoV2373]</b>	<p>NVX-CoV2373 provided protection against VOC Beta for the following outcome after 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• Post-hoc: 43% (95% CI, -9.8 to 70.4) from symptomatic infection</li> </ul> <p>(1 RCT, moderate quality), [<a href="#">17</a>]; <i>last update 2021-07-14</i></p>

**Table 3d: Key findings about vaccine effectiveness for VOC Alpha**

(Last updated [01 December 2021](#) – will not be updated further)

1 or 2 Doses – VOC Alpha		
Alpha	Moderna Spikevax [mRNA-1273]	<p>mRNA-1273 provided protection against VOC Alpha for the following outcomes 14-41 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 58.9 to 88.1% from infection (RME)</li> <li>• 60 to 61% from symptomatic infection (RME)</li> <li>• 81.6% (95% CI, 71.0 to 88.8) from severe, critical, or fatal disease (combined with Beta)</li> </ul> <p>mRNA-1273 provided protection against VOC Alpha for the following outcomes at least 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 86 to 100% from infection (RME)</li> <li>• 90 to 95.7% from symptomatic infection (RME)</li> <li>• 95.7% (95% CI, 73.4 to 99.9) from severe, critical, or fatal disease (combined with Beta)</li> </ul> <p>(10 Obs – 11 refs) <a href="#">[8]</a><a href="#">[23]</a><a href="#">[31]</a><a href="#">[34]</a><a href="#">[37]</a><a href="#">[47]</a><a href="#">[50]</a><a href="#">[60]</a><a href="#">[74]</a><a href="#">[101]</a><a href="#">[102]</a>; <i>last update 2021-10-20</i></p>
Alpha	AstraZeneca [ChAdOx1] Vaxzevria Serum Institute of India [Covishield]	<p>ChAdOx1 provided protection against VOC Alpha for the following outcome 14 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 64% (95% CI, 60 to 68) from symptomatic infection</li> <li>• 85% (95% CI, 81 to 88) from hospitalization</li> </ul> <p>ChAdOx1 provided protection against VOC Alpha for the following outcome 21 to 28 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 44 to 74% from infection (RME)</li> </ul> <p>ChAdOx1 provided protection against confirmed VOC Alpha for the following outcome at least 14 days after 2 doses:</p> <ul style="list-style-type: none"> <li>• 62 to 79% from infection (RME)</li> </ul> <p>(1 RCT, moderate quality; 5 Obs)<a href="#">[9]</a><a href="#">[10]</a><a href="#">[5]</a><a href="#">[47]</a><a href="#">[70]</a><a href="#">[71]</a>;; <i>last update 2021-08-25</i></p>
Alpha	Novavax [NVX-CoV2373]	<p>NVX-CoV2373 provided protection against VOC Alpha for the following outcome after 2 doses:</p> <ul style="list-style-type: none"> <li>• 89.7% (95% CI, 80.2 to 94.6) from symptomatic infection.</li> <li>• No hospitalizations or deaths in vaccinated group</li> <li>• Post hoc: 86.3% (95% CI, 71.3 to 93.5) from confirmed Alpha symptomatic infection</li> </ul> <p>(1 RCT, moderate quality), <a href="#">[19]</a>; <i>last update 2021-06-16</i></p>
Alpha	ChAdOx1 followed by mRNA vaccine	<p>ChAdOx1 followed by BNT162b2 or mRNA-1273 at least 14 days after 2<sup>nd</sup> dose provided protection against VOC Alpha for the following outcomes:</p> <ul style="list-style-type: none"> <li>• 88% (95% CI, 83 to 92) against infection</li> </ul> <p>(1 Obs) <a href="#">[70]</a>; <i>last search date 2021-08-25</i></p>
Transmission – VOC Alpha		
Alpha Transmission Household or close contacts of index case	Pfizer/ BioNTech Comirnaty [BNT162b2]	<p>BNT162b2 reduced transmission of VOC Alpha (VET) from a vaccinated index case (14 to 21 days after 1<sup>st</sup> dose) to household contacts compared to households of unvaccinated index cases:</p> <ul style="list-style-type: none"> <li>• 30 to 49% from infection (RME)</li> </ul> <p>BNT162b2 reduced transmission of VOC Alpha (VET) from a vaccinated HCW (10 weeks after 1<sup>st</sup> dose) to household spouse:</p> <ul style="list-style-type: none"> <li>• 42.9% (95% CI, 22.3 to 58.1) from infection</li> </ul> <p><u>Fully vaccinated index cases</u> showed VET for household contacts (unclear status):</p>

		<ul style="list-style-type: none"> <li>70 to 82% from infection (RME)</li> </ul> <p>Fully vaccinated household contacts showed VES (unclear status of index):</p> <ul style="list-style-type: none"> <li>65 to 94% from infection (RME)</li> </ul> <p>(8 Obs) <a href="#">[6]</a><a href="#">[14]</a><a href="#">[33]</a><a href="#">[40]</a><a href="#">[48]</a><a href="#">[104]</a><a href="#">[107]</a><a href="#">[108]</a>; last update 2021-11-03</p>
Alpha Transmission Household or close contacts of index case	Moderna Spikevax [mRNA-1723]	<p>mRNA-1273 reduced transmission of VOC Alpha (VET) from a vaccinated HCW (10 weeks after 1<sup>st</sup> dose) to household spouse:</p> <ul style="list-style-type: none"> <li>42.9% (95% CI, 22.3 to 58.1) from infection</li> </ul> <p>Fully vaccinated index cases by mRNA-1273 showed VET for household contacts (unclear status):</p> <ul style="list-style-type: none"> <li>88% (95% CI, 50 to 97) from infection</li> </ul> <p>Fully vaccinated household contacts by mRNA-1273 showed VES (unclear status of index):</p> <ul style="list-style-type: none"> <li>86 to 91% from infection (RME)</li> </ul> <p>(3 Obs)<a href="#">[33]</a><a href="#">[104]</a><a href="#">[108]</a>; last update 2021-11-03</p>
Alpha Transmission Household or close contacts of index case	AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]	<p>ChAdOx1 reduced transmission of VOC Alpha (VET) from a vaccinated index case (14 to 21 days after 1<sup>st</sup> dose) to household contacts compared to households of unvaccinated index cases:</p> <ul style="list-style-type: none"> <li>30 to 47% from infection (RME)</li> </ul> <p>Fully vaccinated index cases by ChAdOx1 showed VET to household contacts (unclear status):</p> <ul style="list-style-type: none"> <li>58 to 63% from infection (RME)</li> </ul> <p>Fully vaccinated household contacts by ChAdOx1 showed VES (unclear status of index case):</p> <ul style="list-style-type: none"> <li>38 to 87% from infection (RME)</li> </ul> <p>(6 Obs) <a href="#">[6]</a><a href="#">[14]</a><a href="#">[40]</a><a href="#">[104]</a><a href="#">[107]</a><a href="#">[108]</a>; last update 2021-12-01</p>
Alpha Transmission Household or close contacts of index case	Johnson & Johnson [AD26.COV2.S]	<p>Fully vaccinated index cases by Ad26.COV2.S showed VET for household contacts (unclear status):</p> <ul style="list-style-type: none"> <li>77% (95% CI, 6 to 94) from infection</li> </ul> <p>Fully vaccinated household contacts by Ad26.COV2.S showed VES (unclear status of index):</p> <ul style="list-style-type: none"> <li>12% (95% CI, -71 to 54) from infection</li> </ul> <p>(1 Obs) <a href="#">[104]</a>; last update 2021-11-03</p>

**Table 3e: Key findings about vaccine effectiveness for VOC (multiple in same study)**  
(Last updated [19 January 2022](#) – will be not updated further)

Studies Covering Time Frame for More than One VOC (insufficient data to divide them into separate VOC)		
Alpha to Delta	<p>Pfizer/ BioNTech</p> <p>Comirnaty [BNT162b2]</p>	<p>BNT162b2 provided protection against infection by VOC Alpha to Delta at least 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>69.7% (95% CI, 68.6 to 70.8)</li> </ul> <p>BNT162b2 or mRNA-1273 provided protection against VOC Alpha to Delta for the following outcomes <math>\geq</math> 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>57% (95% CI, 53 to 60) from infection at 144 days after 2<sup>nd</sup> dose</li> <li>68% (95% CI, 64 to 71) from symptomatic infection at 42 to 69 days after 2<sup>nd</sup> dose</li> <li>39% (95% CI, 29 to 48) from symptomatic infection at 98 to 148 days after 2<sup>nd</sup> dose</li> </ul>

Studies Covering Time Frame for More than One VOC (insufficient data to divide them into separate VOC)		
		<ul style="list-style-type: none"> <li>92% (95% CI, 85 to 96) from severe disease in people with no risk conditions</li> <li>72% (95% CI, 51 to 84) from severe disease with very high risk conditions</li> <li>95% (95% CI, 88 to 98) from death at 14 to 41 days after 2<sup>nd</sup> dose</li> <li>86 to 93% from death at 70 to 148 days after 2<sup>nd</sup> dose(RME)</li> </ul> <p>BNT162b2 showed OR 1.61 (95% CI, 1.45 to 1.79) for infection comparing <u>fully vaccinated Jan to Feb</u> (VOC_Alpha) vs <u>fully vaccinated Mar to May</u> (VOC Delta).</p> <p>(5 Obs) <a href="#">[95]</a><a href="#">[96]</a><a href="#">[127]</a><a href="#">[144]</a><a href="#">[145]</a>; <i>last update</i> 2022-01-12</p>
Alpha to Delta	<p><b>Pfizer/ BioNTech (3 doses)</b></p> <p><b>Comirnaty [BNT162b2]</b></p>	<p>BNT162b2 (3 doses) provided protection against VOC Alpha to Delta for the following outcomes <b>compared to unvaccinated</b>:</p> <ul style="list-style-type: none"> <li>88% (95% CI, 86 to 89) from infection at least 14 days after 3rd dose (age&gt;18)</li> </ul> <p>BNT162b2 (3 doses) provided protection against VOC Alpha to Delta for the following outcomes:</p> <ul style="list-style-type: none"> <li>75% (95% CI, 71 to 78) from infection at least 14 days after 3rd dose compared to 2 doses (given at least 6 months previously) (age&gt;18)</li> </ul> <p>(1 Obs) <a href="#">[146]</a>; <i>last update</i> 2022-01-05</p>
Alpha to Delta	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p>mRNA-1273 provided protection against infection by VOC Alpha to Delta at least 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>78.2% (95% CI, 76.7 to 79.6)</li> </ul> <p>mRNA-1273 or BNT162b2 provided protection against VOC Alpha to Delta for the following outcomes <math>\geq</math> 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>73% (95% CI, 70 to 76) from infection at 144 days after 2<sup>nd</sup> dose</li> <li>92% (95% CI, 85 to 96) from severe disease in people with no risk conditions</li> <li>72% (95% CI, 51 to 84) from severe disease with very high risk conditions</li> <li>93% (95% CI, 81 to 97) from death at 144 days after 2<sup>nd</sup> dose</li> </ul> <p>(3 Obs) <a href="#">[95]</a><a href="#">[127]</a><a href="#">[145]</a>; <i>last update</i> 2022-01-05</p>
Alpha to Delta	<p><b>AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]</b></p>	<p>ChAdOx1 provided protection against infection by VOC Alpha to Delta at least 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>43.4% (95% CI, 4.4 to 66.5)</li> </ul> <p>ChAdOx1 provided protection against VOC Alpha to Delta for the following outcomes <math>\geq</math> 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>94% (95% CI, 90 to 96) from severe disease in people with no risk conditions</li> <li>63% (95% CI, 46 to 75) from severe disease with very high risk conditions</li> <li>33% (95% CI, 23 to 42) from symptomatic infection at 42 to 69 days after 2<sup>nd</sup> dose</li> </ul>

Studies Covering Time Frame for More than One VOC (insufficient data to divide them into separate VOC)		
		<ul style="list-style-type: none"> <li>34% (95% CI, 10 to 52) from symptomatic infection at 70 to 140 days after 2<sup>nd</sup> dose</li> <li>95% (95% CI, 90 to 97) from death at least 14 days after 2<sup>nd</sup> dose</li> </ul> (2 Obs) <a href="#">[95]</a> <a href="#">[127]</a> <a href="#">[144]</a> ; <i>last update 2022-01-05</i>
Alpha to Delta	Johnson & Johnson [AD26.COVS.S]	Ad26.COVS.S provided protection against VOC Alpha to Delta for the following outcomes $\geq 14$ days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>36% (95% CI, 30 to 42) from infection at 144 days after 2<sup>nd</sup> dose</li> <li>72% (95% CI, 49 to 85) from death at 144 days after 2<sup>nd</sup> dose</li> </ul> (1 Obs) <a href="#">[145]</a> ; <i>last update 2022-01-05</i>
Alpha to Delta	Heterologous mRNA vaccines ChAdOx1 followed by mRNA vaccine	Heterologous mRNA vaccines provided protection against infection by VOC Alpha to Delta at least 7 days after the 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>84.7% (83.1 to 86.1)</li> </ul> ChAdOx1 followed by either BNT162b2 or mRNA-1273 provided protection against infection by VOC Alpha to Delta at least 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>60.7% (95% CI, 57.5 to 63.6)</li> </ul> (1 Obs) <a href="#">[127]</a> ; <i>last update 2021-12-01</i>
Alpha to Delta  Maintenance hemodialysis  (not updated after Nov 5, 2021)	Moderna Spikevax [mRNA-1723]	mRNA-1273 or BNT162b showed OR of 8.89 (95% CI, 5.92 to 13.34) for unvaccinated vs fully vaccinated against infection (VOC Alpha)  mRNA-1273 or BNT162b showed OR of 2.27 (95% CI, 1.72 to 3.00) for unvaccinated vs fully vaccinated against infection (VOC Delta)  (1 Obs) <a href="#">[106]</a> ; <i>last update 2021-11-03</i>
Alpha or Beta  Immunosuppressed, renal transplant  (not updated after Nov 5, 2021)	Pfizer/ BioNTech  Comirnaty [BNT162b2]	BNT162b2 or mRNA-1273 provided protection against infection by VOC Alpha or Beta at the following number of days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>46.6% (95% CI, 0.0 to 73.7) <math>\geq 14</math> days</li> <li>66.0% (95% CI, 21.3 to 85.3) <math>\geq 42</math> days</li> <li>73.9% (95% CI, 33 to 98.9) <math>\geq 56</math> days</li> </ul> BNT162b2 or mRNA-1273 provided protection against severe, critical, or fatal disease by VOC Alpha or Beta at the following number of days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>72.3% (95% CI, 0.0 to 90.9) <math>\geq 14</math> days</li> <li>85% (95% CI, 35.7 to 96.5) <math>\geq 42</math> days</li> <li>83.8% (95% CI, 31.3 to 96.2) <math>\geq 56</math> days</li> </ul> (1 Obs) <a href="#">[90]</a> ; <i>last update 2021-09-22</i>
Alpha or Beta  Immunosuppressed, renal transplant  (not updated after Nov 5, 2021)	Moderna Spikevax [mRNA-1723]	mRNA-1273 or BNT162b2 provided protection against infection by VOC Alpha or Beta at the following number of days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>46.6% (95% CI, 0.0 to 73.7) <math>\geq 14</math> days</li> <li>66.0% (95% CI, 21.3 to 85.3) <math>\geq 42</math> days</li> <li>73.9% (95% CI, 33 to 98.9) <math>\geq 56</math> days</li> </ul> mRNA-1273 or BNT162b2 provided protection against severe, critical, or fatal disease by VOC Alpha or Beta at the following number of days after 2 <sup>nd</sup> dose:

Studies Covering Time Frame for More than One VOC (insufficient data to divide them into separate VOC)		
		<ul style="list-style-type: none"> <li>72.3% (95% CI, 0.0 to 90.9) <math>\geq</math>14 days</li> <li>85% (95% CI, 35.7 to 96.5) <math>\geq</math>42 days</li> <li>83.8% (95% CI, 31.3 to 96.2) <math>\geq</math>56 days</li> </ul> (1 Obs) [90]; last update 2021-09-22
<b>Alpha or Beta</b>  <b>Previously infected</b>  (not updated after Nov 5, 2021)	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	BNT162b2 (2 doses) <u>after prior infection</u> provided protection against VOC Alpha (or Beta) for the following outcomes: <ul style="list-style-type: none"> <li>85% (95% CI, 80 to 89) against re-infection compared to BNT162b2 without prior infection</li> </ul> (1 Obs) [72]; last update 2021-08-25
<b>Alpha or Beta</b>  <b>Previously infected</b>  (not updated after Nov 5, 2021)	<b>Moderna Spikevax [mRNA-1723]</b>	mRNA-1273 (2 doses) <u>after prior infection</u> did not offer additional protection against VOC Alpha (or Beta) for the following outcomes: <ul style="list-style-type: none"> <li>15% (95% CI, -105 to 66) against re-infection compared to mRNA-1273 without prior infection</li> </ul> (1 Obs) [72]; last update 2021-08-25
<b>Beta to Delta</b>	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	BNT162b2 provided protection against infection by VOC Beta to VOC Delta for the following number of days after the 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>65.8% (95% CI, 63.8 to 67.7) at 5 to 9 weeks</li> <li>29.7% (95% CI, 21.7 to 36.9) at 15 to 19 weeks</li> <li>0% (95% CI, 0 to 0) 20 to 24 weeks</li> </ul> BNT162b2 provided protection against hospitalization or death by VOC Beta to VOC Delta for the following number of days after the 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>94.2% (95% CI, 91.0 to 96.5) at 5 to 9 weeks</li> <li>86.4% (95% CI, 69.9 to 94.8) at 15 to 19 weeks</li> <li>95.3% (95% CI, 70.5 to 99.9) at 20 to 24 weeks</li> </ul> (1 Obs) [98]; last update 2021-10-06
<b>Beta or Gamma</b>  <b>HCW</b>  (not updated after Nov 5, 2021)	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	BNT162b2 provided protection against VOC Beta or Gamma for the following outcomes 14 to 42 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>37.2% (95% CI, 16.6 to 52.7) from infection</li> </ul> BNT162b2 provided protection against VOC Beta or Gamma for the following outcome 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>79.2% (95% CI, 64.6 to 87.8) from infection</li> </ul> (1 Obs)[27]; last update 2021-06-01
<b>Beta or Gamma</b>  <b>Transmission Vaccinated HCW vs unvaccinated community</b>	<b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b>	BNT162b2 reduced transmission of VOC Beta or Gamma from vaccinated HCW (VET) compared to unvaccinated community $\geq$ 14 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>54.7% (95% CI, 44.8 to 62.9) from infection</li> </ul> BNT162b2 reduced transmission of VOC Beta or Gamma from vaccinated HCW (VET) compared to unvaccinated community $\geq$ 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>84.8% (95% CI, 75.2 to 90.7) from infection</li> </ul> (1 Obs) [27]; last update 2021-06-08

**Table 3f: Key findings about vaccine effectiveness for VOC (Special Populations)**

(Last updated [03 November 2021](#) – will be not updated further)

Special Populations		
<p><b>Delta</b></p> <p><b>Adolescents</b></p> <p>(moved to Pediatric/Adolescent LES)</p>	<p><b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b></p>	<p>BNT162b2 provided protection against VOC Delta for the following outcomes at least 14 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 59% (95% CI, 52 to 65) from infection</li> </ul> <p>BNT162b2 provided protection against VOC Delta for the following outcomes at least 7 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 90 to 92% against infection (RME)</li> </ul> <p>(2 Obs) <a href="#">[112]</a><a href="#">[120]</a>; <i>last update 2021-11-17</i></p>
<p><b>Delta</b></p> <p><b>HCW</b></p>	<p><b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b></p>	<p>BNT162b2 provided protection against VOC Delta for the following outcomes <math>\geq</math> 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 66% (95% CI, 26 to 84)</li> </ul> <p>(1 Obs) <a href="#">[81]</a>; <i>last update 2021-09-22</i></p>
<p><b>Delta</b></p> <p><b>HCW</b></p>	<p><b>AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]</b></p>	<p>ChAdOx1 provided protection against VOC Delta for the following outcomes at least 14 days after 2nd dose:</p> <ul style="list-style-type: none"> <li>• 54 to 85% from infection (RME)</li> <li>• 64% (95% CI, 38 to 78) from symptomatic infection</li> </ul> <p>(2 Obs) <a href="#">[59]</a><a href="#">[66]</a>; <i>last update 2021-10-06</i></p>
<p><b>Delta</b></p> <p><b>Previously infected, (65+)</b></p>	<p><b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b></p>	<p>BNT162b2 (2 doses) provided protection against VOC Delta for the following outcomes compared to <u>natural immunity after prior infection</u>:</p> <ul style="list-style-type: none"> <li>• 66% (95% CI, 22 to 86) from infection</li> </ul> <p>(1 Obs) <a href="#">[103]</a>; <i>last update 2021-10-20</i></p>
<p><b>Delta</b></p> <p><b>Previously infected (65+)</b></p>	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p>mRNA-1273 (2 doses) provided protection against VOC Delta for the following outcomes compared to <u>natural immunity after prior infection</u>:</p> <ul style="list-style-type: none"> <li>• 68% (95% CI, 30 to 86) from infection</li> <li>• 30% (-11 to 1) from death</li> </ul> <p>(1 Obs) <a href="#">[103]</a>; <i>last update 2021-10-20</i></p>
<p><b>Delta</b></p> <p><b>Prison</b></p>	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p>mRNA-1273 provided protection against VOC Delta for the following outcomes at least 14 days after 2<sup>nd</sup> dose:</p> <p>57% (95% CI, 42 to 67.5)</p> <p>(1 Obs) <a href="#">[113]</a>; <i>last update 2021-11-03</i></p>
<p><b>Gamma</b></p> <p><b>HCW</b></p>	<p><b>Sinovac [CoronaVac]</b></p>	<p>CoronaVac provided protection against VOC Gamma for the following outcomes <math>\geq</math>14 days after 1<sup>st</sup> dose:</p> <ul style="list-style-type: none"> <li>• 35.1% (95% CI, -6.6 to 60.5) from infection</li> <li>• 49.6% (95% CI, 11.3 to 71.4) from symptomatic infection</li> </ul> <p>(1 Obs)<a href="#">[18]</a>; <i>last update 2021-05-07</i></p>
<p><b>Gamma</b></p> <p><b>LTC residents</b></p>	<p><b>Pfizer/ BioNTech Comirnaty [BNT162b2]</b></p>	<p>BNT162b2 (or mRNA-1273) provided protection against VOC Gamma 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 52.5% (95% CI, 26.9 to 69.1) against infection</li> <li>• 78.6% (95% CI, 47.9 to 91.2) against severe disease</li> </ul> <p>(1 Obs) <a href="#">[61]</a>; <i>last update 2021-08-11</i></p>
<p><b>Gamma</b></p> <p><b>LTC residents</b></p>	<p><b>Moderna Spikevax [mRNA-1723]</b></p>	<p>mRNA-1273 (or BNT162b2) provided protection against VOC Gamma for the following outcomes 14 days after 2<sup>nd</sup> dose:</p> <ul style="list-style-type: none"> <li>• 52.5% (95% CI, 26.9 to 69.1) against infection</li> <li>• 78.6% (95% CI, 47.9 to 91.2) against severe disease</li> </ul> <p>(1 Obs) <a href="#">[61]</a>; <i>last update 2021-08-11</i></p>

Special Populations		
Gamma Over 70 years	Pfizer/ BioNTech Comirnaty [BNT162b2]	BNT162b2 provided protection against VOC Gamma for the following outcomes $\geq 21$ days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>61% (95% CI, 45 to 72) from infection (1 Obs) [35]; last update 2021-07-07</li> </ul>
Gamma Over 70 years	Moderna Spikevax [mRNA-1723]	mRNA-1273 provided protection against VOC Gamma for the following outcome $\geq 21$ days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>61% (95% CI, 45 to 72) from infection (1 Obs) [35]; last update 2021-06-23</li> </ul>
Alpha HCW	Pfizer/ BioNTech Comirnaty [BNT162b2]	BNT162b2 provided protection against VOC Alpha for the following outcomes 14 to 21 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>64 to 84% from infection (RME)</li> </ul> BNT162b2 provided protection against VOC Alpha for the following outcomes at least 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>90 to 97% from infection (RME)</li> </ul> BNT162b2 provided protection against VOC Alpha for the following outcome 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>86% (95% CI, 69 to 93) from asymptomatic infection [25]</li> </ul> BNT162b2 provided protection against infection by VOC Alpha for the following number of days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>85% (95% CI, 68 to 93) at 14 to 119 days</li> <li>73% (95% CI, 49 to 86) <math>\geq 150</math> days</li> </ul> (6 Obs) [11][34][45][46][56][81]; last update 2021-11-17
Alpha HCW	AstraZeneca [ChAd0x1] Vaxzevria Serum Institute of India [Covishield]	ChAdOx1 provided protection against VOC Alpha for the following outcomes at least 14 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>64% (95% CI, 50 to 74) from infection</li> </ul> ChAdOx1 provided protection against VOC Alpha for the following outcomes at least 14 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>90% (95% CI, 62 to 98) from infection (1 Obs) [46]; last update 2021-07-07</li> </ul>
Alpha LTC residents	Pfizer/ BioNTech Comirnaty [BNT162b2]	BNT162b2 provided protection against VOC Alpha for the following outcomes 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>53% (95% CI, 29 to 69) from infection</li> <li>89% (95% CI, 81 to 93) from death</li> </ul> (1 Obs) [32]; last update 2021-10-06
Alpha Over 65 years, requiring home support	Pfizer/ BioNTech Comirnaty [BNT162b2]	BNT162b2 provided protection against VOC Alpha for the following outcomes 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>86% (95% CI, 78 to 91) from infection</li> <li>97% (95% CI, 88 to 99) from death</li> </ul> (1 Obs) [32]; last update 2021-07-07
Alpha Over 70 years	Pfizer/ BioNTech Comirnaty [BNT162b2]	BNT162b2 provided protection against VOC Alpha for the following outcomes at least 21 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>41 to 67% from infection (RME)</li> </ul> BNT162b2 provided protection against VOC Alpha for the following outcomes at least 7 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>75 to 90% from infection (RME)</li> </ul> (3 Obs) [28][35][51]; last update 2021-10-06
Alpha Over 70 years	Moderna Spikevax [mRNA-1723]	mRNA-1273 provided protection against VOC Alpha for the following outcome $\geq 21$ days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>67% (95% CI, 57 to 75) from infection</li> </ul>

Special Populations		
		(1 Obs) <a href="#">[35]</a> ; <i>last update 2021-06-23</i>
<b>Alpha</b> <b>Over 80 years</b>	<b>AstraZeneca [ChAd0x1]</b> <b>Vaxzevria</b> <b>Serum Institute of India</b> <b>[Covishield]</b>	ChAdOx1 provided protection against VOC Alpha for the following outcomes at least 14 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 88% (95% CI, 48 to 97) from symptomatic infection</li> </ul> (1 Obs) <a href="#">[79]</a> ; <i>last update 2021-10-20</i>
<b>Alpha</b> <b>Pregnant</b>	<b>Pfizer/ BioNTech</b> <b>Comirnaty</b> <b>[BNT162b2]</b>	BNT162b2 provided protection against VOC Alpha for the following outcomes at least 28 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>• 78% (95% CI, 57 to 89) from infection</li> </ul> BNT162b2 provided protection against VOC Alpha for the following outcomes 7 to 56 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 86.1% (95% CI, 82.4 to 89.1) from infection</li> <li>• 89% (95% CI, 43 to 100) from hospitalization</li> </ul> (2 Obs) <a href="#">[52]</a> <a href="#">[54]</a> ; <i>last update 2021-07-28</i>
<b>Epsilon</b>	<b>Pfizer/ BioNTech</b> <b>Comirnaty</b> <b>[BNT162b2]</b>	BNT162b2 provided protection against VOC Epsilon for the following outcome 15 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>• 58.9% (95% CI, -9.7 to 84.5) from infection</li> </ul> BNT162b2 provided protection against VOC Epsilon for the following outcome 15 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 85.7% (67.2 to 93.9) from infection</li> </ul> (2 Obs) <a href="#">[8]</a> <a href="#">[31]</a> ; <i>last update 2021-06-08</i>
<b>Epsilon</b>	<b>Moderna</b> <b>Spikevax</b> <b>[mRNA-1723]</b>	mRNA-1273 provided protection against VOC Epsilon for the following outcome 15 days after 1 <sup>st</sup> dose: <ul style="list-style-type: none"> <li>• 58.9% (95% CI, -9.7 to 84.5) from infection</li> </ul> mRNA-1273 provided protection against VOC Epsilon for the following outcome 15 days after 2 <sup>nd</sup> dose: <ul style="list-style-type: none"> <li>• 85.7% (67.2 to 93.9) from infection</li> </ul> (2 Obs) <a href="#">[8]</a> <a href="#">[31]</a> ; <i>last update 2021-06-08</i>

Links to references are provided in Appendix 1

Iorio A, Little J, Linkins L, Abdelkader W, Bennett D, Lavis JN. COVID-19 living evidence synthesis #6 (version 6.38): What is the efficacy and effectiveness of available COVID-19 vaccines in general and specifically for variants of concern? Health Information Research Unit (HIRU); McMaster and Ottawa Knowledge Synthesis and Application Unit, 22 June 2022.

To help Canadian decision-makers as they respond to unprecedented challenges related to the COVID-19 pandemic, COVID-END in Canada is preparing rapid evidence responses like this one. The development and continued updating of this living evidence synthesis has been funded by the Canadian Institutes of Health Research (CIHR) and the Public Health Agency of Canada. The opinions, results, and conclusions are those of the team that prepared the living evidence synthesis, and independent of the Government of Canada, CIHR and the Public Health Agency of Canada. No endorsement by the Government of Canada, CIHR or Public Health Agency of Canada is intended or should be inferred.

## Appendix 1: Summary of Study Findings and Appraisals

Section 1: included studies				
Ref	Author	Bottom line	ROBINS-I*	Design, Notes
*Note: ROBINS-I score risk of bias: Low risk of bias indicates high quality				
1	<a href="#">Dagan</a>	BNT162b2 showed VE 46% (95% CI, 40 to 51) against infection 14 to 20 days after 1 <sup>st</sup> dose and VE 92% (95% CI, 88 to 95) 7 days after 2 <sup>nd</sup> dose.  BNT162b2 showed VE 92% (95% CI, 75 to 100) for severe disease at 7 days after 2 <sup>nd</sup> dose.	Moderate	Data-linkage study in Israel; .5 M matched participants (2 M excluded – also (possible overlap with Haas); time and setting for VOC Alpha (estimated 80%).
2	<a href="#">Haas</a>	BNT162b2 showed VE 95.3% (95% CI, 94.9 to 95.7) against infection; VE 97.5% (95% CI, 97.1 to 97.8) against severe or critical COVID-19-related hospitalization; VE 96.7% (95% CI, 96.0 to 97.3) against death 7 days after 2 <sup>nd</sup> dose.	Serious	Data-linkage study in Israel; >6.5 M matched participants (possible overlap with Dagan) Updated May 14 due to final publication; sample confirmed VOC Alpha (estimated 94%).
3	<a href="#">Kustin</a>  *Delayed exclusion-only included infected	BNT162b2 showed lower relative VE (2.4:1) against Alpha. after 1 <sup>st</sup> dose; and lower VE (8:1) against Beta after 2 <sup>nd</sup> dose in a population with >90% of Alpha and <1% Beta	Moderate	Case-control study in Israel; small sample for Beta (no overlap CHS cohort); confirmed VOC Alpha and Beta.
4	<a href="#">Madhi</a>	ChAdOx1 nCoV-19 showed VE 10.4% (95% CI, -76.8 to 54.8) against mild to moderate disease 14 days after 2 <sup>nd</sup> dose.	Moderate quality (RCT)	RCT in South Africa; Underpowered for 20% efficacy (42 cases); VOC Beta.
5	<a href="#">Emery</a>	ChAdOx1nCoV-19 showed VE 61.7% (95% CI, 36.7 to 76.9) against infection by VOC Alpha ≥ 15 days after 2 <sup>nd</sup> dose.	Moderate quality (RCT)	RCT in UK; neutralization of Alpha 9 times lower; no sequencing for 45% of cases; 52 cases (19%) had VOC Alpha.
6	<a href="#">Shah</a>	ChAdOx1nCoV-19 or BNT162b2 reduced infection in unvaccinated household contacts of vaccinated HCW by about 30% (HR, 0.70, 95% CI, 0.63 to 0.78) ≥ 14 days after 1 <sup>st</sup> dose; ChAdOx1nCoV-19 or BNT162b2 reduced infection in HCW by about 55% (HR 0.45, 95% CI, 0.42 to 0.49) and hospitalization by 84% (HR 0.16, 95% CI, 0.09 to 0.27) ≥ 14 days after 1 <sup>st</sup> dose.	Moderate	Data-linkage study in Scotland - (25% of cases had received 2 doses); time and setting for VOC Alpha.
7	<a href="#">Sadoff</a>	Single dose Ad26.COV2.S showed VE 38.1% (95% CI, 4.2 to 60.4) at 14 days and VE 51.9%	Moderate quality	RCT; over 40,000 participants;

		(95% CI, 19.1 to 72.2) at 28 days against moderate to severe disease and VE 81.7% (95% CI, 46.2 to 95.4) at 28 days against severe disease (confirmed VOC Beta).  Single dose Ad26.COVS showed VE 36.4% (95% CI, 13.9 to 53.2) at 14 days and VE 36.5% (95% CI, 14.1 to 53.3) at 28 days against moderate to severe disease (confirmed VOC Gamma)	(RCT)  Updated 2022/03/16	Argentina, Brazil, Chile, Colombia, Mexico, Peru, South Africa, and the United States; sequenced for VOC Alpha, Beta, Delta, Gamma.
8	<a href="#">Andrejko</a>	BNT162b2 or mRNA-1273 showed VE 58.9% (95% CI, -9.7 to 84.5) at 15 days after 1 <sup>st</sup> dose, and VE 85.7% (95% CI, 67.2 to 93.9) 15 days after 2 <sup>nd</sup> dose against infection.	Serious	Test-negative study in California; 645 participants; 69% of population at time had VOC Alpha or Epsilon.
9	<a href="#">Glampson</a>	ChAdOx1nCoV-19 showed VE 74% (95% CI, 65 to 81) against infection 28 days after 1 <sup>st</sup> dose.  BNT162b2 showed VE 78% (95% CI, 73 to 82) against infection 28 days after 1 <sup>st</sup> dose.	Serious	Retrospective cohort in UK; 2M participants; time and setting for VOC Alpha.
10	<a href="#">Pritchard</a>	ChAdOx1nCoV-19 or BNT162b2 showed VE 66% (95% CI, 59 to 72%) 21 days after 1 <sup>st</sup> dose and 78% (95% CI, 68 to 85%) after 2 <sup>nd</sup> dose against infection.	Serious	Survey of randomly selected private households with longitudinal follow-up in UK; 370,000 participants; sample confirmed VOC Alpha.
11	<a href="#">Hall (SIREN)</a>	BNT162b2 vaccine showed VE of 70% (95% CI, 55 to 85) 21 days after 1 <sup>st</sup> dose and 85% (95% CI, 74 to 96) 7 days after 2 <sup>nd</sup> dose against infection in HCW.	Moderate	Prospective cohort with standardized testing for HCW over all of England; 23,000 participants; time and setting for VOC Alpha
12	<a href="#">Shrotri</a>  *Delayed exclusion – critical ROB	Similar effect sizes were seen for ChAdOx1 (aHR 0.32, 95% CI, 0.15 to 0.66) and BNT162b2 (aHR 0.35, 95% CI, 0.17 to 0.71) at 35-48 days after 1 <sup>st</sup> dose.	Critical	Prospective cohort in England: 9160 of 10412 frail LTC residents; routine screening; time and setting for VOC Alpha
13	<a href="#">Hyams</a>  *Delayed exclusion – did not report clinical outcomes of interest for this LES	BNT162b2 showed VE 71.4% (95% CI, 43.1 to 86.2) against hospitalization 14 days after 1 <sup>st</sup> dose; ChAdOx1nCoV-19 showed VE 80.4% (95% CI, 36.4 to 94.5) against hospitalization 14 days after 1 <sup>st</sup> dose for 80+.  When effectiveness analysis for BNT162b2 was restricted to the period covered by ChAdOx1nCoV-19, the estimate was 79.3% (95% CI, 47.0 to 92.5).		Test negative case-control study in Scotland. Single center; 466 participants, 80+; time and setting for VOC Alpha
14	<a href="#">Harris</a>	BNT162b2 or ChAdOx1 reduced likelihood of VET by vaccinated HCW to household contacts	Serious	Data-linkage and case-control study in England;

		by 40-50% 21 days after 1 <sup>st</sup> dose.		338,887 participants; time and setting for VOC Alpha
15	<a href="#">Goldberg</a>	Prior infection (in unvaccinated) has similar VE against infection [94.8%], and severe illness [96.4%] as two doses of BNT162b2.	Serious	Data-linkage study in Israel; 6,351,903 participants; likely overlaps with Dagan and Haas; time and setting for VOC Alpha
16	<a href="#">Cavanaugh</a>  *Delayed exclusion – VOI instead of VOC	VE 66.2% (95% CI, 40.5% to 80.8%) against infection among LTC residents and 75.9% (95% CI, 32.5% to 91.4%) among HCW. VE 94.4% (95% CI, 73.9% to 98.8%) against hospitalization among residents; no HCW were hospitalized. Three residents died, two of whom were unvaccinated (VE 94.4%; 95% CI, 44.6% to 99.4%).	Critical	Outbreak analysis in LTC in Kentucky; small number of events; VOI R.1
17	<a href="#">Shinde</a>	NVX-CoV2372 VE showed VE 50.4% (95% CI, 16.6 to 70.5) against symptomatic infection 7 days after 2 <sup>nd</sup> dose.	Moderate quality (RCT)	RCT in South Africa; 4387 participants; 38/41 cases VOC Beta
18	<a href="#">Hitchings</a>	CoronaVac showed VE of 35.1% (95% CI, -6.6 to 60.5) against infection in HCW after 1 <sup>st</sup> dose.	Serious	Case-control study in HCWs in Manaus; 53,176 participants; 75% prevalence of Gamma; 776 (28%) of 2797 PCR were used for the case-controls; rate of previous infection high in the population
19	<a href="#">Heath</a>	NVX-CoV2373 showed VE 89.7% (95% CI, 80.2 to 94.6) against symptomatic infection after 2 <sup>nd</sup> dose. No hospitalizations or deaths in vaccinated group.	Moderate quality (RCT)	RCT; 15,187 participants in UK Post hoc: VE 86.3% (95% CI, 71.3 to 93.5) against Alpha variant; 10 cases in vaccinated participants; 66 infections confirmed Alpha; 11 infections no sequencing available
20	<a href="#">Ismail</a>  *Delayed exclusion – did not report clinical outcomes of interest for this LES	BNT162b2 showed VE 81% (95% CI, 76 to 85) against hospitalization 28 days after 1 <sup>st</sup> dose and 93% (95% CI, 89 to 95) 14 days after the 2 <sup>nd</sup> dose for people 80+.  ChAdOx1 showed VE 73% (95% CI, 60 to 81) against hospitalization 28 days after 1 <sup>st</sup> dose; sample size too small to report VE after 2 <sup>nd</sup> dose for people 80+.		Screening study in UK; 13,907 hospitalized patients; results for age 80+; time and setting for VOC Alpha
21	<a href="#">Bernal (2)</a>	BNT162b2 showed VE 44% (95% CI, 32 to 53) after 1 <sup>st</sup> dose and 69% (95% CI, 31 to 86) after 2 <sup>nd</sup> dose against symptomatic infection in 70+.	Critical	Data-linkage study in England; 48,096 cases above age 70+; 12.7%

	*Delayed exclusion – critical ROB	Single dose ChAdOx1 showed VE 55% (95% CI, 41 to 66) against death.		BNT162b2 and 8.2% ChAdOx1; VE also reported for 80+ and LTC; time and setting for VOC Alpha
22	<a href="#">Chodick</a>	BNT162b2 showed VE 90% (95% CI, 79 to 95) against infection and VE 94% (95% CI, 88 to 97) against death 7-27 days after 2 <sup>nd</sup> dose; 71% (95% CI, 37 to 87) in immunosuppressed.	Serious	Data-linkage study in Israel (Maccabi Health Care Organization); 1,178,597 participants; time and setting for VOC Alpha
23	<a href="#">Chung</a>	BNT162b2 or mRNA-1273 showed VE 61% (95% CI, 56 to 66) against symptomatic infection by VOC Alpha 14 days after 1 <sup>st</sup> dose and 90% (95% CI, 85 to 94) 7 days after 2 <sup>nd</sup> dose; 43% (95% CI, 22 to 59) against symptomatic infection by VOC Beta or Gamma 14 days after 1 <sup>st</sup> dose and 88% (95% CI, 61 to 96) 7 days after 2 <sup>nd</sup> dose.	Moderate	Test-negative study in Ontario 324,033 participants; screening for variants started 2 months into study period; results also reported for age>70 and according to vaccine (but not according to confirmed variant)
24	<a href="#">Bailly</a> *Delayed exclusion – critical ROB	BNT162b2 showed VE 50% (95% CI, 34 to 73) against infection with VOC Beta >28 days after 2 doses.	Critical	Outbreak in a single LTC in France; 90 participants; all samples genome sequenced for VOC Beta; 2 deaths in vaccinated group
25	<a href="#">Angel</a>	BNT162b2 showed VE 97% (95% CI, 94 to 99) against symptomatic infection and 86% (95% CI, 69 to 93) against asymptomatic infection ≥ 7 days after 2 doses in HCW.	Serious	Retrospective cohort at a single centre tertiary medical centre in Israel, 6,710 participants; testing strategy was different between vaccinated and unvaccinated; time and setting for VOC Alpha
26	<a href="#">Bianchi</a> *Delayed exclusion – critical ROB	BNT162b2 showed VE 61.9% (95% CI, 19.2 to 82) against infection 14 to 20 days after 1 <sup>st</sup> dose; 96% (95% CI, 82.2 to 99.1) ≥ 7 days after 2 <sup>nd</sup> dose in HCW.	Critical	Data-linkage, single centre medical centre in Italy, 2,034 participants; time and setting for VOC Alpha
27	<a href="#">Yassi</a>	BNT162b2 (93%) or mRNA-1273 showed VE 37.2% (95% CI, 16.6 to 52.70) against infection by VOC Beta or Gamma 14 to 42 days after 1 <sup>st</sup> dose and 79.2% (95% CI, 64.6 to 87.8) 7 days after 2 <sup>nd</sup> dose in HCW.	Serious	Data-linkage, 25,558 Canadian HCW; evenly split between VOC Gamma and VOC Beta by end of study period
28	<a href="#">Bernal (1)</a>	BNT162b2 showed VE 60% (95% CI, 40 to 73) against confirmed symptomatic infection by VOC Alpha at least 28 days after 1 <sup>st</sup> dose and 90% (95% CI, 84 to 94) at least 14 days after 2 <sup>nd</sup> dose for people 70+.	Serious	Test-negative in England, 156,930 participants; spike gene target failure as proxy for confirmed VOC Alpha
29	<a href="#">Bernal (3)</a>	BNT162b2 showed VE 47.5% (95% CI, 41.6 to 52.8) at least 21 days after 1 <sup>st</sup> dose and VE 93.7%	Serious	Test-negative in England; 19,109 sequenced cases:

		<p>(95% CI, 91.6 to 95.3) at least 14 days after 2<sup>nd</sup> dose against symptomatic infection by confirmed VOC Alpha.</p> <p>ChadOx1 showed VE 48.7% (95% CI, 45.2 to 51.9) at least 21 days after 1<sup>st</sup> dose and VE 74.5% (95% CI, 68.4 to 79.4) at least 14 days after 2<sup>nd</sup> dose against symptomatic infection by confirmed VOC Alpha.</p> <p>BNT162b2 showed VE 35.6% (95% CI, 22.7 to 46.4) at least 21 days after 1<sup>st</sup> dose and VE 88% (95% CI, 85.3 to 90.1) at least 14 days after 2<sup>nd</sup> dose against symptomatic infection by confirmed VOC Delta.</p> <p>ChAdOx1 showed VE 30% (95% CI, 24.3 to 35.3) at least 21 days after 1<sup>st</sup> dose and VE 67% (95% CI, 61.3 to 71.8) at least 14 days after 2<sup>nd</sup> dose against symptomatic infection by confirmed VOC Delta.</p>		14,837 VOC Alpha and 4,272 VOC Delta.
30	<a href="#">Ranzani</a>	CoronaVac reduced risk of symptomatic infection by VOC Gamma VE 41.6% (95% CI, 26.9 to 63.3) $\geq$ 14 days after 2 <sup>nd</sup> dose for people 70+.	Serious	Test-negative in Brazil; 44,055 participants; sequencing not performed; effectiveness declined with age; time and setting for VOC Gamma
31	<a href="#">Andrejko (2)</a>	BNT162b2 and mRNA-1273 showed VE 86.8% (95% CI, 68.6 to 94.7) and VE 86.10% (95% CI, 69.1 to 93.9), respectively, against infection 15 days after 2 <sup>nd</sup> dose.	Serious	Test-negative in California; 1,023 participants; expansion of sample size and timeline since previous study by same authors; VOC Alpha, Epsilon
32	<a href="#">Emborg</a>	BNT162b2 showed VE 53-86% against infection across high-risk groups, VE 75-87% against hospitalization across high-risk groups, VE 89% (95% CI, 81 to 93) against death in LTCF residents and VE 97% (95% CI, 88 to 99) against death in 65+ requiring personal care 7 days after 2 <sup>nd</sup> dose.	Serious	Data-linkage population study of high-risk groups in Denmark; 864,096 participants; sample confirmed VOC Alpha
33	<a href="#">Salo</a>	BNT162b2 showed VE 42.9% (95% CI, 22.3 to 58.1) against infection in unvaccinated household members of vaccinated HCW 10 weeks after 1 <sup>st</sup> dose.	Moderate	Data-linkage for household contacts of HCW in Finland; 52,766 spouses of vaccinated HCW; time and setting for VOC Alpha
34	<a href="#">Shrestha</a>	BNT162b2 or mRNA-1273 showed VE 97.1% (95% CI, 94.3 to 98.5) against infection $\geq$ 14 days after 2 <sup>nd</sup> dose (based on multivariable model).	Moderate	Retrospective cohort of employees of a health care system in Ohio; 46,866 participants (60%)

				vaccinated by end of study; time and setting for VOC Alpha
35	<a href="#">Skowronski</a>	<p>BNT162b2 (85%) or mRNA-1273 showed VE 67% (95% CI, 57 to 75) against infection by confirmed VOC Alpha <math>\geq 21</math> days after 1<sup>st</sup> dose for 70+.</p> <p>BNT162b2 (85%) or mRNA-1273 showed VE 61% (95% CI, 45 to 72) against infection by confirmed VOC Gamma <math>\geq 21</math> days after 1<sup>st</sup> dose for 70+.</p>	Serious	Test-negative in Canada; 16,993 specimens; out of 1,131 genetically sequenced: 45% VOC Alpha and 28% Gamma; results reported by vaccine but not according to confirmed variant
36	<a href="#">Abu-Raddad</a>	<p>BNT162b2 showed VE 89.5% (95% CI, 85.9 to 92.3) against infection, VE 100% (95% CI, 81.7 to 100) against any severe, critical, or fatal disease by VOC Alpha <math>\geq 14</math> days after 2<sup>nd</sup> dose.</p> <p>BNT162b2 showed VE 75% (95% CI, 70.5 to 78.9) against infection, VE 100% (95% CI, 73.7 to 100) against severe, critical, or fatal disease by VOC Beta <math>\geq 14</math> days after 1<sup>st</sup> dose.</p>	Serious	Test-negative in Qatar; 17,293 cases; sequencing showed 50% VOC Beta and 45% VOC Alpha between February-March 2021
37	<a href="#">Akhress</a> *Delayed exclusion - failure to report outcomes of interest for this LES	BNT162b2 or mRNA-1273 showed overall VE 60.4% (95% CI, 30 to 77.6) against symptomatic infection $\geq 14$ days after 1 <sup>st</sup> dose; BNT162b2 or mRNA-1273 showed overall VE 95.7% (95% CI, 90 to 98.2) against symptomatic infection $\geq 14$ days after 2 <sup>nd</sup> dose.	Critical	Retrospective cohort of HCW at a single centre in Kentucky, USA; 2,134 participants; time and setting for VOC Alpha
38	<a href="#">Sheikh</a>	<p>BNT162b2 showed VE 30% (95% CI, 17 to 41) against confirmed VOC Delta infection and VE 33% (95% CI, 15 to 47) against symptomatic infection at least 28 days after 1<sup>st</sup> dose; VE 79% (95% CI, 75 to 82) against infection and VE 83% (95% CI, 78 to 87) against symptomatic infection at least 14 days after 2<sup>nd</sup> dose.</p> <p>ChAdOx1 showed VE 18% (95% CI, 9 to 25) against confirmed VOC Delta infection and VE 33% (95% CI, 23 to 41) against symptomatic infection at least 28 days after 1<sup>st</sup> dose; VE 60% (95% CI, 53 to 66) against infection and VE 61% (95% CI, 51 to 70%) against symptomatic infection at least 14 days after 2<sup>nd</sup> dose.</p>	Serious	Test-negative in Scotland; 626,900 specimens; also compared hospitalization rates between S gene positive (VOC Delta) and S gene negative specimens within 14 days of positive test result (not summarized here)
39	<a href="#">Furer</a> *Delayed exclusion – critical risk of bias	BNT162b2 reported no symptomatic infections in the vaccinated group (0/686) compared to 0.83% infections in the vaccinated general population control group.	Critical	Prospective cohort of adults with autoimmune inflammatory rheumatic diseases in Israel; 686 participants; time and setting for VOC Alpha
40	<a href="#">Martinez-Baz</a>	BNT162b2 showed VE 65% (95% CI, 56 to 73) against infection and VE 94% (95% CI, 60 to 99)	Serious	Prospective cohort of close contacts of

		<p>against hospitalization at least 14 days after 2<sup>nd</sup> dose in close contacts of COVID+ index cases.</p> <p>ChAdOx1 showed VE 44% (95% CI, 31 to 54) against infection and VE 92% (95% CI, 46 to 99) against hospitalization at least 14 days after 1<sup>st</sup> dose in close contacts of index cases. Second dose results not reported.</p>		<p>COVID+ people in Spain; 20,961 participants; VOC Alpha confirmed for small sample; sample size for Moderna too small to report results separately</p>
41	<a href="#">Chodick (2)</a>	<p>BNT162b2 showed VE 51.4% (95% CI, 16.3 to 71.8) against infection 13 to 24 days after 1<sup>st</sup> dose.</p>	Serious	<p>Data-linkage study in Israel (Maccabi Health Care Services); 351,897 participants; time and setting for VOC Alpha</p>
42	<a href="#">Stowe</a>	<p>BNT162b2 showed VE 94% (95% CI, 46 to 99) at least 21 days after 1<sup>st</sup> dose and VE 96% (95% CI, 86 to 99) at least 14 days after 2<sup>nd</sup> dose against hospitalization by confirmed VOC Delta.</p> <p>ChAdOx1 showed VE 71% (95% CI, 51 to 83) at least 21 days after 1<sup>st</sup> dose and VE 92% (95% CI, 75 to 97) 14 days after 2<sup>nd</sup> dose against hospitalization by confirmed VOC Delta.</p>	Serious	<p>Same cohort as Bernal (3) with extended time frame for symptomatic infection and adding in data-linkage to hospitalization; 14,019 participants; sample confirmed VOC Delta</p>
43	<a href="#">Saciuk</a>	<p>BNT162b2 showed VE 93% (95% CI, 92.6 to 93.4) against infection, VE 93.4% (95% CI, 91.9 to 94.7) against hospitalization and VE 91.1% (95% CI, 86.5 to 94.1) against death at least 7 days after 2<sup>nd</sup> dose</p>	Serious	<p>Retrospective cohort of members of a health management organization in Israel; 1,650,885 participants; time and setting for VOC Alpha</p>
44	<a href="#">Zacay</a>	<p>BNT162b2 showed VE 61% (95% CI, 49 to 71) at least 14 days after 1<sup>st</sup> dose and VE 89% (95% CI, 82 to 94) at least 7 days after 2<sup>nd</sup> dose against infection</p>	Serious	<p>Retrospective cohort of a subpopulation of members of a health management organization in Israel who had undergone repeated PCR testing; 6,286 participants; time and setting for VOC Alpha</p>
45	<a href="#">Azamgarhi</a>	<p>BNT162b2 showed VE 70% (95% CI, 6 to 91) against infection at least 14 days after 1<sup>st</sup> dose</p>	Serious	<p>Single centre cohort study of HCW in UK; 2,260 participants; time and setting for VOC Alpha</p>
46	<a href="#">Lumley</a>	<p>BNT162b2 (63%) or ChAdOx1 showed VE 64% (95% CI, 50 to 74) 14 days after 1<sup>st</sup> dose and VE 90% (95% CI, 62 to 98) 14 days after 2<sup>nd</sup> dose against infection</p>	Serious	<p>Prospective cohort of HCWs in Oxfordshire, UK; 13,109 participants; confirmed VOC Alpha</p>
47	<a href="#">Nasreen</a>	<p>BNT162b2 showed VE 89% (95% CI, 86 to 91) against symptomatic infection and VE 95% (95% CI, 92 to 97) against hospitalization at least 7 days after 2<sup>nd</sup> dose (VOC Alpha); VE 84% (95% CI, 69 to 92) against symptomatic infection and VE 95% (95% CI, 81 to 99) against hospitalization at least 7 days after 2<sup>nd</sup> dose</p>	Moderate	<p>Test-negative study in Ontario 421,073 participants (same population as for Chung but extended to May 2021 and more detailed with respect to reporting</p>

		<p>(VOC Beta/Gamma); VE 87% (95% CI, 64 to 95) against symptomatic infection at least 7 days after 2<sup>nd</sup> dose (VOC Delta).</p> <p>BNT162b2 showed VE 78% (95% CI, 65 to 86) against hospitalization at least 7 days after 2<sup>nd</sup> dose (VOC Delta).</p> <p>mRNA-1273 showed VE 92% (95% CI, 86 to 96) against symptomatic infection and VE 94% (95% CI, 89 to 97) against hospitalization at least 7 days after 2<sup>nd</sup> dose (VOC Alpha).</p> <p>mRNA-1273 showed VE 77% (95% CI, 63 to 86) against symptomatic infection and VE 89% (95% CI, 73 to 95) against hospitalization at least 14 days after 1<sup>st</sup> dose (VOC Beta/Gamma); VE 72% (95% CI, 57 to 82) against symptomatic infection and VE 96% (95% CI, 72 to 99) against hospitalization at least 14 days after 1<sup>st</sup> dose (VOC Delta).</p> <p>ChAdOx1 showed VE 64% (95% CI, 60 to 68) against symptomatic infection and VE 85% (95% CI, 81 to 88) against hospitalization at least 14 days after 1<sup>st</sup> dose (VOC Alpha); VE 48% (95% CI, 28 to 63) against symptomatic infection and VE 83% (95% CI, 66 to 92) against hospitalization at least 14 days after 1<sup>st</sup> dose (VOC Beta/Gamma); VE 67% (95% CI, 44 to 80) against symptomatic infection and VE 88% (95% CI, 60 to 96) against hospitalization at least 14 days after 1<sup>st</sup> dose (VOC Delta).</p>		<p>of VOC); screening for VOC Alpha, Beta/Gamma and Delta varied during study period</p>
48	<a href="#">Gazit</a>	<p>BNT162b2 showed VE 80% (95% CI, 73 to 85) at least 7 days after 2<sup>nd</sup> dose against infection in vaccinated household members of a confirmed COVID+ case.</p>	Serious	<p>Retrospective cohort of household members (household = 2 adults with no children) of a health management organization in Israel; 173,569 households; time and setting for VOC Alpha</p>
49	<a href="#">Jara</a>	<p>CoronaVac showed VE 65.9% (95% CI, 65.2 to 66.6) against infection and VE 86.3% (95% CI, 84.5 to 87.9) against death at least 14 days after 2<sup>nd</sup> dose.</p>	Moderate	<p>Prospective cohort in Chile; 10.2 million participants; time and setting for VOC Gamma</p>
50	<a href="#">Chemaitelly</a>	<p>mRNA-1273 showed VE 88.1% (95% CI, 83.7 to 91.5) and VE 100% (95% CI, 91.8 to 100) against infection by confirmed VOC Alpha at least 14 days after 1<sup>st</sup> and 2<sup>nd</sup> dose, respectively.</p> <p>mRNA-1273 showed VE 61.3% (95% CI, 56.5</p>	Serious	<p>Test-negative in Qatar; &gt;75,000 participants; sample sequenced for VOC Alpha and VOC Beta</p>

		<p>to 65.5) and VE 96.4% (95% CI, 91.9 to 98.7) against infection by confirmed VOC Beta at least 14 days after 1<sup>st</sup> and 2<sup>nd</sup> dose, respectively.</p> <p>mRNA-1273 showed VE 81.6% (95% CI, 71.0 to 88.8) and VE 95.7% (95% CI, 73.4 to 99.9) against severe, critical, or fatal disease at least 14 days after 1<sup>st</sup> and 2<sup>nd</sup> dose, respectively (combined VOC Alpha and Beta).</p>		
51	<a href="#">Baum</a>	<p>BNT162b2 or mRNA-1273 showed VE 41% (95% CI, 25 to 54) against infection <math>\geq</math> 21 days after 1<sup>st</sup> dose; BNT162b2 or mRNA-1273 showed VE 75% (95% CI, 65 to 82) against infection <math>\geq</math> 7 days after 2<sup>nd</sup> dose in age 70+.</p> <p>BNT162b2 or mRNA-1273 showed VE 41% (95% CI, 17 to 58) against infection <math>\geq</math> 21 days after 1<sup>st</sup> dose; BNT162b2 or mRNA-1273 showed VE 77% (95% CI, 65 to 85) against infection <math>\geq</math> 7 days after 2<sup>nd</sup> dose in chronically ill (age 16-69).</p> <p>ChAdOx1 showed VE 24% (95% CI, -1 to 43) against infection <math>\geq</math> 21 days after 1<sup>st</sup> dose in chronically ill (age 16-69).</p>	Serious	Data-linkage study in Finland; 901,092 participants age 70+ and 774,526 participants age 16 to 69 years with chronic illness; time and setting for VOC Alpha; results for mRNA vaccines not reported separately
52	<a href="#">Balicer</a>	<p>BNT162b2 showed VE 86.1% (95% CI, 82.4 to 89.1) against infection; VE 89% (95% CI, 43 to 100) against hospitalization 7 to 56 days after 2<sup>nd</sup> dose.</p> <p>Too few events to report VE for severe disease or death.</p>	Serious	Data-linkage study of pregnant women over age 16 in Israel (same database as Dagan); 21,722 participants; time and setting for VOC Alpha.
53	<a href="#">Mateo-Urdiales</a>	<p>BNT162b2 (61%) or ChAdOx1 (31%) or mRNA-1273 (7%) or Ad26.COV<sub>2</sub>-S (0.6%) showed VE 78% (95% CI, 76 to 79) against infection 42 to 49 days after at least 1<sup>st</sup> dose; VE 93% (95% CI, 89 to 96) against death 35 to 42 days after at least 1<sup>st</sup> dose.</p>	Serious	Data-linkage study in Italy; 13,721,506 participants; time and setting for VOC Alpha. Results not reported by vaccine and some participants (42%) who also received 2 <sup>nd</sup> dose were included in estimates.
54	<a href="#">Goldshtein</a>	<p>BNT162b2 showed VE 78% (95% CI, 57 to 89) against infection at least 28 days after 1<sup>st</sup> dose.</p>	Serious	Data-linkage study of pregnant women in Israel (same database as Gazit); 15,060 participants; time and setting for VOC Alpha.
55	<a href="#">Mason</a>	<p>BNT162b2 showed VE 55.2% (95% CI, 40.8 to 66.8) and VE 70.1% (95% CI, 55.1 to 80.1) against infection 21 to 27 days and 35 to 41 days after 1<sup>st</sup> dose, respectively.</p>	Moderate	Case-control study of age 80-83 vs 76-79 community-dwelling unvaccinated residents in

				England; time and setting for VOC Alpha
56	<a href="#">Fabiani</a>	BNT162b2 showed VE 84.1% (95% CI, 39.7 to 95.8) and VE 85.4% (95% CI, -35.3 to 98.4) against infection 14 to 21 days and $\geq 21$ days after 1 <sup>st</sup> dose, respectively in HCW.  BNT162b2 showed VE 95.1% (95% CI, 62.4 to 99.4) against infection $\geq 7$ days after 2 <sup>nd</sup> dose in HCW.	Serious	Retrospective cohort of HCW in Italy; 6,423 participants; time and setting for VOC Alpha
57	<a href="#">Chia</a>	BNT162b2 or mRNA-1273 showed VE 92.7% (95% CI, 65.7 to 98.4) against severe disease (defined as requiring supplemental oxygen) > 14 days after 2 <sup>nd</sup> dose.	Serious	Retrospective cohort of confirmed VOC Delta admitted to hospital (including asymptomatic) in Singapore; 218 participants; not reported by vaccine
58	<a href="#">Kaur</a> *Delayed exclusion – critical ROB	Two doses of Covishield showed VE 87% (95% CI, 33 to 97) against severe disease when compared with one dose (timing of doses not reported).	Critical	Preliminary report of prospective cohort in India; 1500 participants; time and setting for VOC Delta
59	<a href="#">Pramod</a> *Delayed exclusion – critical ROB	Covishield showed VE 49% (95% CI, 17 to 68) against infection 21 days after 1 <sup>st</sup> dose and VE 54% (95% CI, 27 to 71) against infection 14 days after 2 <sup>nd</sup> dose.  Covishield showed VE 58% (95% CI, 28 to 75) against symptomatic infection 21 days after 1 <sup>st</sup> dose and VE 64% (95% CI, 38 to 78) against symptomatic infection 14 days after 2 <sup>nd</sup> dose.	Critical	Test-negative study in a single hospital site in India; 360 matched pairs (203 symptomatic pairs); time and setting for VOC Delta
60	<a href="#">Carazo</a>	BNT162b2 or mRNA-1273 showed VE 60% (95% CI, 53.6 to 65.5) against infection by confirmed VOC Alpha 14 days after 1 <sup>st</sup> dose.  BNT162b2 or mRNA-1273 showed VE 92.6% (95% CI, 87.1 to 95.8) against infection by confirmed VOC Alpha 7 days after 2 <sup>nd</sup> dose.	Serious	Test-negative study in Quebec, Canada; 58,476 participants; sample confirmed VOC Alpha; reported according to vaccine but not concurrently for VOC Alpha
61	<a href="#">Williams</a>	BNT162b2 or mRNA-1273 showed VE 52.5% (95% CI, 26.9 to 69.1) against infection and VE 78.6% (95% CI, 47.9 to 91.2) against severe disease 14 days after 2 <sup>nd</sup> dose in residents at LTCF. Two deaths in vaccinated residents but were palliative prior to infection.  BNT162b2 or mRNA-1273 showed VE 66.2% (95% CI, 2.3 to 88.3) against infection 14 days after 2 <sup>nd</sup> dose in staff at LTCF. None of the staff developed severe disease.	Serious	Outbreak in a single LTCF in Ontario; 60 residents and 83 staff; sample confirmed VOC Gamma
62	<a href="#">Hitchings(2)</a>	ChAdOx1 showed VE 33.4% (95% CI, 26.4 to 39.7) against symptomatic infection and VE	Critical	Test-negative study in Sao Paulo, Brazil; 61,164

	*Delayed exclusion – critical ROB	50.9% (95% CI, 33.6 to 63.8) against ICU admission and VE 61.8% (95% CI, 48.9 to 71.4) against death at least 28 days after 1 <sup>st</sup> dose for 60+.  ChAdOx1 showed VE 77.9% (95% CI, 69.2 to 84.2) against symptomatic infection and VE 89.9% (95% CI, 70.9 to 96.5) against ICU admission and VE 93.6% (95% CI, 81.9 to 97.7) against death at least 14 days after 2 <sup>nd</sup> dose.		participants over age 60; time and setting for VOC Gamma
63	<a href="#">Tang</a>	BNT162b2 showed VE 65.5% (95% CI, 40.9 to 79.9) against infection ≥ 14 days after 1 <sup>st</sup> dose; BNT162b2 showed VE 59.6% (95% CI, 50.7 to 66.9) against infection ≥ 14 days after 2 <sup>nd</sup> dose.  BNT162b2 showed VE 100% (95% CI, not reported) against severe, critical or fatal disease ≥ 14 days after 1 <sup>st</sup> dose; BNT162b2 showed VE 97.3% (95% CI, 84.4 to 99.5) against severe, critical or fatal disease ≥ 14 days after 2 <sup>nd</sup> dose.  mRNA-1273 showed VE 79.7% (95% CI, 60.8 to 89.5) against infection ≥ 14 days after 1 <sup>st</sup> dose; mRNA-1273 showed VE 86.1% (95% CI, 78.0 to 91.3) against infection ≥ 14 days after 2 <sup>nd</sup> dose.  mRNA-1273 showed VE 100% (95% CI, not reported) against severe, critical or fatal disease ≥ 14 days after 1 <sup>st</sup> dose; mRNA-1273 showed VE 100% (95% CI, not reported) against severe, critical or fatal disease ≥ 14 days after 2 <sup>nd</sup> dose.	Serious	Test-negative study in Qatar; 1,140,337 participants; weekly random sequencing of positive samples for VOC Delta
64	<a href="#">Puranik</a>	BNT162b2 showed VE 42% (95% CI, 13 to 62) against infection 14 days after 2 <sup>nd</sup> dose.  mRNA-1273 showed VE 76% (95% CI, 58 to 87) against infection 14 days after 2 <sup>nd</sup> dose.	Serious	Data-linkage study involving Mayo Clinic Health in USA; 25,859 matched triples from Minnesota only; time and setting for Delta at end of study time frame so only last month of data (July 2021) reported here
65	<a href="#">Elliot</a>  *Delayed exclusion – critical ROB	BNT162b2 or ChAdOx1 showed VE 64% (95% CI, 11 to 85) against infection unreported number of days after 2 <sup>nd</sup> dose (Round 12: 2021-05-20 to 2021-06-07).  BNT162b2 or ChAdOx1 showed VE 49% (95% CI, 22 to 67) against infection unreported number of days after 2 <sup>nd</sup> dose (Round 13: 2021-06-24 to 2021-07-12).	Critical	Surveillance study in England; 121,872 participants; time and setting for VOC Delta; only included data from aged 18 to 64 years due to lowest risk for misclassification bias due to self-reported vaccination status
66	<a href="#">Issac</a>	ChAdOx1 showed VE 85% (95% CI, 71 to 92)	Serious	Prospective cohort of

		against infection 14 days after 2 <sup>nd</sup> dose.		HCW at a single hospital in India; 342 participants; time and setting for VOC Delta.
67	<a href="#">Marco</a> *Delayed exclusion – critical ROB	ChAdOx1 showed VE 23% (95% CI, not reported) against infection at least 21 days after 1 <sup>st</sup> dose.	Critical	Outbreak study of prison inmates in Barcelona; 217 participants (184 inmates); sequenced for VOC Alpha
68	<a href="#">Kale</a> *Delayed exclusion – critical ROB	ChAdOx1 showed VE 60% (95% CI, 45 to 70) against infection at least 14 days after 2 <sup>nd</sup> dose.	Critical	Prospective cohort of HCW at a single hospital in India; 1858 participants; sample sequenced for VOC Delta
69	<a href="#">Israel</a>	BNT162b2 showed OR 2.06 (95% CI, 1.69 to 2.51) for infection comparing fully vaccinated $\geq 146$ days vs fully vaccinated less than 146 days.	Moderate	Retrospective cohort of <b>fully vaccinated</b> members of a health management organization in Israel who underwent testing; 33,993 participants; time and setting for VOC Delta
70	<a href="#">Gram</a>	ChAdOx1 showed VE 44% (95% CI, 29 to 56) against infection 21 to 27 days after 1 <sup>st</sup> dose. No deaths in vaccinated participants.  First dose ChAdOx1 followed by second dose BNT162b2 or mRNA-1273 showed VE 88% (95% CI, 83 to 92) against infection $\geq 14$ days after 2 <sup>nd</sup> dose.	Serious	Data-linkage study in Denmark; 5,542,079 participants; sequenced for VOC Alpha  <b>(includes heterologous vaccines)</b>
71	<a href="#">Pouwels</a>	BNT162b2 showed VE 59% (95% CI, 52 to 65%) against infection $\geq 21$ days after 1 <sup>st</sup> dose and VE 78% (95% CI, 68 to 84) against infection $\geq 14$ days after 2 <sup>nd</sup> dose (VOC Alpha age 18+).  BNT162b2 showed VE 57% (95% CI, 50 to 63) against infection $\geq 21$ days after 1 <sup>st</sup> dose and VE 80% (95% CI, 77 to 83) against infection $\geq 14$ days after 2 <sup>nd</sup> dose (VOC Delta age 18+).  ChAdOx1 showed VE 63% (95% CI, 55 to 69) against infection $\geq 21$ days after 1 <sup>st</sup> dose and VE 79% (95% CI, 56 to 90) against infection $\geq 14$ days after 2 <sup>nd</sup> dose (VOC Alpha age 18+).  ChAdOx1 showed VE 46% (95% CI, 35 to 55) against infection $\geq 21$ days after 1 <sup>st</sup> dose and VE 67% (95% CI, 62 to 71) against infection $\geq 14$ days after 2 <sup>nd</sup> dose (VOC Delta age 18+).  mRNA-1273 showed VE 75% (95% CI: 64 to	Serious	Survey of randomly selected private households with longitudinal follow-up in UK; 743,526 participants; also reported for 18-64 years; sample sequenced for VOC Alpha and VOC Delta

		83) against infection $\geq 21$ days after 1 <sup>st</sup> dose (VOC Delta age 18 to 64).		
72	<a href="#">Abu-Raddad (2)</a>	BNT162b2 <u>after prior infection</u> showed VE 85% (95% CI, 80 to 89) against re-infection compared to BNT162b2 <u>without prior infection</u> .  mRNA-1273 <u>after prior infection</u> showed VE 15% (95% CI, -105 to 66) against re-infection compared to mRNA-1273 <u>without prior infection</u> .	Serious	Retrospective matched cohorts (2) of <b>fully vaccinated</b> in Qatar; 151,076 participants; sample sequenced for VOC Alpha and VOC Beta
73	<a href="#">Gazit (2)</a>	BNT162b2 showed OR 13.06 (95% CI, 8.08 to 21.11) against infection and OR 27.02 (95% CI, 12.7 to 57.5) against symptomatic disease compared to <b>prior infection</b> .	Moderate	Retrospective matched cohorts of <b>fully vaccinated</b> in Israel; 778,658 participants; time and setting for VOC Delta
74	<a href="#">Rosenberg</a>	BNT162b2 (51%), mRNA-1273 (40%) or Ad26.COV2.S (9%) showed VE 91.7% against infection $\geq 14$ days after 2 <sup>nd</sup> dose (Week of May 3, 2021: VOC Alpha).  BNT162b2 (51%), mRNA-1273 (40%) or Ad26.COV2.S (9%) showed VE 79.8% against infection $\geq 14$ days after 2 <sup>nd</sup> dose (Week of July 19, 2021: VOC Delta).	Serious	Surveillance report in New York, USA; >13 million participants; time and setting for VOC Delta (from 2% to 80% during study period)
75	<a href="#">Al-Qahtani</a>  *Delayed exclusion due to critical ROB	BNT162b2 $\geq 14$ days after 2 <sup>nd</sup> dose, showed VE 99.9% (95% CI, 99.2 to 100) against ICU admission, and VE 99.5% (95% CI, 98.4 to 99.8) against death (VOC Alpha and Delta).  ChAdOx1 $\geq 14$ days after 2 <sup>nd</sup> dose, showed VE 99.2% (95% CI, 97.6 to 99.7) against ICU admission, and VE 99.6% (95% CI, 97.2 to 100) against death (VOC Alpha and Delta).  BBIBP-CorV $\geq 14$ days after 2 <sup>nd</sup> dose, showed VE 95.4% (95% CI, 94.6 to 96.2) against ICU admission, and VE 94.3% (95% CI, 93.1 to 95.4) against death (VOC Alpha and Delta).  Sputnik V $\geq 14$ days after 2 <sup>nd</sup> dose, showed VE 100% (95% CI, 99.2 to 100) against ICU admission, and VE 99.5% (95% CI, 98.5 to 99.9) against death (VOC Alpha and Delta).	Critical	Retrospective cohort of <b>fully vaccinated</b> (>14 days after 2 <sup>nd</sup> dose) in Bahrain; 1,242,279 participants; time and setting for VOC Alpha (dominant before May 2021) and Delta (dominant after May 2021).
76	<a href="#">Goldberg (2)</a>	BNT162b2 showed VE 50% (95% CI, 45 to 55) for those vaccinated in January 2021, and VE 73% (95% CI, 67 to 78) for those vaccinated in May 2021 against infection after the 2 <sup>nd</sup> dose (VOC Delta age 16 to 39).  BNT162b2 showed VE 58% (95% CI, 54 to 62) for those vaccinated in January 2021, and VE	Serious	Data-linkage study of <b>fully vaccinated</b> in Israel; 4,785,245 participants; sequenced for VOC Delta (dominant after May 2021)  (results over varying time

		<p>80% (95% CI, 71 to 86) for those vaccinated in May 2021 against infection after the 2<sup>nd</sup> dose (VOC Delta age 40 to 59).</p> <p>BNT162b2 showed VE 57% (95% CI, 52 to 62) for those vaccinated in January 2021, and VE 75% (95% CI, 58 to 85) for those vaccinated in May 2021 against infection after the 2<sup>nd</sup> dose (VOC Delta age 60+).</p> <p>BNT162b2 showed VE 94% (95% CI, 87 to 97) for those vaccinated in January 2021, and VE 98% (95% CI, 94 to 99) for those vaccinated in March 2021 against severe, critical, or fatal disease after the 2<sup>nd</sup> dose (VOC Delta age 40 to 59).</p> <p>BNT162b2 showed VE 86% (95% CI, 82 to 90) for those vaccinated in January 2021, and VE 91% (95% CI, 85 to 95) for those vaccinated in March 2021 against severe, critical, or fatal disease after the 2<sup>nd</sup> dose (VOC Delta age 60+).</p>		<p>periods since vaccination reported)</p>
77	<p><a href="#">Herlihy</a></p> <p>*Delayed exclusion – critical risk of bias</p>	<p>BNT162b2, mRNA-1273, or Ad26.COV2.S showed VE 78% (95% CI, 71 to 84) in Mesa County and VE 89% (95% CI, 88 to 91) in other Colorado counties against symptomatic infection an unreported number of days after 2<sup>nd</sup> dose (VOC Delta).</p>	Critical	<p>Surveillance report in Mesa County-Colorado, USA; 37,439 cases participants; sample sequenced for VOC Delta (43% to 88% during study period)</p>
78	<p><a href="#">Ghosh</a></p> <p>*Delayed exclusion – critical risk of bias</p>	<p>ChAdOx1 showed unadjusted VE 75.2% (95% CI, 73.8 to 76.8) against infection ≥14 days after 1st dose, and unadjusted VE 54.6% (95% CI, 52.6 to 56.6) ≥14 days after 2nd dose against infection in HCW (VOC Alpha to Delta).</p>	Critical	<p>Retrospective cohort of Armed Forces HCW and frontline workers in India; 1,595,630 participants; time and setting for VOC Delta at end of study only.</p>
79	<p><a href="#">Amirthalingam</a></p>	<p>BNT162b2 showed VE 77% (95% CI, 56 to 88) against symptomatic infection when 2<sup>nd</sup> dose given 19-29 days after 1<sup>st</sup> dose, and VE 94% (95% CI, 73 to 99) against symptomatic infection when 2<sup>nd</sup> dose given 85+ days after 1<sup>st</sup> dose (VOC Alpha age 80+ ).</p> <p>BNT162b2 showed VE 77% (95% CI, 66 to 85) against symptomatic infection when 2<sup>nd</sup> dose given 19-29 days after 1<sup>st</sup> dose, and VE 86% (95% CI, 70 to 94) against symptomatic infection when 2<sup>nd</sup> dose given 85+ days after 1<sup>st</sup> dose (VOC Alpha age 65 to 79).</p> <p>ChAdOx1 showed VE 96% (95% CI, 72 to 100) against symptomatic infection when 2<sup>nd</sup> dose</p>	Moderate	<p>Test-negative study in England; 750 participants; time and setting for VOC Alpha (dominant before May 2021) and Delta (dominant after May 2021).</p> <p>(results over varying time periods since vaccination reported)</p>

		<p>given 19-29 days after 1<sup>st</sup> dose, and VE 88% (95% CI, 48 to 97) against symptomatic infection when 2<sup>nd</sup> dose given 85+ days after 1<sup>st</sup> dose after 2<sup>nd</sup> dose (VOC Alpha age 80+).</p> <p>ChAdOx1 showed VE 66% (95% CI, 47 to 77) against symptomatic infection when 2<sup>nd</sup> dose given 19-29 days after 1<sup>st</sup> dose, and VE 73% (95% CI, 56 to 83) against symptomatic infection when 2<sup>nd</sup> dose given 85+ days after 1<sup>st</sup> dose after 2<sup>nd</sup> dose (VOC Alpha age 65 to 79).</p>		
80	<p><a href="#">Butt (2)</a></p> <p>*Delayed exclusion – critical ROB</p>	<p>Unvaccinated participants had HR 2.84 (95% CI, 1.80 to 4.47) of severe disease compared to BNT162b2 ≥14 days after 2<sup>nd</sup> dose.</p>	Critical	<p>Case-control study in Qatar; 456 matched cases; time and setting for VOC Alpha</p>
81	<p><a href="#">Fowlkes</a></p>	<p>BNT162b2 (65%), mRNA-1273 (33%), or Ad26.COVS.S (2%) showed VE 91% (95% CI, 81 to 96) against infection ≥ 14 days after 2<sup>nd</sup> dose (during time of VOC Alpha).</p> <p>BNT162b2 (65%), mRNA-1273 (33%), or Ad26.COVS.S (2%) showed VE 66% (95% CI, 26 to 84) against infection ≥ 14 days after 2<sup>nd</sup> dose (during time of VOC Delta).</p> <p>BNT162b2 (65%), mRNA-1273 (33%), or Ad26.COVS.S (2%) showed VE 85% (95% CI, 68 to 93) against infection 14-119 days after full vaccination) and VE 73% (95% CI, 49 to 86) against infection ≥150 days after full vaccination (during time of VOC Alpha to Delta).</p>	Moderate	<p>Prospective cohort of HCW and other essential frontline workers in 6 states in the USA; 7,112 participants; updated report to cover VOC Delta period</p>
82	<p><a href="#">Bhattacharya a</a></p> <p>*Delayed exclusion due to critical ROB</p>	<p>Covaxin (94%) and Covishield showed VE 83% (95% CI, 73 to 89) against symptomatic infection ≥ 14 days after 2<sup>nd</sup> dose.</p> <p>Covaxin (94%) and Covishield showed VE 93% (95% CI, 64 to 99) against ICU admission or death ≥ 14 days after 2<sup>nd</sup> dose.</p>	Critical	<p>Cross-sectional cohort of HCW and their families at a single site in India; 638 participants (55 inpatients); time and setting of VOC Delta</p>
83	<p><a href="#">Nunes</a></p>	<p>BNT162b2 (45%) or mRNA-1273 (8%) showed VE 96% (95% CI, 92 to 98) against COVID-related death ≥14 days after 2<sup>nd</sup> dose (age 65 to 79).</p> <p>BNT162b2 (80%) or mRNA-1273 (2%) showed VE 81% (95% CI, 74 to 87) against COVID-related death ≥14 days after 2<sup>nd</sup> dose (age ≥80).</p> <p>BNT162b2 (80%) or mRNA-1273 (2%) showed VE 86% (95% CI, 68 to 93) against COVID-related death 14 to 41 days after 2<sup>nd</sup> dose and VE 74% (95% CI, 60 to 83) against COVID-related</p>	Moderate	<p>Data-linkage study of community-dwelling adults ≥65 in Portugal; 2,050,950 participants; time and setting for VOC Alpha to VOC Delta</p>

		death $\geq$ 98 days after 2 <sup>nd</sup> dose for HR 1.80 (0.77 to 4.25) (age $\geq$ 80).		
84	<a href="#">Tartof</a>	<p>BNT162b2 showed VE 75% (95% CI, 71 to 78) against infection 7 days after 2<sup>nd</sup> dose (confirmed VOC Delta).</p> <p>BNT162b2 showed VE 91% (95% CI, 88 to 92) against infection 7 days after 2<sup>nd</sup> dose (confirmed non-VOC Delta).</p> <p>BNT162b2 showed VE 93% (95% CI, 85 to 87) against infection 7 to 30 days after 2<sup>nd</sup> dose and VE 53% (95% CI, 39 to 65) against infection <math>\geq</math> 127+ days after 2<sup>nd</sup> dose (confirmed VOC Delta).</p> <p>BNT162b2 showed VE 97% (95% CI, 95 to 99) against infection 7 to 30 days after 2<sup>nd</sup> dose and VE 67% (95% CI, 45 to 80) against infection <math>\geq</math> 127+ days after 2<sup>nd</sup> dose (confirmed non-VOC Delta).</p>	Moderate	<p>Retrospective cohort of members of a health management organization in California; 3,436,957 participants; VOC Alpha to VOC Delta (only 28% confirmed Delta)</p> <p>(results over varying time periods since vaccination reported)</p>
85	<a href="#">Li (3)</a> *Delayed exclusion – critical ROB	CoronaVac (combined with other inactivated vaccines) showed VE 59% (95% CI, 16 to 81.6) against symptomatic infection and VE 100% against severe infection $\geq$ 14 days after 2 <sup>nd</sup> dose.	Critical	Test-negative study in Guangzhou, China; 366 participants; sample sequenced for VOC Delta
86	<a href="#">Scobie</a> *Delayed exclusion – critical ROB	<p>BNT162b2 or mRNA-1273 (92%), or Ad26.COVS2 showed VE 90% (95% CI not reported) against infection and VE 93% (95% CI not reported) against death <math>\geq</math> 14 days after 2<sup>nd</sup> dose (April to June: VOC Alpha).</p> <p>BNT162b2, mRNA-1273, or Ad26.COVS2 showed VE 76% (95% CI not reported) against infection and VE 90% (95% CI not reported) against death <math>\geq</math> 14 days after 2<sup>nd</sup> dose (June to July: VOC Delta &gt;50%).</p>	Critical	Surveillance study in 13 states in the USA; 615,454; time and setting for VOC Alpha to VOC Delta
87	<a href="#">Satwik</a> *Delayed exclusion due to critical ROB	<p>ChAdOx1 showed VE 18% (95% CI, -10 to 38) against symptomatic infection; VE 37% (-24 to 68) against moderate to severe disease and VE 69% (95% CI, -160 to 97) against death <math>\geq</math>21 days after 1<sup>st</sup> dose.</p> <p>ChAdOx1 showed VE 28% (95% CI, 10 to 41) against symptomatic infection; VE 67% (44 to 81) against moderate to severe disease and VE 97% (95% CI, 43 to 99.8) against death <math>\geq</math>14 days after 2<sup>nd</sup> dose.</p>	Critical	Retrospective cohort study of HCW at a single hospital in New Delhi, India; 4276 participants; sample sequenced for VOC Delta

88	<a href="#">Seppala</a>	<p>BNT162b2 (74%) or ChAdOx1 (22%) or mRNA-1273 (10%) showed VE 84.4% (95% CI, 81.8 to 86.5) against infection <math>\geq 7</math> days after 2<sup>nd</sup> dose (VOC Alpha).</p> <p>BNT162b2 (74%) or ChAdOx1 (22%) or mRNA-1273 (10%) showed VE 64.6% (95% CI, 60.6 to 68.2) against infection <math>\geq 7</math> days after 2<sup>nd</sup> dose (VOC Delta).</p>	Serious	Population cohort in Norway; 4,204,859 participants; sequenced for VOC Alpha and VOC Delta
89	<a href="#">Polinski</a>	Ad26.COVS2.S showed VE* 67% (95% 60 to 73) against infection unknown number of days after dose (June to July: VOC Delta in high prevalence states). *unadjusted for substantial under-reporting of vaccination status	Serious	Data-linkage of members of a medical insurance group in USA; 1,914,670 participants; time and setting for VOC Alpha to Delta (only data for VOC Delta reported here)
90	<a href="#">Chemaitelly</a> <a href="#">(2)</a>	<p>BNT162b2 or mRNA-1273 showed VE 46.6% (95% CI, 0.0 to 73.7) against infection <math>\geq 14</math> days after 2<sup>nd</sup> dose, VE 66.0% (95% CI, 21.3 to 85.3) <math>\geq 42</math> days after 2<sup>nd</sup> dose, and VE 73.9% (95% CI, 33 to 98.9) <math>\geq 56</math> days after 2<sup>nd</sup> dose (VOC Alpha and Beta).</p> <p>BNT162b2 or mRNA-1273 showed VE 72.3% (95% CI, 0.0 to 90.9) against severe, critical, or fatal disease <math>\geq 14</math> days after 2<sup>nd</sup> dose, VE 85% (95% CI, 35.7 to 96.5) <math>\geq 42</math> days after 2<sup>nd</sup> dose, and VE 83.8% (95% CI, 31.3 to 96.2) <math>\geq 56</math> days after 2<sup>nd</sup> dose (VOC Alpha and Beta).</p>	Serious	Retrospective cohort of immunosuppressed kidney transplant recipients in Qatar; 782 participants; time and setting for VOC Alpha and VOC Beta.
91	<a href="#">Hu</a>	Inactivated vaccines (CoronaVac) showed VE 89% (95% CI, 55 to 98) against severe, critical, or fatal disease $\geq 14$ days after 2 <sup>nd</sup> dose (VOC Delta).	Serious	Outbreak report of hospitalized cases in China; 476 participants; PCR population for VOC Delta.
92	<a href="#">Andrews</a>	<p>BNT162b2 showed VE 62.7% (61.7 to 63.8) against symptomatic infection 1 week after 2<sup>nd</sup> dose and VE 47.3% (45.0 to 49.6) 20+ weeks after 2<sup>nd</sup> dose (VOC Delta).</p> <p>ChAdOx1 showed VE 92.4% (92.1 to 92.7) against symptomatic infection 1 week after 2<sup>nd</sup> dose and VE 69.7% (68.7 to 70.5) 20+ weeks after 2<sup>nd</sup> dose (VOC Delta).</p> <p>mRNA-1273 showed VE 95.2% (94.4 to 95.9) against symptomatic infection 1 week after 2<sup>nd</sup> dose and VE 90.3% (67.2 to 97.1) 10 to 14 weeks after 2<sup>nd</sup> dose (VOC Delta).</p>	Moderate	Test-negative study in England; 1,475,391 participants; VOC Alpha to VOC Delta (only data for VOC Delta reported here)
93	<a href="#">Patalon</a>	BNT162b2 (3 doses) showed relative VE 3% (95% CI, -5 to 10) against infection 0 to 6 days after 3 <sup>rd</sup> dose; relative VE 84.0% (95% CI, 79 to 88) 14 to 20 days after 3 <sup>rd</sup> dose compared to 2	Moderate	Test-negative study of fully vaccinated in Israel comparing (2 doses versus 3 doses); 182,076

		doses.		participants; time and setting for VOC Delta
94	<a href="#">Kissling</a>	BNT162b2 showed VE 87% (95% CI, 74 to 93) against symptomatic infection 14 days after 2 <sup>nd</sup> dose.	Serious	Test-negative study of adults >65 years in primary care setting in I-MOVE group (England, France, Ireland, the Netherlands, Portugal, Scotland, Spain and Sweden); 4,964 participants; sample sequenced for VOC Alpha.
95	<a href="#">McKeigue</a>	BNT162b2 or mRNA-1273 showed VE 92% (95% CI, 85 to 96) against severe disease in people with no risk conditions and VE 72% (95% CI, 51 to 84) against severe disease in people eligible for shielding at least 14 days after 2 <sup>nd</sup> dose.  ChAdOx1 showed VE 94% (95% CI, 90 to 96) against severe disease in people with no risk conditions and VE 63% (95% CI, 46 to 75) against severe disease in people eligible for shielding $\geq$ 14 days after 2 <sup>nd</sup> dose.	Serious	Case-control study of people with clinical risk conditions in Scotland; 50,935 participants; time and setting for VOC Alpha to VOC Delta
96	<a href="#">Kertes</a>	BNT162b2 showed OR 1.61 (95% CI, 1.45 to 1.79) for infection comparing <u>fully vaccinated Jan to Feb</u> vs <u>fully vaccinated Mar to May</u> .	Serious	Data-linkage study of people <b>fully vaccinated</b> 6 months previously in Israel; 1,423,098 participants; time and setting for VOC Alpha to VOC Delta
97	<a href="#">Barlow</a>	BNT162b2 or mRNA-1273 showed VE 74% (95% CI, 65 to 82) against infection $\geq$ 14 days after 2 <sup>nd</sup> dose.  Ad26.COV2.S showed VE 51% (95% CI, -2 to 76) against infection $\geq$ 14 days after 2 <sup>nd</sup> dose.	Serious	Test-negative study in Oregon; 1000 participants; time and setting for VOC Delta
98	<a href="#">Chemaitelly (3)</a>	BNT162b2 showed VE 65.8% (95% CI, 63.8 to 67.7) against infection 5 to 9 weeks after 2 <sup>nd</sup> dose; VE 29.7% (95% CI, 21.7 to 36.9) against infection 15 to 19 weeks after 2 <sup>nd</sup> dose and VE 0% (95% CI, 0 to 0) against infection 20 to 24 weeks after 2 <sup>nd</sup> dose.  BNT162b2 showed VE 94.2% (95% CI, 91.0 to 96.5) against hospitalization or death 5 to 9 weeks after 2 <sup>nd</sup> dose; VE 86.4% (95% CI, 69.9 to 94.8) against hospitalization or death 15 to 19 weeks after 2 <sup>nd</sup> dose and VE 95.3% (95% CI, 70.5 to 99.9) against hospitalization or death 20 to 24 weeks after 2 <sup>nd</sup> dose.	Serious	Test-negative study in Qatar; 1,472,761 participants; time and setting for VOC Beta to VOC Delta  (results over varying time periods since vaccination reported)

99	<a href="#">Thompson (3)</a>	<p>BNT162b2 <b>or mRNA-1273</b> showed VE 90% (95% CI, 86 to 93) against ICU admission <math>\geq 14</math> days after 2<sup>nd</sup> dose.</p> <p>BNT162b2 showed VE 92% (95% CI, 88 to 94) against hospitalization at 28 to 41 days after 2<sup>nd</sup> dose and VE 86% (95% CI, 74 to 93) <math>\geq 112</math> days after 2<sup>nd</sup> dose.</p>	Serious	<p>Test-negative study of adults <math>\geq 50</math> years in the USA; 76,463 participants; time and setting for VOC Alpha</p> <p>(results over varying time periods since vaccination reported)</p>
100	<a href="#">Bar-On</a>	BNT162b2 (3 doses) showed adjusted rate ratio of 11.3 (95% CI, 10.4 to 12.3) against any infection and adjusted rate ratio of 19.5 (95% CI, 12.9 to 29.5) against severe illness $\geq 12$ days after 3 <sup>rd</sup> dose compared to 2 doses.	Serious	Data-linkage study of fully vaccinated (age $>60$ ) (2 doses versus 3 doses) in Israel; 1,137,804 participants; time and setting for VOC Delta
101	<a href="#">Bruxvoort (2)</a>	<p>mRNA-1273 showed VE 98.4% (95% CI, 96.9 to 99.1) against infection <math>\geq 14</math> days after 2<sup>nd</sup> dose (VOC Alpha).</p> <p>mRNA-1273 showed VE 95.5% (95% CI, 90.9 to 97.8) against infection <math>\geq 14</math> days after 2<sup>nd</sup> dose (VOC Gamma).</p> <p>mRNA-1273 showed VE 86.7% (95% CI, 84.3 to 88.7) against infection <math>\geq 14</math> days after 2<sup>nd</sup> dose (VOC Delta).</p> <p>mRNA-1273 showed VE 94.1% (95% CI, 90.5 to 96.3) against infection 14 to 60 days after 2<sup>nd</sup> dose (VOC Delta).</p> <p>mRNA-1273 showed VE 80.0% (95% CI, 70.2 to 86.6) against infection 151 to 180 days after 2<sup>nd</sup> dose (VOC Delta).</p>	Serious	<p>Test-negative study in Kaiser Permanente group in California; 48,918 participants; sequenced for VOC Alpha, VOC Delta, VOC Gamma and VOI Mu (results not included in this LES)</p> <p>(results over varying time periods since vaccination reported)</p>
102	<a href="#">Tande (2)</a>	<p>BNT162b2 or mRNA-1273 showed VE 91% (95% CI, 72 to 98) against infection <math>\geq 14</math> days after 2<sup>nd</sup> dose (January to March – VOC Alpha).</p> <p>BNT162b2 or mRNA-1273 showed VE 63% (95% CI, 44 to 76) against infection <math>\geq 14</math> days after 2<sup>nd</sup> dose (June to August – VOC Delta).</p>	Serious	Point prevalence screening study in Mayo Clinic, USA; 46,008 participants; time and setting for VOC Alpha to VOC Delta
103	<a href="#">Young-Xu (2)</a>	<p>Two doses of BNT162b2 reduced risk of infection by HR 66% (95% CI, 22 to 86) compared to <b>previously infected</b> adults age 65+ (June to August VOC Delta).</p> <p>Two doses of mRNA-1273 reduced risk of infection by HR 68% (95% CI, 30 to 86) and death by HR 30% (95% CI, -11 to 1) compared to <b>previously infected</b> adults age 65+ (June to August VOC Delta).</p>	Moderate	Retrospective cohort study of <b>previously infected adults</b> followed by Veterans Affairs in USA; 47,102 participants; time and setting for VOC Delta
104	<a href="#">de Gier (1)</a>	Fully vaccinated index to unvaccinated (hh	Serious	Retrospective cohort of

		<p>contact) showed <b>VET</b> 73% (95% CI: 65 to 79).</p> <p>BNT162b (case) showed <b>VET</b> 70% (95% CI, 61 to 77) when fully vaccinated.</p> <p>mRNA-1273 (case) showed <b>VET</b> 88% (95% CI, 50 to 97) when fully vaccinated.</p> <p>ChAdOx1 (case) showed <b>VET</b> 58% (95% CI, -12 to 84) when fully vaccinated.</p> <p>Ad26.COVS2.S (case) showed <b>VET</b> 58% (95% CI, -12 to 84) when fully vaccinated.</p> <p>BNT162b showed VE 65% (95% CI, 60 to 70) when hh contact was fully vaccinated.</p> <p>mRNA-1273 showed VE 91% (95% CI, 79 to 97) when hh contact was fully vaccinated.</p> <p>ChAdOx1 showed VE 87% (95% CI, 77 to 93) when hh contact was fully vaccinated.</p> <p>Ad26.COVS2.S showed VE 12% (95% CI, -71 to 54) when hh contact was fully vaccinated.</p>		<p>household and close contacts in the Netherlands; 113,582 cases and 253,168 contacts; time and setting for VOC Alpha</p> <p>(hh = household)</p>
105	<a href="#">de Gier (2)</a>	<p>Fully vaccinated index to unvaccinated (hh contact) showed <b>VET</b> 63% (95% CI: 46 to 75).</p> <p>BNT162b (&gt;50%) or mRNA-1273 or ChAdOx1 or Ad26.COVS2.S (case) showed <b>VET</b> 40% (95% CI, 20 to 54) when both case and contacts are fully vaccinated.</p>	Serious	Retrospective cohort of household and close contacts in the Netherlands; 4,921 cases and 7,771 contacts; time and setting for VOC Delta
106	<a href="#">Manley</a>	<p>mRNA-1273 (50%) or BNT162b (48%) or Ad26.COVS2.S (2%) showed OR of 8.89 (95% CI, 5.92 to 13.34) for unvaccinated vs fully vaccinated against infection (VOC Alpha)</p> <p>mRNA-1273 (50%) or BNT162b (48%) or Ad26.COVS2.S (2%) showed OR of 2.27 (95% CI, 1.72 to 3.00) for unvaccinated vs fully vaccinated against infection (VOC Delta)</p>	Serious	Retrospective cohort of maintenance dialysis patients in USA; 15,251 participants; time and setting for VOC Alpha to VOC Delta
107	<a href="#">Eyre</a>	<p>BNT162b2 (cases) showed <b>VET</b> 82% (95% CI, 71 to 88) against transmission after 2<sup>nd</sup> dose. (VOC Alpha)</p> <p>ChAdOx1 (cases) showed <b>VET</b> 63% (95% CI, 37 to 78) against transmission after 2<sup>nd</sup> dose. (VOC Alpha)</p> <p>BNT162b2 (contacts) showed VE 94% (95% CI, 90 to 96) against infection after 2<sup>nd</sup> dose. (VOC Alpha)</p>	Serious	Retrospective cohort of contacts in England; 99,597 cases and 151,821 contacts; S-gene proxy for VOC Alpha and VOC Delta

		<p>ChAdOx1 (contacts) showed VE 71% (95% CI, 51 to 83) against infection after 2<sup>nd</sup> dose. (VOC Alpha)</p> <p>BNT162b2 (cases) showed <b>VET</b> 65% (95% CI, 52 to 74) against transmission after 2<sup>nd</sup> dose. (VOC Delta)</p> <p>ChAdOx1 (cases) showed <b>VET</b> 36% (95% CI, 28 to 43) against transmission after 2<sup>nd</sup> dose. (VOC Delta)</p> <p>BNT162b2 (contacts) showed VE 90% (95% CI, 87 to 92) against infection after 2<sup>nd</sup> dose. (VOC Delta)</p> <p>ChAdOx1 (contacts) showed VE 72% (95% CI, 68 to 75) against infection after 2<sup>nd</sup> dose. (VOC Delta).</p>		
108	<a href="#">Martinez-Baz (2)</a>	<p>BNT162b2 (contacts) showed VE 71% (95% CI, 61 to 78) against infection after 2<sup>nd</sup> dose (VOC Alpha)</p> <p>mRNA-1273 (contacts) showed VE 86% (95% CI, 56 to 95) against infection after 2<sup>nd</sup> dose (VOC Alpha)</p> <p>ChAdOx1 (contacts) showed VE 38% (95% CI, -42 to 73) against infection after 2<sup>nd</sup> dose (VOC Alpha)</p> <p>BNT162b2 (contacts) showed VE 67% (95% CI, 59 to 74) against infection after 2<sup>nd</sup> dose (VOC Delta)</p> <p>mRNA-1273 (contacts) showed VE 77% (95% CI, 64 to 85) against infection after 2<sup>nd</sup> dose (VOC Delta)</p> <p>ChAdOx1 (contacts) showed VE 55% (95% CI, 39 to 67) against infection after 2<sup>nd</sup> dose (VOC Delta)</p> <p>ChAdOx1 <b>followed by BNT162b2</b> (contacts) showed VE 86% (95% CI, 45 to 97) against infection (VOC Delta)</p>	Serious	<p>Prospective cohort of close contacts in Spain; 12,263 cases and 30,240 contacts; sequenced for VOC Alpha to VOC Delta</p> <p><b>(includes heterologous vaccines)</b></p>
109	<a href="#">Cohn</a>	<p>BNT162b2 showed VE 49% (95% CI, 47 to 52) against infection at least 15 days after last dose (August: VOC Delta)</p> <p>mRNA-1273 showed VE 64% (95% CI, 62 to</p>	Serious	Data-linkage study of veterans in USA; 619,755 participants; time and setting for VOC Alpha to VOC Delta (only Delta)

		<p>66) against infection at least 15 days after last dose (August: VOC Delta)</p> <p>Ad26.COVS2 showed VE 3% (95% CI, -0.1 to 12) against infection at least 15 days after last dose (August: VOC Delta)</p>		reported here)
110	<a href="#">Rosenberg (2)</a>	<p>BNT162b2 showed VE 69% (95% CI, 67.4 to 70.6) against infection at least 15 days after last dose (August: VOC Delta; age 18-49)</p> <p>mRNA-1273 showed VE 78.4% (95% CI, 75.9 to 79.6) against infection at least 15 days after last dose (August: VOC Delta; age 18-49)</p> <p>Ad26.COVS2 showed VE 70.2% (95% CI, 67.4 to 73.0) against infection at least 15 days after last dose (August: VOC Delta; age 18-49)</p> <p>BNT162b2 showed VE 77.8% (95% CI, 67.4 to 70.6) against infection at least 15 days after last dose (August: VOC Delta; age 65+)</p> <p>mRNA-1273 showed VE 84.3% (95% CI, 82.8 to 85.7) against infection at least 15 days after last dose (August: VOC Delta; age 65+)</p> <p>Ad26.COVS2 showed VE 70.8% (95% CI, 65.7 to 76.0) against infection at least 15 days after last dose (August: VOC Delta; age 65+)</p>	Serious	Prospective study in New York; 8,834,604 participants; time and setting for VOC Alpha to VOC Delta (only Delta reported here). Also compared VE over time since vaccination (results not reported here)
111	<a href="#">Robles-Fontan</a>	<p>BNT162b2 showed VE 56% (95% CI, 53 to 59) against infection at least 15 days after 2<sup>nd</sup> dose (October: VOC Delta)</p> <p>mRNA-1273 showed VE 71% (95% CI, 68 to 74) against infection at least 15 days after 2<sup>nd</sup> dose (October: VOC Delta)</p> <p>Ad26.COVS2 showed VE 27% (95% CI, 17 to 37) against infection at least 15 days after last dose (October: VOC Delta)</p>	Serious	Data-linkage study in Puerto Rico; 1,913,454 person-years; time and setting for VOC Alpha to VOC Delta (only results for Delta reported here)
112	<a href="#">Glatman-Freedman (2)</a>	<p>BNT162b2 showed VE 91.5% (95% CI, 88.2 to 93.9) against infection at least 8 days after 2<sup>nd</sup> dose in adolescents age 12 to 15 years. There were no deaths in either group.</p>	Serious	Population cohort in Israel of adolescents age 12 to 15 years; 2,034,591 vaccinated person-days and 13,623,714 unvaccinated person-days; time and setting for VOC Delta
113	<a href="#">Chin</a>	<p>mRNA-1273 showed VE 56.6% (95% CI, 42 to 67.5) against infection at least 14 days after 2<sup>nd</sup> dose.</p>	Serious	Outbreak report from a prison in California; 827 participants; sample sequenced for VOC

				Delta
114	<a href="#">Nordstrom</a>	<p>BNT162b2 showed VE 47% (95% CI, -39 to 55) against symptomatic infection 121 to 180 days after second dose.</p> <p>mRNA-1273 showed VE 71% (95% CI, 56 to 81) against symptomatic infection 121 to 180 days after second dose.</p> <p>ChAdOx1 showed VE 41% (95% CI, 29 to 51) against symptomatic infection to 120 days after second dose.</p> <p>ChAdOx1 followed by mRNA vaccine showed VE 66% (95% CI, 41 to 80) against symptomatic infection &gt;120 days after second dose.</p> <p>BNT162b2 or mRNA-1273 or ChAdOx1 showed VE 42% (95% CI, -35 to 75) against severe disease (hospitalization or death) &gt;180 days after second dose</p>	Serious	<p>Case-control study in Sweden; 1,684,958 participants; time and setting for VOC Alpha to VOC Delta (only Delta results reported here) (includes heterologous vaccines)</p> <p>(results over varying time periods since vaccination reported)</p>
116	<a href="#">Ranzani (2)</a>	ChAdOx1 showed VE 42.4% (95% CI, 24.6 to 56.0) against symptomatic infection 21 days after 1 <sup>st</sup> dose.	Low	Test-negative study in Brazil; 9,197 tests; time and setting for VOC Gamma to Delta
117	<a href="#">Ranzani(3)</a>	Ad26.COV2.S showed VE 50.9% (95% CI, 35.5 to 63.0) against symptomatic infection, VE 92.5% (95% CI, 54.9 to 99.6) against ICU admission, and VE 90.5% (95% CI, 31.5 to 99.6) against death 28 days after dose.	Serious	Test-negative study in Brazil; 11,817 tests; time and setting for VOC Gamma to Delta
118	<a href="#">Chadeau-Hyam</a>	<p>BNT162b2 showed VE 71.3% (95% CI, 56.6 to 81.0) against infection unreported number of days after 2<sup>nd</sup> dose (Round 13 and Round 14)</p> <p>mRNA-1273 showed VE 75.1% (95% CI, 22.7 to 92.0) against infection unreported number of days after 2<sup>nd</sup> dose (Round 13 and Round 14)</p> <p>ChAdOx1 showed VE 44.8% (95% CI, 22.5 to 60.7) against infection unreported number of days after 2<sup>nd</sup> dose (Round 13 and Round 14)</p>	Serious	Surveillance study in England; 87,966 participants who consented to data-linkage for vaccine status; sequenced for VOC Delta
119	<a href="#">Sheikh (2)</a>	<p>BNT162b2 showed VE 90% (95% CI, 86 to 94) against death at least 14 days after 2<sup>nd</sup> dose (confirmed VOC Delta)</p> <p>ChAdOx1 showed VE 91% (95% CI, 83 to 94) against death at least 14 days after 2<sup>nd</sup> dose (confirmed VOC Delta)</p>	Serious	Retrospective cohort in Scotland; 114,706 participants; proxy for VOC Delta
120	<a href="#">Reis</a>	BNT162b2 showed VE 59% (95% CI, 52 to 65) against infection 14 to 20 days after 1 <sup>st</sup> dose (age 12 to 18)	Moderate	Case-control study in Israel; 94,354 vaccinated matched to 94,354 unvaccinated adolescents

		BNT162b2 showed VE 90% (95% CI, 88 to 92) against infection 7 to 21 days after 2 <sup>nd</sup> dose (age 12 to 18)		age 12 to 18; time and setting for VOC Delta
121	<a href="#">Nordstrom</a> (2)	<p>BNT162b2 showed VE 78% (95% CI, 78 to 79) against symptomatic infection at least 14 days after 2<sup>nd</sup> dose.</p> <p>mRNA-1273 showed VE 87% (95% CI, 84 to 88) against symptomatic infection at least 14 days after 2<sup>nd</sup> dose.</p> <p>ChAdOx1 showed VE 50% (95% CI, 41 to 58) against symptomatic infection at least 14 days after 2<sup>nd</sup> dose.</p> <p>ChAdOx1 followed by BNT162b2 showed VE 67% (95% CI, 59 to 73) against symptomatic infection at least 14 days after 2<sup>nd</sup> dose.</p> <p>ChAdOx1 followed by mRNA-1273 showed VE 79% (95% CI, 62 to 88) against symptomatic infection at least 14 days after 2<sup>nd</sup> dose.</p>	Serious	Retrospective cohort study in Sweden; 721,787 participants; time and setting for VOC Delta (includes heterologous vaccines)
122	<a href="#">Skowronski</a> (2)	<p>BNT162b2 showed VE 79% (95% CI, 73 to 84) against infection at least 21 days after 1<sup>st</sup> dose (VOC Gamma)</p> <p>mRNA-1273 showed VE 85% (95% CI, 71 to 92) against infection at least 21 days after 1<sup>st</sup> dose (VOC Gamma)</p> <p>ChAdOx1 showed VE 60% (95% CI, 48 to 69) against infection at least 21 days after 1<sup>st</sup> dose (VOC Gamma)</p>	Serious	Test-negative study in Canada; 68,074 participants; sample sequenced for VOC Alpha, Gamma and Delta (only VOC Gamma reported here)
123	<a href="#">Skowronski</a> (3)	<p><b>Delta</b></p> <p>BNT162b2 showed VE 89% (95% CI, 88 to 89) against infection at least 14 days after 2<sup>nd</sup> dose (Quebec- VOC Delta)</p> <p>mRNA-1273 showed VE 91% (95% CI, 90 to 92) against infection at least 14 days after 2<sup>nd</sup> dose (Quebec- VOC Delta)</p> <p>ChAdOx1 showed VE 73% (95% CI, 69 to 78) against infection at least 14 days after 2<sup>nd</sup> dose (Quebec- VOC Delta)</p> <p>ChAdOx1 followed by mRNA vaccine showed VE 88% (95% CI, 85 to 89) against infection at least 14 days after 2<sup>nd</sup> dose (Quebec- VOC Delta)</p> <p><b>Gamma</b></p> <p>BNT162b2 showed VE 93% (95% CI, 89 to 95)</p>	Serious	<p>Test-negative study in Canada; 380,532 British Columbia and 854,915 Quebec participants; sequenced for VOC Alpha, Gamma and Delta (selected data only reported here due to space constraints)</p> <p>(includes heterologous vaccines)</p> <p>(results over varying time periods since vaccination reported)</p>

	<p>against infection at least 14 days after 2<sup>nd</sup> dose (BC- VOC Gamma)</p> <p>mRNA-1273 showed VE 95% (95% CI, 85 to 99) against infection at least 14 days after 2<sup>nd</sup> dose (BC- VOC Gamma)</p> <p>ChAdOx1 showed VE 90% (95% CI, 61 to 98) against infection at least 14 days after 2<sup>nd</sup> dose (BC- VOC Gamma)</p> <p>ChAdOx1 followed by mRNA vaccine showed VE 96% (95% CI, 70 to 99) against infection at least 14 days after 2<sup>nd</sup> dose (BC- VOC Gamma)</p> <p><u>Time since vaccination (Delta)</u></p> <p>BNT162b2 showed VE 85% (95% CI, 84 to 86) against infection at 4 months after 2<sup>nd</sup> dose (Quebec – VOC Delta)</p> <p>mRNA-1273 showed VE 88% (95% CI, 86 to 90) against infection at 4 months after 2<sup>nd</sup> dose (Quebec – VOC Delta)</p> <p>ChAdOx1 showed VE 72% (95% CI, 66 to 77) against infection at 4 months after 2<sup>nd</sup> dose (Quebec – VOC Delta)</p> <p>ChAdOx1 followed by mRNA vaccine showed VE 86% (95% CI, 81 to 89) against infection at 4 months after 2<sup>nd</sup> dose (Quebec – VOC Delta)</p> <p><u>Time since vaccination and interval between doses (VOC Alpha to Delta)</u></p> <p>BNT162b2 showed VE 92% (95% CI, 91 to 93) at 14 to 27 days after 2<sup>nd</sup> dose (interval 7+ weeks) and VE 90% (95% CI, 88 to 91) at 4 months after 2<sup>nd</sup> dose (interval 7+ weeks) (Quebec)</p> <p>mRNA-1273 showed VE 92% (95% CI, 90 to 94) at 14 to 27 days after 2<sup>nd</sup> dose (interval 7+ weeks) and VE 91% (95% CI, 87 to 94) at 112+ days after 2<sup>nd</sup> dose (interval 7+ weeks) (Quebec)</p> <p>ChAdOx1 showed VE 85% (95% CI, 60 to 94) at 14 to 27 days after 2<sup>nd</sup> dose (interval 7+ weeks) and VE 72% (95% CI, 66 to 77) at 84 days after 2<sup>nd</sup> dose (interval 7+ weeks) (Quebec)</p>		
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124	<a href="#">Lin</a>	<p>BNT162b2 showed VE 94.9% (94.5 to 95.2) against symptomatic infection and VE 95.9% (95% CI, 92.9 to 97.6) against death at 60 days months after 2<sup>nd</sup> dose.</p> <p>BNT162b showed VE 70.1% (95% CI, 68.9 to 71.2) against symptomatic infection and VE 88.4% (95% CI, 83 to 92.1) against death at 210 days after 2<sup>nd</sup> dose)</p> <p>mRNA-1273 showed VE 96% (95.6 to 96.4) against symptomatic infection at 60 days; VE 96% (95% CI, 91.9 to 98) against death at 90 days after 2<sup>nd</sup> dose.</p> <p>mRNA-1273 showed VE 81.9% (95% CI, 81 to 82.7) against symptomatic infection and VE 93.7% (95% CI, 90.2 to 95.9) against death at 210 days after 2<sup>nd</sup> dose)</p> <p>Ad26.COVS2.S showed VE 79% (77.1 to 80.7) against symptomatic infection at 30 days and VE 64.3% (95% CI, 62.3 to 66.1) at 150 days months after dose.</p> <p>Ad26.COVS2.S showed VE 89.4% (95% CI, 52.3 to 97.6) against death at 120 days after dose)</p>	Serious	<p>Data-linkage study in North Carolina; 10,600,823 participants; time and setting for VOC Alpha to Delta</p> <p>(results over varying time periods since vaccination reported)</p>
125	<a href="#">Barda</a>	<p>BNT162b2 (3 doses) showed VE 92% (82 to 97) against severe disease and VE 81% (95% CI, 59 to 97) against death at least 7 days after 3<sup>rd</sup> dose compared to 2 doses (given 5 months previously).</p>	Serious	<p>Data-linkage study of fully vaccinated (2 doses vs 3 doses) participants in Israel; 728,321 participants in each group; time and setting for VOC Delta</p>
126	<a href="#">Andrews (2)</a>	<p>BNT162b2 (3 doses) showed VE 94% (95% CI, 93.4 to 94.6) against symptomatic infection at least 14 days after 3<sup>rd</sup> dose in age&gt;50 (compared to unvaccinated)</p> <p>ChAdOx1 (2 doses followed by BNT162b2) showed VE 93.1% (95% CI, 91.7 to 94.3) against symptomatic infection at least 14 days after 3<sup>rd</sup> dose in age&gt;50 (compared to unvaccinated)</p>	Moderate	<p>Test-negative study of fully vaccinated participants (&gt;140 days since 2<sup>nd</sup> dose) over age 50 in England; 271,747 participants; sequencing for VOC Delta</p>
127	<a href="#">Starrfelt (2)</a>	<p>BNT162b2 showed VE 69.7% (95% CI, 68.6 to 70.8) against infection at least 7 days after 2<sup>nd</sup> dose (VOC Alpha to Delta)</p> <p>mRNA-1273 showed VE 78.2% (95% CI, 76.7 to 79.6) against infection at least 7 days after 2<sup>nd</sup> dose (VOC Alpha to Delta)</p> <p>ChAdOx1 showed VE 43.4% (95% CI, 4.4 to</p>	Moderate	<p>Population cohort study in Norway; 4,293,544 participants; time and setting for VOC Alpha to VOC Delta</p> <p>(includes heterologous vaccines)</p>

		<p>66.5) against infection at least 7 days after 2<sup>nd</sup> dose (VOC Alpha to Delta)</p> <p><b>Heterologous mRNA</b> showed VE 84.7% (95% CI, 83.1 to 86.1) against infection at least 7 days after 2<sup>nd</sup> dose (VOC Alpha to Delta)</p> <p>ChAdOx1 <b>followed by</b> mRNA showed VE 60.7% (95% CI, 57.5 to 63.6) against infection at least 7 days after 2<sup>nd</sup> dose (VOC Alpha to Delta)</p>		
128	<a href="#">Preio-Alhambra</a>	ChAdOx1 <b>followed by</b> BNT162b2 showed HR 0.61 (95% CI, 0.52 to 0.71) against infection vs ChAdOx1 (homologous) – unreported number of days after 2 <sup>nd</sup> dose	Serious	Retrospective cohort study in Spain; 28,650 participants aged 19 to 59 years; time and setting for VOC Delta <b>(compared heterologous vaccines with homologous vaccines)</b>
129	<a href="#">Ng</a>	BNT162b2 or mRNA-1273 showed VE 61.6% (95% CI, 37.5 to 80.4) against transmission to fully vaccinated hh contacts and VE 100% (95% CI, not reported) against severe disease in fully vaccinated hh contacts	Serious	Retrospective cohort study of household contacts in Singapore; 753 contacts; index sequenced for VOC Delta
130	<a href="#">Desai</a>	BBV152 showed VE 50% (95% CI, 33 to 62) against symptomatic infection at least 14 days after 2 <sup>nd</sup> dose	Serious	Test-negative study of HCW in India; 1,068 matched pairs; time and setting for VOC Delta
131	<a href="#">Thiruvengadam(pub)</a>	ChAdOx1 showed VE 46.2% (95% CI, 31.6 to 57.7) against infection at least 21 days after 1 <sup>st</sup> dose.  ChAdOx1 showed VE 63.1% (95% CI, 51.5 to 72.1) against infection at least 14 days after 2 <sup>nd</sup> dose.	Serious	Test-negative study in India; 5,143 participants; sequencing for VOC Delta
132	<a href="#">Sharma</a>	BNT162b2 showed VE 45.7% (95% CI, 37.9 to 52.5) against infection median of 30 days after 3 <sup>rd</sup> dose <b>compared to 2 doses</b> (given at least 180 days previously)  mRNA-1273 showed VE 46.6% (95% CI, 36.4 to 55.3) against infection median of 16 days after 3 <sup>rd</sup> dose <b>compared to 2 doses</b> (given at least 180 days previously)	Serious	Case-control study of <b>fully vaccinated (2 doses versus 3 doses)</b> in veterans in USA; 129,130 pairs; time and setting for VOC Delta
133	<a href="#">Cohn (2)</a>	BNT162b2 showed VE 43% (95% CI, 42 to 45) against infection after unclear number of days after 2 <sup>nd</sup> dose (September 2021)  mRNA-1273 showed VE 58% (95% CI, 57 to 59) after unclear number of days against infection after 2 <sup>nd</sup> dose (September 2021)	Serious	Retrospective cohort study of Veterans in the US; 780,225 Veterans; time and setting for VOC Delta (same population as Cohn but extended study time frame)

		Ad26.COV2.S showed VE 13% (95% CI, 9 to 17) against infection after unclear number of days after dose (September 2021)		
134	<a href="#">Arbel</a>	BNT162b2 (3 doses) showed VE 90% (95% CI, 86 to 93) against death at 7 to 54 days after 3 <sup>rd</sup> dose compared to 2 doses (given at least 5 months previously)	Moderate	Data-linkage study of fully vaccinated (>50 years) (2 doses versus 3 doses) in Israel; 843,208 participants; time and setting for VOC Delta
135	<a href="#">Bar-On (2)</a>	BNT162b2 (3 doses) showed adjusted rate ratio of 12.3 (95% CI, 11.8 to 12.8) against infection and adjusted rate ratio of 17.9 (95% CI, 15.1 to 21.2) against severe disease and adjusted rate ratio of 14.7 (95% CI, 10 to 21.4) against death at least 12 days after 3 <sup>rd</sup> dose compared to 2 doses (given at least 5 months previously) (age>60).  BNT162b2 (3 doses) showed adjusted rate ratio of 9.0 (95% CI, 8.4 to 9.7) against infection at least 12 days after 3 <sup>rd</sup> dose compared to 2 doses (given at least 5 months previously) (age 30-39).	Serious	Data-linkage study of fully vaccinated (>16 years) (2 doses versus 3 doses) in Israel; 4,696,865 participants; time and setting for VOC Delta (same population as Bar-On but extended end of study and additional ages and outcomes)
136	<a href="#">Andrews (3)</a>	BNT162b2 (3 doses) showed VE 67.2% (95% CI, 66.5 to 67.8) against symptomatic infection at 2 to 4 weeks after 3 <sup>rd</sup> dose; VE 55.0% (95% CI, 54.2 to 55.8) at 5 to 9 weeks after 3 <sup>rd</sup> dose (VOC Omicron)  BNT162b2 (2 doses) showed VE 48.7% (95% CI, 47.1 to 50.2) against symptomatic infection at 5 to 9 weeks after 2 <sup>nd</sup> dose; VE 30.1% (95% CI, 28.7 to 31.5) against symptomatic infection at 10 to 14 weeks after 2 <sup>nd</sup> dose (VOC Omicron)  mRNA-1273 (3 doses) showed VE 66.3% (95% CI, 63.7 to 68.8) against symptomatic infection at 2 to 4 weeks after 3 <sup>rd</sup> dose (VOC Omicron)  mRNA-1273 (2 doses) showed VE 52.8% (95% CI, 48.2 to 57.1) against symptomatic infection at 5 to 9 weeks after 2 <sup>nd</sup> dose; VE 35.6% (95% CI, 32.7 to 38.4) against symptomatic infection at 10 to 14 weeks after 2 <sup>nd</sup> dose (VOC Omicron)  ChAdOx1 (3 doses) showed VE 55.6% (95% CI, 44.4 to 64.6) against symptomatic infection at 2 to 4 weeks after 3 <sup>rd</sup> dose; 46.7% (95% CI, 34.3 to 56.7) against symptomatic infection at 5 to 9 weeks after 3 <sup>rd</sup> dose (VOC Omicron)  ChAdOx1 (2 doses followed by 1 dose of BNT162b2) showed VE 62.4% (95% CI, 61.8 to	Moderate	Test-negative study of fully vaccinated participants in England; 2,663,549 participants; sequencing for VOC Delta and Omicron  (updated June 22, 2022 based on differences in published version)

63) against symptomatic infection at 2 to 4 weeks after 3<sup>rd</sup> dose; VE 52.9% (95% CI, 52.1 to 53.7) against symptomatic infection at 5 to 9 weeks after 3<sup>rd</sup> dose (VOC Omicron)

ChAdOx1 (2 doses followed by 1 dose of mRNA-1273) showed VE 70.1% (95% CI, 69.5 to 70.7) against symptomatic infection at 2 to 4 weeks; VE 60.9% (95% CI, 59.7 to 62.1) against symptomatic infection at 5 to 9 weeks after 3<sup>rd</sup> dose (VOC Omicron)

ChAdOx1 (2 doses) showed VE 33.7% (95% CI, 25.0 to 41.5) against symptomatic infection at 5 to 9 weeks after 2<sup>nd</sup> dose; VE 28.6% (95% CI, 20.9 to 35.6) against symptomatic infection at 10 to 14 weeks after 2<sup>nd</sup> dose (VOC Omicron)

Changes for VOC Delta listed below have NOT been transferred to Table 3a as of June 22, 2022  
BNT162b2 (3 doses) showed VE 95.1% (95% CI, 94.8 to 95.4) against symptomatic infection at 2 to 4 weeks after 3<sup>rd</sup> dose; VE 91.8% (95% CI, 91.4 to 92.1) against symptomatic infection at 5 to 9 weeks after 3<sup>rd</sup> dose (VOC Delta)

BNT162b2 (2 doses) showed VE 85.5% (95% CI, 84.5 to 86.5) against symptomatic infection at 5 to 9 weeks after 2<sup>nd</sup> dose; VE against symptomatic infection after 2<sup>nd</sup> dose; VE 78.7% (95% CI, 78.0 to 79.4) against symptomatic infection at 10 to 14 weeks after 2<sup>nd</sup> dose (VOC Delta)

mRNA-1273 (3 doses) showed VE 96.4% (95% CI, 91.4 to 98.5) against symptomatic infection at 2 to 4 weeks after 3<sup>rd</sup> dose (VOC Delta)

mRNA-1273 (2 doses) showed VE 91.8% (95% CI, 89.6 to 93.6) against symptomatic infection at 5 to 9 weeks after 2<sup>nd</sup> dose; VE 84.1% (95% CI, 82.7 to 85.3) against symptomatic infection at 10 to 14 weeks after 2<sup>nd</sup> dose (VOC Delta)

ChAdOx1 (3 doses) showed VE 82.3% (95% CI, 44.4 to 64.6) against symptomatic infection at 2 to 4 weeks after 3<sup>rd</sup> dose; 83.3% (95% CI, 69.7 to 90.8) against symptomatic infection at 5 to 9 weeks after 3<sup>rd</sup> dose (VOC Delta)

ChAdOx1 (2 doses followed by 1 dose of BNT162b2) showed VE 95.4% (95% CI, 95.1 to

		<p>95.6) against symptomatic infection at 2 to 4 weeks after 3<sup>rd</sup> dose; VE 92.6% (95% CI, 92.2 to 92.9) against symptomatic infection at 5 to 9 weeks after 3<sup>rd</sup> dose (VOC Delta)</p> <p>ChAdOx1 (2 doses followed by 1 dose of mRNA-1273) showed VE 97.0% (95% CI, 96.7 to 97.3) against symptomatic infection at 2 to 4 weeks; VE 94.9% (95% CI, 93.8 to 95.9) against symptomatic infection at 5 to 9 weeks after 3<sup>rd</sup> dose (VOC Delta)</p> <p>ChAdOx1 (2 doses) showed VE 76.5% (95% CI, 70.3 to 81.5) against symptomatic infection at 5 to 9 weeks after 2<sup>nd</sup> dose; VE 69.2% (95% CI, 64.7 to 73.1) against symptomatic infection at 10 to 14 weeks after 2<sup>nd</sup> dose (VOC Delta)</p>		
137	<a href="#">Hansen</a>	<p>BNT162b2 showed VE 55.2% (95% CI, 23.5 to 73.7) against infection up to 44 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>BNT162b2 showed VE -76.5% (95% CI, -95.3 to -59.5) against infection up to 164 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>BNT162b2 (3 doses) showed VE 54.6% (95% CI, 30.4 to 70.4) against infection up to 30 days after 3<sup>rd</sup> dose (VOC Omicron)</p> <p>mRNA-1273 showed VE 36.7% (95% CI, -69.9 to 76.4) against infection up to 44 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>mRNA-1273 showed VE -39.3% (95% CI, -61.6 to -20) against infection up to 164 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>BNT162b2 showed VE 86.7% (95% CI, 84.6 to 88.6) against infection up to 44 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>BNT162b2 showed VE 53.8% (95% CI, 52.9 to 54.6) against infection up to 164 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>BNT162b2 (3 doses) showed VE 81.2% (95% CI, 79.2 to 82.9) against infection up to 30 days after 3<sup>rd</sup> dose (VOC Delta)</p> <p>mRNA-1273 showed VE 88.2% (95% CI, 83.1 to 91.8) against infection up to 44 days after 2<sup>nd</sup> dose (VOC Delta)</p>	Serious	<p>Retrospective cohort study in Denmark; 5,767 identified Omicron cases; sequenced for VOC Delta and Omicron</p> <p>(results over varying time periods since vaccination reported)</p>

		<p>mRNA-1273 showed VE 65.0% (95% CI, 63.6 to 66.3) against infection up to 164 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>mRNA-1273 (3 doses) showed VE 82.8% (95% CI, 58.8 to 92.9) against infection up to 30 days after 3<sup>rd</sup> dose (VOC Delta)</p>		
138	<a href="#">McLean</a>	<p>BNT162b2 showed VE 52% (95% CI, 20 to 71) against infection at least 14 days after 2<sup>nd</sup> dose (VOC Delta - June to Dec 2021)</p> <p>mRNA-1273 showed VE 59% (95% CI, 24 to 78) against infection at least 14 days after 2<sup>nd</sup> dose (VOC Delta - June to Dec 2021)</p>	Serious	Prospective cohort in Wisconsin, USA; 1,518 participants; time and setting for VOC Delta
139	<a href="#">Berec</a>	<p>BNT162b2 (3 doses) showed VE 92% (95% CI, 91 to 92) against infection at least 7 days after 3<sup>rd</sup> dose.</p> <p>mRNA-1273 (3 doses) showed VE 94% (95% CI, 91 to 95) against infection at least 7 days after 3<sup>rd</sup> dose.</p> <p>ChAdOx1 (2 doses) followed by BNT162b2 showed VE 82% (95% CI, 68 to 90) against infection at least 7 days after 3<sup>rd</sup> dose</p> <p>ChAdOx1 (2 doses) followed by mRNA1273 showed VE 91% (95% CI, 63 to 98) against infection at least 7 days after 3<sup>rd</sup> dose</p>	Serious	<p>Population cohort in Czech Republic; 693,579 fully vaccinated participants; time and setting for VOC Delta</p> <p>(includes heterologous vaccines)</p>
140	<a href="#">Florea</a>	<p>mRNA-1273 showed VE 86.5% (95% CI, 84.8 to 88.0) against infection at least 14 days after 2<sup>nd</sup> dose</p>	Serious	Prospective matched cohort study in California, USA; 1,854,008 participants; sequencing for VOC Delta
141	<a href="#">Kissling (2)</a>	<p>BNT162b2 showed VE 76% (95% CI, 72 to 81) against symptomatic infection at 30 -59 days after 2<sup>nd</sup> dose; VE 72% (95% CI, 61 to 80) at 60-89 days after 2<sup>nd</sup> dose and VE 65% (95% CI, 56 to 71) &gt;90 days after 2<sup>nd</sup> dose (age 30-59)</p> <p>mRNA-1273 showed VE 91% (95% CI, 85 to 95) against symptomatic infection at 30 -59 days after 2<sup>nd</sup> dose; VE 90% (95% CI, 76 to 96) at 60-89 days after 2<sup>nd</sup> dose (age 30-59)</p> <p>ChAdOx1 showed VE 67% (95% CI, 57 to 75) against symptomatic infection at 30 -59 days after 2<sup>nd</sup> dose; VE 65% (95% CI, 48 to 76) at 60-89 days after 2<sup>nd</sup> dose (age 30-59)</p>	Serious	<p>Test-negative study in 10 out of 14 I-MOVE countries; 14,282 participants; sample sequenced for VOC Delta</p> <p>(results over varying time periods since vaccination reported)</p>

		Ad26.COV2.S showed VE 50% (95% CI, 36 to 62) against symptomatic infection at 30 -59 days after dose; VE 52% (95% CI, 33 to 66) at 60-89 days after dose (age 30-59)		
142	<a href="#">Katikireddi</a>	<p>ChAdOx1 showed VE 63.3% (95% CI, 61.3 to 65.3) against symptomatic infection at 8 to 9 weeks after 2<sup>nd</sup> dose; VE 48.7% (95% CI, 45.9 to 51.4) against symptomatic infection at 16 to 17 weeks after 2<sup>nd</sup> dose (VOC Delta)</p> <p>ChAdOx1 showed VE 79.0% (95% CI, 75.9 to 81.7) against severe disease (hospitalization or death) at 8 to 9 weeks after 2<sup>nd</sup> dose; VE 70.5% (95% CI, 67.0 to 73.7) against severe disease 16 to 17 weeks after 2<sup>nd</sup> dose (VOC Delta)</p> <p>ChAdOx1 showed VE 65.4% (95% CI, 64.6 to 66.2) against symptomatic infection at 8 to 9 weeks after 2<sup>nd</sup> dose; VE 58.7% (95% CI, 56.7 to 60.5) against symptomatic infection at 16 to 17 weeks after 2<sup>nd</sup> dose (VOC Gamma)</p> <p>ChAdOx1 showed VE 75.6% (95% CI, 73.4 to 77.6) against severe disease (hospitalization or death) at 8 to 9 weeks after 2<sup>nd</sup> dose; VE 50.5% (95% CI, 43.4 to 56.6) against severe disease 16 to 17 weeks after 2<sup>nd</sup> dose (VOC Gamma)</p>	Serious	<p>Retrospective cohort in Scotland and Brazil; 1,972,454 <b>fully vaccinated</b> participants in Scotland (Delta); 42,558,839 <b>fully vaccinated</b> participants in Brazil (Gamma); time and setting for VOC Delta and VOC Gamma</p> <p><b>(results over varying time periods since vaccination reported)</b></p>
143	<a href="#">Abu-Raddad (4)</a>	<p>mRNA-1273 showed VE 90.6% (95% CI, 88.7 to 92.1) against infection at 60 days after 2<sup>nd</sup> dose; VE 80.7% (95% CI, 77 to 83.8) against infection at 120 days after 2<sup>nd</sup> dose</p> <p>mRNA-1273 showed VE 97.8% (95% CI, 83.7 to 99.7) against severe disease (hospitalization or death) at 60 days after 2<sup>nd</sup> dose; VE 91.5% (95% CI, 60.8 to 98.1) against infection at 120 days after 2<sup>nd</sup> dose</p>	Serious	<p>Test-negative study in Qatar; 1,781,505 participants; time and setting for VOC Beta to VOC Delta (same setting and methodology as Chemaitelly 3)</p> <p><b>(results over varying time periods since vaccination reported)</b></p>
144	<a href="#">Machado</a>	<p>BNT162b2 (majority) or mRNA-1273 showed VE 68% (95% CI, 64 to 71) against symptomatic infection at 42-69 days after 2<sup>nd</sup> dose; VE 39% (95% CI, 29 to 48) against symptomatic infection at 98-148 days after 2<sup>nd</sup> dose</p> <p>ChAdOx1 showed VE 33% (95% CI, 23 to 42) against symptomatic infection at 42-69 days after 2<sup>nd</sup> dose; VE 34% (95% CI, 10 to 52) against symptomatic infection at 70-140 days after 2<sup>nd</sup> dose</p> <p>BNT162b2 (majority) or mRNA-1273 showed</p>	Moderate	<p>Retrospective cohort study of community-dwelling adults ≥65 in Portugal; 2,117,002 participants; time and setting for VOC Alpha to VOC Delta (same population as Nunes)</p> <p><b>(results over varying time periods since vaccination reported)</b></p>

		<p>VE 95% (95% CI, 88 to 98) against death at 14-41 days after 2<sup>nd</sup> dose; VE 93% (95% CI, 87 to 96) against death at 70-148 days after 2<sup>nd</sup> dose</p> <p>ChAdOx1 showed VE 95% (95% CI, 90 to 97) against death at least 14 days after 2<sup>nd</sup> dose</p>		
145	<a href="#">Irizarry</a>	<p>BNT162b2 showed VE 57% (95% CI, 53 to 60) against infection at 144 days after 2<sup>nd</sup> dose; VE 86% (95% CI, 75 to 92) against death at 144 days after 2<sup>nd</sup> dose</p> <p>mRNA-1273 showed VE 73% (95% CI, 70 to 76) against infection at 144 days after 2<sup>nd</sup> dose; VE 93% (95% CI, 81 to 97) against death at 144 days after 2<sup>nd</sup> dose</p> <p>Ad26.COVS.S showed VE 36% (95% CI, 30 to 42) against infection at 144 days after 2<sup>nd</sup> dose; VE 72% (95% CI, 49 to 85) against death at 144 days after 2<sup>nd</sup> dose</p>	Serious	<p>Retrospective cohort study in Puerto Rico; 2,276,966 participants; time and setting for VOC Alpha to VOC Delta (same population as Robles-Fontan?)</p> <p>(results over varying time periods since vaccination reported)</p>
146	<a href="#">Tartof (2)</a>	<p>BNT162b2 (3 doses) showed VE 88% (95% CI, 86 to 89) against infection at least 14 days after 3<sup>rd</sup> dose compared to unvaccinated (age&gt;18)</p> <p>BNT162b2 (3 doses) showed VE 75% (95% CI, 71 to 78) against infection at least 14 days after 3<sup>rd</sup> dose compared to 2 doses (given at least 6 months previously) (age&gt;18)</p>	Moderate	<p>Retrospective cohort study in California, USA; 3,133,075 participants; time and setting for VOC Alpha to VOC Delta</p>
147	<a href="#">Buchan</a>	<p>BNT1652b2 or mRNA-1273 (2 doses) showed VE 6% (95% CI, -25 to 30) against infection at 7 to 59 days after 2<sup>nd</sup> dose; VE -13% (95% CI, -38 to 8) against infection at 60 to 119 days after 2<sup>nd</sup> dose; VE -38% (95% CI, -61 to -18) against infection at 120 to 179 days after 2<sup>nd</sup> dose; VE -16% (95% CI, -62 to 17) against infection at &gt;240 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>BNT162b2 (3 doses) showed VE 34% (95% CI, 16 to 49) against infection at 7 days after 3<sup>rd</sup> dose (VOC Omicron)</p> <p>mRNA-1273 (3 doses) showed VE 59% (95% CI, 16 to 80) against infection at 7 days after 3<sup>rd</sup> dose (VOC Omicron)</p> <p>BNT1652b2 or mRNA-1273 (2 doses) showed VE 84% (95% CI, 81 to 86) against infection at 7 to 59 days after 2<sup>nd</sup> dose; VE 81% (95% CI, 79 to 82) against infection at 60 to 119 days after 2<sup>nd</sup> dose; VE 80% (95% CI, 79 to 81) against infection at 120 to 179 days after 2<sup>nd</sup> dose; VE 71% (95% CI, 66 to 75) against infection at &gt;240</p>	Moderate	<p>Test-negative study in Ontario, Canada; 484,188 fully vaccinated participants; sample sequenced for VOC Delta and VOC Omicron</p> <p>(results over varying time periods since vaccination reported)</p>

		<p>days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>BNT162b2 (3 doses) showed VE 93% (95% CI, 91 to 94) against infection at 7 days after 3<sup>rd</sup> dose (VOC Delta)</p> <p>mRNA-1273 (3 doses) showed VE 93% (95% CI, 90 to 96) against infection at 7 days after 3<sup>rd</sup> dose (VOC Delta)</p>		
148	<a href="#">Tseng</a>	<p>mRNA-1273 (2 doses) showed VE 30.4% (95% CI, 5.0 to 49.0) against infection at 14 to 90 days after 2<sup>nd</sup> dose; VE 15.2% (0 to 30.7) against infection at 91 to 180 days after 2<sup>nd</sup> dose; VE 0% (95% CI, 0 to 1.2) against infection at 181 to 270 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>mRNA-1273 (3 doses) showed VE 63.6% 95% CI, 57.4 to 68.9) against infection at median of 35 days after 3<sup>rd</sup> dose (VOC Omicron)</p> <p>mRNA-1273 (2 doses) showed VE 82.8% (95% CI, 69.6 to 90.3) against infection at 14 to 90 days after 2<sup>nd</sup> dose; VE 63.6% (51.8 to 72.5) against infection at 91 to 180 days since 2<sup>nd</sup> dose; VE 61.4% (95% CI, 56.8 to 65.5) against infection at 181 to 270 days after 2<sup>nd</sup> dose; VE 52.9% (95% CI, 43.7 to 60.5) against infection at &gt;270 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>mRNA-1273 (3 doses) showed VE 95.7% 95% CI, 94.2 to 96.8) against infection at median of 35 days after 3<sup>rd</sup> dose (VOC Delta)</p>	Serious	<p>Test-negative study in California, USA; 60,420 participants; sample sequenced for VOC Delta and VOC Omicron</p> <p>(results over varying time periods since vaccination reported)</p>
149	<a href="#">Lyngse</a>	<p>BNT162b2* (cases) showed VET 10% (95% CI, 0 to 18) against transmission to vaccinated household contacts at least 7 days after 2<sup>nd</sup> dose</p> <p>BNT162b2* (cases) showed VET 31% (95% CI, 26 to 36) against transmission to unvaccinated household contacts at least 7 days after 2<sup>nd</sup> dose</p> <p>BNT162b2* (contacts) showed VES 46% (95% CI, 40 to 52) against susceptibility to infection from vaccinated case at least 7 days after 2<sup>nd</sup> dose</p> <p>BNT162b2* (contacts) showed VES 61% (95% CI, 59 to 63) against susceptibility to infection from unvaccinated household contacts at least 7 days after 2<sup>nd</sup> dose</p> <p>*vast majority</p>	Serious	Household transmission study in Denmark; 24,693 index cases; sequencing for VOC Delta

150	<a href="#">Hitchings (3)</a>	<p>CoronaVac (2 doses) showed OR 1.59 (95% CI, 0.60 to 4.24) for infection comparing fully vaccinated <math>\geq 182</math> days vs fully vaccinated 14 to 41 days (age 40-64)</p> <p>CoronaVac (2 doses) showed OR 3.32 (95% CI, 1.85 to 5.94) for infection comparing fully vaccinated <math>\geq 182</math> days vs fully vaccinated 14 to 41 days (age 80+)</p>	Serious	Test-negative study in Brazil; 37,929 matched <b>fully vaccinated</b> participants; time and setting for VOC Gamma and VOC Delta
151	<a href="#">Abu-Raddad (5)</a>	<p>BNT162b2 (3 doses) showed VE 49.4% (95% CI, 47.1 to 51.6) 50.1% (95% CI, 47.3 to 52.8) against symptomatic infection; VE 100% (71.4 to 100) against hospitalization and death median of 249 days after 3<sup>rd</sup> dose <b>compared to 2 doses</b></p> <p>mRNA-1273 (3 doses) showed VE 47.3% (95% CI, 40.7 to 53.3) 50.8% (95% CI, 43.4 to 57.3) against symptomatic infection median of 249 days after 3<sup>rd</sup> dose <b>compared to 2 doses</b></p>	Serious	<p>Retrospective cohort studies in Qatar; <b>2,239,193 fully vaccinated</b> participants; sample sequenced for VOC Omicron</p> <p><b>(updated June 22, 2022 based on differences in published version)</b></p>
152	<a href="#">Zheutlin</a>	<p>BNT162b2 showed VE 84% (95% CI, 82 to 85) against infection <math>\geq 5</math> months after 2<sup>nd</sup> dose</p> <p>mRNA-1273 showed VE 88% (95% CI, 87 to 89) against infection <math>\geq 5</math> months after 2<sup>nd</sup> dose</p> <p>Ad26.COVS2.S showed VE 74% (95% CI, 70 to 76) against infection <math>\geq 5</math> months after dose</p>	Serious	<p>Matched case-control in USA; 17,017,435 <b>fully vaccinated</b> participants; time and setting for VOC Alpha to VOC Delta (only Delta data shown here)</p> <p><b>(results over varying time periods since vaccination reported)</b></p>
153	<a href="#">Cerqueira-Silva</a>	<p>BNT162b2 showed VE 64.8% (95% CI, 54.9 to 72.4) against symptomatic infection <math>\geq 14</math> days after 2<sup>nd</sup> dose</p> <p>ChAdOx1 showed VE 56% (95% CI, 51.4 to 60.2) <math>\geq 14</math> days after 2<sup>nd</sup> dose</p> <p>CoronaVac showed VE 39.4% (95% CI, 36.1 to 42.6) against symptomatic infection <math>\geq 14</math> days after 2<sup>nd</sup> dose</p> <p>Ad26.COVS2.S showed VE 44% (95% CI, 31.5 to 54.2) against symptomatic infection <math>\geq 14</math> days after dose</p>	Serious	Test-negative study in Brazil; 231,212 <b>previously infected</b> participants; time and setting for VOC Gamma to VOC Delta
154	<a href="#">Jara (2)</a>	<p>CoronaVac (3 doses) showed VE 78.8% (95% CI, 76.8 to 80.6) against symptomatic infection; VE 92.2% (95% CI, 88.7 to 94.6) against ICU admission; VE 86.7% (95% CI, 80.5 to 91.0) against death <math>\geq 14</math> days after 3<sup>rd</sup> dose</p> <p><b>BNT162b2 booster after CoronaVac (2 doses) showed VE 96.5% (95% CI, 96.2 to 96.7) against</b></p>	Moderate	<p>Prospective cohort in Chile; 11,174,257 <b>fully vaccinated</b> participants; time and setting for VOC Delta</p> <p><b>(includes heterologous vaccines)</b></p>

		<p>symptomatic infection; VE 96.2% (95% CI, 94.6 to 97.3) against ICU admission; VE 96.8% (95% CI, 93.9 to 98.3) against death <math>\geq</math>14 days after 3<sup>rd</sup> dose</p> <p><b>ChAdOx1 booster after CoronaVac (2 doses)</b> showed VE 93.2% (95% CI, 92.9 to 93.6) against symptomatic infection; VE 98.9% (95% CI, 98.5 to 99.2) against ICU admission; VE 98.1% (95% CI, 97.3 to 98.6) against death <math>\geq</math>14 days after 3<sup>rd</sup> dose</p>		
155	<a href="#">Tan</a>	<p><b>BNT162b2 (3 doses)</b> showed VE 73% (95% CI, 71 to 74) against infection; VE 95% (95% CI, 92 to 97) against severe disease <math>\geq</math>12 days after 3<sup>rd</sup> dose <b>compared to 2 doses</b></p> <p><b>mRNA-1273 (3 doses)</b> showed VE 86% (95% CI, 81 to 90) against infection <math>\geq</math>12 days after 3<sup>rd</sup> dose <b>compared to 2 doses of BNT162b2</b></p> <p><b>BNT162b2 (2 doses) followed by mRNA-1273</b> showed VE 82% (95% CI, 77 to 86) against infection; VE 92% (95% CI, 44 to 99) against severe disease <math>\geq</math>12 days after 3<sup>rd</sup> dose <b>compared to 2 doses of BNT162b2</b></p> <p><b>mRNA-1273 (2 doses) followed by BNT162b2</b> showed VE 90% (95% CI, 73 to 96) against infection <math>\geq</math>12 days after 3<sup>rd</sup> dose <b>compared to 2 doses of BNT162b2</b></p>	Serious	<p>Retrospective cohort study in Singapore; 73,209 <b>fully vaccinated</b> participants (age&gt;60); time and setting for VOC Delta</p> <p><b>(includes heterologous vaccines)</b></p>
156	<a href="#">Suah</a>	<p><b>BNT162b2 (2 dose vaccinated July to August)</b> showed VE 90.8% (95% CI, 89.4 to 92.0) against infection; VE 83.8% (95% CI, 78.5 to 87.8) against ICU admission; VE 90.3% (95% CI, 88.1 to 92.2) against death in September (at least 14 days after 2<sup>nd</sup> dose)</p> <p><b>BNT162b2 (2 dose vaccinated April to June)</b> showed VE 79.1% (95% CI, 75.8 to 81.9) against infection; VE 57.2% (95% CI, 43.4 to 67.6) against ICU admission ; VE 89.3% (95% CI, 85.9 to 91.9) against death in September (at least 14 days after 2<sup>nd</sup> dose)</p> <p><b>CoronaVac (2 dose vaccinated July to August)</b> showed VE 74.4% (95% CI, 70.4 to 77.8) against infection; VE 46.1% (95% CI, 37.2 to 53.7) against ICU admission; VE 76.5% (95% CI, 72.9 to 79.6) against death in September (at least 14 days after 2<sup>nd</sup> dose)</p> <p><b>CoronaVac (2 dose vaccinated April to June)</b></p>	Serious	<p>Retrospective cohort study in Malaysia; 9,927,350 <b>fully vaccinated</b> participants; time and setting for VOC Delta</p> <p><b>(results over varying time periods since vaccination reported)</b></p>

		showed VE 30% (95% CI, 18.4 to 39.9) against infection; VE 30.2% (95% CI, 7.6 to 47.3) against ICU admission; VE 75.7% (95% CI, 67.0 to 82.1) against death in September (at least 14 days after 2 <sup>nd</sup> dose)		
157	<a href="#">Amodio</a>	mRNA-1273 showed VE 69.2% (95% CI, 67.6 to 70.8) against infection; VE 85.2% (95% CI, 82.7 to 87.7) against severe disease at 6 months after 2 <sup>nd</sup> dose  mRNA-1273 showed VE 69.2% (95% CI, 67.6 to 70.8) against infection; VE 90.3% (95% CI, 86.2 to 94.4) against severe disease at 8 months after 2 <sup>nd</sup> dose	Serious	Retrospective cohort study in Italy; 3,966,976 participants; time and setting for VOC Alpha to VOC Delta (only Delta data shown here)  (results over varying time periods since vaccination reported)
158	<a href="#">Roberts</a>	BNT162b2 showed VE 72.7% (95% CI, 65.4 to 78.5) against infection; VE 71.7% (95% CI, 45.1 to 85.6) against severe disease (21 days to <3 months after 2 <sup>nd</sup> dose) (participants tested July–September 2021)  BNT162b2 showed VE 73.8% (95% CI, 63.6 to 81.2) against infection; VE 68.3% (95% CI, 23.6 to 87.2) against severe disease (21 days to <3 months after 2 <sup>nd</sup> dose) (participants tested October–December 2021)  mRNA-1273 showed VE 79.0% (95% CI, 70.8 to 84.9) against infection; VE 74.5% (95% CI, 42.7 to 88.9) against severe disease (21 days to <3 months after 2 <sup>nd</sup> dose) (participants tested July–September 2021)  mRNA-1273 showed VE 83.1% (95% CI, 68.9 to 90.9) against infection; VE 93.4% (95% CI, 5.3 to 99.6) against severe disease (21 days to <3 months after 2 <sup>nd</sup> dose) (participants tested October–December 2021)	Serious	Test-negative study in USA; 170,487 participants; time and setting for VOC Alpha to VOC Delta (only Delta data shown here)
159	<a href="#">Bar-On (3)</a>	BNT162b2 (3 doses) showed a rate ratio (RR) of 1.9 (95% CI, 1.8 to 1.9) for infection; RR 4.0 (95% CI, 2.3 to 7.0) for severe disease compared to 4 doses	Serious	Data-linkage study of 4 doses (>60 years) (3 doses versus 4 doses) in Israel; 1,138,681 participants; time and setting for VOC Omicron
160	<a href="#">Willett</a>	BNT162b2 (3 doses) showed VE 43.2% (95% CI, 38.1 to 47.8) against infection (VOC Omicron)  mRNA-1273 (3 doses) showed VE 46.3% (95% CI, 41.3 to 51.0) against infection (VOC Omicron)	Serious	Test-negative study in Scotland; 1,200,000 participants; sample sequenced for VOC Omicron and VOC Delta

		<p>BNT162b2 (2 doses) showed VE 26% (95% CI, x to x) against infection (VOC Omicron)</p> <p>mRNA-1273 (2 doses) showed VE 23.7% (95% CI, x to x) against infection (VOC Omicron)</p> <p>BNT162b2 (3 doses) showed VE 85.9% (95% CI, 84.2 to 87.4) against infection (VOC Delta)</p> <p>mRNA-1273 (3 doses) showed VE 86.5% (95% CI, 84.8 to 88.0) against infection (VOC Delta)</p> <p>BNT162b2 (2 doses) showed VE 83.5% (95% CI, x to x) against infection (VOC Delta)</p> <p>mRNA-1273 (2 doses) showed VE 87.8% (95% CI, x to x) against infection (VOC Delta)</p>		
161	<a href="#">Jalali</a>	<p>BNT162b2 or mRNA-1273 (3 doses) showed <b>VES</b> 47% (95% CI, 17 to 64) against transmission at least 7 days after 3<sup>rd</sup> dose (VOC Omicron)</p> <p>BNT162b2 or mRNA-1273 (2 doses) showed <b>VES</b> 16% (95% CI, 0 to 37) against transmission at least 7 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>BNT162b2 or mRNA-1273 (3 doses) showed <b>VES</b> 62% (95% CI, 38 to 78) against transmission at least 7 days after 3<sup>rd</sup> dose (VOC Delta)</p> <p>BNT162b2 or mRNA-1273 (2 doses) showed <b>VES</b> 46% (95% CI, 28 to 58) against transmission at least 7 days after 2<sup>nd</sup> dose (VOC Delta)</p>	Serious	Retrospective cohort study in Norway; 979 primary cases and 1,888 household contacts; sample sequenced for VOC Omicron and VOC Delta
162	<a href="#">Chemaitelly (4)</a>	<p>BNT162b2 (3 doses) showed VE 56.6% (95% CI, 50.8 to 61.7) against symptomatic infection at 28 to 35 days; VE 43.7% (95% CI, 32.9 to 52.7) against symptomatic infection 70 to 77 days after 3<sup>rd</sup> dose</p> <p>BNT162b2 (3 doses) showed VE 90.6% (95% CI, 77.8 to 96) against severe, critical, or fatal disease at 7 to 42 days; VE 90.8% (95% CI, 81.5 to 95.5) against severe, critical, or fatal disease at 49 days+ after 3<sup>rd</sup> dose</p> <p>mRNA-1273 (3 doses) showed VE 54.6% (95% CI, 41.1 to 65.0) against symptomatic infection at 28 to 35 days; VE 38.6% (95% CI, 19.4 to 53.1) against symptomatic infection at least 42 days</p>	Serious	<p>Test negative study in Qatar; 2,193,013 participants; proxy for VOC Omicron</p> <p>(results over varying time periods since vaccination reported)</p>

		<p>after 3<sup>rd</sup> dose</p> <p>mRNA-1273 (3 doses) showed VE 80.8% (95% CI, -51.9 to 97.6) against severe, critical, or fatal disease at 7 to 42 days after 3<sup>rd</sup> dose</p> <p>BNT162b2 (2 doses) showed VE 61.9% (95% CI, 49.9 to 71.1) against symptomatic infection at 30 days; VE 45.9% (95% CI, 33.8 to 55.8) against symptomatic infection at 60 days; VE 36.3% (95% CI, 25.1 to 45.8) against symptomatic infection at 90 days after 2<sup>nd</sup> dose</p> <p>mRNA-1273 (2 doses) showed VE 44.8% (95% CI, 16.0 to 63.8) against symptomatic infection at 28 to 35 days after 2<sup>nd</sup> dose</p>		
163	<a href="#">Fabiani (2)</a>	<p>BNT162b2 showed VE 82% (95% CI, 80.5 to 83.5) against infection at 21 to 30 days after 2<sup>nd</sup> dose; VE 67.3% (95% CI, 65.2 to 69.3) against infection at 44 to 98 days after 2<sup>nd</sup> dose <b>compared to non-immune period after 1<sup>st</sup> dose</b></p> <p>BNT162b2 showed VE 96.3% (95% CI, 95 to 97.3) against severe disease at 21 to 30 days after 2<sup>nd</sup> dose; VE 91.1% (95% CI, 90 to 92) against severe disease at 44 to 98 days after 2<sup>nd</sup> dose <b>compared to non-immune period after 1<sup>st</sup> dose</b></p>	Serious	<p>Retrospective cohort study in Italy; 33,250,344 partially vaccinated participants; time and setting for VOC Delta</p> <p><b>(results over varying time periods since vaccination reported)</b></p>
164	<a href="#">Sritipsukho</a>	<p>CoronaVac (2 doses) + BNT162b2 showed VE 98% (95% CI, 87 to 100) against infection at least 7 days after 3<sup>rd</sup> dose</p> <p>CoronaVac (2 doses) + ChAdOx1 showed VE 86% (95% CI, 74 to 93) against infection at least 7 days after 3<sup>rd</sup> dose</p> <p>ChAdOx1 (2 doses) showed VE 83% (95% CI, 70 to 90) against infection at least 7 days after 2<sup>nd</sup> dose</p> <p>CoronaVac (1 dose) + ChAdOx1 showed VE 74% (95% CI, 43 to 88) against infection at least 7 days after 2<sup>nd</sup> dose</p> <p>CoronaVac (2 doses) showed VE 60% (95% CI, 49 to 69) against infection at least 7 days after 2<sup>nd</sup> dose</p>	Serious	<p>Test-negative study in Thailand; 3,353 participants; time and setting for VOC Delta</p> <p><b>(includes heterologous vaccines)</b></p>
165	<a href="#">Cerqueira-Silva(2)</a>	<p>CoronaVac (2 doses) + BNT162b2 showed VE 92.7% (95% CI, 91 to 94) against infection at 14 to 30 days after 3<sup>rd</sup> dose</p> <p>CoronaVac (2 doses) + BNT162b2 showed VE 97.3% (95% CI, 96.1 to 98.1) against severe</p>	Serious	<p>Test-negative study in Brazil; 7,314,318 participants; time and setting for VOC Gamma and Delta (only booster data shown here because</p>

		disease (hospitalization or death) at 14 to 30 days after 3 <sup>rd</sup> dose		it is most likely to represent Delta) (results over varying time periods since vaccination reported)  (includes heterologous vaccines)
166	<a href="#">Grima</a>	BNT162b2 or mRNA-1273 or ChAdOx1 (3 doses) showed OR 0.60 (95% CI, 0.33 to 1.10) against transfer to ICU; OR 0.70 (95% CI, 0.27 to 1.80) against death unreported number of days after 3 <sup>rd</sup> dose (VOC Omicron)  BNT162b2 or mRNA-1273 or ChAdOx1 (3 doses) showed OR 0.38 (95% CI, 0.16 to 0.92) against transfer to ICU; OR 0.80 (95% CI, 0.35 to 1.81) against death unreported number of days after 3 <sup>rd</sup> dose (VOC Delta)	Serious	Time-matched cohort in Canada; 20,064 participants hospitalized due to COVID; sequenced for variants (only VOC Omicron and VOC Delta reported here) (results not reported according to vaccine brand)
167	<a href="#">Monge(2)</a>	BNT162b2 (2 doses) followed by an mRNA vaccine showed VE 49.7% (95% CI, 48.3 to 51.1) against infection at least 7 days after 3 <sup>rd</sup> dose  mRNA-1273 (2 doses) followed by an mRNA vaccine showed VE 55.3% (95% CI, 52.3 to 58.2) against infection at least 7 days after 3 <sup>rd</sup> dose  ChAdOx1 (2 doses) followed by an mRNA vaccine showed VE 58.6% (95% CI, 55.5 to 61.6) against infection at least 7 days after 3 <sup>rd</sup> dose  Ad26.COV2.S followed by an mRNA vaccine showed VE 48.0% (95% CI, 42.5 to 53.7) against infection at least 7 days after 3 <sup>rd</sup> dose	Serious	Retrospective cohort study in Spain; 6,222,318 fully vaccinated participants >40 years; time and setting for VOC Omicron  (results over varying time periods since vaccination reported)  (includes heterologous vaccines)
168	<a href="#">Patalon (2)</a>	BNT162b2 (3 doses) showed VE 35.7% (95% CI, 29.8 to 41.2) against infection up to 90 days after 3 <sup>rd</sup> dose (Nov 2021 compared to Aug 2021)	Moderate	Test-negative study in Israel; 109,633 fully vaccinated participants; time and setting for VOC Omicron
169	<a href="#">Smid</a>	BNT162b2 (3 doses) showed VE 58% (95% CI, 57 to 58) against infection up to 60 days after 3 <sup>rd</sup> dose (VOC Omicron)  BNT162b2 (2 doses) showed VE 49% (95% CI, 48 to 50) against infection up to 60 days after 2 <sup>nd</sup> dose (VOC Omicron)  mRNA-1273 (3 doses) showed VE 61% (95% CI, 60 to 62) against infection up to 60 days after	Serious	Retrospective cohort study in Czech Republic; 4,874,253 participants (for the outcomes reported here); sample sequenced for VOC Omicron and VOC Delta

		<p>3<sup>rd</sup> dose (VOC Omicron)</p> <p>mRNA-1273 (2 doses) showed VE 48% (95% CI, 44 to 52) against infection up to 60 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>ChAdOx1 (2 doses) showed VE 51% (95% CI, 23 to 69) against infection up to 120 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>Ad26.COV2.S (1 dose) showed VE 47% (95% CI, 45 to 49) against infection up to 60 days after 2<sup>nd</sup> dose (VOC Omicron)</p> <p>BNT162b2 (3 doses) showed VE 90% (95% CI, 89 to 90) against infection up to 60 days after 3<sup>rd</sup> dose (VOC Delta)</p> <p>BNT162b2 (2 doses) showed VE 82% (95% CI, 80 to 83) against infection up to 60 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>mRNA-1273 (3 doses) showed VE 92% (95% CI, 91 to 93) against infection up to 60 days after 3<sup>rd</sup> dose (VOC Delta)</p> <p>mRNA-1273 (2 doses) showed VE 71% (95% CI, 64 to 76) against infection up to 60 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>ChAdOx1 (2 doses) showed VE 65% (95% CI, 57 to 71) against infection up to 120 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>Ad26.COV2.S (1 dose) showed VE 60% (95% CI, 57 to 62) against infection up to 60 days after 2<sup>nd</sup> dose (VOC Delta)</p>		
170	<a href="#">Norddahl</a>	<p>BNT162b2 (3 doses) showed <b>relative effectiveness</b> 47% (95% CI, 36 to 56) against infection unknown number of days after 3<sup>rd</sup> dose <b>relative to 2 doses of BNT162b2</b> (VOC Omicron)</p> <p><b>BNT162b2 (2 doses) followed by mRNA-1273</b> showed relative VE 50% (95% CI, 34 to 62) against infection unknown number of days after 3<sup>rd</sup> dose <b>relative to 2 doses of BNT162b2</b> (VOC Omicron)</p> <p>mRNA-1273 (3 doses) showed relative VE 9% (95% CI, -21 to 32) against infection unknown number of days after 3<sup>rd</sup> dose <b>relative to 2 doses</b></p>	Serious	<p>Retrospective population cohort study in Iceland; 278,026 at least partly vaccinated participants; sequenced for VOC Omicron and VOC Delta (only Omicron data shown here)</p> <p>(includes heterologous vaccines)</p>

		<p>of BNT162b2 (VOC Omicron)</p> <p>mRNA-1273 (2 doses) followed BNT162b2 showed relative VE 27% (95% CI, 9 to 61) against infection unknown number of days after 3<sup>rd</sup> dose relative to 2 doses of BNT162b2 (VOC Omicron)</p> <p>ChAdOx1 (2 doses) followed by BNT162b2 showed relative VE 30% (95% CI, 14 to 43) against infection unknown number of days after 3<sup>rd</sup> dose relative to 2 doses of BNT162b2 (VOC Omicron)</p> <p>ChAdOx1 (2 doses) followed by mRNA-1273 showed relative VE 7% (95% CI, -16 to 25) against infection unknown number of days after 3<sup>rd</sup> dose relative to 2 doses of BNT162b2 (VOC Omicron)</p> <p>Ad26.COV2 followed by BNT162b2 showed relative VE 5% (95% CI, -7 to 15) against infection unknown number of days after 2<sup>nd</sup> dose relative to 2 doses of BNT162b2 (VOC Omicron)</p> <p>Ad26.COV2 followed by mRNA-1273 showed relative VE -70% (95% CI, -50 to -80) against infection unknown number of days after 2<sup>nd</sup> dose relative to 2 doses of BNT162b2 (VOC Omicron)</p>		
171	<a href="#">Rane</a>	<p>BNT162b2 (2 doses) showed VE 76% (95% CI, 74 to 78) against symptomatic infection unknown number of days after 2<sup>nd</sup> dose</p> <p>mRNA-1273 (2 doses) showed VE 83% (95% CI, 81 to 84) against symptomatic infection unknown number of days after 2<sup>nd</sup> dose</p> <p>Ad26.COV2.S showed VE 29% (95% CI, 26 to 32) against symptomatic infection unknown number of days after dose</p>	Serious	Test-negative study in New York; 1,058,493 participants; time and setting for VOC Alpha to VOC Delta (results for VOC Delta shown here)
172	<a href="#">Wu</a>	<p>BBIBP-CorV showed VES 39.4% (-20.4 to 69.5) against symptomatic infection from 14 to 90 days after 2<sup>nd</sup> dose</p> <p>CoronaVac showed VES 45.5% (-6 to 72) against symptomatic infection from 14 to 90 days after 2<sup>nd</sup> dose</p>	Serious	<p>Outbreak cohort in China; 1,462 close-contacts of index case; sequenced for VOC Delta</p> <p>(results over varying time periods since vaccination reported)</p>

173	<a href="#">Gazit (3)</a>	BNT162b2 (single dose) after <b>previously infected</b> showed VE 82% (95% CI, 80 to 85) against re-infection <b>compared to previously infected and unvaccinated</b>	Serious	Series of retrospective multiple nested emulated target trials in Israel; 107,413 <b>previously infected</b> participants; time and setting from VOC Alpha to VOC Delta (unable to separate results reported but <1% Alpha so predominantly Delta)
174	<a href="#">Korves</a>	BNT162b2 or mRNA-1273 ( <b>3 doses</b> ) showed relative VE 56% (95% CI, 39 to 67) against infection at 14 to 16 days after 3 <sup>rd</sup> dose <b>compared to 2 doses of an mRNA vaccine</b> (VOC Omicron)  BNT162b2 or mRNA-1273 ( <b>3 doses</b> ) showed relative VE 70% (95% CI, 42 to 84) against infection at 14 to 16 days after 3 <sup>rd</sup> dose <b>compared to 2 doses of an mRNA vaccine</b> (VOC Delta)	Moderate	Self-controlled risk interval analysis in USA; 259 <b>fully vaccinated</b> participants; time and setting for VOC Omicron and VOC Delta
175	<a href="#">Chemaitelly (5)</a>	BNT162b2 ( <b>3 doses</b> ) showed VE 49.5% (95% CI, 44.3 to 54.1) against symptomatic infection up to 30 days after 3 <sup>rd</sup> dose; VE 90.9% (95% CI, 78.6 to 96.1) against severe, critical or fatal disease 7 to 42 days after 3 <sup>rd</sup> dose (VOC Omicron – any subtype)  BNT162b2 ( <b>3 doses</b> ) showed VE 59.9% (95% CI, 51.2 to 67.0) against symptomatic infection up to 30 days after 3 <sup>rd</sup> dose (VOC Omicron BA.1)  BNT162b2 ( <b>3 doses</b> ) showed VE 43.7% (95% CI, 36.5 to 50.0) against symptomatic infection up to 30 days after 3 <sup>rd</sup> dose (VOC Omicron BA.2)  BNT162b2 ( <b>2 doses</b> ) showed VE 47.8% (95% CI, 40.8 to 53.9) against symptomatic infection up to 30 to 90 days after 2 <sup>nd</sup> dose (VOC Omicron – any subtype)  BNT162b2 ( <b>2 doses</b> ) showed VE 46.6% (95% CI, 33.4 to 57.2) against symptomatic infection up to 30 to 90 days after 2 <sup>nd</sup> dose (VOC Omicron BA.1)  BNT162b2 ( <b>2 doses</b> ) showed VE 51.7% (95% CI, 43.2 to 58.9) against symptomatic infection up to 30 to 90 days after 2 <sup>nd</sup> dose (VOC Omicron BA.2)  mRNA-1273 ( <b>3 doses</b> ) showed VE 43.6% (95%	Serious	Test-negative study in Qatar; 134,619 participants; sample sequenced for VOC Omicron (overlaps with population in ref #162)  <b>(results over varying time periods since vaccination reported)</b>

		<p>CI, 33.2 to 52.4) against symptomatic infection up to 30 days after 3<sup>rd</sup> dose; VE 81.8% (95% CI, -49.5 to 97.8) against severe, critical or fatal disease 7 to 42 days after 3<sup>rd</sup> dose (VOC Omicron – any subtype)</p> <p>mRNA-1273 (3 doses) showed VE 51.5% (95% CI, 32.3 to 65.2) against symptomatic infection up to 30 days after 3<sup>rd</sup> dose (VOC Omicron BA.1)</p> <p>mRNA-1273 (3 doses) showed VE 39.4% (95% CI, 24.8 to 51.2) against symptomatic infection up to 30 days after 3<sup>rd</sup> dose (VOC Omicron BA.2)</p> <p>mRNA-1273 (2 doses) showed VE 43.2% (95% CI, 15.0 to 62.1) against symptomatic infection up to 30 to 90 days after 2<sup>nd</sup> dose (VOC Omicron – any subtype)</p> <p>mRNA-1273 (2 doses) showed VE 71.0% (95% CI, 24.0 to 89.0) against symptomatic infection up to 30 to 90 days after 2<sup>nd</sup> dose (VOC Omicron BA.1)</p> <p>mRNA-1273 (2 doses) showed VE 35.9% (95% CI, -5.9 to 61.2) against symptomatic infection up to 30 to 90 days after 2<sup>nd</sup> dose (VOC Omicron BA.2)</p>		
176	<a href="#">Altarawneh</a>	<p>BNT162b2 (3 doses) plus prior infection showed VE 76.3% (95% CI, 71.7 to 80.1) against symptomatic infection median 42 days after 3<sup>rd</sup> dose (VOC Omicron – any subtype)</p> <p>BNT162b2 (3 doses) plus prior infection showed VE 74.4% (95% CI, 63.4 to 82.2) against symptomatic infection median 42 days after 3<sup>rd</sup> dose (VOC Omicron BA.1)</p> <p>BNT162b2 (3 doses) plus prior infection showed VE 77.3% (95% CI, 72.4 to 81.4) against symptomatic infection median 43 days after 3<sup>rd</sup> dose (VOC Omicron BA.2)</p> <p>BNT162b2 (2 doses) plus prior infection showed VE 51.7% (95% CI, 43.5 to 58.7) against symptomatic infection median 268 days after 2<sup>nd</sup> dose (VOC Omicron BA.1)</p> <p>BNT162b2 (2 doses) plus prior infection showed VE 55.1% (95% CI, 50.9 to 58.9) against</p>	Serious	<p>Series of test-negative studies in Qatar; 49,071 (BNT162b2) and 25,598 (mRNA-1273) previously infected participants; sample sequenced for VOC Omicron</p> <p>(study population overlaps with population for ref# 175 so only hybrid data of vaccinated plus prior infection reported here)</p>

		<p>symptomatic infection median 268 days after 2<sup>nd</sup> dose (VOC Omicron BA.2)</p> <p>mRNA-1273 (3 doses) plus prior infection showed VE 79.4% (95% CI, 66.1 to 87.5) against symptomatic infection unknown median days after 3<sup>rd</sup> dose (VOC Omicron – any subtype)</p> <p>mRNA-1273 (3 doses) plus prior infection showed VE 77.2% (95% CI, 38.5 to 91.5) against symptomatic infection unknown median days after 3<sup>rd</sup> dose (VOC Omicron BA.1)</p> <p>mRNA-1273 (3 doses) plus prior infection showed VE 69.8% (95% CI, 50.1 to 81.7) against symptomatic infection unknown median days after 3<sup>rd</sup> dose (VOC Omicron BA.2)</p> <p>mRNA-1273 (2 doses) plus prior infection showed VE 44.3 (95% CI, 30.4 to 55.4) against symptomatic infection unknown median after 2<sup>nd</sup> dose (VOC Omicron BA.1)</p> <p>mRNA-1273 (2 doses) plus prior infection showed VE 47.9% (95% CI, 40.8 to 54.1) against symptomatic infection unknown median after 2<sup>nd</sup> dose (VOC Omicron BA.2)</p>		
177	<a href="#">Kirsebom</a>	<p>BNT162b2, mRNA-1273 or ChAdOx1 primary series followed by BNT162b2 or mRNA-1273 booster showed VE 70.2% (95% CI, 69.5 to 71.0) against symptomatic infection 14 to 30 days after 3<sup>rd</sup> dose; VE 66.2% (95% CI, 65.5 to 66.9) against symptomatic infection 35 to 63 days after 3<sup>rd</sup> dose (VOC Omicron BA.1)</p> <p>BNT162b2, mRNA-1273 or ChAdOx1 primary series followed by BNT162b2 or mRNA-1273 booster showed VE 74.2% (95% CI, 72.4 to 75.8) against symptomatic infection 14 to 30 days after 3<sup>rd</sup> dose; VE 68.1% (95% CI, 66.7 to 69.5) against symptomatic infection 35 to 63 days after 3<sup>rd</sup> dose (VOC Omicron BA.2)</p>	Moderate	<p>Test-negative study in UK; 626,148 participants; sequenced or proxy for VOC Omicron</p> <p>(results not reported separately by manufacturer; BNT162b2, mRNA-1273 or ChAdOx1 primary series followed by BNT162b2 or mRNA-1273 booster)</p>
178	<a href="#">Gazit (4)</a>	<p>BNT162b2 (4 doses) showed <b>relative effectiveness</b> 63% (95% CI, 60 to 65.8) against infection 21 to 27 days after 4<sup>th</sup> dose; relative VE 56% (95% CI, 53.4 to 58.5) against infection 35 to 41 days after 4<sup>th</sup> dose; relative VE 27.1% (95% CI, 4.2 to 44.5) against infection 63 to 69 days after 4<sup>th</sup> dose <b>compared to 3 doses</b></p> <p>BNT162b2 (4 doses) showed relative VE 82.5% (95% CI, 70.5 to 89.6) against severe disease 7 to</p>	Serious	<p>Test-negative study in Israel; 97,499 <b>fully vaccinated</b> participants age 60+ (69,623 three doses; 27,876 four doses); time and setting for VOC Omicron</p>

		27 days after 4 <sup>th</sup> dose; relative VE 70.3% (95% CI, 37.4 to 85.9) against severe disease 28 to 48 days after 4 <sup>th</sup> dose; relative VE 87.1% (95% CI, 0 to 98.4) against severe disease 49 to 69 days after 4 <sup>th</sup> dose <b>compared to 3 doses</b>		
179	<a href="#">Rearte</a>	<p>ChAdOx1 showed VE 39.9% (95% CI 39 to 41) against infection up to 126 days after 1<sup>st</sup> dose; VE 68.5% (95% CI, 67 to 71) against infection up to 126 days after 2<sup>nd</sup> dose</p> <p>ChAdOx1 showed VE 71.8% (95% CI 71 to 73) against death up to 126 days after 1<sup>st</sup> dose; VE 80.1% (95% CI, 78 to 82) against death up to 126 days after 2<sup>nd</sup> dose</p> <p>rAd26-rAd5 showed VE 39.5% (95% CI 39 to 40) against infection up to 126 days after 1<sup>st</sup> dose; VE 64% (95% CI, 63 to 65) against infection up to 126 days after 2<sup>nd</sup> dose</p> <p>rAd26-rAd5 showed VE 68.8% (95% CI 68 to 70) against death up to 126 days after 1<sup>st</sup> dose; VE 80.7% (95% CI, 79 to 82) against death up to 126 days after 2<sup>nd</sup> dose</p> <p>BBIBP-CorV showed VE 22.6% (95% CI 20 to 25) against infection up to 126 days after 1<sup>st</sup> dose; VE 43.6% (95% CI, 42 to 45) against infection up to 126 days after 2<sup>nd</sup> dose</p> <p>BBIBP-CorV showed VE 61.8% (95% CI 59 to 64) against death up to 126 days after 1<sup>st</sup> dose; VE 73.4% (95% CI, 71 to 75) against death up to 126 days after 2<sup>nd</sup> dose</p>	Serious	Test-negative study in Argentina; 1,282,928 participants age 60+; time and setting for VOC Gamma (predominantly)
180	<a href="#">Butt (4)</a>	<p>BNT162b2 (3 doses) showed <b>relative effectiveness</b> 84% (95% CI, 78 to 88) against symptomatic infection up to 40 days after 3<sup>rd</sup> dose <b>compared to 2 doses</b></p> <p>mRNA-1273 (3 doses) showed relative VE 87% (95% CI, 83 to 90) against symptomatic infection up to 40 days after 3<sup>rd</sup> dose <b>compared to 2 doses</b></p>	Serious	Retrospective cohort in US; 791,372 <b>fully vaccinated</b> participants; time and setting for VOC Delta
181	<a href="#">Castillo (2)</a>	<p>BNT162b2 (majority) showed VE 78.6% (95% CI, 77.4 to 79.9) against symptomatic infection 15 to 30 days after 2<sup>nd</sup> dose; VE 74% (95% CI, 73.1 to 74.8) against symptomatic infection 30 to 60 days after 2<sup>nd</sup> dose; VE 68.6% (95% CI, 67.6 to 69.5) against symptomatic infection 60 to 90 days after 2<sup>nd</sup> dose (VOC Delta)</p> <p>BNT162b2 (majority) showed VE 84.2% (95% CI, 78.2 to 90.3) against symptomatic infection</p>	Serious	Test-negative study in France; 1,296,351 participants age 50+; sequenced for VOC Alpha, Beta/Gamma and Delta (only Beta/Gamma and Delta results reported here)  (mixture of vaccine

		15 to 30 days after 2 <sup>nd</sup> dose; VE 68% (95% CI, 59.1 to 76.9) against symptomatic infection 30 to 60 days after 2 <sup>nd</sup> dose; VE 61.2% (95% CI, 45.7 to 76.8) against symptomatic infection 60 to 90 days after 2 <sup>nd</sup> dose (VOC Beta/Gamma)		brands used but >75% BNT162b2 so reported under this brand only in this synopsis)  (results over varying time periods since vaccination reported)
182	<a href="#">McMenamin</a>	BNT162b2 (3 doses) showed VE 71.6% (95% CI, 43.5 to 85.7) against mild/moderate infection; VE 99.2% (95% CI, 96.7 to 99.8) against severe or fatal disease; VE 98.9% (95% CI, 95.3 to 99.7) against death median 35 days after 3 <sup>rd</sup> dose  CoronaVac (3 doses) showed VE 50.7% (95% CI, 12.9 to 72.1) against mild/moderate infection; VE 98.5% (95% CI, 95.3 to 99.6) against severe or fatal disease; VE 98.7% (95% CI, 94.4 to 99.7) median 35 days after 3 <sup>rd</sup> dose	Serious	Ecological study in Hong Kong; 14,861 cases; sample sequenced for VOC Omicron BA.2
183	<a href="#">Arbel (2)</a>	BNT162b2 (4 doses) showed relative effectiveness 78% (95% CI, 72 to 83) against death 7 to 40 days after 4 <sup>th</sup> dose compared to 3 doses	Moderate	Retrospective cohort study in Israel; 563,465 fully vaccinated plus boosted participants ages 60 to 100; time and setting for VOC Omicron
184	<a href="#">Wang (2)</a>	BNT162b2 or mRNA-1273 (3 doses) showed VE 65% (95% CI, 63 to 66) against infection; VE 85% (95% CI, 60 to 94) against death 14-179 days after 3 <sup>rd</sup> dose (VOC Omicron)  BNT162b2 or mRNA-1273 (2 doses) showed VE 26% (95% CI, 22 to 30) against infection; VE 60% (95% CI, 49 to 68) against death 14-179 days (VOC Omicron)  BNT162b2 or mRNA-1273 (3 doses) showed VE 91% (95% CI, 90 to 92) against infection; VE 76% (95% CI, 46 to 89) against death 14-179 days after 3 <sup>rd</sup> dose (VOC Delta)  BNT162b2 or mRNA-1273 (2 doses) showed VE 70% (95% CI, 68 to 72) against infection; VE 58% (95% CI, 49 to 66) against death 14-179 days vaccination (VOC Delta)	Serious	Test-negative study in US; 249,070 participants; time and setting for VOC Delta and VOC Omicron

185	<a href="#">Horne</a>	<p>BNT162b2 (2 doses) showed VE 73% (95% CI, 69 to 77) against infection 3-6 weeks following the second dose</p> <p>ChAdOx1 (2 doses) showed VE 21% (95% CI, 18 to 24) against infection 3-6 weeks following the second dose</p>	Moderate	Retrospective cohort study in the UK; 7,168,969 participants aged 40-64 years; time and setting for VOC Delta
186	<a href="#">Starrfelt (3)</a>	<p>BNT162b2 (3 doses) showed VE 75.3% (95% CI, 72.5 to 77.8) against infection at &gt;1 week compared to no vaccination</p> <p>BNT162b2 (2 doses) showed VE 77.7% (95% CI, 76.8 to 78.5) against infection at 2-9 weeks compared to no vaccination</p> <p>mRNA-1273 (3 doses) showed VE 84.9% (95% CI, 71.8 to 91.9) against infection at &gt;1 week compared to no vaccination</p> <p>mRNA-1273 (2 doses) showed VE 86.6% (95% CI, 85.6 to 87.6) against infection at 2-9 weeks compared to no vaccination</p> <p>mRNA-1273 (2 doses), followed by BNT162b2 booster showed VE 87.1% (95% CI, 80.1 to 91.6) against infection at &gt;1 week compared to no vaccination</p> <p>BNT162b2 (2 doses), followed by mRNA-1273 booster showed VE 68.2% (95% CI, 57.6 to 76.1) against infection at &gt;1 week compared to no vaccination</p>	Serious	Retrospective cohort study in Norway; 4,301,995 participants, time and setting for VOC Delta
187	<a href="#">Hansen (2)</a>	<p>BNT162b2 (2 doses) showed VE 37.0% (95% CI, 35.6 to 38.3) against infection at 14-30 days following the second dose compared to no vaccination</p> <p>BNT162b2 (3 doses) showed VE 47.9% (95% CI, 47.4 to 48.3) against infection at 14-30 days following the third dose compared to no vaccination</p> <p>mRNA-1273 (2 doses) showed VE 37.9% (95% CI, 34.4 to 41.2) against infection at 14-30 days following the second dose compared to no vaccination</p> <p>mRNA-1273 (3 doses) showed VE 47.7% (95% CI, 47.0 to 48.3) against infection at 14-30 days following the third dose compared to no vaccination</p>	Serious	Retrospective cohort study in Denmark; 3,090,833 participants, time and setting for VOC Omicron

188	<a href="#">Tenforde (4)</a>	<p><b>BNT162b2 or mRNA-1273 (3 doses)</b> showed VE 95% (95% CI, 91 to 97) against infection &gt;14 days after 3<sup>rd</sup> dose compared to no vaccination (VOC Delta)</p> <p><b>BNT162b2 or mRNA-1273 (3 doses)</b> showed VE 94% (95% CI, 88 to 97) against infection &gt;14 days after 3<sup>rd</sup> dose compared to no vaccination (VOC Omicron)</p>	Serious	Case-control study in US; 7544 participants; time and setting for VOC Delta and VOC Omicron
189	<a href="#">Ranzani (4)</a>	<p>CoronaVac (<b>3 doses</b>) showed VE 15.0% (95% CI, 12.0 to 18.0) against symptomatic infection; VE 71.3% (95% CI, 60.3 to 79.2) against severe disease at 8-59 days after booster dose compared to no vaccination</p> <p><b>CoronaVac (2 doses), followed by BNT162b2 booster</b> showed VE 56.8% (95% CI, 56.3 to 57.4) against symptomatic infection; VE 85.5% (95% CI, 83.3 to 87.0) against severe disease at 8-59 days after booster dose compared to no vaccination</p>	Serious	Test-negative study in Brazil; 2,679,972 participants; time and setting for VOC Omicron
190	<a href="#">Magen</a>	<p>BNT162b2 (<b>4 doses</b>) showed <b>relative effectiveness</b> 45% (95% CI, 44 to 47) against confirmed infection 7-30 days after 4<sup>th</sup> dose; relative VE 55% (95% CI, 53 to 58) against symptomatic infection 7 to 30 days after 4<sup>th</sup> dose; relative VE 62% (95% CI, 50 to 74) against severe infection 7-30 days after 4<sup>th</sup> dose; relative VE 74% (95% CI, 50 to 90) against death 7-30 days after 4<sup>th</sup> dose <b>compared with 3 doses.</b></p> <p>BNT162b2 (<b>4 doses</b>) showed <b>relative effectiveness</b> 52% (95% CI, 49 to 54) against confirmed infection 14-30 days after 4<sup>th</sup> dose; relative VE 61% (95% CI, 58 to 64) against symptomatic infection 14-30 days after 4<sup>th</sup> dose; relative VE 64% (95% CI, 48 to 77) against severe infection 14-30 days after 4<sup>th</sup> dose; relative VE 76% (95% CI, 48 to 91) against death 14-30 days after 4<sup>th</sup> dose <b>compared with 3 doses.</b></p>	Serious	Data-linkage study in Israel; 182,122 matched pairs of <b>fully vaccinated and boosted participants</b> ; time and setting for VOC Omicron
191	<a href="#">Cerqueira-Silva (3)</a>	<p>BNT162b2 (<b>3 doses</b>) showed VE <b>70% (95% CI, 68.4 to 71.6)</b> against symptomatic infection 2-9 weeks after 3<sup>rd</sup> dose; VE <b>95.7% (95% CI, 90.6 to 98)</b> against severe disease 2-9 weeks after 3<sup>rd</sup> dose <b>in individuals with hybrid immunity (prior infection) compared to no vaccination and no prior infection</b></p> <p>BNT162b2 (<b>2 doses</b>) showed VE <b>66.5% (95% CI, 65.5 to 67.5)</b> against symptomatic infection 2-9 weeks after 2<sup>nd</sup> dose; VE <b>90.9% (95% CI, 84 to 94.8)</b> against severe disease 2-9 weeks after 2<sup>nd</sup></p>	Serious	<p>Test-negative study in Brazil; 918,219 tests; time and setting for VOC Omicron</p> <p><b>(updated on June 22, 2022 to matched study design which includes municipality of residence)</b></p>

		<p>dose in individuals with hybrid immunity (prior infection) compared to no vaccination and no prior infection</p> <p>ChAdOx-1 (3 doses) showed VE 72.9% (95% CI, 72.2 to 73.5) against symptomatic infection 2-9 weeks after 3<sup>rd</sup> dose; VE 97.5% (95% CI, 96.6 to 98.1) against severe disease 2-9 weeks after 3<sup>rd</sup> dose in individuals with hybrid immunity (prior infection) compared to no vaccination and no prior infection</p> <p>ChAdOx-1 (2 doses) showed VE 49% (95% CI, 46.6 to 51.3) against symptomatic infection 2-9 weeks after 2<sup>nd</sup> dose; VE 90.2% (95% CI, 77.4 to 95.8) against severe disease 2-9 weeks after 2<sup>nd</sup> dose in individuals with hybrid immunity (prior infection) compared to no vaccination and no prior infection</p> <p>Ad26.COVS.2.S (2 doses) showed VE 47.2% (95% CI, 45.2 to 49.2) against symptomatic infection 2-9 weeks after 2<sup>nd</sup> dose; VE 97.5% (95% CI, 91.3 to 99.3) against severe disease 2-9 weeks after 2<sup>nd</sup> dose in individuals with hybrid immunity (prior infection) compared to no vaccination and no prior infection</p> <p>CoronaVac (3 doses) showed VE 74% (95% CI, 73.1 to 74.8) against symptomatic infection 2-9 weeks after 3<sup>rd</sup> dose; VE 95.9% (95% CI, 94.1 to 97.1) against severe disease 2-9 weeks after 3<sup>rd</sup> dose in individuals with hybrid immunity (prior infection) compared to no vaccination and no prior infection</p> <p>CoronaVac (2 doses) showed VE 49.3% (95% CI, 46.5 to 52) against symptomatic infection 2-9 weeks after 2<sup>nd</sup> dose; VE 78.4% (95% CI, 48.2 to 91) against severe disease 2-9 weeks after 2<sup>nd</sup> dose in individuals with hybrid immunity (prior infection) compared to no vaccination and no prior infection</p>		
192	<a href="#">Dale</a>	<p>BNT162b2 or mRNA-1273 (2 doses) showed VE 63% (95% CI, -9 to 88) against infection &gt;14 days after 2<sup>nd</sup> dose; VE 80% (95% CI, 15 to 95) against symptomatic infection &gt;14 days after 2<sup>nd</sup> dose; VE 88% (95% CI, -10 to 99) against death &gt;14 days after 2<sup>nd</sup> dose compared to no vaccination</p>	Serious	<p>Outbreak in a single short-term rehabilitation unit in the USA; 161 residents (analysis excluding immunocompromised residents); time and setting (partial</p>

				sequencing) for VOC Delta
193	<a href="#">Kim (2)</a>	<p><b>BNT162b2 or mRNA-1273 (3 doses)</b> showed VE 62% (95% CI, 48 to 72) against symptomatic infection &gt;7 days after 3<sup>rd</sup> dose compared to no vaccination (VOC Omicron)</p> <p><b>BNT162b2 or mRNA-1273 (2 doses)</b> showed VE 45% (95% CI, 14 to 66) against symptomatic infection 14-149 days after 2<sup>nd</sup> dose compared to no vaccination (VOC Omicron)</p> <p><b>BNT162b2 or mRNA-1273 (3 doses)</b> showed VE 96% (95% CI, 93 to 98) against symptomatic infection &gt;7 days after 3<sup>rd</sup> dose compared to no vaccination (VOC Delta)</p> <p><b>BNT162b2 or mRNA-1273 (2 doses)</b> showed VE 89% (95% CI, 78 to 94) against symptomatic infection 14-149 days after 2<sup>nd</sup> dose compared to no vaccination (VOC Delta)</p>	Serious	Test-negative study in the US; 3847 participants; time and setting for VOC Delta and VOC Omicron
194	<a href="#">Nasreen (2)</a>	<b>BNT162b2 or mRNA-1273 (2 doses)</b> showed VE 99% (95% CI, 97 to 99) against severe disease at least 7 days after 2 <sup>nd</sup> dose compared to no vaccination	Serious	Test-negative study in Canada; 2,508,296 participants; sequenced for VOC Delta
195	<a href="#">Petrie</a>	<b>BNT162b2 (majority) or mRNA-1273 (3 doses)</b> showed <b>relative effectiveness</b> 70% (95% CI, 51 to 81) against symptomatic infection* median 33 days after 3 <sup>rd</sup> dose <b>relative to 2 doses of BNT162b2 or mRNA-1273</b>	Serious	Prospective cohort in USA; 884 <b>fully vaccinated participants</b> ; time and setting for VOC Omicron  *from sensitivity analysis that excluded prior infection
196	<a href="#">Gram (2)</a>	<p><b>BNT162b2 or mRNA-1273 (3 doses)</b> showed VE 57.6% (95% CI, 55.8 to 59.4) against infection 14 to 30 days; VE 55.3% (95% CI, 53.6 to 56.9) against infection 31 to 60 days; VE 58.3% (95% CI, 56.5 to 60.0) against infection 61 to 90 days after the 3<sup>rd</sup> dose (VOC Omicron age 60+)</p> <p><b>BNT162b2 or mRNA-1273 (2 doses)</b> showed VE 39.9% (95% CI, 26.4 to 50.9) against infection 14 to 30 days; VE 39.2% (27.8 to 48.8) against infection 31 to 60 days; VE 26.4% (95% CI, 10.4 to 39.6) against infection 61 to 90 days after 2<sup>nd</sup> dose (VOC Omicron age 60+)</p>	Serious	Population cohort study in Denmark (age 12+); 530,635 participants over age 60; sample sequenced for VOC Omicron
197	<a href="#">Bjork (2)</a>	<b>BNT162b2 (majority) (3 doses)</b> showed VE 94% (95% CI, 76 to 98) against severe disease	Serious	Continuous density case-control study in Sweden; 1,419 BA.1 and 3,388

		<p>unknown number of days<sup>^</sup> after 3<sup>rd</sup> dose (VOC Omicron BA.1 age 65+)</p> <p>BNT162b2 (majority) (2 doses) showed VE 84% (95% CI, 37 to 96) against severe disease unknown number of days after 2<sup>nd</sup> dose (VOC Omicron BA.1 age 65+)</p> <p>BNT162b2 (majority) (3 doses*) showed VE 82% (95% CI, 56 to 93) against severe disease unknown number of days after 3<sup>rd</sup> dose (VOC Omicron BA.2 age 65+)</p> <p>BNT162b2 (majority) (2 doses) showed VE 43% (95% CI, 0 to 79) against severe disease unknown number of days after 3<sup>rd</sup> dose (VOC Omicron BA.2 age 65+)</p>		<p>BA.2 participants; sequenced for VOC Omicron (by subtype); transition period not reported here</p> <p>*9 BA.2 participants had 4 doses</p> <p><sup>^</sup>majority less than 3 months but a smaller proportion &gt;6 months</p>
198	<a href="#">Carazo (2)</a>	<p><b>BNT162b2 or mRNA-1273 (3 doses) + non-Omicron infection</b> showed VE 83% (95% CI, 81 to 84) against reinfection up to 60 days after 3<sup>rd</sup> dose</p> <p><b>BNT162b2 or mRNA-1273 (2 doses) + non-Omicron infection</b> showed VE 82% (95% CI, 80 to 84) against reinfection up to 60 days after 3<sup>rd</sup> dose; VE 67% (95% CI, 65 to 68) against reinfection up to 150 days after 2<sup>nd</sup> dose</p> <p><b>BNT162b2 or mRNA-1273 (1 dose) + non-Omicron infection</b> showed VE 81% (95% CI, 74 to 86) against reinfection up to 60 days after dose; VE 64% (95% CI, 60 to 67) against reinfection up to 150 days after dose</p>	Serious	<p>Test-negative study in Canada; 39,217 <b>previously infected</b> participants; sample sequenced for VOC Omicron</p>
199	<a href="#">Castillo (3)</a>	<p>BNT162b2 (majority) (3 doses) showed VE 67% (95% CI, 67 to 68) against symptomatic infection 15 to 30 days after 3<sup>rd</sup> dose; VE 59% (95% CI, 59 to 60) against symptomatic infection 30 to 60 days after 3<sup>rd</sup> dose; VE 58% (95% CI, 57 to 59) against symptomatic infection 60 to 90 days after 3<sup>rd</sup> dose</p> <p>BNT162b2 (majority) (3 doses) showed VE 82% (95% CI, 72 to 92) against death 15 to 30 days after 3<sup>rd</sup> dose; VE 85% (95% CI, 79 to 90) against death 30 to 60 days after 3<sup>rd</sup> dose; VE 86% (95% CI, 80 to 92) against death 60 to 90 days after 3<sup>rd</sup> dose</p> <p>BNT162b2 (majority) (2 doses) showed VE 32% (95% CI, 30 to 34) against symptomatic infection 30 to 60 days after 2<sup>nd</sup> dose; VE 27% (95% CI, 26 to 29) against symptomatic infection 60 to 90</p>	Serious	<p>Test-negative study in France; <b>2,701,992</b> participants; sequenced for VOC Omicron</p>

		<p>days after 2<sup>nd</sup> dose; VE 26% (95% CI, 24 to 27) against symptomatic infection 90 to 120 days after 2<sup>nd</sup> dose</p> <p>BNT162b2 (majority) (2 doses) showed VE 62% (95% CI, 33 to 90) against death 30 to 60 days after 2<sup>nd</sup> dose; VE 88% (95% CI, 71 to 105) against death 60 to 90 days after 2<sup>nd</sup> dose; VE 57% (95% CI, 35 to 78) against death 90 to 120 days after 2<sup>nd</sup> dose</p>		
200	<a href="#">Cerqueira-Silva (4)</a>	<p>BNT162b2 (3 doses) showed VE 36.9% (95% CI, 36.2 to 37.6) against symptomatic disease 14 to 63 days after 3<sup>rd</sup> dose; VE 74.5% (95% CI, 71.4 to 77.2) against severe disease (hospitalization or death) 14 to 63 days after 3<sup>rd</sup> dose (Brazil)</p> <p><b>ChAdOx1 (2 doses) + BNT162b2 booster</b> showed VE 15.9% (95% CI, 14.3 to 17.4) against symptomatic disease 14 to 63 days after 3<sup>rd</sup> dose; VE 66.7% (95% CI, 61 to 71.6) against severe disease (hospitalization or death) 14 to 63 days after 3<sup>rd</sup> dose (Brazil)</p> <p><b>BNT162b2 (2 doses) + mRNA booster</b> showed VE 43.7% (95% CI, 37.3 to 49.5) against symptomatic disease 14 to 63 days after 3<sup>rd</sup> dose; VE 68.8% (95% CI, -87 to 94.8) against severe disease (hospitalization or death) 14 to 63 days after 3<sup>rd</sup> dose (Scotland)</p> <p><b>ChAdOx1 (2 doses) + mRNA booster</b> showed VE 18.1% (95% CI, -6.7 to 37.2) against symptomatic disease 14 to 63 days after 3<sup>rd</sup> dose (Scotland)</p>	Serious	Test-negative study in Brazil and Scotland; 4,219,703 and 370,556 participants, respectively; time and setting for VOC Omicron
201	<a href="#">Kirsebom (2)</a>	<p>BNT162b2 (3 doses) showed VE 68.5% (95% CI, 65.7 to 71.2) against symptomatic infection 14 to 34 days after 3<sup>rd</sup> dose; 54.1% (95% CI, 50.5 to 57.5) against symptomatic infection 35 to 69 days after 3<sup>rd</sup> dose; VE 40.1% (95% CI, 35.2 to 44.5) against symptomatic infection 70 to 104 days after 3<sup>rd</sup> dose</p> <p>ChAdOx1 (3 doses) showed VE 51.6% (95% CI, 20.8 to 70.4) against symptomatic infection 14 to 34 days after 3<sup>rd</sup> dose; 44.5% (95% CI, 22.4 to 60.2) against symptomatic infection 35 to 69 days after 3<sup>rd</sup> dose; VE -27.2% (95% CI, -131.6 to 30.1) against symptomatic infection 70 to 104 days after 3<sup>rd</sup> dose</p>	Serious	Test-negative study in England; 43,171 ChAdOx1 boosted and 13,038,908 BNT162b2 boosted; sequencing or proxy for VOC Omicron (only 65+ reported here)

202	<a href="#">Suah (2)</a>	<p>BNT162b2 (3 doses) showed <b>relative effectiveness</b> 51.1% (95% CI, 50.3 to 51.9) against infection up to 90 days post 3<sup>rd</sup> dose <b>compared to BNT162b2 (2 doses)</b></p> <p>ChAdOx1 (3 doses) showed relative VE 30.1% (95% CI, 28.4 to 31.8) against infection up to 90 days post 3<sup>rd</sup> dose <b>compared to BNT162b2 (2 doses)</b></p> <p>CoronaVac (3 doses) showed relative VE 33.4% (95% CI, 31.9 to 34.9) against infection up to 90 days post 3<sup>rd</sup> dose <b>compared to BNT162b2 (2 doses)</b></p> <p><b>ChAdOx1 (2 doses) + BNT162b2</b> showed relative VE 53.0% (95% CI, 51.6 to 54.3) against infection up to 90 days post 3<sup>rd</sup> dose <b>compared to BNT162b2 (2 doses)</b></p> <p><b>CoronaVac (2 doses) + BNT162b2</b> showed relative VE 47.6% (95% CI, 46.9 to 48.3) against infection up to 90 days post 3<sup>rd</sup> dose <b>compared to BNT162b2 (2 doses)</b></p> <p><b>CoronaVac (2 doses) + ChAdOx1</b> showed relative VE 49.0% (95% CI, 46.7 to 51.3) against infection up to 90 days post 3<sup>rd</sup> dose <b>compared to BNT162b2 (2 doses)</b></p>	Serious	Test-negative study in Malaysia; 955,829 <b>fully vaccinated</b> participants; time and setting for VOC Omicron and VOC Delta (only VOC Omicron results reported here)
203	<a href="#">Amir</a>	<p>BNT162b2 (4 doses) showed rate ratio of 9.2 (95% CI, 7.9 to 10.7) against severe disease up to 60 days after 4<sup>th</sup> dose <b>compared to BNT162b2 (2 doses)</b></p> <p>BNT162b2 (3 doses) showed rate ratio of 2.3 (95% CI, 1.6 to 3.4) against severe disease up to 30 days after 3<sup>rd</sup> dose; rate ratio of 2.9 (95% CI, 1.8 to 4.7) against severe disease 30 to 60 days after 3<sup>rd</sup> dose; rate ratio 3.1 (95% CI, 2.2 to 4.6) against severe disease 60 to 90 days after 3<sup>rd</sup> dose <b>compared to BNT162b2 (2 doses)</b></p>	Serious	Retrospective cohort in Israel; 1,178,704 <b>fully vaccinated</b> participants; time and setting for VOC Omicron
204	<a href="#">Lind</a>	<p><b>BNT162b2 or mRNA-1273 (3 doses)</b> showed VE 38.1% (95% CI, 18.6 to 52.9) against infection up to 14 days after 3<sup>rd</sup> dose in participants <b>without prior infection</b>; VE 36.3% (95% CI, -71.8 to 76.4) against infection up to 14 days after 3<sup>rd</sup> dose in <b>previously infected</b> participants</p> <p><b>BNT162b2 or mRNA-1273 (2 doses)</b> showed VE 28.5% (95% CI, 20 to 36.2) against infection up to 149 days after 2<sup>nd</sup> dose in participants</p>	Moderate	Test-negative study in USA; 130,073 participants; proxy for VOC Omicron BA.1

		<p>without prior infection; VE 36.1% (95% CI, 7.1 to 56.1) against infection up to 149 days after 2<sup>nd</sup> dose in previously infected participants</p> <p>BNT162b2 or mRNA-1273 (3 doses) showed relative effectiveness 54% (95% CI, 48 to 60) against infection 14 to 59 days after 3<sup>rd</sup> dose compared to 2 doses; relative effectiveness 47% (95% CI, 37 to 56) against infection 60 to 89 days after 3<sup>rd</sup> dose compared to 2 doses</p>		
205	<a href="#">Rennert</a>	<p>BNT162b2 (3 doses) showed VE 42.8% (95% CI, 22.7 to 57.6) against infection median of 1.31 months after 3<sup>rd</sup> dose (students: 18 to 24); 74.3% (95% CI, 42.1 to 88.6) against infection median of 2.03 months after 3<sup>rd</sup> dose (employees: 18 to 64)</p> <p>BNT162b2 (2 doses) showed VE 2.1% (95% CI, -21.2 to 21.0) against infection median of 4.3 months after 2<sup>nd</sup> dose (students: 18 to 24); 30.1% (95% CI, -24.5 to 60.8) against infection median of 4.5 months after 2<sup>nd</sup> dose (employees: 18 to 64)</p> <p>mRNA-1273 (3 doses) showed VE 48.5% (95% CI, 25.0 to 64.7) against infection median of 1.31 months after 3<sup>rd</sup> dose (students: 18 to 24); 60.4% (95% CI, 32.4 to 76.8) against infection median of 2.03 months after 3<sup>rd</sup> dose (employees: 18 to 64)</p> <p>mRNA-1273 (2 doses) showed VE 17.3% (95% CI, -10.8 to 38.3) against infection median of 4.3 months after 2<sup>nd</sup> dose (students: 18 to 24); 14.4% (95% CI, -64.2 to 55.4) against infection median of 4.5 months after 2<sup>nd</sup> dose (employees: 18 to 64)</p>	Serious	Propensity-matched retrospective cohort in USA; 1,944 students and 658 employees; time and setting for VOC Omicron
206	<a href="#">Braeye (2)</a>	<p>ChAdOx1 (2 doses) or Ad26.COVS.2.S (1 dose) followed by BNT162b2 or mRNA-1273 showed VE 52% (95% CI, 52 to 53) against symptomatic infection up to 100 days after booster dose; VE 25% (95% CI, 24 to 27) against symptomatic infection at 100 to 150 days after booster dose</p> <p>ChAdOx1 (2 doses) or Ad26.COVS.2.S (1 dose) showed VE 37% (95% CI, 34 to 40) against symptomatic infection up to 50 days after last dose</p>	Serious	Test-negative study from Belgium; 1,433,135 participants; time and setting for VOC Delta and VOC Omicron (only Omicron data shown here)

207	<a href="#">Butt (5)</a>	<p>BNT162b2 (3 doses) showed <b>relative VE</b> 11% (95% CI, 7 to 14) against infection up to 120 days after 3<sup>rd</sup> dose; <b>relative VE</b> 88% (95% CI, 68 to 96) against severe disease or death up to 120 days after 3<sup>rd</sup> dose <b>relative to 2 doses of BNT162b2</b></p> <p>mRNA-1273 (3 doses) showed <b>relative VE</b> 27% (95% CI, 24 to 30) against infection up to 120 days after 3<sup>rd</sup> dose; <b>relative VE</b> 72% (95% CI, 24 to 90) against severe disease or death up to 120 days after 3<sup>rd</sup> dose <b>relative to 2 doses of mRNA-1273</b></p>	Serious	Retrospective cohort study of veterans (median age 71) in the US; 925,900 <b>fully vaccinated</b> participants; time and setting for VOC Omicron
208	<a href="#">Accorsi</a>	<p>BNT162b2 (3 doses) showed VE 66.8% (95% CI, 66 to 67.6) against symptomatic infection 14 day to 30 days after 3<sup>rd</sup> dose; VE 59.6% (95% CI, 58.9 to 60.3) against symptomatic infection 60 to 120 days after 3<sup>rd</sup> dose</p> <p>mRNA-1273 (3 doses) showed VE 71.3% (95% CI, 70.4 to 72.1) against symptomatic infection 14 day to 30 days after 3<sup>rd</sup> dose; VE 66.8% (95% CI, 66.1 to 67.5) against symptomatic infection 60 to 120 days after 3<sup>rd</sup> dose</p> <p>Ad26.COVS.2.S (2 doses) showed VE 28% (95% CI, 18.3 to 36.5) against symptomatic infection 14 to 30 days after 2<sup>nd</sup> dose; VE 29.3% (95% CI, 23.2 to 34.9) against symptomatic infection 60 to 120 days after 2<sup>nd</sup> dose</p> <p><b>Ad26.COVS.2.S followed by BNT162b2</b> showed VE 58.9% (95% CI, 54.6 to 62.8) against symptomatic infection 14 to 30 days after 2<sup>nd</sup> dose; VE 51.5% (95% CI, 48.3 to 54.5) against symptomatic infection 60 to 120 days after 2<sup>nd</sup> dose</p> <p><b>Ad26.COVS.2.S followed by mRNA-1273</b> showed VE 63.7% (95% CI, 59.7 to 67.3) against symptomatic infection 14 to 30 days after 2<sup>nd</sup> dose; VE 56.7% (95% CI, 53.9 to 59.3) against symptomatic infection 60 to 120 days after 2<sup>nd</sup> dose</p> <p>Ad26.COVS.2.S showed VE 17.9% (95% CI, 4.3 to 29.5) against symptomatic infection 14 to 30 days after dose; VE 8.4% (95% CI, 1.5 to 14.8) against symptomatic infection 60 120 days after dose</p>	Serious	<p>Test-negative study in US; 512,928 participants; time and setting for VOC Omicron</p> <p><b>(includes heterologous vaccines)</b></p>

209	<a href="#">Nielsen</a>	BNT162b2 (84%) (2 doses) showed VE 60% (95% CI, 58 to 62) against reinfection 14 to 43 days after 2 <sup>nd</sup> dose; VE 43% (95% CI, 39 to 46) against reinfection 44 to 73 days after 2 <sup>nd</sup> dose; VE 34% (95% CI, 32 to 37) against reinfection 104 to 133 days after 2 <sup>nd</sup> dose <b>compared to previously infected and unvaccinated</b>	Serious	Population cohort study in Denmark; 245,530 <b>previously infected</b> participants; time and setting for VOC Omicron (results for VOC Alpha and VOC Delta not reported here)
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## Section 2: excluded studies

Author	Reason for exclusion
<a href="#">Abu-Raddad (3)</a>	Vaccine effectiveness not reported
<a href="#">Akhrass</a>	Delayed exclusion – Clinical outcomes of interest for this LES not reported
<a href="#">Albahrani</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Alencar</a>	Critical risk of bias
<a href="#">Alhamlan</a>	Vaccine effectiveness not reported
<a href="#">Alharbi</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Ali</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Alkhafaji</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Allen</a>	Serious risk of bias
<a href="#">Allen(2)</a>	Results not reported according to vaccine type/brand
<a href="#">Almadhi</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Almufty</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Al-Qahtani</a>	Delayed exclusion – critical risk of bias
<a href="#">Andeweg</a>	Vaccine effectiveness not reported
<a href="#">Andeweg (2)</a>	Results not reported according to vaccine type/brand
<a href="#">Apisarntharak</a>	Vaccine effectiveness not reported
<a href="#">Arashiro</a>	Vaccine effectiveness not reported
<a href="#">Araujo</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Auvigne</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Ayass</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Baden</a>	Critical risk of bias
<a href="#">Bailly</a>	Delayed exclusion – critical risk of bias
<a href="#">Bajema</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Bajema (2)</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Bal</a>	Vaccine effectiveness not reported
<a href="#">Barchuk</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Belayachi</a>	Results not reported by variant
<a href="#">Bello-Chavolla</a>	Results not reported according to VOC
<a href="#">Bergwerk</a>	Vaccine effectiveness not reported
<a href="#">Bernal (2)</a>	Delayed exclusion – critical risk of bias
<a href="#">Bhatnagar</a>	Critical risk of bias
<a href="#">Bhattacharya</a>	Delayed exclusion – critical risk of bias
<a href="#">Bianchi</a>	Delayed exclusion – critical risk of bias
<a href="#">Bjork</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Blaiszik</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Blaiszik</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Borobia</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Bosch</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Branda</a>	Results not reported according to vaccine type/brand
<a href="#">Britton</a>	Prevalence of variants unknown and suspected to be <50%

<a href="#">Britton (2)</a>	Critical risk of bias
<a href="#">Brown</a>	Vaccine effectiveness not reported
<a href="#">Brunelli</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Bruxvoort</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Butt</a>	Critical risk of bias
<a href="#">Butt (2)</a>	Delayed exclusion – critical risk of bias
<a href="#">Butt (3)</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Cabezas</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Caillard</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Cardona</a>	Vaccine effectiveness not reported
<a href="#">Cavanaugh</a>	Delayed exclusion – VOI not VOC
<a href="#">Chadeau-Hyams(2)</a>	Results not reported according to vaccine type/brand
<a href="#">Chaguza</a>	Vaccine effectiveness not reported
<a href="#">Charles Pon Ruban</a>	Vaccine effectiveness not reported
<a href="#">Charmet</a>	Serious risk of bias
<a href="#">Chau</a>	Vaccine effectiveness not reported
<a href="#">Chemaitelly (6)</a>	Results not reported according to time post 2nd dose or VOC
<a href="#">Christensen</a>	Vaccine effectiveness not reported
<a href="#">Chung (2)</a>	Results not reported according to vaccine type/brand
<a href="#">Clemens</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Cohen</a>	Vaccine effectiveness not reported
<a href="#">Cohen(2)</a>	Vaccine effectiveness not reported
<a href="#">Collie</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Corchado-Garcia</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Corrao</a>	Results not reported according to vaccine type/brand
<a href="#">Cura-Bilbao</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Dash</a>	Critical risk of bias
<a href="#">Davies</a>	Results not reported according to vaccine type/brand
<a href="#">de Gier Brechje</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">De Jesus</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Dickerman</a>	Results reported comparison of two vaccines (no unvaccinated or early vaccinated groups)
<a href="#">Dolzhikova</a>	Critical risk of bias
<a href="#">Domi</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Drawz</a>	Critical risk of bias
<a href="#">Eick-Cost</a>	Results not reported for variants of interest for this LES (Only reported Delta variant)
<a href="#">El Sahly</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Ella</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Elliot</a>	Delayed exclusion – critical risk of bias
<a href="#">El-Sahly</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Epaulard</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Falsey</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Fang</a>	Modelling study

<a href="#">Farah</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Farinholt</a>	Vaccine effectiveness not reported
<a href="#">Ferdinands</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Fisher</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Fisman (2)</a>	Results not reported according to vaccine type/brand
<a href="#">Flacco</a>	Results not reported according to vaccine type/brand
<a href="#">Frenck</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Furer</a>	Delayed exclusion – critical risk of bias
<a href="#">Gardner</a>	Modelling study
<a href="#">Geisen</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Gharpure</a>	Vaccine effectiveness not reported
<a href="#">Ghosh</a>	Delayed exclusion – critical risk of bias
<a href="#">Gils</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Goga</a>	Vaccine effectiveness not reported
<a href="#">Gorgels</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Grannis</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Gray</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Gray (2)</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Griffin</a>	Vaccine effectiveness not reported
<a href="#">Guijarro</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Gupta</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Gupta</a>	Vaccine effectiveness not reported
<a href="#">Haas (2)</a>	Modelling study
<a href="#">Hacisuleyman</a>	Critical risk of bias
<a href="#">Hardt</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Harris</a>	Modelling study
<a href="#">Herlihy</a>	Delayed exclusion – critical risk of bias
<a href="#">Hetemaki</a>	Vaccine effectiveness not reported
<a href="#">Hitchings (3)</a>	Vaccine effectiveness not reported
<a href="#">Hitchings(2)</a>	Delayed exclusion – critical risk of bias
<a href="#">Hollinghurst</a>	Serious risk of bias
<a href="#">Hyams</a>	Delayed exclusion - Clinical outcomes of interest for this LES not reported
<a href="#">Iliaki</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Iliaki</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Ioannou</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Ismail</a>	Delayed exclusion - Clinical outcomes of interest for this LES not reported
<a href="#">Jacobson</a>	Critical risk of bias
<a href="#">John</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Johnson</a>	Results not reported according to vaccine type/brand
<a href="#">Jones</a>	Critical risk of bias
<a href="#">Jucker</a>	Results not reported according to vaccine type/brand
<a href="#">Kaabi</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Kahn</a>	Results not reported according to vaccine type/brand

<a href="#">Kale</a>	Delayed exclusion – critical risk of bias
<a href="#">Kaur</a>	Delayed exclusion – critical risk of bias
<a href="#">Keegan</a>	Critical risk of bias
<a href="#">Kemp</a>	Modelling study
<a href="#">Khan</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Khawaja</a>	Critical risk of bias
<a href="#">Kislaya</a>	Vaccine effectiveness not reported
<a href="#">Kislaya (2)</a>	Results reported comparison of two variants
<a href="#">Kojima</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Kshirsagar</a>	Vaccine effectiveness not reported
<a href="#">Kustin</a>	Delayed exclusion - only included infected population
<a href="#">Lamprini</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Lan</a>	Results not reported according to vaccine type/brand
<a href="#">Lauring</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Lee</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Lefèvre</a>	Critical risk of bias
<a href="#">León</a>	Results not reported according to vaccine type/brand
<a href="#">Levin-Rector</a>	Only included previously infected
<a href="#">Lewis</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Lewnard</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Li</a>	Phase 1 trial
<a href="#">Li (2)</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Li (3)</a>	Delayed exclusion – critical risk of bias
<a href="#">Ling</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Linsenmeyer</a>	Vaccine effectiveness not reported
<a href="#">Lippi</a>	Results not reported according to vaccine type/brand
<a href="#">Lippi (2)</a>	Critical risk of bias
<a href="#">Liu</a>	Vaccine effectiveness not reported
<a href="#">Loconsole</a>	Vaccine effectiveness not reported
<a href="#">Luo</a>	Vaccine effectiveness not reported
<a href="#">Lyngse (2)</a>	Results not reported according to vaccine type/brand
<a href="#">Lytras</a>	For Waning LES
<a href="#">Ma</a>	Critical risk of bias
<a href="#">Maeda</a>	Critical risk of bias
<a href="#">Mallow</a>	Results not reported according to time frame: cannot separate Alpha from Delta
<a href="#">Marco</a>	Delayed exclusion – critical risk of bias
<a href="#">Marquis</a>	Vaccine effectiveness not reported
<a href="#">Martelucci</a>	Results not reported according to vaccine type/brand (during the Omicron timeframe)
<a href="#">Mattar</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Mattiuzzi</a>	Results not reported according to vaccine type/brand
<a href="#">Maurya</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Mazgatos</a>	Critical risk of bias
<a href="#">McEvoy</a>	Prevalence of variants unknown and suspected to be <50%

<a href="#">McKeigue(2)</a>	Results not reported according to vaccine type/brand
<a href="#">Medic</a>	Results not reported according to vaccine type/brand
<a href="#">Medic</a>	Results not reported according to vaccine type/brand
<a href="#">Menni</a>	Serious risk of bias
<a href="#">Mielke</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Mirahmadizadeh</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Mizrahi</a>	Modelling study
<a href="#">Molani</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Monge</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Mor</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Moustsen-Helms</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Munitz</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Munro</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Murali</a>	Results not reported for variants of interest for this LES (Only reported Delta variant)
<a href="#">Murison</a>	Results not reported according to vaccine type/brand
<a href="#">Musser</a>	Vaccine effectiveness not reported
<a href="#">Mutnal</a>	Vaccine effectiveness not reported
<a href="#">Nabirova</a>	Results not reported for variants of interest for this LES (Only reported Delta variant)
<a href="#">Nanduri</a>	Critical risk of bias
<a href="#">Natarajan</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Nguyen</a>	Results not reported according to vaccine type/brand
<a href="#">Nguyen (2)</a>	Vaccine reported is not approved by health Canada (Nanocovax vaccine)
<a href="#">Niessen</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Nordstrom (3)</a>	Results not reported according to VOC
<a href="#">Nordstrom (4)</a>	Results not reported according to VOC
<a href="#">Nyberg</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Oduwole</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Olmedo</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Olson</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Open-SAFELY</a>	Vaccine effectiveness not reported
<a href="#">Ostropolets</a>	Not reported separately according to variant
<a href="#">Palacios</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Pardo-Seco</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Paredes</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Paris</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Pattni</a>	Modelling study
<a href="#">Pawlowski</a>	Critical risk of bias
<a href="#">Peralta-Santos</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Perrella</a>	Vaccine effectiveness not reported
<a href="#">Perry</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Perry</a>	Results not reported according to vaccine type/brand
<a href="#">Peter</a>	Vaccine effectiveness not reported
<a href="#">Peter</a>	Vaccine effectiveness not reported

<a href="#">Pilishvili</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Piltch-Loeb</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Plumb</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Plumb</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Polinski</a>	Delayed exclusion – critical risk of bias
<a href="#">Poukka</a>	Critical risk of bias
<a href="#">Pulliam</a>	Modelling study
<a href="#">Raches Ella</a>	Phase 1 trial
<a href="#">Rana</a>	Critical risk of bias
<a href="#">Regev-Yochay</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Reynolds</a>	Results not reported according to vaccine type/brand
<a href="#">Richardson</a>	Results not reported for variants of interest for this LES (Only reported Delta variant)
<a href="#">Riemersma</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Riley</a>	Critical risk of bias
<a href="#">Rivelli</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Robinson</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Rosero-Bixby</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Rovida</a>	Critical risk of bias
<a href="#">Rudolph</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Salmeron Rios</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Sansone</a>	Critical risk of bias
<a href="#">Satwik</a>	Delayed exclusion – critical risk of bias
<a href="#">Scobie</a>	Delayed exclusion – critical risk of bias
<a href="#">Self</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Sharma</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Sheikh (3)</a>	Results not reported according to vaccine type/brand
<a href="#">Shimabukuro</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Shrotri</a>	Delayed exclusion – critical risk of bias
<a href="#">Simon</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Simşek-Yavuz</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Smoliga</a>	Critical risk of bias
<a href="#">Starrfelt</a>	Serious risk of bias
<a href="#">Stowe (2)</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Suri</a>	Vaccine effectiveness not reported
<a href="#">Suryatma</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Swift</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Tande</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Tanriover</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Taquet</a>	Modelling study
<a href="#">Tartof (3)</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Tenforde</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Tenforde (2)</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Tenforde (3)</a>	Clinical outcomes of interest for this LES not reported

<a href="#">Thangaraj</a>	Critical risk of bias
<a href="#">Thiruvengadam</a>	Critical risk of bias
<a href="#">Thompson (1)</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Thompson (2)</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">thompson (4)</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Tobolowsky</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Ulloa</a>	Vaccine effectiveness not reported
<a href="#">Uschner</a>	Critical risk of bias
<a href="#">Vahidy</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Vasileiou</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Veerapu</a>	Results not reported for variants of interest for this LES (Only reported Delta variant)
<a href="#">Veneti</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Victor</a>	Critical risk of bias
<a href="#">Vo</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Voko</a>	Results not reported for variants of interest for this LES (Only reported Delta variant)
<a href="#">Volkov</a>	Modelling study
<a href="#">Voysey</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Waldhorn</a>	Serious risk of bias
<a href="#">Wang</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Ward</a>	Results not reported according to vaccine type/brand
<a href="#">Waxman</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Wickert</a>	Critical risk of bias
<a href="#">Wijtvliet</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Williams (2)</a>	Critical risk of bias
<a href="#">Wolff</a>	Vaccine effectiveness not reported
<a href="#">Woolley</a>	Results not reported according to vaccine type/brand
<a href="#">Wright</a>	Results not reported according to vaccine type/brand
<a href="#">Xiang</a>	Clinical outcomes of interest for this LES not reported
<a href="#">Young-Xu</a>	Prevalence of variants unknown and suspected to be <50%
<a href="#">Young-Xu (4)</a>	Critical risk of bias
<a href="#">Zacay</a>	Delayed exclusion – critical risk of bias
<a href="#">Zhang</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Zheutlin</a>	Results not reported for variants of interest for this LES (Only reported Alpha variant)
<a href="#">Zhong</a>	Clinical outcomes of interest for this LES not reported

## Appendix 2: Glossary

**AZ:** AstraZeneca

**Alpha:** variant of concern B.1.1.7

**Beta:** variant of concern B.1.351

**Delta:** variant of concern B.1.617.2

**Gamma:** variant of concern P.1

**Epsilon:** variant of concern B.1.427/B.1.429

**HCW:** Healthcare workers

**LTC:** Long-term care

**LTCF:** Long-term care facility

**MOD:** Moderna

**Obs:** observational study

**Omicron:** variant of concern B.1.1.529

**OR:** odds ratio

**PF:** Pfizer

**RME:** range of mean estimates across 2 or more studies

**VE (Vaccine effectiveness):** measure of how well a vaccine protects people from getting the outcome of interest in real-world practice (For example: VE of 92% against infection means that 92% of people will be protected from becoming infected with COVID and 8% of people will still be at risk of becoming infected with COVID)

**VES:** vaccine effectiveness against susceptibility (vaccinated contact)

**VET:** vaccine effectiveness against transmission (vaccinated index case)

**VOC:** variant of concern

**VOI:** variant of interest

### Appendix 3: Data-extraction template

<b>Vaccine product</b>	
Source	First author of study
Link	DOI or Pubmed ID
Date published	in format YYYY/MM/DD or preprint
Country	
Funding	public or industry
<b>Study details</b>	
Study type	RCT/cohort/data-linkage/test-negative/case-control/other
Surveillance	routine screening Y or N
Population(s)	general public/LTC/Households/HCW/Other
Control group	not vaccinated, <7day vaccinated internal control, none, other
Total (N)	number of all study participants
Female	number or %
LTC	number or %
HCW	number or %
Households	number or %
>80	number or %
>70	number or %
>60	number or %
<b>Outcomes</b>	outcomes separated by VOC type
Outcomes	confirmed infection/asymptomatic/mild symptomatic/severe symptoms/hospitalized/ICU/death
1st Dose VE	VE with 95% CI
Days post 1st dose	days post 1st dose when VE provided
2nd Dose VE	VE with 95% CI
Days post 2nd dose	days post 2nd dose when VE provided
Rates per X person-days/years	vaccinated vs control
HR	vaccinated vs control
RR	vaccinated vs control
Adjusted	Regression, stratification, matching and associated variables
<b>Transmission</b>	infection rates in unvaccinated contacts of vaccinated individuals
<b>Critical appraisal</b>	See Appendix 5

#### **Appendix 4: Process for assigning Variant of Concern to studies**

A Variant of Concern is considered to be the dominant ( $\geq 50\%$ ) strain in a study if any of the following conditions apply:

- i) the authors make a statement about prevalence of VOC during the study time frame
- ii) time and setting of the study is consistent with a VOC being dominant according to the following open tracking sources:

Nextstrain. Real-time tracking of pathogen evolution. <https://nextstrain.org/>  
Outbreak Info. <https://outbreak.info/location-reports>

## Appendix 5: Research question and critical appraisal process (revised 06 Oct 2021)

Review question:

Participants	People at risk of COVID-19 (usually without but sometimes with previous COVID-19 infection)
Intervention	COVID-19 Vaccine
Comparator	Unvaccinated people (*)
Outcomes	PCR-diagnosis of COVID-19 infection (**); symptomatic disease; hospital/ICU admission; death; transmission

(\*) before-after studies, where the infection rate in the first 2 weeks after the vaccination are used as control are (\*\*)

(\*\*) commonly performed and may be appraised confirmation of specific variant, or reasonable evidence the variant was the dominant circulating strain

### Critical Appraisal Process

We appraise the quality of the individual studies using an adapted version of ROBINS-I. This tool classifies the Risk of Bias of a study as **Low, Moderate, Serious, Critical, or No Information**. Low Risk of Bias indicates High Quality, and Critical Risk of Bias indicates Very Low (insufficient) Quality. ROBINS-I appraises 7 bias domains and judges each study against an ideal reference randomized controlled trial. To improve the utility of ROBINS-I for assessing studies reporting vaccine effectiveness, we have focused on study characteristics that introduce bias as reported in the vaccine literature. (WHO. Evaluation of COVID-19 vaccine effectiveness. Interim Guidance. 17 March 2021). Studies rated as “critical” risk of bias will not be included in the Summary statements on Page 1-2 (exception: if limited data available for an outcome for a VOC). An overall judgement of “serious” or “critical” is given when the study is judged to be at critical risk of bias in at least one domain. Three of more serious risk of bias domains is given an overall risk of bias of critical.

VE Study Characteristics that may introduce bias	Description
<b>Study design</b>  ROBINS-I: Bias in selection of participants into study	In cohort studies, people who get vaccinated may differ in health-seeking behaviour from people who do not get vaccinated; using a test-negative study design minimizes this type of bias  <u>Examples and typical judgement:</u> <ul style="list-style-type: none"> <li>• test-negative design with a clearly defined symptomatic study population (low)</li> <li>• test-negative design (mixed or unclear study population) or case-control or cohort design or data-linkage with no concerns (moderate)</li> <li>• cross-sectional design or case-control (concerns about whether controls had same access to vaccines/risk of exposure to COVID or unclear) or cohort design (concerns that exposed and non-exposed were not drawn from the same population) (serious)</li> </ul>
<b>Method for confirming vaccination</b>  ROBINS-I: Bias in classification of interventions	Questionnaires are prone to recollection bias; Population databases developed for purpose of tracking COVID vaccines minimize this type of bias  <u>Examples and typical judgement:</u> <ul style="list-style-type: none"> <li>• database linkage study (low)</li> <li>• Questionnaire with confirmation by an additional method (e.g. registry) of at least a subset of study population (moderate)</li> </ul>

	<ul style="list-style-type: none"> <li>• Questionnaire without confirmation by an additional method (serious)</li> <li>• Estimating vaccination status based on surveillance data alone (critical)</li> </ul>
<p><b>Databases used for retrieval of COVID test results, participant prognostic factors, and clinical outcomes</b></p> <p>ROBINS-I: Bias in classification of interventions</p>	<p>Databases developed for collecting data on COVID are less prone to bias due to missing information and misclassification</p> <p><u>Examples and typical judgement:</u></p> <ul style="list-style-type: none"> <li>• database for non-COVID purpose but with individual level data (moderate)</li> <li>• database for non-COVID purpose without individual level data (serious)</li> <li>• no or unclear description of database type (critical)</li> </ul>
<p><b>Assignment of infection start date</b></p> <p>ROBINS-I: Bias in classification of interventions</p>	<p>Using date of symptom onset (if within 10 days of testing) as infection start date reduces risk of misclassification bias (e.g., vaccinated participant who is reported as COVID+ may have been infected prior to receiving the vaccine or during non-immune period) and sensitivity of assays decreases over time</p> <p><u>Examples and typical judgement:</u></p> <ul style="list-style-type: none"> <li>• using a PCR positive test that was part of an ongoing standardized monitoring system (e.g., within a health network) (low)</li> <li>• using sample date without interview or documented confirmation of symptoms <math>\leq 10</math> days (relevant for symptomatic disease only) (serious)</li> </ul>
<p><b>Verification of symptoms</b></p> <p>ROBINS-I: Bias in classification of interventions</p>	<p>Prospective, standardized collection of symptoms from patients reduces risk of missing information bias; testing within 10 days after symptom onset reduces risk of false-negative COVID test</p> <p><u>Examples and typical judgement:</u></p> <ul style="list-style-type: none"> <li>• using sample date without patient report/ documented confirmation of symptoms <math>\leq 10</math> days (relevant for symptomatic disease only) (serious)</li> <li>• if symptomatic COVID is not an outcome (no information)</li> </ul>
<p><b>Accounting for non-immune period (first 14 days after first vaccine dose)</b></p> <p>ROBINS-I: Bias due to confounding</p>	<p>Reported absence of vaccine effect during non-immune period reduces risk of residual confounding bias</p> <p><u>Example/common case:</u></p> <ul style="list-style-type: none"> <li>• presence of an effect during non-immune period or result not reported (moderate)</li> <li>• unclear that non-immune period was considered (serious)</li> </ul>
<p><b>Inclusion of participants with prior COVID infection</b></p> <p>ROBINS-I: Bias due to confounding</p>	<p>Exclusion (or separate analysis) of participants with prior COVID infection reduces concern about differences in infectivity as well as risk-taking and health-seeking behaviour</p> <p><u>Examples and typical judgement:</u></p> <ul style="list-style-type: none"> <li>• inclusion of prior infection status as a covariate in the models (moderate)</li> <li>• previously infected not excluded or analyzed separately (serious)</li> </ul>

<p><b>Accounting for calendar time</b></p> <p>ROBINS-I: Bias due to confounding (time-varying confounding)</p>	<p>Accounting for calendar time reduces bias due to differences in vaccine accessibility and risk of exposure over time</p> <p><u>Examples and typical judgement:</u></p> <ul style="list-style-type: none"> <li>• use of time-varying statistics without explicit mention of adjustment for calendar time (moderate)</li> <li>• not taken into account but short-time frame (e.g. <math>\leq 2</math> months) (serious)</li> <li>• not taken into account and time frame <math>&gt; 2</math> months (critical)</li> </ul>
<p><b>Adjustment for prognostic factors</b></p> <p>ROBINS-I: Bias due to confounding</p>	<p>Adjustment for prognostic factors for COVID infection, severity of disease, and vaccination, such as age, gender, race, ethnicity, socioeconomic factors, occupation (HCW, LTC), and chronic medical conditions</p> <p><u>Examples and typical judgement:</u></p> <ul style="list-style-type: none"> <li>• no or insufficient adjustment for occupation (or number of tests as a surrogate for exposure risk) -exception age <math>&gt; 65</math> or LTCF resident (moderate)</li> <li>• no or insufficient adjustment for socioeconomic factors (or neighborhood or income as a surrogate), race, ethnicity (serious)</li> <li>• no or insufficient adjustment for age (any study population) or chronic medical conditions (LTC)(critical)</li> </ul>
<p><b>Testing frequency</b></p> <p>ROBINS-I: Bias in measurement of outcomes</p>	<p>Similar frequency of testing between groups reduces risk of bias introduced by detecting asymptomatic infection in one group but not in another (e.g. when only one group undergoes surveillance screening)</p> <p><u>Examples and typical judgement:</u></p> <ul style="list-style-type: none"> <li>• no systematic screening but consistent methods for detection in one group vs. the other, e.g., within health networks (moderate)</li> <li>• screening performed for a subset of both study groups (serious)</li> <li>• screening performed routinely in one study group but not in the other (critical)</li> </ul>

## Appendix 6: Detailed description of the narrative summary statement

We include studies with the following clinical outcomes: prevention of infection, severe disease (as defined by the study investigators), death, and prevention of transmission. These outcomes were selected because they are less susceptible to bias. If data are not available for these specific outcomes, but are available for symptomatic infection and/or hospitalization, data for these additional outcomes are provided temporarily. Studies reporting only antibody responses are excluded.

We aim at providing a lay language, standardized summary statement for each combination of vaccine and VOC for which we found evidence.

Where more than one study was found, we will provide a summary statement with a **range of the estimates across the studies.**

Where a single study provided data, we will provide the **estimate plus 95% confidence interval** for that study. As additional studies are added, the estimate plus confidence interval will be replaced by a range as described above.

In the summaries, “reach threshold” will be applied to mean estimates or range of mean estimates that are greater than or equal to 70% with lower limit of 95% CI at 50% or higher for infection and 90% with lower limit of 95% CI at 70% for severe disease (revised June 22, 2022 due to updated WHO criteria)

### Section 3: Special Groups (after 5 November 2021)

Author	Special Group
<a href="#">Arriola</a>	Healthcare workers
<a href="#">Ashmawy</a>	Healthcare workers
<a href="#">Baum (2)</a>	Elderly >70 years
<a href="#">Bedston</a>	Elderly >75 years
<a href="#">Bekker</a>	Healthcare workers
<a href="#">Bieber</a>	patients with autoimmune rheumatic diseases
<a href="#">Botton</a>	Elderly >75 years
<a href="#">Bukatko</a>	Homeless shelter residents
<a href="#">Butt (2)</a>	Veterans (on hemodialysis)
<a href="#">Can</a>	Healthcare workers
<a href="#">Cohen (3)</a>	Healthcare workers
<a href="#">Dujmovic</a>	Nursing Home residents
<a href="#">El Adam</a>	Healthcare workers
<a href="#">Embi</a>	Immunocompromised
<a href="#">Filon</a>	Healthcare workers
<a href="#">Gaio</a>	Healthcare workers
<a href="#">Goldhaber-Fiebert</a>	Prison residents and staff
<a href="#">Goldin</a>	LTCF
<a href="#">Gray (3)</a>	Healthcare workers
<a href="#">Grebe</a>	blood donors
<a href="#">Grewal</a>	LTCF
<a href="#">Hall (2)</a>	Healthcare workers
<a href="#">Helmsdal</a>	Healthcare workers
<a href="#">Iskander</a>	Coast guard personnel
<a href="#">Kaur (2)</a>	Healthcare workers
<a href="#">Kawasuji</a>	Healthcare workers
<a href="#">Krutikov</a>	LTCF
<a href="#">Kwon</a>	Organ Transplant Recipients
<a href="#">Lustig</a>	Healthcare workers
<a href="#">Malhotra</a>	Healthcare workers
<a href="#">Manteghinejad</a>	Cancer patients only
<a href="#">Marra</a>	Healthcare workers
<a href="#">McConeghy</a>	LTCF
<a href="#">Mohr</a>	Healthcare workers
<a href="#">Muhsen</a>	Healthcare workers
<a href="#">Nunes (2)</a>	Healthcare workers
<a href="#">Oliver</a>	Maintenance dialysis patients
<a href="#">Paixao</a>	Pregnant women
<a href="#">Petraš</a>	Healthcare workers
<a href="#">Quach</a>	Healthcare workers

<a href="#">Regev-Yochay (2)</a>	Healthcare workers
<a href="#">Salvatore</a>	Prison staff and prisoners
<a href="#">Sharma</a>	Veterans (elderly population)
<a href="#">Shen</a>	immunosuppressed patients
<a href="#">Shrestha (3)</a>	Healthcare workers
<a href="#">Shrotri (2)</a>	LTCF
<a href="#">Simwanza</a>	Prisoners
<a href="#">Smith</a>	Renal patients only
<a href="#">Spensley</a>	End-stage kidney disease patients
<a href="#">Spitzer</a>	Healthcare workers
<a href="#">Subbarao</a>	LTCF
<a href="#">Sultan</a>	Healthcare workers
<a href="#">Tai</a>	special population (NBA)
<a href="#">Yassi (2)</a>	Healthcare workers
<a href="#">Yoon</a>	Frontline workers
<a href="#">Young-Xu (3)</a>	Male Veterans