Results of COVID-19 Vaccine Effectiveness Studies: An Ongoing Systematic Review

Duration of Protection Weekly Summary Table

Updated July 28, 2022

Prepared by:

International Vaccine Access Center,
Johns Hopkins Bloomberg School of Public Health

and

World Health Organization

and

Coalition for Epidemic Preparedness Innovations

For comments or questions, please contact: Anurima Baidya at abaidya1@jhmi.edu or Karoline Walter at kwalte21@jhmi.edu

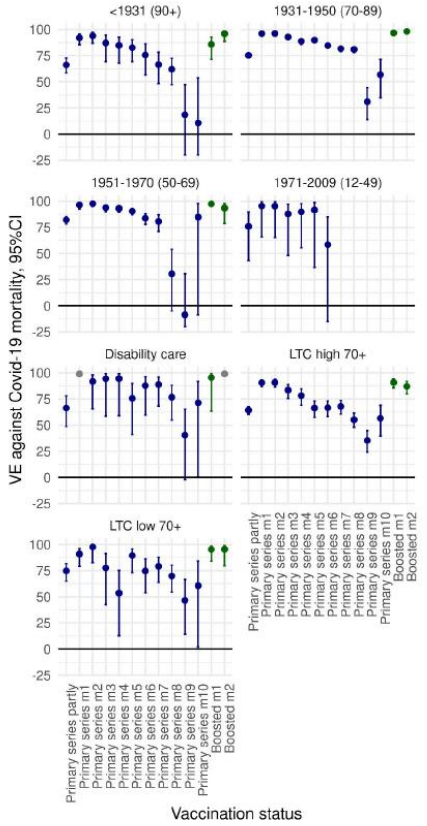
Duration of Protection Studies

These are studies that assess duration of protection criteria as outlined above along with those studies that do not meet aforementioned criteria that are relevant to evaluating duration of protection. Some of these studies are also in the above table but duplicated here for ease. As of April 28, 2022, those studies that provide VE estimates at least 4 months after the primary series or at least 2 months after the booster series are included below.

We would like to highlight:

- Countries have implemented different dose intervals and vaccination strategies that can make comparisons across studies challenging.
- Persons who are vaccinated early in a program are different than those who are vaccinated later. For example, many who were vaccinated early were those at highest risk, and this could confound the results. Some of the older individuals also might have some degree of immunosenescence.

#	Reference (date)	Country	Population	Dominant Variants	Vaccine product	Study Period	Descriptive Findings
185	De Gier et al (July 22, 2022)	Netherlands	General population	Alpha, Delta, Omicron	AZD1222 Comirnaty mRNA-1273 Ad26.COV2.S	January 1, 2021-January 31, 2022	Cohort study linking adminsitrative databases evaluating relative VE against mortality of the primary series (vs partial vaccination) and thebooster dose (vs primary series).

							
184	Hatfield et al (July 20, 2022)	USA	Residents of nursing homes	Pre-delta Delta	Comirnaty mRNA-1273	December 14, 2020-November 9, 2021	Cohort study of nursing home residents.

Vaccination Status [a]	Number of residents	Resident-Days	Median days contributed per resident (IQR)	Number of SARS-CoV-2 infections	Vaccine Effectiveness % (95% CI)
Model 1: Pre-Delta variant predominance (Dec 14, 2020 - May 9, 2021)					
Unvaccinated	871	57,871	51 (21, 122)	109	REF
Completed Pfizer-BioNTech, within past 150 days	1,196	103,668	95 (87, 104)	22	67% (40%, 82%)
Completed Moderna, within past 150 days	466	35,290	86 (73, 89)	6	75% (32%, 91%)
Model 2: Delta variant predominance (Jun 21, 2021 - Nov 9, 2021)					
Unvaccinated	245	25,707	141 (60, 141)	36	REF
Completed Pfizer-BioNTech, within past 150 days	687	8,970	11 (5, 14)	2	Not Estimated[b]
Completed Pfizer-BioNTech, over 150 days ago	858	90,195	126 (84, 135)	108	33% (-2%, 56%)
Completed Moderna, within past 150 days	409	12,845	21 (14, 32)	5	Not Estimated[b]
Completed Moderna, over 150 days ago	357	31,093	109 (30, 122)	9	77% (48%, 91%)

183	Cerqueria-Silva et al (July 18, 2022)	Brazil	≥18 year olds	**Omicron**	Coronavac followed by Comirnaty booster	January 1-April 17, 2022	TND study evaluating VE against symptomatic disease, hospitalization, and death.

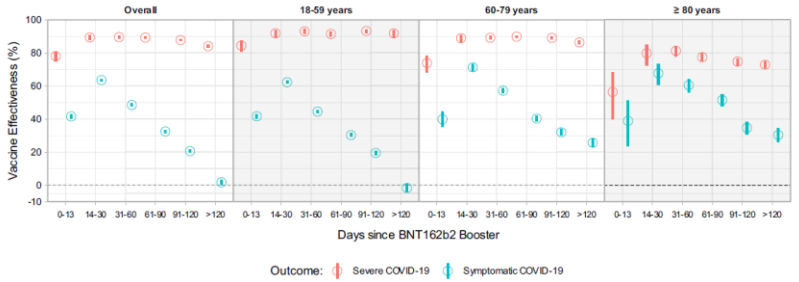
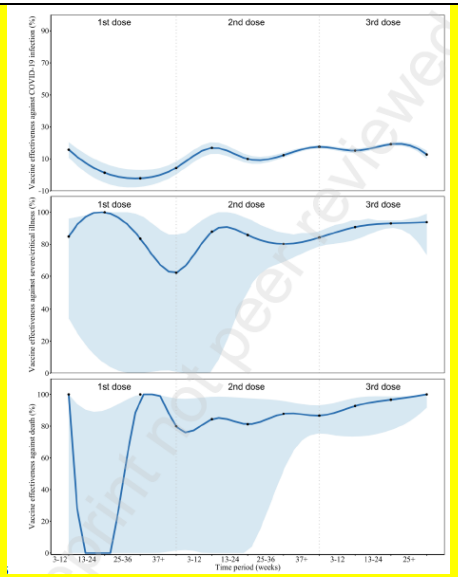


Fig. 3 Vaccine Effectiveness against symptomatic and Severe COVID-19. According to days after booster dose during the Omicron dominance period, stratified by age group. Point estimates are adjusted vaccine effectiveness (1- adjusted odds ratio), with error bars indicating the corresponding 95% Wald's C.I. Blue represents adjusted VE against symptomatic infection, and red adjusted VE against severe outcomes. All models the comparison group is unvaccinated.

Supplementary Table 5: Vaccine effectiveness [%-(95% CI)] against death associated with COVID-19 during the Omicron dominance period, stratified by age group

Vaccination Status	Overall	18-59 years	60-79 years	≥ 80 years
First dose				
≥ 14	51.8 (46.5 — 56.5)	52.8 (42.1 —61.5)	53.2 (45.2 —60.1)	42.7 (31.3 —52.2)
Second dose				
14-180	67.8 (64.0 —71.3)	74.5 (70.3 —78.1)	54.8 (43.6 —63.8)	56.1 (42.1 —66.6)
> 180	63.1 (60.9 —65.1)	78.3 (73.9 —81.9)	64.2 (61.1 —67.0)	49.2 (44.1 —53.8)
Booster with BNT162b2				
0-13	84.4 (79.9 — 87.9)	88.2 (79.1 — 93.4)	84.9 (78.3 — 89.5)	75.8 (61.2 — 84.9)
14-30	90.2 (87.6 — 92.3)	97.2 (92.4 — 98.9)	88.3 (84.4 — 91.3)	87.5 (80.3 — 92.1)
31-60	90.5 (89.3 — 91.6)	96.1 (92.9 — 97.9)	90.8 (89.2 — 92.1)	85.3 (81.5 — 88.4)
61-90	90.6 (89.8 — 91.3)	97.0 (94.7 — 98.3)	91.9 (91.0 — 92.7)	80.9 (77.9 — 83.4)
91-120	89.7 (88.9 — 90.3)	95.1 (93.0 — 96.6)	91.4 (90.5 — 92.2)	81.2 (79.1 — 83.1)
>120	87.0 (85.9 — 88.0)	93.8 (88.8 — 96.6)	89.9 (88.4 — 91.2)	80.2 (78.0 — 82.3)

<table>
<tr>
<td>182</td>
<td>Link-Gelles et al (July 15, 2022)</td>
<td>USA</td>
<td>≥18 year olds</td>
<td>Omicron (BA1, BA2 / BA2.12.1)</td>
<td>Comirnaty mRNA-1273</td>
<td>December 18, 2021-June 10, 2022</td>
<td>TND study in the VISION network evaluating VE against ED/urgent care visit and hospitalizaiton.
<table>
<tr><th rowspan="2">Encounter type</th><th colspan="4">Omicron BA.1–predominant period[¶]</th><th colspan="4">Omicron BA.2/BA.2.12.1–predominant period[**]</th></tr>
<tr><th>Total</th><th>No. (%) of positive test results[†]</th><th>Median interval since last dose, days (IQR)</th><th>VE %* (95% CI)</th><th>Total</th><th>No. (%) of positive test results[†]</th><th>Median interval since last dose, days (IQR)</th><th>VE %* (95% CI)</th></tr>
<tr><td>ED or UC, age group (days since last dose)</td></tr>
<tr><td>All ages, yrs</td></tr>
<tr><td>Unvaccinated (Ref)</td><td>51,359</td><td>23,175 (45.1)</td><td>—</td><td>—</td><td>27,907</td><td>3,501 (12.6)</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (14–149)</td><td>7,286</td><td>2,377 (32.6)</td><td>107 (76–129)</td><td>47 (44–50)</td><td>1,774</td><td>110 (6.2)</td><td>104 (71–128)</td><td>51 (38–60)</td></tr>
<tr><td>2 doses (≥150)</td><td>32,740</td><td>11,365 (34.7)</td><td>267 (232–306)</td><td>39 (37–41)</td><td>20,883</td><td>2,584 (12.4)</td><td>352 (278–398)</td><td>12 (7–17)</td></tr>
<tr><td>3 doses (7–119)</td><td>29,333</td><td>3,667 (12.5)</td><td>66 (41–89)</td><td>84 (83–85)</td><td>9,142</td><td>441 (4.8)</td><td>94 (72–108)</td><td>56 (51–61)</td></tr>
<tr><td>3 doses (≥120)</td><td>3,315</td><td>217 (6.5)</td><td>132 (125–142)</td><td>73 (68–77)</td><td>26,654</td><td>3,186 (11.9)</td><td>166 (145–190)</td><td>26 (21–30)</td></tr>
<tr><td>18–49 yrs</td></tr>
<tr><td>Unvaccinated (Ref)</td><td>33,003</td><td>14,236 (43.1)</td><td>—</td><td>—</td><td>18,429</td><td>2,269 (12.3)</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (14–149)</td><td>4,909</td><td>1,621 (33.0)</td><td>106 (76–129)</td><td>40 (36–44)</td><td>1,192</td><td>75 (6.3)</td><td>105 (72–129)</td><td>47 (31–60)</td></tr>
<tr><td>2 doses (≥150)</td><td>16,313</td><td>5,918 (36.3)</td><td>252 (220–288)</td><td>24 (21–28)</td><td>11,203</td><td>1,427 (12.7)</td><td>332 (254–379)</td><td>7 (0–14)</td></tr>
<tr><td>3 doses (7–119)</td><td>8,755</td><td>1,259 (14.4)</td><td>55 (33–79)</td><td>76 (75–78)</td><td>4,132</td><td>207 (5.0)</td><td>91 (69–107)</td><td>55 (47–62)</td></tr>
<tr><td>3 doses (≥120)</td><td>426</td><td>39 (9.2)</td><td>130 (124–141)</td><td>29 (−1–50)</td><td>7,613</td><td>1,096 (14.4)</td><td>159 (140–182)</td><td>17 (10–25)</td></tr>
<tr><td>≥50 yrs</td></tr>
<tr><td>Unvaccinated (Ref)</td><td>18,356</td><td>8,939 (48.7)</td><td>—</td><td>—</td><td>9,478</td><td>1,232 (13.0)</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (14–149)</td><td>2,377</td><td>756 (31.8)</td><td>109 (77–129)</td><td>59 (54–63)</td><td>582</td><td>35 (6.0)</td><td>102 (68–128)</td><td>59 (40–71)</td></tr>
<tr><td>2 doses (≥150)</td><td>16,427</td><td>5,447 (33.2)</td><td>283 (248–316)</td><td>52 (50–54)</td><td>9,680</td><td>1,157 (11.9)</td><td>376 (319–414)</td><td>18 (10–26)</td></tr>
<tr><td>3 doses (7–119)</td><td>20,578</td><td>2,408 (11.7)</td><td>71 (46–93)</td><td>87 (86–88)</td><td>5,010</td><td>234 (4.7)</td><td>96 (73–109)</td><td>58 (51–64)</td></tr>
<tr><td>3 doses (≥120)</td><td>2,889</td><td>178 (6.2)</td><td>133 (125–143)</td><td>81 (77–84)</td><td>19,041</td><td>2,090 (11.0)</td><td>170 (147–193)</td><td>32 (26–38)</td></tr>
<tr><td>4 doses (≥7)[††]</td><td>N/A</td><td>—</td><td>—</td><td>—</td><td>4,094</td><td>355 (8.7)</td><td>28 (17–42)</td><td>66 (60–71)</td></tr>
<tr><td>Hospitalization, age group (days since last dose)</td></tr>
<tr><td>All ages, yrs</td></tr>
<tr><td>Unvaccinated (Ref)</td><td>14,742</td><td>6,829 (46.3)</td><td>—</td><td>—</td><td>6,682</td><td>494 (7.4)</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (14–149)</td><td>1,236</td><td>297 (24.0)</td><td>105 (73–129)</td><td>68 (63–73)</td><td>343</td><td>12 (3.5)</td><td>102 (71–128)</td><td>57 (19–77)</td></tr>
<tr><td>2 doses (≥150)</td><td>8,850</td><td>2,542 (28.7)</td><td>289 (252–322)</td><td>61 (58–63)</td><td>5,118</td><td>393 (7.7)</td><td>371 (308–413)</td><td>24 (12–35)</td></tr>
<tr><td>3 doses (7–119)</td><td>9,146</td><td>786 (8.6)</td><td>72 (47–93)</td><td>92 (91–93)</td><td>2,350</td><td>72 (3.1)</td><td>94 (74–108)</td><td>69 (58–76)</td></tr>
<tr><td>3 doses (≥120)</td><td>1,425</td><td>80 (5.6)</td><td>132 (125–142)</td><td>85 (81–89)</td><td>7,686</td><td>519 (6.8)</td><td>168 (146–191)</td><td>52 (44–59)</td></tr>
<tr><td>18–49 yrs[§§]</td></tr>
<tr><td>Unvaccinated (Ref)</td><td>4,057</td><td>1,515 (37.3)</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (14–149)</td><td>392</td><td>83 (21.2)</td><td>101 (67–127)</td><td>64 (52–73)</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (≥150)</td><td>1,304</td><td>329 (25.2)</td><td>258 (226–294)</td><td>52 (43–59)</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>3 doses (7–119)</td><td>812</td><td>53 (6.5)</td><td>57 (36–81)</td><td>91 (87–94)</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>3 doses (≥120)</td><td>56</td><td>1 (1.8)</td><td>133 (126–142)</td><td>94 (62–99)</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>≥50 yrs[§§]</td></tr>
<tr><td>Unvaccinated (Ref)</td><td>10,685</td><td>5,314 (49.7)</td><td>—</td><td>—</td><td>4,595</td><td>393 (8.6)</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (14–149)</td><td>844</td><td>214 (25.4)</td><td>108 (76–129)</td><td>71 (65–75)</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>2 doses (≥150)</td><td>7,546</td><td>2,213 (29.3)</td><td>294 (259–325)</td><td>63 (60–66)</td><td>4,139</td><td>352 (8.5)</td><td>381 (325–418)</td><td>22 (8–34)</td></tr>
<tr><td>3 doses (7–119)</td><td>8,334</td><td>733 (8.8)</td><td>73 (49–94)</td><td>92 (91–93)</td><td>1,957</td><td>57 (2.9)</td><td>95 (74–108)</td><td>73 (63–81)</td></tr>
<tr><td>3 doses (≥120)</td><td>1,369</td><td>79 (5.8)</td><td>132 (125–142)</td><td>86 (82–89)</td><td>7,113</td><td>480 (6.8)</td><td>169 (147–191)</td><td>55 (46–62)</td></tr>
<tr><td>4 doses (≥7)[††]</td><td>N/A</td><td>—</td><td>—</td><td>—</td><td>1,204</td><td>74 (6.2)</td><td>27 (17–41)</td><td>80 (71–85)</td></tr>
</table>
</td>
</tr>
<tr>
<td>181</td>
<td>Huang et al (July 8,2022)</td>
<td>China</td>
<td>3+ year olds</td>
<td>Omicron</td>
<td>Coronavac BBIBP-CorV + other inactivated vaccines in use in China
Cansino Recombinant SARS-CoV-2 Vaccine (CHO Cell)</td>
<td>December 2, 2021-May 13, 2022</td>
<td>TND study evaluating VE against infection, severe/critical disease, death. Combined for all vaccines in use in China.</td>
</tr>
</table>

<table>
<tr>
<td></td><td></td><td></td><td></td><td></td><td></td><td></td>
<td> 
</td>
</tr>
<tr>
<td>180</td>
<td>Tonnaro et al (July 4, 2022)</td>
<td>San Marino</td>
<td>≥18 year old</td>
<td>Alpha, Delta</td>
<td>Sputnik V</td>
<td>February 21-October 1, 2021</td>
<td>Cohort study of entire country.
<table>
<tr><th></th><th>Period</th><th colspan="5">Any vaccine</th><th colspan="5">Gam-COVID-Vac</th></tr>
<tr><th></th><th></th><th rowspan="2">Cases*</th><th colspan="2">Crude</th><th colspan="2">Adjusted[a]</th><th rowspan="2">Cases*</th><th colspan="2">Crude</th><th colspan="2">Adjusted[a]</th></tr>
<tr><th></th><th></th><th>VE</th><th>95% CI</th><th>VE</th><th>95% CI</th><th>VE</th><th>95% CI</th><th>VE</th><th>95% CI</th></tr>
<tr><td>SARS-CoV-2 infections</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td><60 days</td><td>25</td><td>96.6</td><td>94.9-97.8</td><td>88.7</td><td>82.8-92.6</td><td>16</td><td>97.1</td><td>95.3-98.2</td><td>91.8</td><td>86.3-95.1</td></tr>
<tr><td></td><td>60-119</td><td>122</td><td>84.7</td><td>81.0-87.7</td><td>51.6</td><td>40.3-60.7</td><td>117</td><td>81.1</td><td>77.1-84.4</td><td>47.0</td><td>34.3-57.2</td></tr>
<tr><td></td><td>120+</td><td>70</td><td>85.5</td><td>81.1-88.9</td><td>52.1</td><td>36.7-63.8</td><td>53</td><td>85.8</td><td>81.3-89.2</td><td>57.8</td><td>42.2-69.2</td></tr>
<tr><td></td><td>Total</td><td>217</td><td>89.3</td><td>87.2-91.0</td><td>67.6</td><td>61.8-72.5</td><td>186</td><td>89.9</td><td>87.7-91.6</td><td>68.5</td><td>62.5-73.6</td></tr>
<tr><td>COVID-19 related Hospitalizations</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td><60 days</td><td>5</td><td>94.5</td><td>84.9-98.0</td><td>90.6</td><td>74.9-96.5</td><td>2</td><td>97.5</td><td>88.9-99.4</td><td>95.2</td><td>79.1-98.9</td></tr>
<tr><td></td><td>60-119</td><td>4</td><td>96.2</td><td>88.4-98.7</td><td>90.5</td><td>73.4-96.6</td><td>4</td><td>95.5</td><td>86.5-98.5</td><td>87.8</td><td>66.0-95.6</td></tr>
<tr><td></td><td>120+</td><td>6</td><td>89.3</td><td>71.5-95.9</td><td>76.1</td><td>35.1-91.2</td><td>2</td><td>96.2</td><td>82.5-99.2</td><td>89.7</td><td>52.7-97.7</td></tr>
<tr><td></td><td>Total</td><td>15</td><td>94.0</td><td>88.1-97.0</td><td>87.9</td><td>77.4-93.5</td><td>8</td><td>96.4</td><td>91.6-98.4</td><td>91.6</td><td>81.5-96.2</td></tr>
</table></td>
</tr>
<tr>
<td>179</td>
<td>Tartof et al (June 30, 2022)</td>
<td>USA</td>
<td>≥18 year old members of Kaiser Permanente southern California</td>
<td>Omicron (BA1 and BA2)</td>
<td>Comirnaty</td>
<td>December 27, 2021-June 4, 2022</td>
<td>TND study evaluating VE against hospitalization and emergency department (ED) admission.</td>
</tr>
</table>

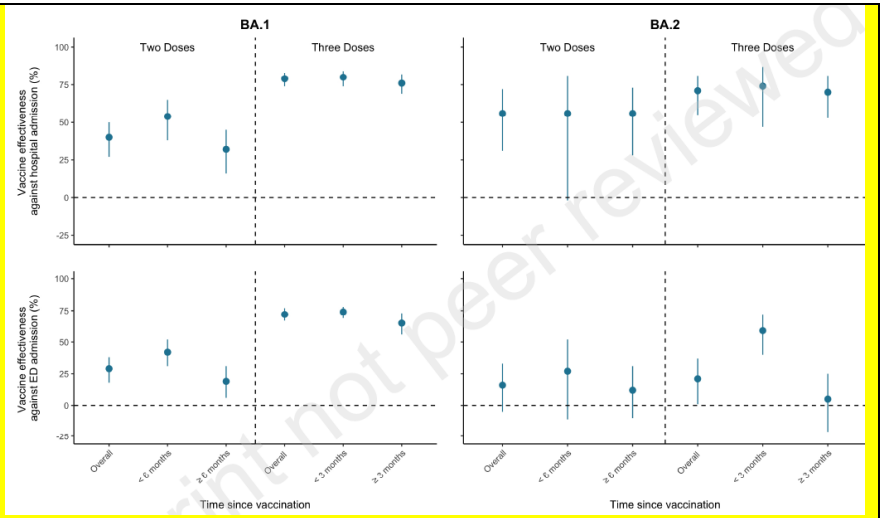
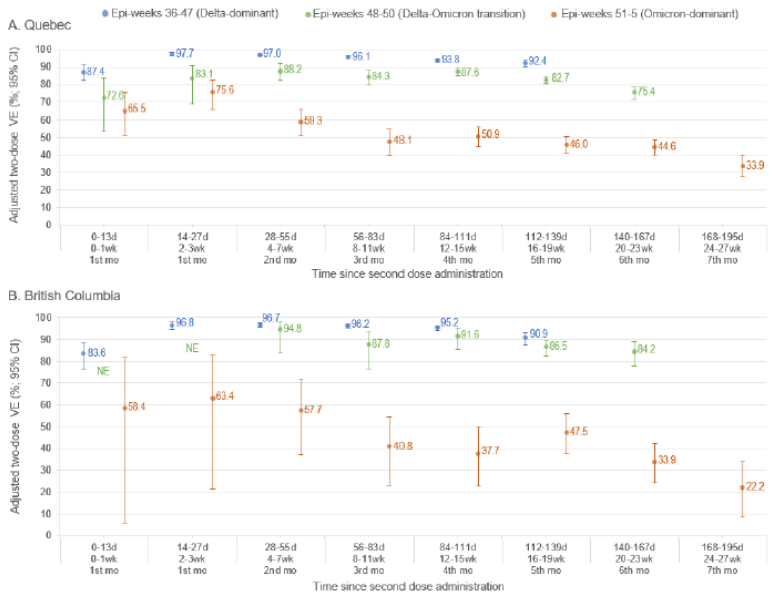
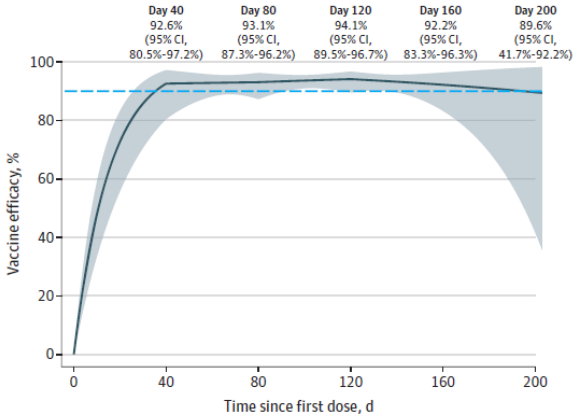
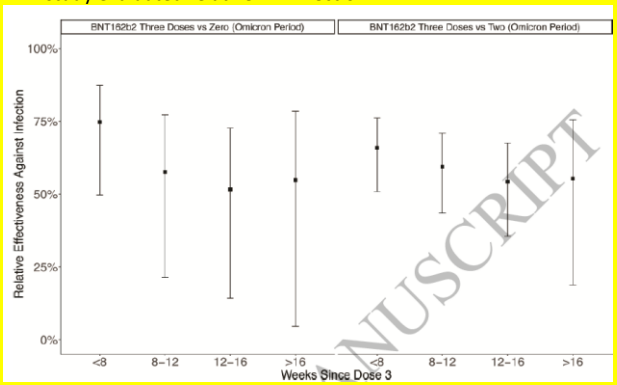
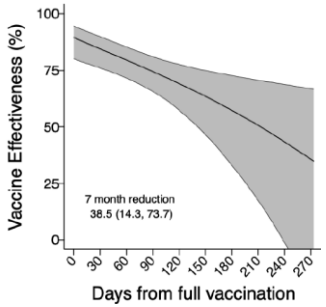
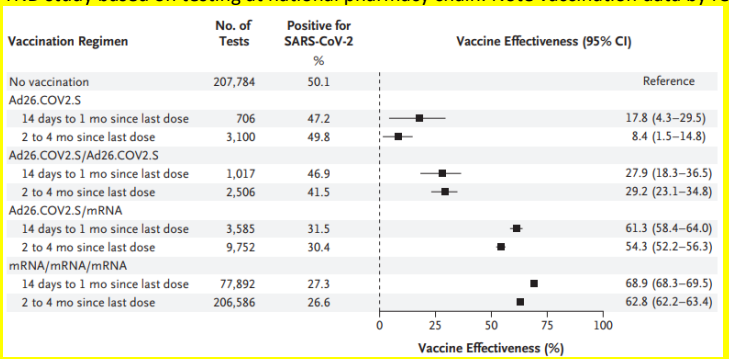
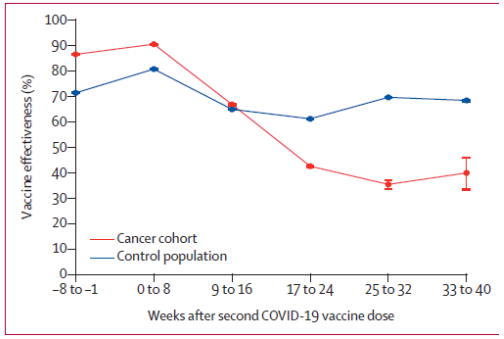
							
178	Ionescu et al (June 28, 2022)	Canada	12-17 year olds	Delta **Omicron**	Comirnaty	September 5, 2021-April 30, 2022	TND study conducted by linking adminsitrative databases evaluating VE against infection and symptomatic disease.

							Figure 2. Adjusted Two-Dose BNT162b2 Vaccine Effectiveness Against Infection by Time Since Second Dose Administration and Epidemiological Period, 12-17-Year-Olds, Quebec (A) and British Columbia (B), Canada 
177	Adams et al (June 14, 2022)	USA	≥18 years	**Omicron**	Comirnaty mRNA-1273 Ad26.COV2.S	December 26, 2021–April 30, 2022	Multi-center TND study evaluating VE against hospitalization. VE after a primary series for immunocompetent patients at 14–150 days (median 109 days) since the last vaccine dose was 54% (95% CI: 32–69), and at >150 days (median 279 days) was 42% (95% CI: 28–54%) . VE after a booster dose for immunocompetent patients at 7–120 days (median 69 days) following the booster dose was 80% (95%: 74–84%) and at >120 days (median 147 days) was 65% (95% CI: 47–77%). For immunocompromised patients, VE for a primary series at 14–150 days (median 91 days) was 65% (95% CI: 46–77%) and at >150 days (median 172 days) was 48% (95% CI: 5–72%).
176	Al Kaabi et al (June 9, 2022)	UAE	≥18 years	Ancestral, Alpha, Delta	BBIBP-CorV	October 2020-July 2021	Cohort study based on medical records evaluating VE against severe outcomes. The effectiveness against COVID-19 hospitalization declined from 82.8% (95% CI, 80.5–84.8) at two months after complete vaccination to 62.1% (95% CI 60.2–64.0) at 6 months after complete vaccination. VE against ICU admission was 85.7% (95% CI, 80.3–89.6) at two months after complete vaccination to 72.8% (95% CI, 68.8–76.3) at six months post complete vaccination, without further decline from seven to twelve months post-vaccination. The vaccine effectiveness against mortality due to COVID-19 remained above 80% throughout and did not show significant decline over the 12-month follow-up period

175	Lewis et al (June 8, 2022)	USA	≥18 years	Alpha, Delta	Ad26.COV2.S	March 11-December 15, 2021	TND study evaluating VE against hospitalization and VE against progression to invasive mechanical ventilation or death. VE was 14–90 days (73% [59%–82%]), 91–180 days (71% [60%–80%]), and 181–274 days (70% [54%–81%]).
174	Lin et al (June 8, 2022)	USA	Adults	Ancestral	mRNA-1273	July 27, 2020-?May 2021	RCT participants followed up as a cohort study to evaluate VE against symptomatic disease. 
173	Richterman et al (June 6, 2022)	USA	HCW	Delta, **Omicron**	Comirnaty	July 1, 2021 - April 5, 2022	TND study evaluated relative VE infection. 

172	Andrejko et al (June 3, 2022)	USA	12+ year olds	Pre-Omicron	Comirnaty mRNA-1273	February 23-December 5, 2021	TND study evaluating VE against symptomatic disease. Note that vaccination data was self-reported. The figure belows shows VE over time among persons who were asked to reference their vaccination card for vaccination data. 
171	Accorsi et al (May 25, 2022)	USA	18+ year olds	**Omicron**	Comirnaty mRNA-1273 Ad26.COV2.S	January 2-March 23, 2022	TND study based on testing at national pharmacy chain. Note vaccination data by recall. 
170	Amir et al (May 25, 2022)	Israel	12-15 year olds	**Omicron**	Comirnaty	December 26, 2021-January 8, 2022	Cohort study conducted by linking admin databases looking at risk against infection. Ages 12-15 3rd dose effect Cohort / Confirmed infections (at-risk days) / Adjusted rate ratio vs. 3rd dose Unvaccinated / 2,684 (834,149) / 5.0 [4.3, 5.9] 2nd dose (14-60 days) / 153 (115,371) / 2.2 [1.8, 2.8] 2nd dose (60-120 days) / 1,999 (815,036) / 3.8 [3.3, 4.5] 2nd dose (120+ days) / 5,983 (2,003,011) / 4.2 [3.6, 4.9] Internal control / 494 (180,100) / 3.3 [2.8, 4.0] 3rd dose (14-60 days) / 166 (171,281) / Ref

<table>
<tr>
<td>169</td>
<td>Lee et al
(May 23, 2022)</td>
<td>UK</td>
<td>Persons with cancer and general population</td>
<td>Alpha, Delta</td>
<td>ChAdOx1
Comirnaty</td>
<td>December 8, 2020-
October 15, 2021</td>
<td>Two TND studies conducted in different populations with comparison of VE against infection, hospitazliation, and death among the two groups.
 

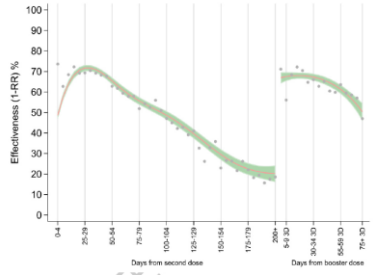
<table>
<tr><th rowspan="2">Outcome measure</th><th colspan="5">Post-second dose (overall)</th><th colspan="5">3-6 months post-second dose</th></tr>
<tr><th colspan="2">Exposed (PCR-positive)</th><th colspan="2">Not exposed (PCR-negative)</th><th>Vaccine Effectiveness (%)</th><th colspan="2">Exposed (PCR-positive)</th><th colspan="2">Not exposed (PCR-negative)</th><th>Vaccine Effectiveness (%)</th></tr>
<tr><th>Post-2nd dose (n)</th><th>Unvaccinated (N)</th><th>Post-2nd dose (n)</th><th>Unvaccinated (N)</th><th></th><th>Post-2nd dose (n)</th><th>Unvaccinated (N)</th><th>Post-2nd dose (n)</th><th>Unvaccinated (N)</th><th></th></tr>
<tr><td>Breakthrough Infections</td><td>18292</td><td>31649</td><td>780054</td><td>465982</td><td>65.5% (65.1-65.9)</td><td>12513</td><td>31649</td><td>347414</td><td>465982</td><td>47.0% (46.3-47.6)</td></tr>
<tr><td>Coronavirus Hospitalisation</td><td>837</td><td>3227</td><td>780054</td><td>465982</td><td>84.5% (83.6-85.4)</td><td>611</td><td>3227</td><td>347414</td><td>465982</td><td>74.6% (72.8-76.3)</td></tr>
<tr><td>Coronavirus Death</td><td>560</td><td>5139</td><td>780054</td><td>465982</td><td>93.5% (93.0-94.0)</td><td>373</td><td>5139</td><td>347414</td><td>465982</td><td>90.3% (89.3-91.2)</td></tr>
</table></td>
</tr>
<tr>
<td>168</td>
<td>Paranthaman et al
(May 5, 2022)</td>
<td>England</td>
<td>≥65 years living in LTCF</td>
<td>Alpha, Delta</td>
<td>ChAdOx1
Comirnaty</td>
<td>December 8, 2020-
September 30, 2021</td>
<td>Cohort study conducted by linking adminsitrative databases evaluating VE against infection and death.
Table 2. Adjusted HRs for infection by vaccination status for LTCF residents, England
<table>
<tr><th rowspan="2">Vaccination status</th><th rowspan="2">Time since dose</th><th colspan="3">Any</th><th colspan="3">ChAdOx-1</th><th colspan="3">BNT162b2</th></tr>
<tr><th>Person-time in days (unique individuals)[a]</th><th>Events</th><th>Adjusted HR[b]</th><th>Person-time in days (unique individuals)[a]</th><th>Events</th><th>Adjusted HR[b]</th><th>Person-time in days (unique individuals)[a]</th><th>Events</th><th>Adjusted HR[b]</th></tr>
<tr><td>Unvaccinated</td><td></td><td>6,958,732 (190,202)</td><td>26,765</td><td></td><td>6,958,732 (190,202)</td><td>26,765</td><td></td><td>6,958,732 (190,202)</td><td>26,765</td><td></td></tr>
<tr><td>First dose</td><td>1–2 wks</td><td>2,070,258 (153,383)</td><td>8,190</td><td>0.68 (0.62–0.74)</td><td>1,427,012 (105,580)</td><td>5,256</td><td>0.67 (0.6–0.75)</td><td>643,246 (47,803)</td><td>2,934</td><td>0.68 (0.6–0.78)</td></tr>
<tr><td></td><td>3 wks</td><td>990,274 (143,432)</td><td>2,762</td><td>0.64 (0.57–0.73)</td><td>684,527 (99,045)</td><td>1,731</td><td>0.73 (0.63–0.86)</td><td>305,747 (44,387)</td><td>1,031</td><td>0.56 (0.48–0.67)</td></tr>
<tr><td></td><td>4 wks</td><td>965,091 (139,327)</td><td>1,554</td><td>0.5 (0.43–0.59)</td><td>671,379 (96,744)</td><td>921</td><td>0.58 (0.48–0.7)</td><td>293,712 (42,583)</td><td>633</td><td>0.48 (0.39–0.59)</td></tr>
<tr><td></td><td>5 wks</td><td>948,533 (136,661)</td><td>1,057</td><td>0.47 (0.4–0.56)</td><td>660,612 (95,140)</td><td>654</td><td>0.59 (0.47–0.73)</td><td>287,921 (41,521)</td><td>403</td><td>0.44 (0.36–0.55)</td></tr>
<tr><td></td><td>6–7 wks</td><td>185,2109 (134,595)</td><td>1,190</td><td>0.46 (0.38–0.56)</td><td>129,0208 (93,718)</td><td>642</td><td>0.5 (0.4–0.62)</td><td>561,901 (40,877)</td><td>548</td><td>0.52 (0.41–0.66)</td></tr>
<tr><td></td><td>8–10 wks</td><td>2,472,998 (130,173)</td><td>815</td><td>0.64 (0.5–0.82)</td><td>1,715,549 (90,634)</td><td>547</td><td>0.51 (0.38–0.68)</td><td>757,449 (39,539)</td><td>468</td><td>0.79 (0.59–1.06)</td></tr>
<tr><td></td><td>11+ wks</td><td>1,112,436 (86,502)</td><td>254</td><td>0.83 (0.62–1.11)</td><td>768,455 (57,784)</td><td>181</td><td>0.94 (0.67–1.33)</td><td>343,981 (28,718)</td><td>73</td><td>0.63 (0.44–0.9)</td></tr>
<tr><td>Second dose</td><td>1–4 wks</td><td>3,432,288 (124,173)</td><td>239</td><td>0.4 (0.29–0.55)</td><td>2,401,640 (86,845)</td><td>119</td><td>0.39 (0.26–0.6)</td><td>1,030,648 (37,328)</td><td>120</td><td>0.38 (0.27–0.54)</td></tr>
<tr><td></td><td>5–10 wks</td><td>5,037,822 (122,400)</td><td>179</td><td>0.47 (0.34–0.64)</td><td>3,521,278 (85,615)</td><td>134</td><td>0.54 (0.37–0.78)</td><td>1,516,544 (36,785)</td><td>45</td><td>0.34 (0.21–0.55)</td></tr>
<tr><td></td><td>11–15 wks</td><td>4,035,312 (117,409)</td><td>384</td><td>0.45 (0.34–0.59)</td><td>2,810,444 (81,979)</td><td>327</td><td>0.48 (0.36–0.64)</td><td>1,224,868 (35,430)</td><td>57</td><td>0.31 (0.2–0.48)</td></tr>
<tr><td></td><td>16–20 wks</td><td>3,757,167 (111,858)</td><td>1384</td><td>0.66 (0.54–0.81)</td><td>2,599,430 (77,764)</td><td>1090</td><td>0.72 (0.58–0.9)</td><td>1,157,737 (34,094)</td><td>294</td><td>0.55 (0.39–0.78)</td></tr>
<tr><td></td><td>21+ wks</td><td>3,381,529 (99,696)</td><td>2,104</td><td>0.6 (0.49–0.74)</td><td>2,070,748 (68,221)</td><td>1,474</td><td>0.71 (0.57–0.9)</td><td>1,310,781 (31,475)</td><td>630</td><td>0.53 (0.42–0.68)</td></tr>
</table>
[a]Number of unique individuals at risk for any duration of time within each time period. [b]Adjusted for gender, age group, case rate in local authority and deprivation, along with a cluster term for care home postcode. See Supplementary Figure S4, Supplementary Tables S1 and S2 in Supplementary data.</td>
</tr>
</table>

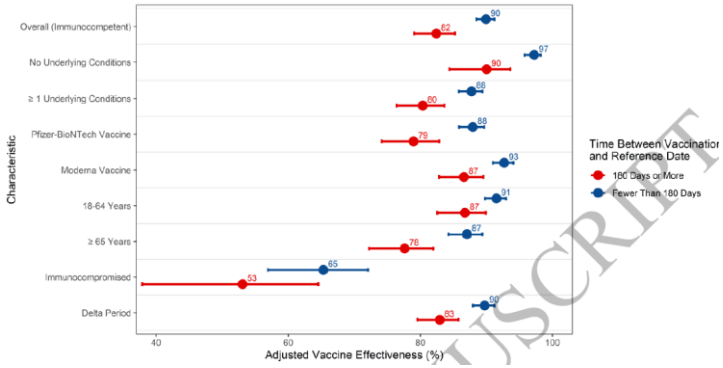
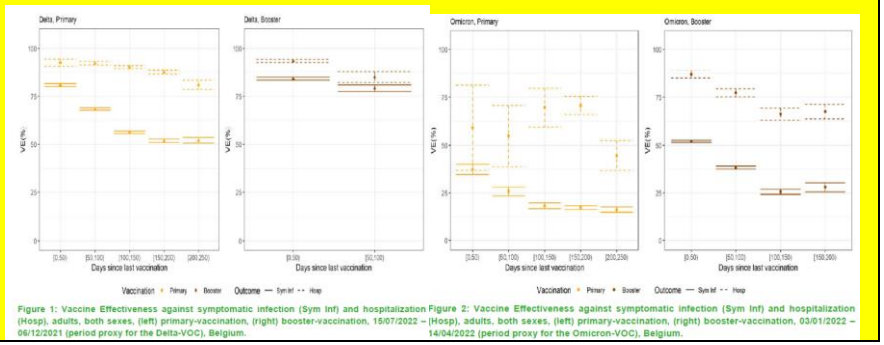
							Table 3. Adjusted HRs for COVID-related death by vaccination status among LTCF residents, England [a]Number of unique individuals at risk for any duration of time within each time period. [b]Adjusted for gender, age group, case rate in local authority and deprivation, along with a cluster term for care home postcode. See Supplementary Figure S5, Supplementary Tables S3 and S4 in Supplementary data.
167	Martellucci et al (April 22, 2022)	Italy	General population	Alpha, Delta, **Omicron**	ChAdOx1 Comirnaty mRNA-1273 Ad26.COV2.S	January 2, 2021-December 18, 2021	Cohort study conducted by linking adminsitrative databases evaluating VE against infection, hospitalization, and death.
166	Fano et al (May 18, 2022)	Italy	12+ year olds	Alpha, Delta, **Omicron**	ChAdOx1 Comirnaty mRNA-1273 Ad26.COV2.S	January 1, 2021-January 10, 2022	Cohort study conducted by linking administrative databases evaluating VE against infection. Data available in manuscript for individual vaccines including heterolous combinations.

Vaccination status	Time since dose	Any: Person-time in days (unique individuals)[a]	Any: Events	Any: Adjusted HR[b]	ChAdOx-1: Person-time in days (unique individuals)[a]	ChAdOx-1: Events	ChAdOx-1: Adjusted HR[b]	BNT162b2: Person-time in days (unique individuals)[a]	BNT162b2: Events	BNT162b2: Adjusted HR[b]
Unvaccinated		6,931,978 (190,109)	7,425		6,931,978 (190,109)	7,425		6,931,978 (190,109)	7,425	
First dose	1–2 wks	2,070,228 (153,379)	2,125	0.59 (0.52–0.66)	1,426,998 (105,578)	1,364	0.58 (0.5–0.66)	643,230 (47,801)	761	0.6 (0.51–0.7)
	3–4 wks	1,955,365 (143,880)	812	0.41 (0.35–0.48)	1,355,906 (99,324)	485	0.49 (0.4–0.61)	599,459 (44,556)	327	0.35 (0.29–0.43)
	5–8 wks	3,697,628 (137,419)	347	0.33 (0.26–0.41)	2,575,162 (95,636)	178	0.37 (0.27–0.5)	1,122,466 (41,783)	169	0.34 (0.26–0.45)
	9+ wks	2,668,668 (124,523)	71	0.44 (0.3–0.63)	1,844,561 (86,556)	36	0.43 (0.26–0.71)	824,107 (37,967)	35	0.5 (0.32–0.78)
Second dose	1–4 wks	343,2248 (124,168)	18	0.15 (0.07–0.3)	240,1617 (86,843)	9	0.17 (0.06–0.42)	1,030,631 (37,325)	9	0.14 (0.06–0.33)
	5–10 wks	5,037,675 (122394)	15	0.19 (0.09–0.41)	3,521,162 (85,610)	10	0.18 (0.07–0.47)	1,516,513 (36,784)	5	0.19 (0.05–0.7)
	11–15 wks	4,035,106 (117,399)	43	0.21 (0.13–0.34)	2,810,271 (81,971)	39	0.22 (0.13–0.38)	1,224,835 (35,428)	4	0.09 (0.03–0.25)
	16–20 wks	3,756,005 (111,804)	193	0.35 (0.24–0.52)	2,598,423 (77,717)	155	0.39 (0.26–0.58)	1,157,582 (34,087)	38	0.27 (0.16–0.46)
	21+ wks	3,146,624 (94,716)	280	0.37 (0.25–0.53)	1,916,253 (64,662)	196	0.44 (0.3–0.67)	1,230,371 (30,054)	84	0.31 (0.2–0.49)

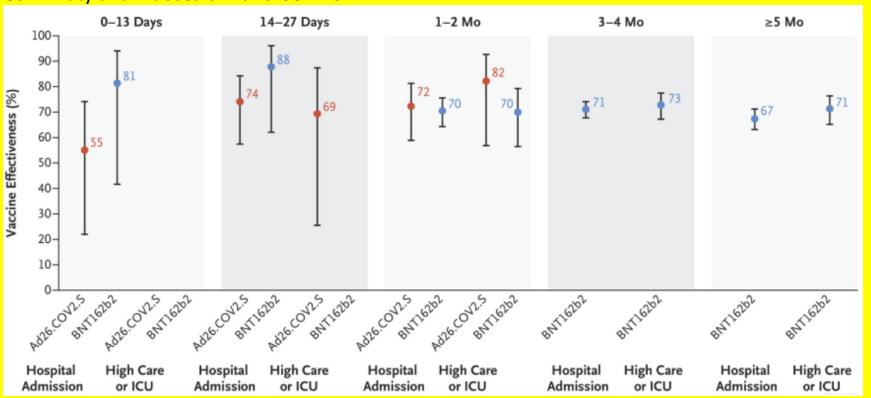
Variables	COVID-19 Hospitalization [A]	COVID-19-Related Death
Follow-up duration [B]	OR (95% CI)	OR (95% CI)
≤6 months of follow-up		
Unvaccinated	1 (Ref. cat.)	1 (Ref. cat.)
2 doses	0.03 (0.02–0.03) *	0.01 (0.01–0.02) *
3 doses	0.18 (0.15–0.23) *	0.15 (0.10–0.24) *
>6 months of follow-up		
Unvaccinated	1 (Ref. cat.)	1 (Ref. cat.)
2 doses	0.31 (0.26–0.37) *	0.25 (0.17–0.35) *

Figure 2 – Adjusted[1] vaccine effectiveness (VE) against SARS-CoV-2 infection at different times after the administration of the second dose and the booster dose. Reference: unvaccinated[2].

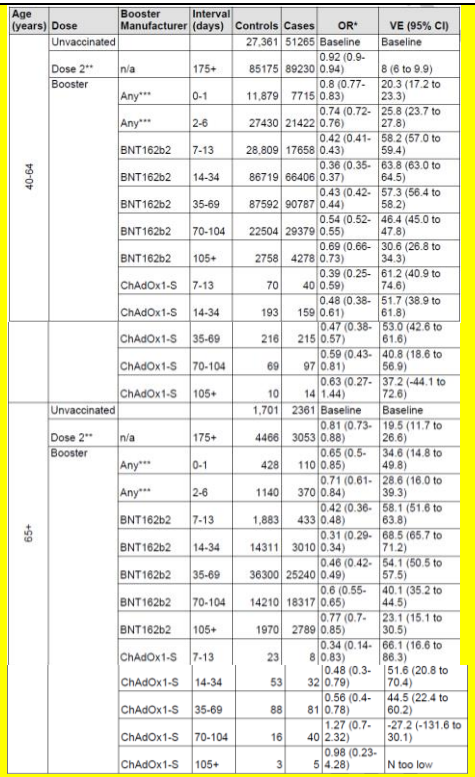


165	Tenforde et al (May 17, 2022)	USA	General population	Pre-Omicron	Comirnaty mRNA-1273	March 11-December15, 2021	TND study evaluating 2-dose VE against hopsitalization. 
164	Braeye et al (May 11, 2022)	Belgium	18+ year olds	Delta, **Omicron**	ChAdOx1 Comirnaty mRNA-1273 Ad26.COV2.S	Delta: July 15, 2021-December 6, 2021 Omicron: January 3, 2022-April 14, 2022	TND study by linking adminsitartive databases looking at VE against symptomatic diseaes and COVID-19 hospitalization.  Figure 1: Vaccine Effectiveness against symptomatic infection (Sym Inf) and hospitalization (Hosp), adults, both sexes, (left) primary-vaccination, (right) booster-vaccination, 15/07/2022 – 06/12/2021 (period proxy for the Delta-VOC), Belgium. Figure 2: Vaccine Effectiveness against symptomatic infection (Sym Inf) and hospitalization (Hosp), adults, both sexes, (left) primary-vaccination, (right) booster-vaccination, 03/01/2022 – 14/04/2022 (period proxy for the Omicron-VOC), Belgium.

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>163</td><td>Butt et al (May 3, 2022)</td><td>USA</td><td>Veterans</td><td>Omicron</td><td>Comirnaty mRNA-1273</td><td>January 1-February 20, 2022</td><td>Cohort study among veterans. Relative vaccine effectiveness was highest for patients receiving their booster vaccine within 28 days of the start of the period of omicron predominance (RVE=40% [35-44%] for BNT-162b2; RVE=30% [23-36%] for mRNA-1273), and protection against infection was negligible for both vaccines for patients with 4 or more months since receiving the booster vaccination. Relative vaccine effectiveness for hospitalizations remained above 44% for all groups.</td></tr>
<tr><td>162</td><td>Amir et al (May 5, 2022)</td><td>Israel</td><td>60+ year olds</td><td>Omicron</td><td>Comirnaty</td><td>January 16, 2022, to March 12, 2022</td><td>Cohort study by linking adminsitrative databases evaluating relative VE against severe disease.
<table>
<tr><th></th><th></th><th>VE</th><th>LCI</th><th>UCI</th></tr>
<tr><td>2nd dose</td><td>4+ months</td><td colspan="3">ref</td></tr>
<tr><td rowspan="8">3rd dose</td><td>0-1 month</td><td>57%</td><td>38%</td><td>71%</td></tr>
<tr><td>1-2 months</td><td>66%</td><td>44%</td><td>79%</td></tr>
<tr><td>2-3 months</td><td>68%</td><td>55%</td><td>78%</td></tr>
<tr><td>3-4 months</td><td>67%</td><td>58%</td><td>73%</td></tr>
<tr><td>4-5 months</td><td>64%</td><td>60%</td><td>70%</td></tr>
<tr><td>5-6 months</td><td>64%</td><td>60%</td><td>69%</td></tr>
<tr><td>6-7 months</td><td>68%</td><td>58%</td><td>76%</td></tr>
<tr><td>4th dose</td><td>0-2 months</td><td>89%</td><td>87%</td><td>91%</td></tr>
</table></td></tr>
</table>

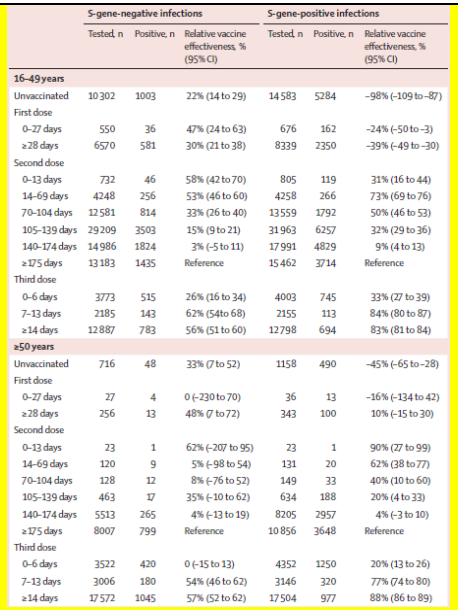
<table>
<tr>
<td>161</td>
<td>Gray et al (May 4, 2022)</td>
<td>South Africa</td>
<td>HCW</td>
<td>Omicron</td>
<td>Comirnaty
Ad26.COV2.S</td>
<td>November 15, 2021-January 14, 2022</td>
<td>TND study conducted as part of Sisonke study. Note that they evaluated VE of 2 doses of Comirnaty and 2 doses of Ad26.COV2.S.
 
</td>
</tr>
<tr>
<td>160</td>
<td>Castillo et al (April 21, 2022)</td>
<td>France</td>
<td>18+ year olds</td>
<td>Delta, Omicron</td>
<td>Comirnaty
mRNA-1273</td>
<td>December 13, 2021 – January 31, 2021</td>
<td>TND study linking adminsitrative databases to assess VE against symptomatic disease, with a cohort study done among covid hospitalized cases.
<table>
<tr><th rowspan="3">Immune status: time since named vaccine dose[b]</th><th colspan="3">Omicron[a]</th><th colspan="3">Delta[a]</th></tr>
<tr><th colspan="2">Risk reduction[c] against</th><th>Protection 1− OR× HR</th><th colspan="2">Risk reduction[c] against</th><th>Protection 1− OR× HR</th></tr>
<tr><th>Symptomatic infection OR[d](95%CI)</th><th>Hospital admission among symptomatic cases HR[e](95%CI)</th><th>Protection(95%CI)</th><th>Symptomatic infection OR[d](95%CI)</th><th>Hospital admission among symptomatic cases HR[e](95%CI)</th><th>Protection (95%CI)</th></tr>
<tr><td colspan="7">Vaccinated (ref.: unvaccinated without prior infection evidence)</td></tr>
<tr><td>D1: 0 day–28 days</td><td>0.88 (0.86 to 0.91)</td><td>0.99 (0.75 to 1.23)</td><td>0.12 (−0.09 to 0.34)</td><td>0.62 (0.59 to 0.66)</td><td>0.66 (0.50 to 0.81)</td><td>0.59 (0.49 to 0.69)</td></tr>
<tr><td>D2: 0 days–30 days</td><td>0.57 (0.55 to 0.59)</td><td>0.72 (0.50 to 0.95)</td><td>0.59 (0.46 to 0.72)</td><td>0.22 (0.20 to 0.23)</td><td>0.40 (0.23 to 0.57)</td><td>0.91 (0.87 to 0.95)</td></tr>
<tr><td>D2: 1 month–2 months</td><td>0.68 (0.66 to 0.70)</td><td>0.40 (0.27 to 0.53)</td><td>0.73 (0.64 to 0.82)</td><td>0.30 (0.28 to 0.31)</td><td>0.41 (0.25 to 0.57)</td><td>0.88 (0.83 to 0.93)</td></tr>
<tr><td>D2: 2 months–3 months</td><td>0.73 (0.71 to 0.74)</td><td>0.56 (0.41 to 0.71)</td><td>0.59 (0.49 to 0.70)</td><td>0.32 (0.31 to 0.33)</td><td>0.36 (0.25 to 0.47)</td><td>0.88 (0.85 to 0.92)</td></tr>
<tr><td>D2: 3 months–4 months</td><td>0.74 (0.73 to 0.76)</td><td>0.58 (0.48 to 0.68)</td><td>0.57 (0.49 to 0.65)</td><td>0.32 (0.32 to 0.33)</td><td>0.29 (0.23 to 0.35)</td><td>0.91 (0.89 to 0.92)</td></tr>
<tr><td>D2: 4 months–5 months</td><td>0.84 (0.83 to 0.85)</td><td>0.43 (0.36 to 0.49)</td><td>0.64 (0.59 to 0.70)</td><td>0.35 (0.34 to 0.36)</td><td>0.21 (0.17 to 0.24)</td><td>0.93 (0.91 to 0.94)</td></tr>
<tr><td>D2: 5 months–6 months</td><td>0.97 (0.96 to 0.98)</td><td>0.30 (0.24 to 0.35)</td><td>0.71 (0.66 to 0.76)</td><td>0.40 (0.39 to 0.41)</td><td>0.14 (0.12 to 0.16)</td><td>0.94 (0.94 to 0.95)</td></tr>
<tr><td>D2: > 6 months</td><td>0.89 (0.87 to 0.90)</td><td>0.50 (0.43 to 0.56)</td><td>0.56 (0.51 to 0.62)</td><td>0.37 (0.36 to 0.38)</td><td>0.26 (0.23 to 0.29)</td><td>0.90 (0.89 to 0.91)</td></tr>
<tr><td>DB: 1 day –7 days</td><td>0.65 (0.64 to 0.66)</td><td>0.35 (0.27 to 0.43)</td><td>0.77 (0.72 to 0.83)</td><td>0.29 (0.28 to 0.30)</td><td>0.14 (0.10 to 0.17)</td><td>0.96 (0.95 to 0.97)</td></tr>
<tr><td>DB: 8 days–14 days</td><td>0.36 (0.36 to 0.37)</td><td>0.28 (0.21 to 0.36)</td><td>0.90 (0.87 to 0.92)</td><td>0.09 (0.09 to 0.10)</td><td>0.16 (0.12 to 0.21)</td><td>0.98 (0.98 to 0.99)</td></tr>
<tr><td>DB: 15 days–30 days</td><td>0.33 (0.32 to 0.33)</td><td>0.18 (0.14 to 0.22)</td><td>0.94 (0.93 to 0.95)</td><td>0.04 (0.04 to 0.05)</td><td>0.16 (0.11 to 0.21)</td><td>0.99 (0.99 to 1.00)</td></tr>
<tr><td>DB: 1 month–2 months</td><td>0.41 (0.40 to 0.41)</td><td>0.16 (0.13 to 0.18)</td><td>0.94 (0.93 to 0.95)</td><td>0.05 (0.05 to 0.06)</td><td>0.14 (0.10 to 0.17)</td><td>0.99 (0.99 to 0.99)</td></tr>
<tr><td>DB: 2 months –3 months</td><td>0.42 (0.41 to 0.43)</td><td>0.18 (0.15 to 0.21)</td><td>0.92 (0.91 to 0.94)</td><td>0.06 (0.05 to 0.07)</td><td>0.10 (0.06 to 0.14)</td><td>0.99 (0.99 to 1.00)</td></tr>
<tr><td>DB> 3 months</td><td>0.50 (0.49 to 0.52)</td><td>0.14 (0.11 to 0.16)</td><td>0.93 (0.92 to 0.94)</td><td>0.06 (0.05 to 0.07)</td><td>0.10 (0.06 to 0.15)</td><td>0.99 (0.99 to 1.00)</td></tr>
<tr><td colspan="7">Naturally-acquired and hybrid immunity[f](ref.: unvaccinated without prior infection evidence)</td></tr>
<tr><td>Unvaccinated: NA</td><td>0.49 (0.48 to 0.50)</td><td>0.45 (0.30 to 0.60)</td><td>0.78 (0.70 to 0.85)</td><td>0.11 (0.11 to 0.12)</td><td>0.43(0.22 to 0.64)</td><td>0.95(0.93 to 0.98)</td></tr>
<tr><td>D1 or D2: NA</td><td>0.33 (0.32 to 0.34)</td><td>0.51 (0.36 to 0.66)</td><td>0.83 (0.78 to 0.88)</td><td>0.08 (0.08 to 0.09)</td><td>0.56 (0.34 to 0.77)</td><td>0.95 (0.94 to 0.97)</td></tr>
<tr><td>DB: NA</td><td>0.19 (0.19 to 0.20)</td><td>0.29 (0.22 to 0.36)</td><td>0.94 (0.93 to 0.96)</td><td>0.02 (0.02 to 0.02)</td><td>0.29 (0.13 to 0.44)</td><td>0.99 (0.99 to 1.00)</td></tr>
</table>
CI: confidence interval; COVID-19: coronavirus disease; D1: first vaccine dose; D2: second vaccine dose; DB: booster dose; HR: hazard ratio; NA: not applicable; OR: odds ratio; ref.: reference; RT-PCR: reverse-transcription PCR; SARS-CoV-2: severe acute respiratory coronavirus 2.
[a] Delta (respective Omicron): laboratory-confirmed (RT-PCR) SARS-CoV-2 infection with mutation screening indicative of Delta (respective Omicron) variant [14].
[b] Duration since receiving the COVID-19 vaccine dose in question, at presentation to the screening centre.
[c] Risk reductions are relative to symptoms attributable respectively to the Delta or the Omicron variant.
[d] Odds ratios of symptomatic infections, according to the time elapsed since each COVID-19 vaccine dose reception or according to evidence of prior infection.
[e] Hazard ratios of hospitalisations after symptomatic infections, according to the time elapsed since each COVID-19 vaccine dose reception or according to evidence of prior infection.
[f] Naturally-acquired immunity: individuals with evidence of prior SARS-CoV-2 infection; the causative variant for prior infection is unknown.</td>
</tr>
</table>

							<table><tr><th rowspan="2">Immune status: time since named vaccine dose[b]</th><th colspan="3">Omicron[a]</th><th colspan="3">Delta[a]</th></tr><tr><th>Hospital admission HR[c] (95%CI)</th><th>ICU admission HR[c] (95%CI)</th><th>Death HR[c] (95%CI)</th><th>Hospital admission HR[c] (95%CI)</th><th>ICU admission HR[c] (95%CI)</th><th>Death HR[c] (95%CI)</th></tr><tr><td colspan="7">Vaccinated (ref.: unvaccinated without prior infection evidence)</td></tr><tr><td>D1: 0–28 days</td><td>0.99 (0.75 to 1.23)</td><td>1.09 (0.49 to 1.69)</td><td>1.09 (0.53 to 1.65)</td><td>0.66 (0.50 to 0.81)</td><td>0.43 (0.21 to 0.65)</td><td>0.93 (0.48 to 1.37)</td></tr><tr><td>D2: 0–30 days</td><td>0.72 (0.50 to 0.95)</td><td>0.54 (0.06 to 1.02)</td><td>0.71 (0.14 to 1.29)</td><td>0.40 (0.23 to 0.57)</td><td>0.32 (0.04 to 0.60)</td><td>0.44 (0.01 to 0.87)</td></tr><tr><td>D2: 1–2 months</td><td>0.40 (0.27 to 0.53)</td><td>0.32 (0.06 to 0.59)</td><td>0.38 (0.10 to 0.67)</td><td>0.41 (0.25 to 0.57)</td><td>0.52 (0.21 to 0.84)</td><td>0.14 (−0.13 to 0.42)</td></tr><tr><td>D2: 2–3 months</td><td>0.56 (0.41 to 0.71)</td><td>0.22 (0.00 to 0.43)</td><td>0.12 (−0.05 to 0.29)</td><td>0.36 (0.25 to 0.47)</td><td>0.35 (0.16 to 0.54)</td><td>0.11 (−0.04 to 0.26)</td></tr><tr><td>D2: 3–4 months</td><td>0.58 (0.48 to 0.68)</td><td>0.25 (0.09 to 0.42)</td><td>0.43 (0.22 to 0.65)</td><td>0.29 (0.23 to 0.35)</td><td>0.18 (0.10 to 0.26)</td><td>0.31 (0.12 to 0.49)</td></tr><tr><td>D2: 4–5 months</td><td>0.43 (0.36 to 0.49)</td><td>0.15 (0.07 to 0.24)</td><td>0.30 (0.14 to 0.45)</td><td>0.21 (0.17 to 0.24)</td><td>0.17 (0.12 to 0.23)</td><td>0.37 (0.20 to 0.53)</td></tr><tr><td>D2: 5–6 months</td><td>0.30 (0.24 to 0.35)</td><td>0.19 (0.11 to 0.28)</td><td>0.32 (0.15 to 0.48)</td><td>0.14 (0.12 to 0.16)</td><td>0.10 (0.07 to 0.13)</td><td>0.20 (0.11 to 0.28)</td></tr><tr><td>D2: > 6 months</td><td>0.50 (0.43 to 0.56)</td><td>0.32 (0.21 to 0.42)</td><td>0.51 (0.36 to 0.65)</td><td>0.26 (0.23 to 0.29)</td><td>0.14 (0.11 to 0.18)</td><td>0.35 (0.25 to 0.44)</td></tr><tr><td>DB: 1–7 days</td><td>0.35 (0.27 to 0.43)</td><td>0.12 (0.02 to 0.22)</td><td>0.29 (0.07 to 0.50)</td><td>0.14 (0.10 to 0.17)</td><td>0.06 (0.03 to 0.10)</td><td>0.29 (0.15 to 0.43)</td></tr><tr><td>DB: 8–14 days</td><td>0.28 (0.21 to 0.36)</td><td>0.12 (0.02 to 0.21)</td><td>0.14 (0.00 to 0.28)</td><td>0.16 (0.12 to 0.21)</td><td>0.07 (0.02 to 0.12)</td><td>0.24 (0.09 to 0.39)</td></tr><tr><td>DB: 15–30 days</td><td>0.18 (0.14 to 0.22)</td><td>0.13 (0.07 to 0.20)</td><td>0.18 (0.08 to 0.28)</td><td>0.16 (0.11 to 0.21)</td><td>0.15 (0.07 to 0.23)</td><td>0.15 (0.02 to 0.29)</td></tr><tr><td>DB: 1–2 months</td><td>0.16 (0.13 to 0.18)</td><td>0.06 (0.03 to 0.08)</td><td>0.15 (0.10 to 0.21)</td><td>0.14 (0.10 to 0.17)</td><td>0.13 (0.07 to 0.19)</td><td>0.16 (0.06 to 0.25)</td></tr><tr><td>DB: 2–3 months</td><td>0.18 (0.15 to 0.21)</td><td>0.08 (0.04 to 0.13)</td><td>0.14 (0.08 to 0.20)</td><td>0.10 (0.06 to 0.14)</td><td>0.08 (0.00 to 0.15)</td><td>0.09 (0.01 to 0.16)</td></tr><tr><td>DB > 3 months</td><td>0.14 (0.11 to 0.16)</td><td>0.05 (0.01 to 0.09)</td><td>0.13 (0.08 to 0.17)</td><td>0.10 (0.06 to 0.15)</td><td>0.03 (−0.03 to 0.09)</td><td>0.10 (0.01 to 0.19)</td></tr><tr><td colspan="7">Naturally-acquired or hybrid immunity[d] (ref.: unvaccinated without prior infection evidence)</td></tr><tr><td>Unvaccinated: NA</td><td>0.45 (0.30 to 0.60)</td><td>0.14 (−0.05 to 0.33)</td><td>0.24 (−0.09 to 0.58)</td><td>0.43 (0.22 to 0.64)</td><td>0.54 (0.10 to 0.97)</td><td>1.06 (0.02 to 2.10)</td></tr><tr><td>D1 or D2: NA</td><td>0.51 (0.36 to 0.66)</td><td>0.42 (0.12 to 0.72)</td><td>0.34 (0.07 to 0.61)</td><td>0.56 (0.34 to 0.77)</td><td>0.39 (0.08 to 0.71)</td><td>0.90 (0.17 to 1.62)</td></tr><tr><td>DB: NA</td><td>0.29 (0.22 to 0.36)</td><td>0.16 (0.05 to 0.28)</td><td>0.19 (0.06 to 0.32)</td><td>0.29 (0.13 to 0.44)</td><td>0.13 (−0.05 to 0.30)</td><td>0.11 (−0.11 to 0.33)</td></tr></table>
159	Kirsebom et al (April 28, 2022)	England	General population	**Omicron** Delta	ChAdOx1 Comirnaty mRNA-1273 followed by ChAdOx1 booster	September 13, 2021-February 17, 2022	TND study linking adminsitrative databases to assess VE against symptomatic disease

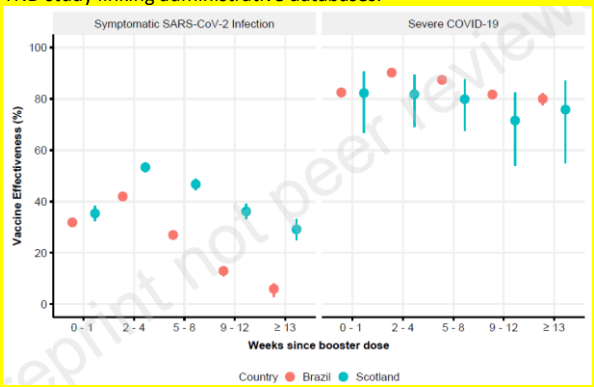
							

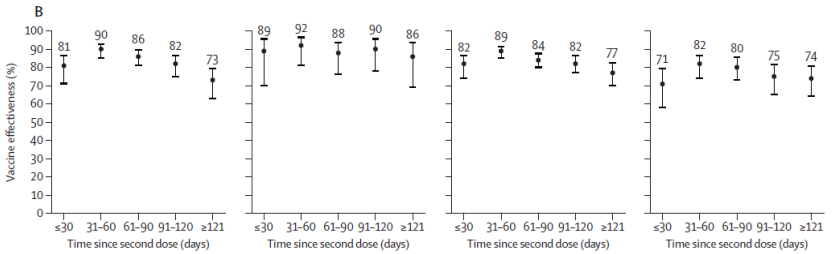
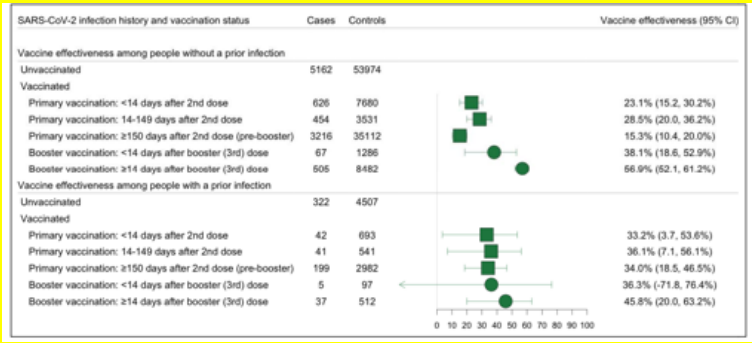
Age (years)	Dose	Booster Manufacturer	Interval (days)	Controls	Cases	OR*	VE (95% CI)
40-64	Unvaccinated			27,361	51265	Baseline	Baseline
	Dose 2**	n/a	175+	85175	89230	0.92 (0.9-0.94)	8 (6 to 9.9)
	Booster	Any***	0-1	11,879	7715	0.8 (0.77-0.83)	20.3 (17.2 to 23.3)
		Any***	2-6	27430	21422	0.74 (0.72-0.76)	25.8 (23.7 to 27.8)
		BNT162b2	7-13	28,809	17658	0.42 (0.41-0.43)	58.2 (57.0 to 59.4)
		BNT162b2	14-34	86719	66406	0.36 (0.35-0.37)	63.8 (63.0 to 64.5)
		BNT162b2	35-69	87592	90787	0.43 (0.42-0.44)	57.3 (56.4 to 58.2)
		BNT162b2	70-104	22504	29379	0.54 (0.52-0.55)	46.4 (45.0 to 47.8)
		BNT162b2	105+	2758	4278	0.69 (0.66-0.73)	30.6 (26.8 to 34.3)
		ChAdOx1-S	7-13	70	40	0.39 (0.25-0.59)	61.2 (40.9 to 74.6)
		ChAdOx1-S	14-34	193	159	0.48 (0.38-0.61)	51.7 (38.9 to 61.8)
		ChAdOx1-S	35-69	216	215	0.47 (0.38-0.57)	53.0 (42.6 to 61.6)
		ChAdOx1-S	70-104	69	97	0.59 (0.43-0.81)	40.8 (18.6 to 56.9)
		ChAdOx1-S	105+	10	14	0.63 (0.27-1.44)	37.2 (-44.1 to 72.6)
65+	Unvaccinated			1,701	2361	Baseline	Baseline
	Dose 2**	n/a	175+	4466	3053	0.81 (0.73-0.88)	19.5 (11.7 to 26.6)
	Booster	Any***	0-1	428	110	0.65 (0.5-0.85)	34.6 (14.8 to 49.8)
		Any***	2-6	1140	370	0.71 (0.61-0.84)	28.6 (16.0 to 39.3)
		BNT162b2	7-13	1,883	433	0.42 (0.36-0.48)	58.1 (51.6 to 63.8)
		BNT162b2	14-34	14311	3010	0.31 (0.29-0.34)	68.5 (65.7 to 71.2)
		BNT162b2	35-69	36300	25240	0.46 (0.42-0.49)	54.1 (50.5 to 57.5)
		BNT162b2	70-104	14210	18317	0.6 (0.55-0.65)	40.1 (35.2 to 44.5)
		BNT162b2	105+	1970	2789	0.77 (0.7-0.85)	23.1 (15.1 to 30.5)
		ChAdOx1-S	7-13	23	8	0.34 (0.14-0.83)	66.1 (16.6 to 86.3)
		ChAdOx1-S	14-34	53	32	0.48 (0.3-0.79)	51.6 (20.8 to 70.4)
		ChAdOx1-S	35-69	88	81	0.56 (0.4-0.78)	44.5 (22.4 to 60.2)
		ChAdOx1-S	70-104	16	40	1.27 (0.7-2.32)	-27.2 (-131.6 to 30.1)
		ChAdOx1-S	105+	3	5	0.98 (0.23-4.28)	N too low

158	Sheikh et al (April 22, 2022)	Scotland	General population	**Omicron**	ChAdOx1 Comirnaty mRNA-1273	November 1-December 19, 2021	TND study linking adminsitrative databases to assess VE against symptomatic disease.

	S-gene-negative infections			S-gene-positive infections		
	Tested, n	Positive, n	Relative vaccine effectiveness, % (95% CI)	Tested, n	Positive, n	Relative vaccine effectiveness, % (95% CI)
16–49 years						
Unvaccinated	10 302	1003	22% (14 to 29)	14 583	5284	−98% (−109 to −87)
First dose						
0–27 days	550	36	47% (24 to 63)	676	162	−24% (−50 to −3)
≥28 days	6570	581	30% (21 to 38)	8339	2350	−39% (−49 to −30)
Second dose						
0–13 days	732	46	58% (42 to 70)	805	119	31% (16 to 44)
14–69 days	4248	256	53% (46 to 60)	4258	266	73% (69 to 76)
70–104 days	12 581	814	33% (26 to 40)	13 559	1792	50% (46 to 53)
105–139 days	29 209	3503	15% (9 to 21)	31 963	6257	32% (29 to 36)
140–174 days	14 986	1824	3% (−5 to 11)	17 991	4829	9% (4 to 13)
≥175 days	13 183	1435	Reference	15 462	3714	Reference
Third dose						
0–6 days	3773	515	26% (16 to 34)	4003	745	33% (27 to 39)
7–13 days	2185	143	62% (54to 68)	2155	113	84% (80 to 87)
≥14 days	12 887	783	56% (51 to 60)	12 798	694	83% (81 to 84)
≥50 years						
Unvaccinated	716	48	33% (7 to 52)	1158	490	−45% (−65 to −28)
First dose						
0–27 days	27	4	0 (−230 to 70)	36	13	−16% (−134 to 42)
≥28 days	256	13	48% (7 to 72)	343	100	10% (−15 to 30)
Second dose						
0–13 days	23	1	62% (−207 to 95)	23	1	90% (27 to 99)
14–69 days	120	9	5% (−98 to 54)	131	20	62% (38 to 77)
70–104 days	128	12	8% (−76 to 52)	149	33	40% (10 to 60)
105–139 days	463	17	35% (−10 to 62)	634	188	20% (4 to 33)
140–174 days	5513	265	4% (−13 to 19)	8205	2957	4% (−2 to 10)
≥175 days	8007	799	Reference	10 856	3648	Reference
Third dose						
0–6 days	3522	420	0 (−15 to 13)	4352	1250	20% (13 to 26)
7–13 days	3006	180	54% (46 to 62)	3146	320	77% (74 to 80)
≥14 days	17 572	1045	57% (52 to 62)	17 504	977	88% (86 to 89)

157	Cerqueria-Silva et al (April 14, 2022)	Brazil, Scotland	18+ year olds	**Omicron**	ChAdOx1 Comirnaty mRNA-1273	January 1-March 7, 2022	TND study linking administrative databases. 
156	Widdifield et al (April 14, 2022)	Canada	Patients with rheumatoid arthritis, ankylosing spondylitis, psoriasis, and inflammatory bowel disease	Alpha, Delta	Comirnaty mRNA-1273	March 1-November 21, 2021	TND study among patients with inflammatory diseases to evaluate VE against infection

							
155	Lind et al (April 20,2022)	USA	5+ years	**Omicron specifically ^**	Comirnaty mRNA-1273	November 1, 2021-January 31, 2022	This TND study assessed the benefit of primary series an booster doses in the context of Omicron VOC circulation among people with and without a prior documented infection. Primary vaccination had significant but low levels of protection in people with and without prior infection which was increased by booster doses; however, the study did not find a signifcant increase in people with prior infection. 
154	Gram et al (April 20,2022)	Denmark	12+ years	Alpha, Delta and **Omicron^**	Comirnaty mRNA-1273	December 27,2020-January 31,2022	This study evaluated the VE of mRNA vaccines in Denmark against infection and hospitalisation. The study reported that vaccination with mRNA vaccines was associated with protection against infection and hospitaliztion by Alpha, Delta and Omicron VOCs. VE of 2 doses mRNA agains infection: VE 2 doses mRNA against hospitalizaton:

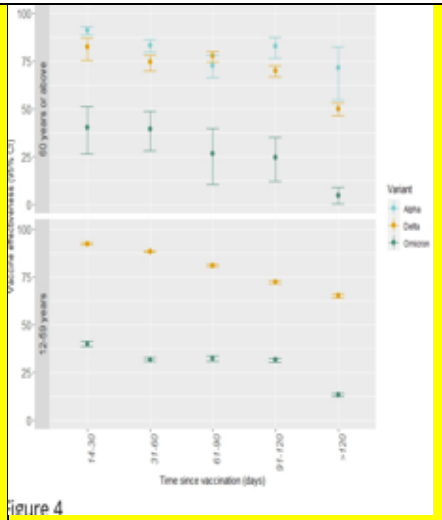


Figure 4

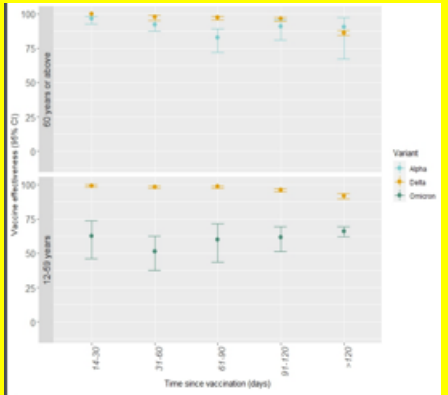


Figure 6

VE of 3 doses mRNA agains infection:

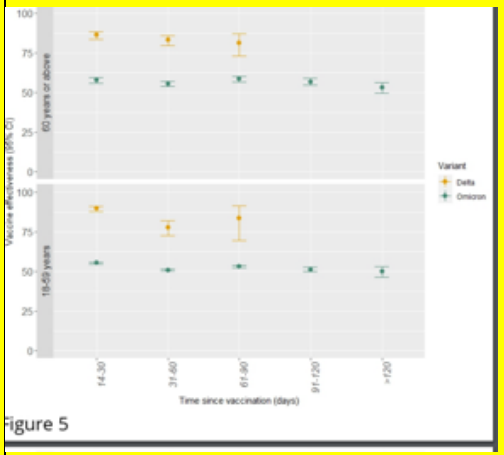


Figure 5

VE 2 doses mRNA against hospitalizaton:

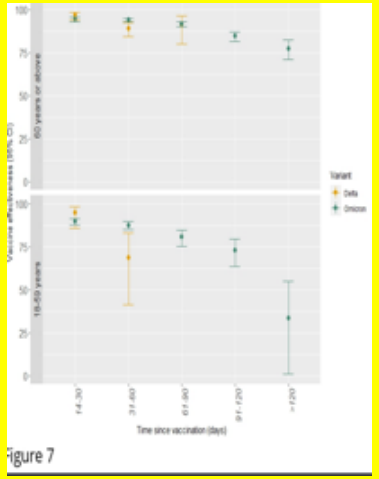
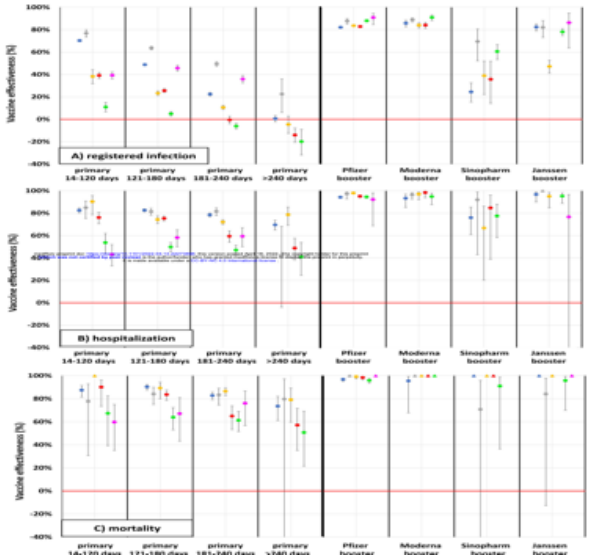


Figure 7

153	Voko et al (April 18,2022)	Hungary	18-100 years	Delta^	Comirnaty, mRNA-1273, ChAdOx1, Ad26.COV2.S, Sputnik, Sinopharm	March 4, 2020-December 31, 2021	This study assessed the effectiveness and duration of protection of six different types of vaccines with combinations as primary or booster vaccines against COVID-19 infection, hospitalization and death during a period of Delta variant predominance. 
152	Grewal et al (April 18,2022) (updated June 1, 2022) (final publication July 6, 2022)	Canada	LTC residents aged ≥60 years	**Omicron specifically^**	Comirnaty, mRNA-1273	December 30, 2021-April 27, 2022	This test-negative case control study estimated the marginal effectiveness of a fourth dose of COVID-19 vaccines relative to individuals with a third dose and or unvaccinated.

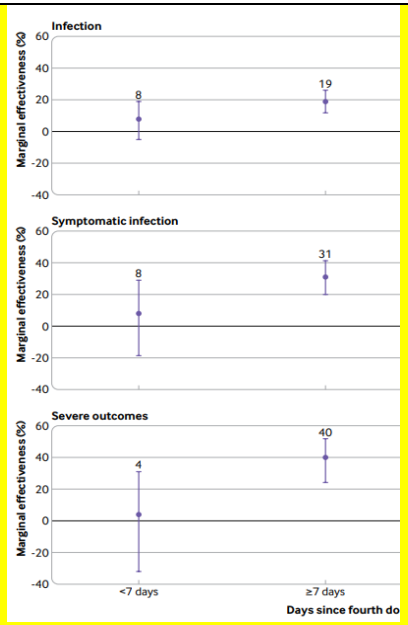
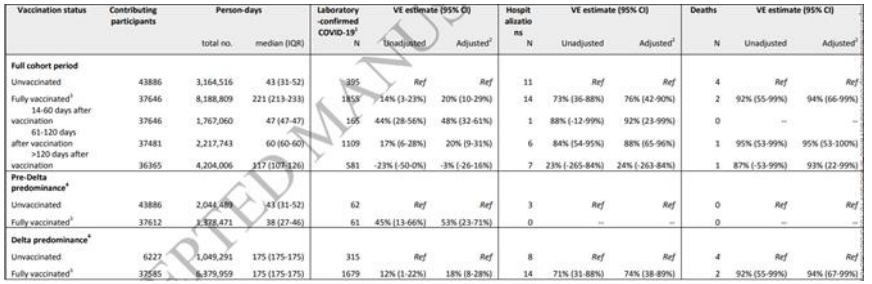
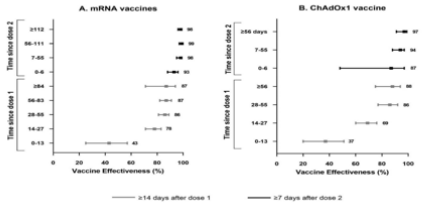
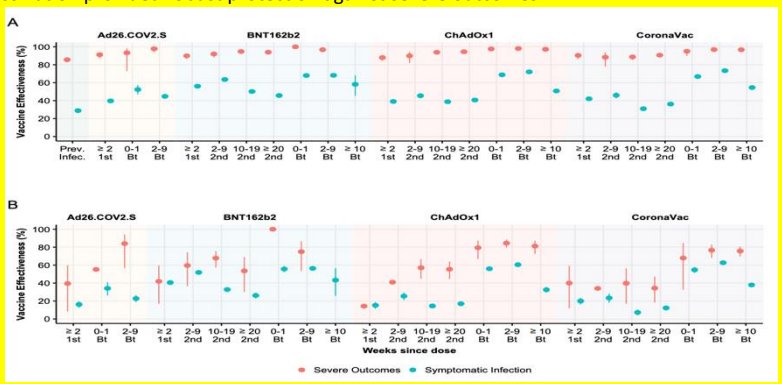
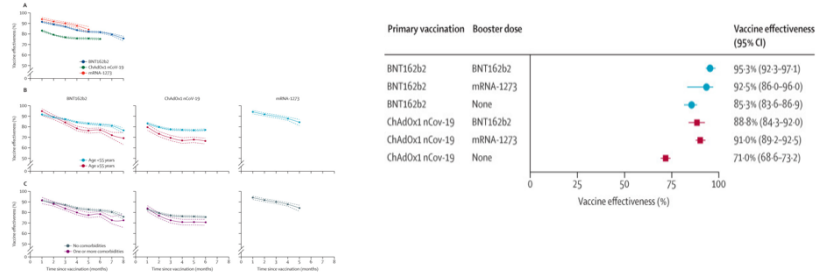
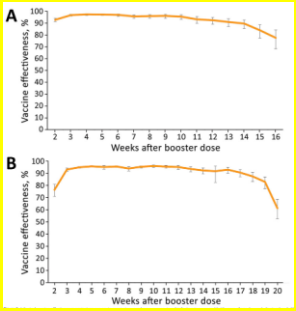
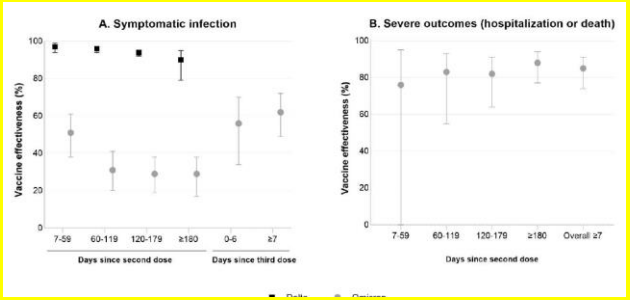
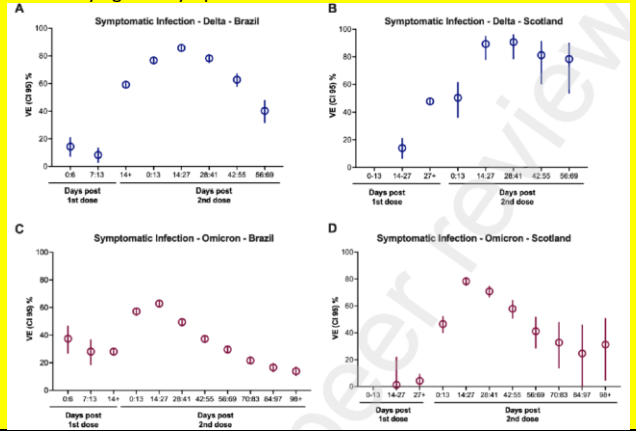
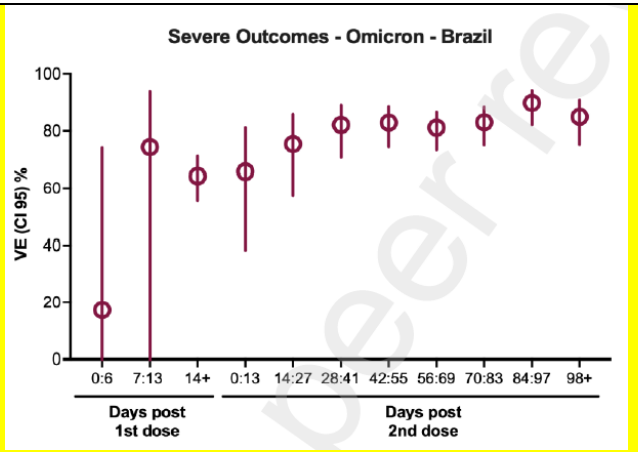
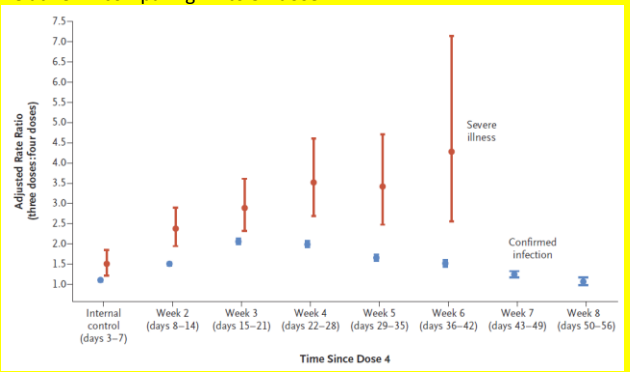
							
151	Richardson et al (April 17,2022) (updated June 20, 2022)	Mexico	Childcare workers aged ≥18 years	Non-VOC, Alpha, Gamma and Delta^	CanSino	March 30, 2021-December 31, 2021	Prospective cohort study evaluating the VE of Cansino against laboratory-confirmed illness, hospitalisation and death associated with COVID-19. Vaccination with Cansino provided moderate protection against infection, and robust protection against hospitalization and death up to 4 months, with declines in VE seen after 120 days. 
150	Nasreen et al (April 13,2022)	Canada	18+ year olds	Non-VOC, Alpha, Beta, Gamma, Delta^	Comirnaty mRNA-1273 ChAdOx1	December 14, 2020-September 30, 2021	Test-negative case control study conducted across 4 canadian provinces to evaluate the effectiveness of heterologous and homologous regimen of COVID-19 vaccines in preventing hospitalization or death.

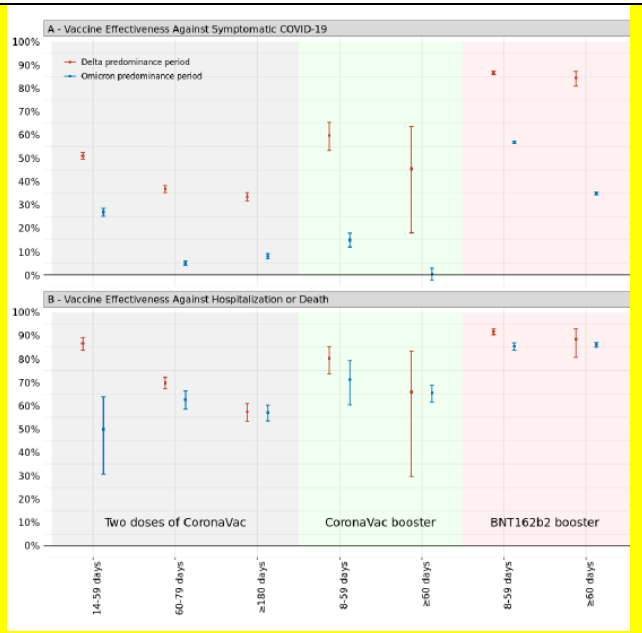
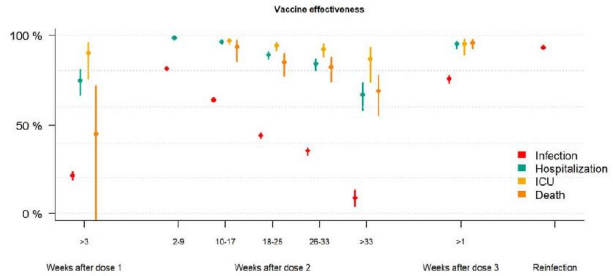
							Figure 2: Pooled adjusted vaccine effectiveness against severe outcomes of hospitalization or death for mRNA (panel A) and ChAdOx1 (panel B) vaccines in Ontario, Quebec, British Columbia, and Manitoba. 
149	Cerqueira-Silva (April 13, 2022)	Brazil	18+ year olds	**Omicron^**	BNT162b2, ChAdOx1, Ad26.COV2.S and CoronaVac	January 01,2022-March 22,2022	TND and matched case-control study evaluating the impact of hybrid immunity in preventing symptomatic infection and severe disease during Omicron circulation. Prior infection with vaccination provided robust protection against severe outcomes. 
148	Plumb et al (April 15, 2022)	USA	18+ year olds	Delta→ **Omicron**	Comirnaty and mRNA-1273	June 20, 2021-February 24,2022	Test-negative case control study assessed effectiveness of mRNA primary series and booster vaccines in hospitalised patients with prior infection. ** Among persons with a previous infection, adjusted VE <90 days after dose 1 was 42.0% (95% CI = 16.8%–59.5%) and ≥90 days after dose 1 was 42.2% (95% CI = 26.0%–54.8%); adjusted VE <90 days after dose 2 was 44.6% (95% CI = 28.6%–56.9%) and ≥90 days after dose 2 was 39.3% (95% CI = 32.4%–45.4%); and adjusted VE <90 days after dose 3 was 67.9% (95% CI = 60.3%–74.0%) and ≥90 days after dose 3 was 62.4% (95% CI = 48.6%–72.5%).
147	Kim et al (April 10, 2022)	USA	18+ year olds	Delta→ **Omicron**	Comirnaty and mRNA-1273	October 1, 2021-February 12, 2022	Test-negative case control study evaluating VE of 2nd and 3rd doses of mRNA vaccines against symptomatic infection over time across outpatient centers in 7 US states. Paper contains data stratified by prior infection, chronic conditions, and high-risk exposure. **Delta**[b] 2-Dose 327/552 (59) 763/942 (81) 66 (57 to 73) 63 (51 to 72) 14-149 Days 14/239 (6) 106/285 (37) 89 (81 to 94) 89 (78 to 94) ≥150 Days 313/538 (58) 657/836 (79) 62 (52 to 70) 58 (44 to 68) 3-Dose 22/247 (9) 259/438 (59) 93 (89 to 96) 96 (93 to 98) **Omicron**[b] 2-Dose 464/684 (68) 257/380 (68) 0 (-32 to 23) 21 (-6 to 41) 14-149 Days 69/289 (24) 53/176 (30) 27 (-11 to 52) 45 (14 to 66) ≥150 Days 395/615 (64) 204/327 (62) -8 (-43 to 18) 11 (-21 to 35) 3-Dose 322/542 (59) 408/531 (77) 56 (43 to 66) 62 (48 to 72)

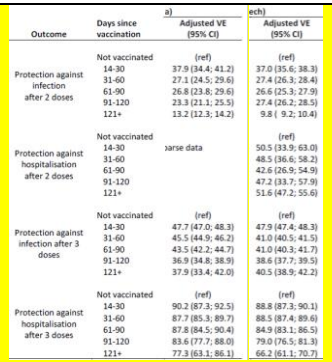
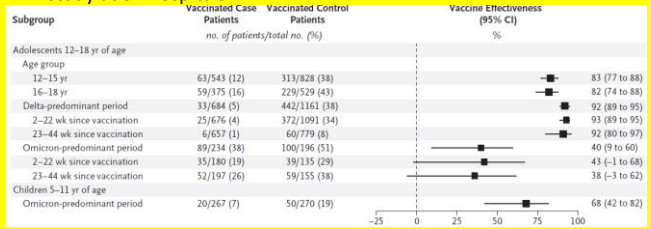
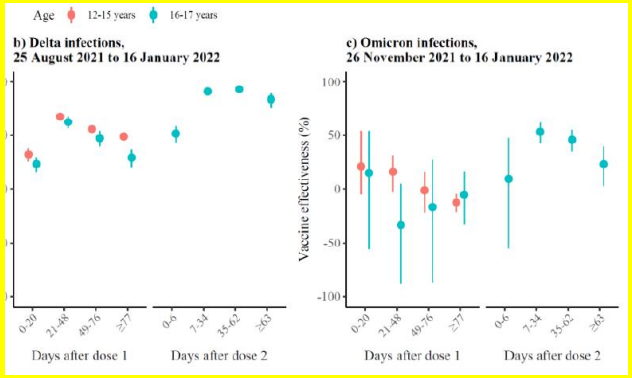
146	Menni et al* (April 08,2022)	UK	General population	Delta^	Comirnaty mRNA-1273 ChAdOx1	May 23, 2021-November 23, 2021	Prospective cohort study analysed sel-reported lateral flow or PCR test positivity data from an app in the UK among adults, 5-8 months after receiving primary dose and an mRNA booster. VE showed a gradual decline after the second dose. 
145	Glatman-Freedman et al (March 31, 2022)	Israel	16+ year olds	Delta→ **Omicron**	Comirnaty	September 6, 2021-January 1, 2022	Cohort study by linking administrative databases evaluate VE of 3rd dose versus 0 doses against infection over time. A=16-59 year olds; B=60+ year olds. 
144	Buchan et al (April 7, 2022)	Canada	12-17 year olds	Delta→ **Omicron**	Comirnaty	November 22, 2021-March 6, 2022	TND conducted by linking adminsitrative databases evaluating VE against symptomatic infection and severe disease. 

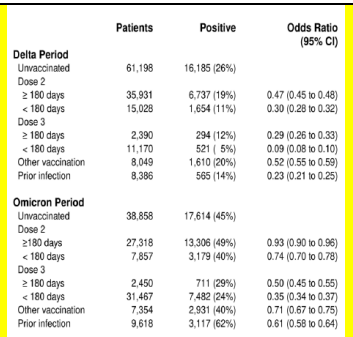
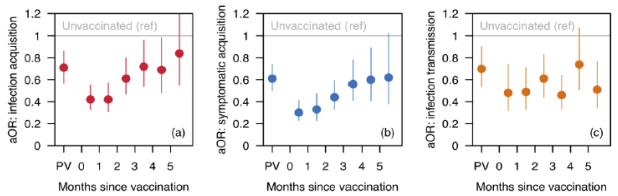
143	Fabiani et al (April 6, 2022)	Italy	60+ and other priority groups (e.g. hcws)	Delta	Comirnaty mRNA-1273 ChAdOx1 Ad26.COV2.S	July 19, 2021-December 12, 2021	Cohort study among vaccine recipients comparing time intervals to day 4-10 post dose 1. Paper contains data stratified by priority groups. Any SARS-CoV-2 infection[a] / Severe COVID-19[b] Total 4-10 days since 1st dose (reference): 608 / 11.2 / ref. / 115 / 2.2 / ref. >2 wks. after 1st dose to ≤2 wks. after 2nd: 7,451 / 6.7 / 29.3 (16.3 / 767 / 0.7 / 59.5 (49.4 3-13 wks. after completion of primary series: 24,09 / 3.3 / 67.2 (62.5 / 1,406 / 0.2 / 89.5 (86.1 14-18 wks. after completion of primary series: 25,56 / 4.9 / 51.4 (43.6 / 2,041 / 0.4 / 82.7 (76.5 19-26 wks. after completion of primary series: 63,90 / 8.6 / 29.4 (15.5 / 4,366 / 0.7 / 75.9 (66.3 >26 wks. after completion of primary series: 56,69 / 12.5 / 12.2 (-4.7 / 3,912 / 1.1 / 65.3 (50.3 3-10(8)[c] wks. after booster dose: 4,319 / 4.3 / 76.1 (70.4 / 171 / 0.4 / 93.0 (90.2
142	Bansal et al (April 6, 2022)	Qatar	General population	Alpha, Beta, Delta, Omicron (but no omicron specific estimate)	Comirnaty mRNA-1273 ChAdOx1 (1.6% of all vaccinated)	January 1, 2021-February 20, 2022	Matched case-control among all cases in Qatar, looking at progression to ICU. VE 89% (95% CI, 85 to 92) between 0-4 months post the second dose. VE 91%; 95% CI 84 to 95) between 4 -6 months after the second dose; VE 90%; 95% CI 84 to 94)) at 6 to 9 months after the second dose.
141	Florentino et al (April 5, 2022)	Brazil, Scotland	12-17 year olds	Delta→ **Omicron**	Comirnaty	Brazil: September 8, 2021-March 8, 2022 Scotland: August 6, 2021-March 1, 2022	TND study against symptomatic and severe disease. 

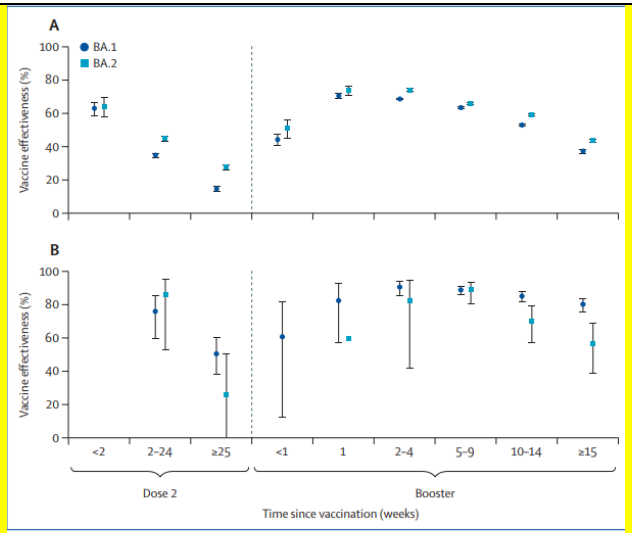
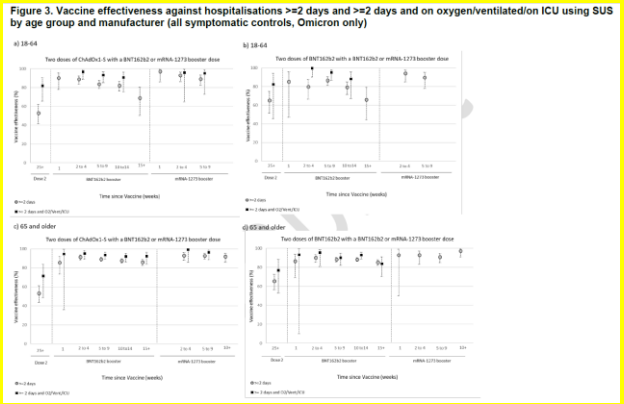
							
140	Bar-On et al (April 5, 2022)	Israel	60+ year olds	**Omicron**	Comirnaty	January 10-March 2, 2022	Relative VE comparing 4th to 3rd dose. 
139	Perumal et al (April 1, 2022)	Germany	12+ year olds	Delta, **Omicron**	Comirnaty mRNA-1273	November 8, 2021-February 13, 2022	Analysis of surveillance data with comparison to aggregate vaccination data to calculate the VE against symptomatic disease, hospitalization, and severe disease. (Note unable to adjust for many confounders).

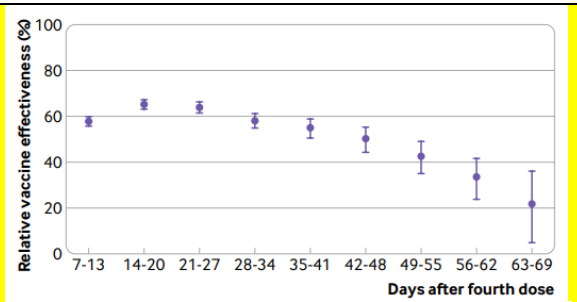
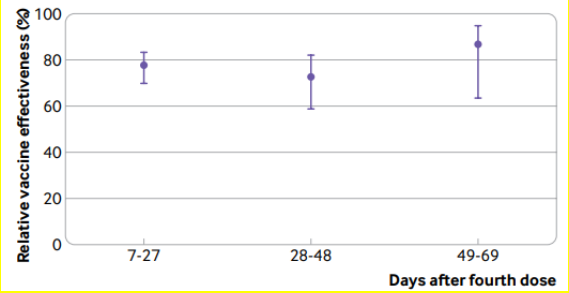
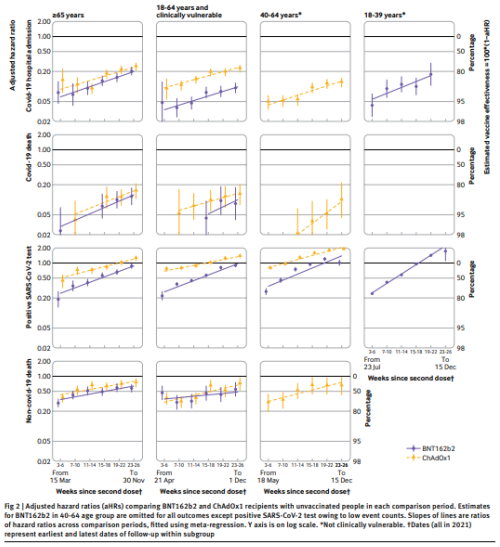
<table>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Table 3: Effectiveness of booster vaccination against symptomatic SARS-CoV-2 infection and COVID-19-associated hospitalizations and severe illness during dominant circulation of the Omicron variant in Germany, CW52/2021-06/2022, by age group and time interval.
<table>
<tr><th></th><th colspan="2">12-17 years</th><th colspan="6">≥18 years</th></tr>
<tr><th></th><th colspan="2"></th><th colspan="2">All</th><th colspan="2">18-59 years</th><th colspan="2">≥60 years</th></tr>
<tr><th></th><th>N (Cases)</th><th>VE (95% CI)</th><th>N (Cases)</th><th>VE (95% CI)</th><th>N (Cases)</th><th>VE (95% CI)</th><th>N (Cases)</th><th>VE (95% CI)</th></tr>
<tr><td>Symptomatic infection</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Unvaccinated</td><td>46,544</td><td>Ref.</td><td>166,565</td><td>Ref.</td><td>147,877</td><td>Ref.</td><td>18,688</td><td>Ref.</td></tr>
<tr><td>Boosted*</td><td>2,565</td><td>88·3 (86·2–90·2)</td><td>156,215</td><td>69·7 (65·2–73·6)</td><td>131,523</td><td>67·4 (62·3–71·8)</td><td>26,959</td><td>81·6 (77·2–85·2)</td></tr>
<tr><td>Boosted, by time interval</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><4 weeks</td><td>1,694</td><td>89·7 (88·1–91·1)</td><td>42,311</td><td>78·7 (75·8–81·3)</td><td>37,326</td><td>77·4 (74·6–79·9)</td><td>4,985</td><td>87·8 (86·0–89·4)</td></tr>
<tr><td>4 to <8 weeks</td><td>871</td><td>84·4 (81·1–87·3)</td><td>76,028</td><td>65·9 (62·1–69·4)</td><td>64,484</td><td>62·9 (59·2–66·3)</td><td>11,544</td><td>81·3 (79·3–83·2)</td></tr>
<tr><td>8 to <12 weeks</td><td>..</td><td>NC</td><td>37,876</td><td>56·7 (50·0–62·5)</td><td>29,713</td><td>51·1 (44·3–57·2)</td><td>8,163</td><td>76·4 (73·4–79·0)</td></tr>
<tr><td>12 to <16 weeks</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>2,267</td><td>75·0 (69·7–79·5)</td></tr>
<tr><td>Hospitalization</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Unvaccinated</td><td>222</td><td>Ref.</td><td>5,325</td><td>Ref.</td><td>2,404</td><td>Ref.</td><td>2,921</td><td>Ref.</td></tr>
<tr><td>Boosted*</td><td>9</td><td>90·5 (86·4–93·6)</td><td>1,340</td><td>94·4 (92·6–95·8)</td><td>617</td><td>89·9 (86·9–92·3)</td><td>905</td><td>95·9 (94·6–97·0)</td></tr>
<tr><td>Boosted by time interval</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><4 weeks</td><td>6</td><td>91·4 (85·2–95·6)</td><td>351</td><td>96·4 (94·9–97·6)</td><td>180</td><td>93·7 (92·3–95·0)</td><td>171</td><td>97·7 (97·0–98·3)</td></tr>
<tr><td>4 to <8 weeks</td><td>3</td><td>83·9 (66·2–93·9)</td><td>580</td><td>94·8 (93·0–96·1)</td><td>279</td><td>88·6 (86·5–90·5)</td><td>301</td><td>96·7 (95·9–97·4)</td></tr>
<tr><td>8 to <12 weeks</td><td>..</td><td>NC</td><td>409</td><td>91·4 (88·0–94·1)</td><td>158</td><td>77·1 (71·4–82·0)</td><td>251</td><td>94·3 (92·8–95·5)</td></tr>
<tr><td>12 to <16 weeks</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>182</td><td>85·6 (81·3–89·1)</td></tr>
<tr><td>Severe illness</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Unvaccinated</td><td>5</td><td>Ref.</td><td>1,535</td><td>Ref.</td><td>289</td><td>Ref.</td><td>1,246</td><td>Ref.</td></tr>
<tr><td>Boosted*</td><td>0</td><td>NC</td><td>244</td><td>97·5 (96·8–98·2)</td><td>24</td><td>96·2 (92·2–98·4)</td><td>220</td><td>97·7 (97·0–98·2)</td></tr>
<tr><td>Boosted by time interval</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td><4 weeks</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>39</td><td>98·8 (98·2–99·2)</td></tr>
<tr><td>4 to <8 weeks</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>73</td><td>98·1 (97·4–98·6)</td></tr>
<tr><td>8 to <12 weeks</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>46</td><td>97·3 (96·0–98·2)</td></tr>
<tr><td>12 to <16 weeks</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>..</td><td>NC</td><td>62</td><td>87·9 (83·1–91·6)</td></tr>
</table>
</td>
</tr>
<tr>
<td>138</td>
<td>Ranzani et al (April 1, 2022)</td>
<td>Brazil</td>
<td>18+ year olds</td>
<td>Delta, Omicron</td>
<td>Coronavac Comirnaty</td>
<td>September 6, 2021-March 10, 2022</td>
<td>TND study linking adminsitrative databases. Note booster dose VE is a relative VE (compared to primary series recipients) while primary series VE is compared to unvaccianted.</td>
</tr>
</table>

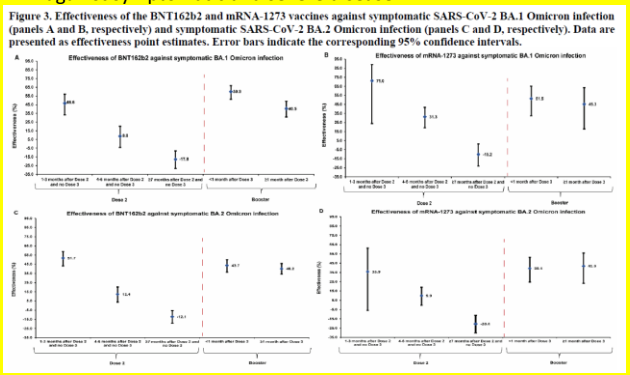
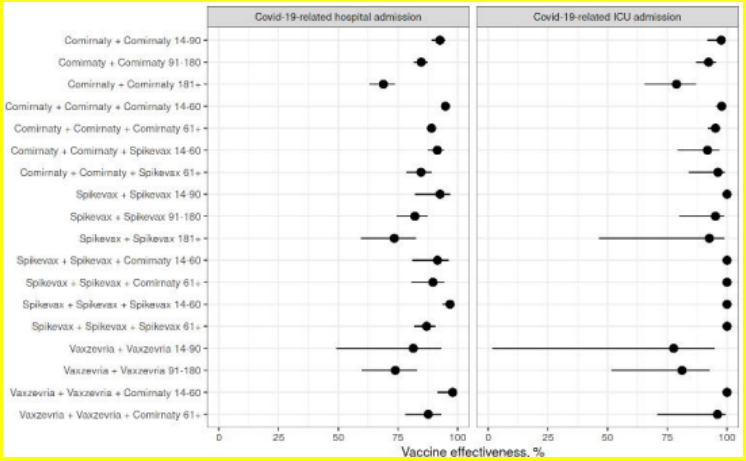
							
137	Starrfelt et al (March 30, 2022)	Norway	18+ year olds	Delta	Comirnaty mRNA-1273 ChAdOx1	July 15-November 30, 2021	Cohort study conducted by linking adminsitrative databases. 
136	Hansen et al (March 30, 2022)	Denmark	12+ year olds	**Omicron**	Comirnaty mRNA-1273	December 28, 2021-February 15, 2022	Cohort study by linking administrative databases. (first column Pfizer, second Moderna)

							
135	Price et al (March 30, 2022)	USA	5-18 year olds	Delta→ **Omicron**	Comirnaty	July 1, 2021-February 17, 2022	TND study at 31 hospitals. 
134	Veneti et al (March 25, 2022)	Norway	12-17 year olds	Delta→ **Omicron**	Comirnaty	August 24, 2021-January 16, 2022	Cohort study of 12-17 year olds evaluating VE against infection based on linking adminiistrative databases. 
133	Wang et al (March 25, 2022)	USA	General population	Delta→ **Omicron**	Comirnaty mRNA-1273	October 1, 2021-January 31, 2022	TND study at Cleveland Clinic evaluating risk against infection (top table, note this can be converted to VE by subtracting the OR from 1) and death (bottom table, not this is among cases only and thus is VE against progression of infection to death).

							 **Variable** — **Delta Variant** Hazard Ratio (95 CI) — **Omicron Variant** Hazard Ratio (95 CI) Vaccination status Unvaccinated — Reference — Reference Dose 2 ⩾ 180 days — 0.43 (0.29 to 0.64) — 0.43 (0.25 to 0.74) Dose 2 < 180 days — 0.42 (0.34 to 0.51) — 0.40 (0.32 to 0.51) Dose 3 ⩾ 180 days — 0.77 (0.53 to 1.13) — 0.23 (0.17 to 0.31) Dose 3 < 180 days — 0.24 (0.11 to 0.54) — 0.15 (0.06 to 0.40) Other vaccination — 0.87 (0.64 to 1.19) — 0.74 (0.53 to 1.04)
132	Ng et al (March 24, 2022)	Singapore	Contacts of cases	Delta	Comirnaty mRNA-1273	March 1-August 31, 2021	Cohort study looking at transmission in households of cases. 
131	Kirsebom et al (March 24, 2022) (updated to final publication May 24, 2022)	England	General population	**Omicron (BA.1 vs BA.2)**	Comirnaty mRNA-1273 ChAdOx1	January 17-February 17, 2022	TND study comparing VE against symptomatic disease with BA.1 vs BA.2

							 *Figure:* Vaccine effectiveness against symptomatic disease (A) and hospitalisation (B) following infection with the omicron sub-lineages BA.1 and BA.2 in adults aged 18 years and older in England
130	Stowe et al (March 24, 2022)	England	General population	Delta **Omicron**	Comirnaty mRNA-1273 ChAdOx1	April 26-February 23, 2022	TND study evaluating impact of different case defintions on VE against severe disease/hospitalization. 
129	Gazit et al (March 24, 2022)	Israel	≥60 years	**Omicron**	Comirnaty	January 10-March 23, 2022	TND study evaluating the relative VE of the 4th dose to the 3rd dose against infection (top) and hospitalizaiton/death (bottom).

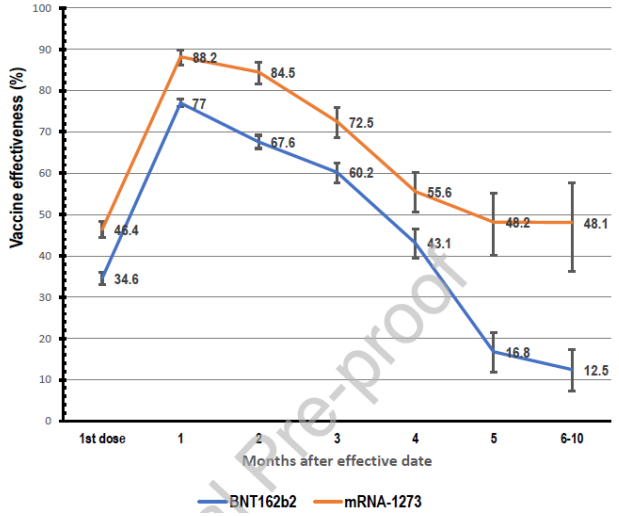
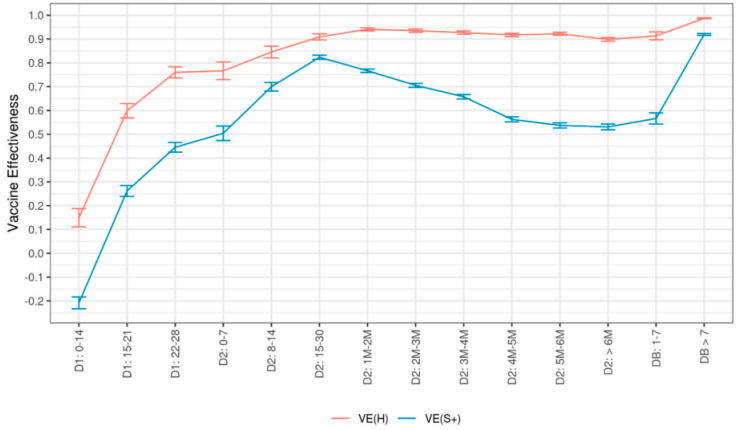
	(updated to final publication on May 24, 2022)						 
128	Horne et al (March 23, 2022) (updated to final publication on July 20, 2022)	UK	General population	Alpha, Delta	Comirnaty ChAdOx1	March 2021 - December 15, 2021	Cohort study based on linking of administrative databases.  Fig 2 | Adjusted hazard ratios (aHRs) comparing BNT162b2 and ChAdOx1 recipients with unvaccinated people in each comparison period. Estimates for BNT162b2 in 40-64 age group are omitted for all outcomes except positive SARS-CoV-2 test owing to low event counts. Slopes of lines are ratios of hazard ratios across comparison periods, fitted using meta-regression. Y axis is on log scale. *Not clinically vulnerable. †Dates (all in 2021) represent earliest and latest dates of follow-up within subgroup

127	Shrothi et al (March 12, 2022) (updated to final publication on July 11 2022)	UK	LTCF residents and staff	Alpha, Delta	Comirnaty mRNA-1273 ChAdOx1	December 8, 2020-December 11, 2021	Cohort study of LTCF residents and staff. 61.7% (35.1-77· 4) to 22.0% (–14.9 to 47.0) against infection; from 89.0% (70.6-95.9) to 56.3% (30.1-72.6) against hospitalisation; and from 96.4% (84.3 -99.2) to 64·4% (36.1-80.1) against death, when comparing 14–83 days after dose two and 84 days or more. For staff VE against infection decreased slightly from 57.9% (43.1-68.9) at 14–83 days after dose two to 42.1% (29.9-52.2) at 84 days or more after dose two.
126	Chemaitelly et al (March 13, 2022)	Qatar	General population (including children)	**Omicron (BA.1 and BA.2)**	Comirnaty mRNA-1273	December 23, 2021-February 28, 2022	TND against symptomatic and severe disease.  Figure 3. Effectiveness of the BNT162b2 and mRNA-1273 vaccines against symptomatic SARS-CoV-2 BA.1 Omicron infection (panels A and B, respectively) and symptomatic SARS-CoV-2 BA.2 Omicron infection (panels C and D, respectively). Data are presented as effectiveness point estimates. Error bars indicate the corresponding 95% confidence intervals.
125	Baum et al (March 13, 2022) (updated July 6, 2022)	Finland	70+	Pre Omicron/ **Omicron**	Comirnaty mRNA-1273 ChAdOx1	December 27, 2020-February 19, 2022	Cohort study evaluating VE against hospitalizaiton/ICU admission. 

							Supplementary Table 11: VE against Covid-19-related hospital admission in 2022 Q1, i.e., between January 01 and February 19. Vaccine effectiveness (in %) quantified as 1 minus the hazard ratio adjusted for age, sex, region of residence, residence in a long-term care facility, influenza vaccination in 2019–2020, number of nights hospitalized between 2015 and 2019 and presence of predisposing comorbidities. MLE, maximum likelihood estimate; LCI/UCI, lower/upper limit of the 95% Wald confidence interval [1] Likelihood-ratio test (2022 Q1 only covers the period from January 01 to February 19—and was mostly Omicron)

	Cases	P-years	MLE	LCI	UCI	p-value[1]
Not vaccinated	145	5121	.	.	.	.
Comirnaty 0-20	<5	100	67	-134	95	.
Comirnaty 21-83	6	330	36	-44	72	.
Comirnaty 84+	6	606	62	13	83	.
Comirnaty + Comirnaty 0-13	<5	164	79	-49	97	.
Comirnaty + Comirnaty 14-90	6	2148	91	79	96	.
Comirnaty + Comirnaty 91-180	12	1894	76	56	86	.
Comirnaty + Comirnaty 181+	75	6450	61	48	71	.
Comirnaty + Comirnaty + Comirnaty 0-13	15	4227	87	77	92	.
Comirnaty + Comirnaty + Comirnaty 14-60	63	45889	95	94	97	.
Comirnaty + Comirnaty + Comirnaty 61+	64	20872	90	87	93	.
Comirnaty + Comirnaty + Spikevax 0-13	9	1934	85	70	92	.
Comirnaty + Comirnaty + Spikevax 14-60	11	6190	94	89	97	.
Comirnaty + Comirnaty + Spikevax 61+	7	416	48	-13	76	.
Spikevax 0-20	<5	40	36	-355	91	.
Spikevax 21-83	<5	75	64	-156	95	.
Spikevax 84+	<5	122	14	-132	68	.
Spikevax + Spikevax 0-13	0	32	100	.	.	0.117
Spikevax + Spikevax 14-90	<5	341	92	43	99	.
Spikevax + Spikevax 91-180	<5	362	90	28	99	.
Spikevax + Spikevax 181+	8	860	72	43	86	.
Spikevax + Spikevax + Comirnaty 0-13	0	168	100	.	.	0.002
Spikevax + Spikevax + Comirnaty 14-60	<5	1466	96	82	99	.
Spikevax + Spikevax + Comirnaty 61+	0	529	100	.	.	<0.001
Spikevax + Spikevax + Spikevax 0-13	<5	697	86	56	96	.
Spikevax + Spikevax + Spikevax 14-60	5	4529	97	92	99	.
Spikevax + Spikevax + Spikevax 61+	<5	1350	92	79	97	.
Vaxzevria 21-83	0	<5	100	.	.	0.894
Vaxzevria 84+	<5	37	8	-558	87	.
Vaxzevria + Vaxzevria 14-90	0	<5	100	.	.	0.865
Vaxzevria + Vaxzevria 91-180	<5	140	41	-140	86	.
Vaxzevria + Vaxzevria 181+	10	652	43	-10	70	.
Vaxzevria + Vaxzevria + Comirnaty 0-13	<5	383	80	19	95	.
Vaxzevria + Vaxzevria + Comirnaty 14-60	<5	2252	98	89	100	.
Vaxzevria + Vaxzevria + Comirnaty 61+	<5	365	90	27	99	.
Vaxzevria + Vaxzevria + Spikevax 0-13	<5	313	89	21	98	.
Vaxzevria + Vaxzevria + Spikevax 14-60	0	1075	100	.	.	<0.001
Vaxzevria + Vaxzevria + Spikevax 61+	<5	60	40	-336	92	.

124	Fowlkes et al (March 11, 2022)	USA	5-15 year olds	Delta, **Omicron**	Comirnaty	July 25, 2021–February 12, 2022	Cohort study finding the adjusted VE at 14–149 days after receipt of dose 2 was 87% (95% CI = 49%–97%) against Delta infection and 59% (95% CI = 22%–79%) against Omicron infection. Adjusted VE ≥150 days after dose 2 was 60% against Delta infection and 62% against Omicron, with wide CIs that included zero.
123	Syed et al (March 2, 2022)	Qatar	12+	Alpha, Beta/Gamma, Delta	Comirnaty mRNA-1273	December 16, 2020-October 31, 2021	Cohort study linking adminsitrative databases. VEs are unadjusted

							
122	Suarez-Castillo et al (March 3, 2022) (updated June 6, 2022)	France	50+ year olds	Alpha, Beta/Gamma, Delta	Comirnaty mRNA-1273 Ad26.COV2.S ChAdOx1	January 1-December 12, 2021	TND study/survival analysis by linking administrative databases.  **Fig. 2.** Covid-19 vaccine effectiveness against symptomatic infections and hospitalizations among persons aged 50 years or over, according to the time elapsed since the receipt of each vaccine dose, data collected from January 1st to December 12, 2021 Abbreviations: D1: First vaccine dose. D2: Second vaccine dose. DB: Booster dose. M: Month. S+: Symptomatic infection. H: Hospitalization. VE: Vaccine effectiveness. The numbers in the x-axis indicate the time (in days or months) elapsed since the receipt of the dose of interest. Precisely, thresholds used to define month intervals are 31–62, 63–90, 91–120, 121–150, 151–182, >182 in days

121	Klein et al (March 1, 2022)	USA	5-17 year olds	**Omicron** Delta	Comirnaty	April 2021-January 2022	TND study evaluating VE against emergency department/urgent care visits and hospitalizations.

Encounter type/Vaccination status	Total	SARS-CoV-2 test-positive, no. (%)	VE %* (95% CI)
ED or UC encounters during Delta or Omicron predominance, by age group			
5–11 yrs			
Unvaccinated (Ref)	8,599	2,652 (30.8)	—
2 doses (14–67 days earlier)	582	124 (21.3)	46 (24–61)
12–15 yrs			
Unvaccinated (Ref)	12,064	3,238 (26.8)	—
2 doses (14–149 days earlier)	4,547	254 (5.6)	83 (80–85)
2 doses (≥150 days earlier)	1,517	378 (24.9)	38 (28–48)
3 doses (≥7 days earlier)	10	3 (30)	NC
16–17 yrs			
Unvaccinated (Ref)	7,421	2,068 (27.9)	—
2 doses (14–149 days earlier)	2,692	193 (7.2)	76 (71–80)
2 doses (≥150 days earlier)	1,721	329 (19.1)	46 (36–54)
3 doses (≥7 days earlier)	64	13 (20.3)	86 (73–93)
ED or UC encounters, by age group and predominant variant			
5–11 yrs**			
Omicron predominant††			
Unvaccinated (Ref)	5,938	2,409 (40.6)	—
2 doses (14–67 days earlier)	486	118 (24.3)	51 (30–65)
12–15 yrs			
Delta predominant††			
Unvaccinated (Ref)	9,633	1,978 (20.5)	—
2 doses (14–149 days earlier)	4,060	80 (2.0)	92 (89–94)
2 doses (≥150 days earlier)	798	32 (4.0)	79 (68–86)
Omicron predominant††			
Unvaccinated (Ref)	2,336	1,254 (53.7)	—
2 doses (14–149 days earlier)	472	174 (36.9)	45 (30–57)
2 doses (≥150 days earlier)	719	346 (48.1)	−2 (−25–17)
3 doses (≥7 days earlier)	10	3 (30.0)	NC
16–17 yrs			
Delta predominant††			
Unvaccinated (Ref)	5,302	1,191 (22.5)	—
2 doses (14–149 days earlier)	2,340	78 (3.3)	85 (81–89)
2 doses (≥150 days earlier)	1,156	47 (4.1)	77 (67–84)
3 doses (≥7 days earlier)	2	0 (—)	NC
Omicron predominant††			
Unvaccinated (Ref)	1,363	771 (56.6)	—
2 doses (14–149 days earlier)	263	114 (43.4)	34 (8–53)
2 doses (≥150 days earlier)	565	282 (49.9)	−3 (−30–18)
3 doses (≥7 days earlier)	62	13 (21.0)	81 (59–91)
Hospitalizations during Delta or Omicron predominance, by age group			
5–11 yrs			
Unvaccinated (Ref)	262	59 (22.5)	—
2 doses (14–67 days earlier)	23	2 (8.7)	74 (−35–95)
12–15 yrs			
Unvaccinated (Ref)	496	149 (30)	—
2 doses (14–149 days earlier)	182	7 (3.8)	92 (79–97)
2 doses (≥150 days earlier)	63	13 (20.6)	73 (43–88)
16–17 yrs			
Unvaccinated (Ref)	437	136 (31.1)	—
2 doses (14–149 days earlier)	150	7 (4.7)	94 (87–97)
2 doses (≥150 days earlier)	82	14 (17.1)	88 (72–95)
3 doses (≥7 days earlier)	4	1 (25.0)	NC

<table>
<tr>
<td>120</td>
<td>Smid et al (February 25, 2022)

(updated April 28, 2022)</td>
<td>Czech Republic</td>
<td>General population of country</td>
<td>Omicron
Delta</td>
<td>Comirnaty
mRNA-1273
Ad26.COV2.S
ChAdOx1</td>
<td>December 7, 2021-February 13, 2022</td>
<td>Cohort study created by linking administrative databases. (<2 months and >=2 months prior to onset)

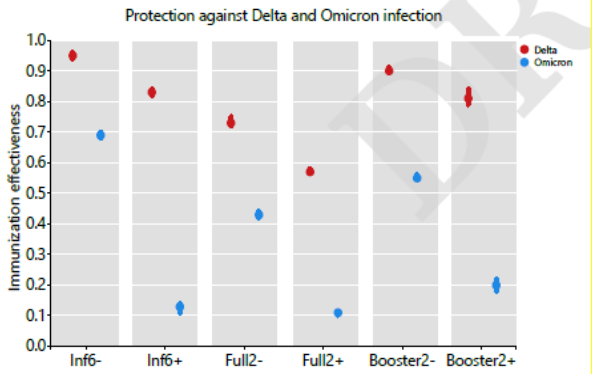
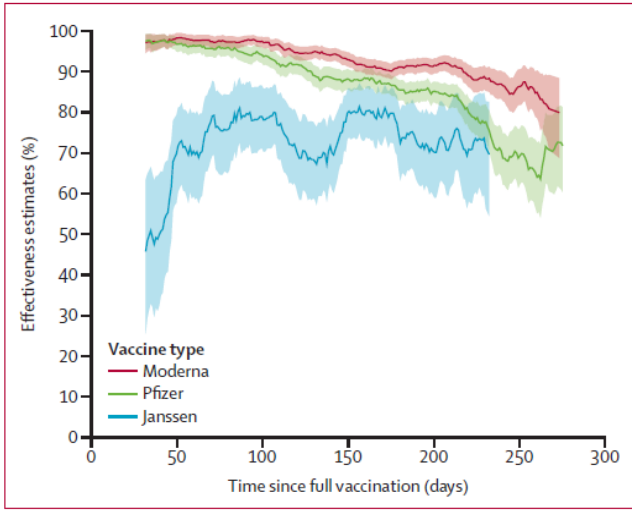
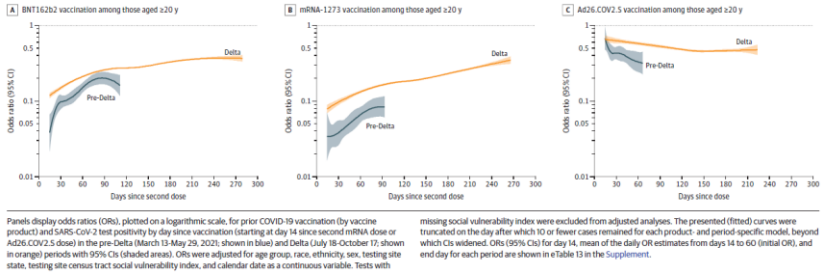
 

Fig. 2. Protection provided by vaccination or previous infection against infection by the Omicron and Delta variants of the SARS-CoV-2 virus. Inf6-, previous infection <6 months ago; Inf6+, previous infection >6 months ago; Full2-, complete vaccination <2 months ago; Full2+, complete vaccination >2 months ago; Booster2-, booster dose <2 months ago; Booster2+, booster dose >2 months ago. Shown are point estimates of protection with 95% CI.

Table 3. Vaccine effectiveness and protection provided by post-infection immunity against hospitalization, for the Omicron and Delta variants of the SARS-CoV-2 virus, 95% confidence intervals (CI) in parentheses.
<table>
<tr><th>Effect ag. Hosp.</th><th>Omicron</th><th>Delta</th></tr>
<tr><td>Full 2-</td><td>45% (29-57%)</td><td>75% (68-80%)</td></tr>
<tr><td>Full 2+</td><td>29% (21-37%)</td><td>79% (78-81%)</td></tr>
<tr><td>Booster 2-</td><td>87% (84-88%)</td><td>98% (97-98%)</td></tr>
<tr><td>Booster 2+</td><td>79% (75-83%)</td><td>97% (95-98%)</td></tr>
</table>
Table 6. Vaccine effectiveness and protection provided by post-infection immunity against hospitalization with a need for oxygen therapy, for the Omicron and Delta variants of the SARS-CoV-2 virus, 95% confidence intervals (CI) in parentheses.
<table>
<tr><th>Effect ag. O_2</th><th>Omicron</th><th>Delta</th></tr>
<tr><td>Full 2-</td><td>57% (32-72%)</td><td>82% (76-87%)</td></tr>
<tr><td>Full 2+</td><td>32% (20-43%)</td><td>82% (80-83%)</td></tr>
<tr><td>Booster 2-</td><td>90% (87-92%)</td><td>98% (98-98%)</td></tr>
<tr><td>Booster 2+</td><td>85% (80-88%)</td><td>97% (95-98%)</td></tr>
</table>
</td>
</tr>
</table>

							Table 7. Vaccine effectiveness and protection provided by post-infection immunity against hospitalization with a need for *intensive care*, for the Omicron and Delta variants of the SARS-CoV-2 virus, 95% confidence intervals (CI) in parentheses. Effect ag. *ICU* / Omicron / Delta Full 2- / 58% (3-82%) / 84% (72-91%) Full 2+ / 37% (12-55%) / 86% (83-88%) Booster 2- / 83% (75-89%) / 98% (97-99%) Booster 2+ / 60% (37-74%) / 97% (92-99%)
119	Patalon et al (February 26, 2022) (updated June 9, 2022)	Israel	16+ Maccabi insured patients	**Omicron**	Comirnaty	January 1-January 21, 2022	Matched TND study to evaluate relative VE against infection and hospitalization/death. All persons had received the primary series by August 1, 2021. Marginal effectiveness against infection of a booster dose given a month before the outcome period was at its peak at 59.4% (95% CI, 54.9%-63.5%). Effectiveness declined gradually with time from inoculation, reaching 16% (95% CI, 12.3%-19.5%) in those vaccinated 5 months prior to the outcome period compared to those not receiving the booster dose. As for the marginal effectiveness against severe disease, it seems that waning exists though to a much lesser degree, as effectiveness declines from 72.2% (95% CI, 37.8%-87.6%) 3 months after inoculation to 54.5% (95% CI, 13.4-76.1) five months after vaccination. However, numbers are small as also reflected by the confidence intervals.
118	Wright et al (February 25, 2022)	USA	18+ hospitalized	Pre Delta; Delta	Comirnaty mRNA-1273 Ad26.COV2.S	April 1-October 26, 2021	Case-control study of patients hospitalized in one large US network of hospitals.  *Figure 3:* Vaccine effectiveness against severe COVID-19 by time since vaccination and vaccine type

<table>
<tr><td>117</td><td>Liu et al (February 18, 2022)</td><td>Australia</td><td>Persons exposed in two outbreaks (1 at a night club, 1 at a medical school graduation event)</td><td>Omicron</td><td>Comirnaty
mRNA-1273
ChAdOx1</td><td>December 8, 2021-December 22, 2021</td><td>Unadjusted VE in two outbreaks by time since 2nd dose (combined for all vaccines)
<table>
<tr><th>Timing</th><th>Night club outbreak</th><th>Graduation event outbreak</th></tr>
<tr><td><1 month</td><td>-33.3 (-141.4-26.3)</td><td>No cases</td></tr>
<tr><td>1-2 months</td><td>-18.1 (-85.7-24.8)</td><td>87.5 (64-95.7)</td></tr>
<tr><td>2-3 months</td><td>-5.9 (-67.5-33.1)</td><td>60 (38-74.2)</td></tr>
<tr><td>3+ months</td><td>-36.2 (-114.3-13.4)</td><td>32 (22-40.6)</td></tr>
</table></td></tr>
<tr><td>116</td><td>Wu et al (February 2022)</td><td>China</td><td>18+ year old contacts of cases</td><td>Delta</td><td>Coronavac
BBIBP-CorV</td><td>July 31, 2021-? (prior to November 17, 2021)</td><td>Study done in the context of an outbreak. The adjusted VE of full vaccination against symptomatic COVID-19 was 52.32% (25.73-69.39) for ≤3-month intervals and 49.95% (1.2-74.64) for 4–6-month intervals; against COVID-19 pneumonia, VEs were 60.31 (31.31-77.07) for ≤3-month and 67.08% (9.33-88.05) for 4–6-month intervals.</td></tr>
<tr><td>115</td><td>Britton et al (February 14, 2022)</td><td>USA</td><td>12+ year olds</td><td>Pre-Delta and Delta</td><td>Comirnaty
mRNA-1273
Ad26.COV2.S</td><td>March 13, April 15, or June 15 (based on age-based vaccine-eligibility October 17, 2021</td><td>TND study to evaluate VE against symptomatic disease based on data collected from pharmacies (note vaccination data based on recall and some portion of 2 dose recipients received 3 doses). In the paper, there is a stratification by age group.
 

Panels display odds ratios (ORs), plotted on a logarithmic scale, for prior COVID-19 vaccination (by vaccine product) and SARS-CoV-2 test positivity by day since vaccination (starting at day 14 since second mRNA dose or Ad26.COV2.S dose) in the pre-Delta (March 13-May 29, 2021; shown in blue) and Delta (July 18-October 17; shown in orange) periods with 95% CIs (shaded areas). ORs were adjusted for age group, race, ethnicity, sex, testing site state, testing site census tract social vulnerability index, and calendar date as a continuous variable. Tests with missing social vulnerability index were excluded from adjusted analyses. The presented (fitted) curves were truncated on the day after which 10 or fewer cases remained for each product- and period-specific model, beyond which CIs widened. ORs (95% CIs) for day 14, mean of the daily OR estimates from days 14 to 60 (initial OR), and end day for each period are shown in eTable 13 in the Supplement.</td></tr>
<tr><td>114</td><td>Ferdinands et al (February 11, 2022)</td><td>USA</td><td>18+ years</td><td>Delta, Omicron</td><td>Comirnaty
mRNA-1273</td><td>August 26, 2021-January 22, 2022</td><td>TND study at 8 VISION network sites evaluating VE against emergency room/urgent care visits nad hospitalizations.</td></tr>
</table>

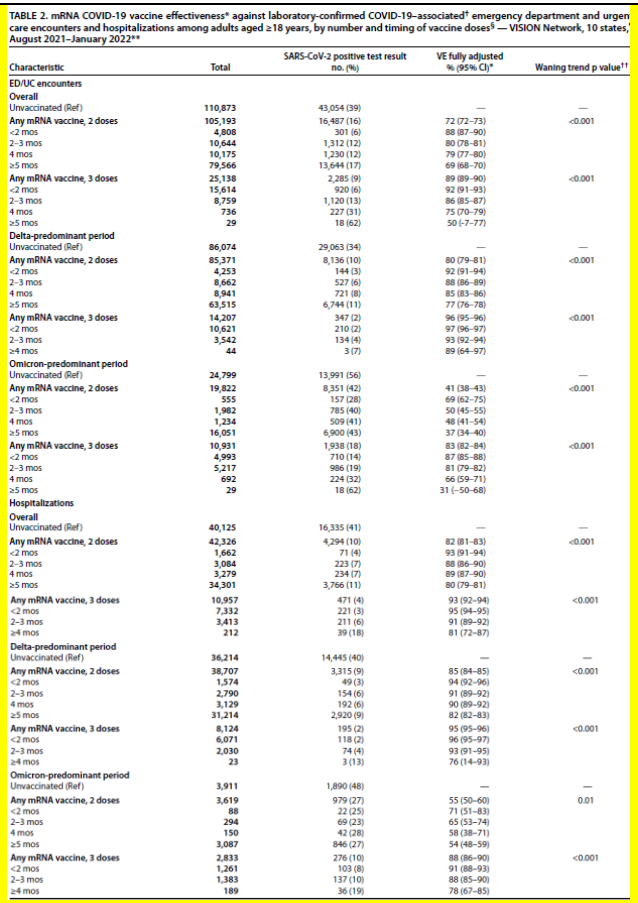
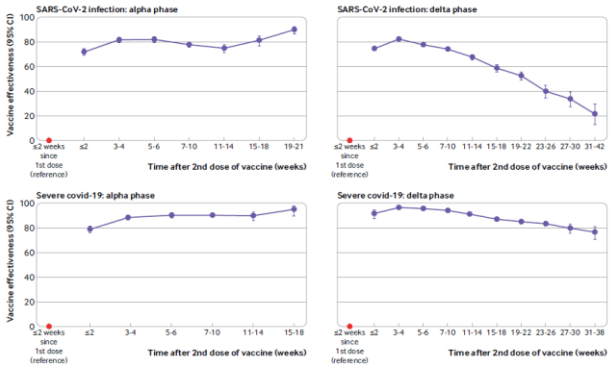
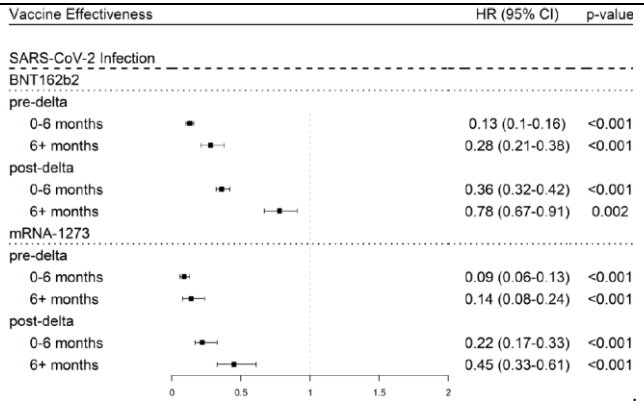
							

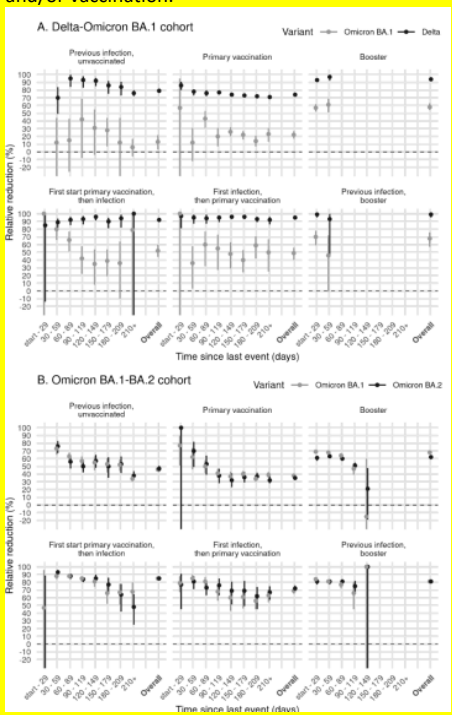
TABLE 2. mRNA COVID-19 vaccine effectiveness* against laboratory-confirmed COVID-19–associated† emergency department and urgent care encounters and hospitalizations among adults aged ≥18 years, by number and timing of vaccine doses§ — VISION Network, 10 states, August 2021–January 2022**

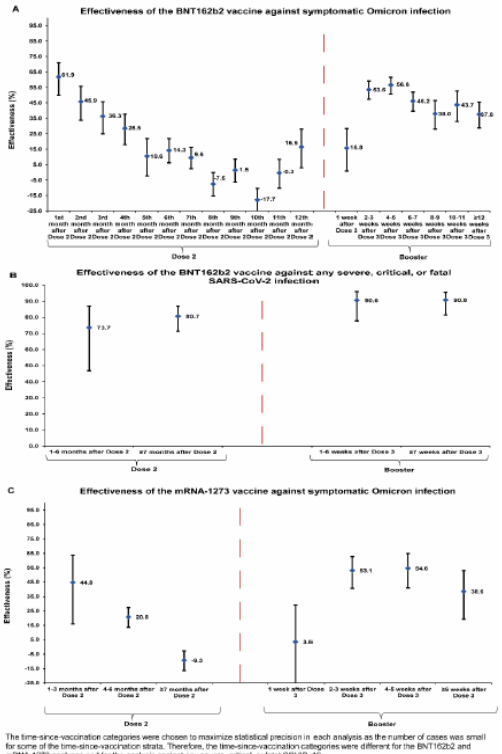
Characteristic	Total	SARS-CoV-2 positive test result no. (%)	VE fully adjusted % (95% CI)*	Waning trend p value††
ED/UC encounters				
Overall				
Unvaccinated (Ref)	110,873	43,054 (39)	—	—
Any mRNA vaccine, 2 doses	105,193	16,487 (16)	72 (72–73)	<0.001
<2 mos	4,808	301 (6)	88 (87–90)	
2–3 mos	10,644	1,312 (12)	80 (78–81)	
4 mos	10,175	1,230 (12)	79 (77–80)	
≥5 mos	79,566	13,644 (17)	69 (68–70)	
Any mRNA vaccine, 3 doses	25,138	2,285 (9)	89 (89–90)	<0.001
<2 mos	15,614	920 (6)	92 (91–93)	
2–3 mos	8,759	1,120 (13)	86 (85–87)	
4 mos	736	227 (31)	75 (70–79)	
≥5 mos	29	18 (62)	50 (−7–77)	
Delta-predominant period				
Unvaccinated (Ref)	86,074	29,063 (34)	—	—
Any mRNA vaccine, 2 doses	85,371	8,136 (10)	80 (79–81)	<0.001
<2 mos	4,253	144 (3)	92 (91–94)	
2–3 mos	8,662	527 (6)	88 (86–89)	
4 mos	8,941	721 (8)	85 (83–86)	
≥5 mos	63,515	6,744 (11)	77 (76–78)	
Any mRNA vaccine, 3 doses	14,207	347 (2)	96 (95–96)	<0.001
<2 mos	10,621	210 (2)	97 (96–97)	
2–3 mos	3,542	134 (4)	93 (92–94)	
≥4 mos	44	3 (7)	89 (64–97)	
Omicron-predominant period				
Unvaccinated (Ref)	24,799	13,991 (56)	—	—
Any mRNA vaccine, 2 doses	19,822	8,351 (42)	41 (38–43)	<0.001
<2 mos	555	157 (28)	69 (62–75)	
2–3 mos	1,982	785 (40)	50 (45–55)	
4 mos	1,234	509 (41)	48 (41–54)	
≥5 mos	16,051	6,900 (43)	37 (34–40)	
Any mRNA vaccine, 3 doses	10,931	1,938 (18)	83 (82–84)	<0.001
<2 mos	4,993	710 (14)	87 (85–88)	
2–3 mos	5,217	986 (19)	81 (79–82)	
4 mos	692	224 (32)	66 (59–71)	
≥5 mos	29	18 (62)	31 (−50–68)	
Hospitalizations				
Overall				
Unvaccinated (Ref)	40,125	16,335 (41)	—	—
Any mRNA vaccine, 2 doses	42,326	4,294 (10)	82 (81–83)	<0.001
<2 mos	1,662	71 (4)	93 (91–94)	
2–3 mos	3,084	223 (7)	88 (86–90)	
4 mos	3,279	234 (7)	89 (87–90)	
≥5 mos	34,301	3,766 (11)	80 (79–81)	
Any mRNA vaccine, 3 doses	10,957	471 (4)	93 (92–94)	<0.001
<2 mos	7,332	221 (3)	95 (94–95)	
2–3 mos	3,413	211 (6)	91 (89–92)	
≥4 mos	212	39 (18)	81 (72–87)	
Delta-predominant period				
Unvaccinated (Ref)	36,214	14,445 (40)	—	—
Any mRNA vaccine, 2 doses	38,707	3,315 (9)	85 (84–85)	<0.001
<2 mos	1,574	49 (3)	94 (92–96)	
2–3 mos	2,790	154 (6)	91 (89–92)	
4 mos	3,129	192 (6)	90 (89–92)	
≥5 mos	31,214	2,920 (9)	82 (82–83)	
Any mRNA vaccine, 3 doses	8,124	195 (2)	95 (95–96)	<0.001
<2 mos	6,071	118 (2)	96 (95–97)	
2–3 mos	2,030	74 (4)	93 (91–95)	
≥4 mos	23	3 (13)	76 (14–93)	
Omicron-predominant period				
Unvaccinated (Ref)	3,911	1,890 (48)	—	—
Any mRNA vaccine, 2 doses	3,619	979 (27)	55 (50–60)	0.01
<2 mos	88	22 (25)	71 (51–83)	
2–3 mos	294	69 (23)	65 (53–74)	
4 mos	150	42 (28)	58 (38–71)	
≥5 mos	3,087	846 (27)	54 (48–59)	
Any mRNA vaccine, 3 doses	2,833	276 (10)	88 (86–90)	<0.001
<2 mos	1,261	103 (8)	91 (88–93)	
2–3 mos	1,383	137 (10)	88 (85–90)	
≥4 mos	189	36 (19)	78 (67–85)	

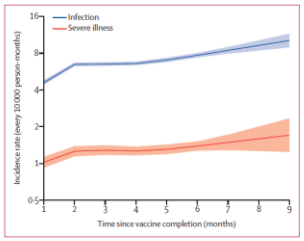
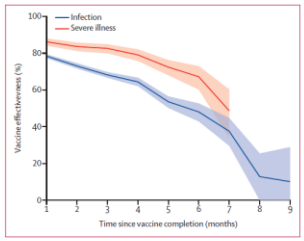
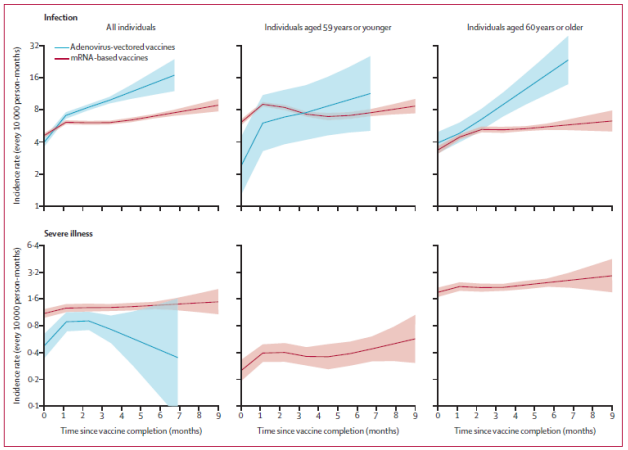
113	Fabiani et al (February 10, 2022)	Italy	16+ years	Alpha, Delta	Comirnaty mRNA-1273	December 27, 2020-November 7, 2021	Cohort study of people who received at least one dose of vaccine at some point before Sept 27. Used of day 0-<14 days post dose 1 as proxy for unvaccinated group. Provide stratification by age and risk group in paper.

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td> 
</td></tr>
<tr><td>112</td><td>Butt et al (February 9, 2022)</td><td>USA</td><td>Veterans on chronic hemodialysis</td><td>Pre-Delta→ Delta</td><td>Comirnaty mRNA-1273</td><td>January 26-August 31, 2021</td><td>TND study linking adminsitrative databases. (Month=month since complete vaccination). VE against infection.
<table>
<tr><th></th><th colspan="2">Test positive</th><th colspan="2">Test negative</th><th></th></tr>
<tr><th>Month</th><th>Vaccinated (N)</th><th>Unvaccinated (N)</th><th>Vaccinated (N)</th><th>Unvaccinated (N)</th><th>VE (95% CI)</th></tr>
<tr><td>1</td><td>247</td><td>822</td><td>112</td><td>573</td><td>49.1 (38.2, 58.1)</td></tr>
<tr><td>2</td><td>245</td><td>822</td><td>107</td><td>573</td><td>40.4 (27.8, 50.9)</td></tr>
<tr><td>3</td><td>246</td><td>822</td><td>85</td><td>573</td><td>23.2 (7.3, 36.4)</td></tr>
<tr><td>4</td><td>246</td><td>822</td><td>70</td><td>573</td><td>45.3 (33.2, 55.2)</td></tr>
<tr><td>5</td><td>242</td><td>822</td><td>74</td><td>573</td><td>36.8 (23.0, 48.2)</td></tr>
<tr><td>6</td><td>216</td><td>822</td><td>69</td><td>573</td><td>34.1 (19.0, 46.4)</td></tr>
<tr><td>7</td><td>246</td><td>822</td><td>54</td><td>573</td><td>42.9 (29.5, 53.8)</td></tr>
<tr><td>8</td><td>49</td><td>822</td><td>4</td><td>573</td><td>87.6 (76.0, 93.6)</td></tr>
</table></td></tr>
<tr><td>111</td><td>Risk et al (February 7, 2022)</td><td>USA</td><td>18+</td><td>Pre-Delta→ Delta</td><td>Comirnaty mRNA-1273</td><td>April 1-October 20, 2021</td><td>Cohort study based on electronic medical records (note 33% of infections and 19% of hospitalizations not based on laboratory testing but based on diagnostic code, though reported sensitivity analysis showed no difference but did not provide the data).</td></tr>
</table>

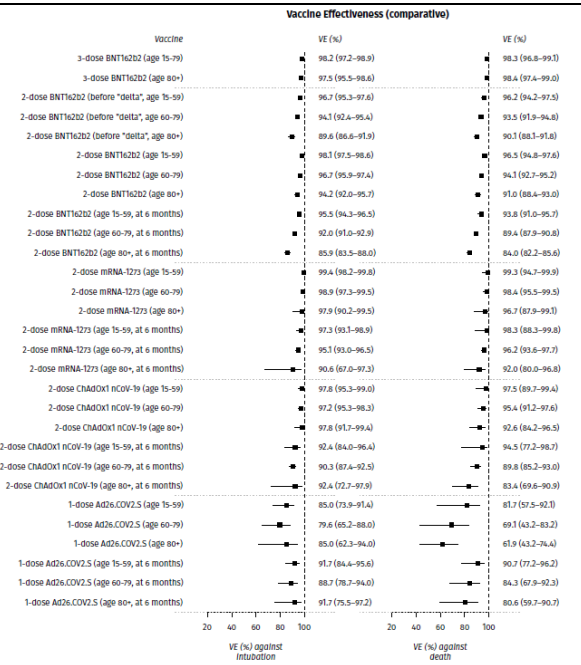
							
110	Cerqueria-Silva et al (February 9, 2022)	Brazil	General population	Gamma, Delta	Coronavac followed by Comirnaty booster	January 18-November 11, 2021	TND study linking administrative databases **Table 3 | Effectiveness of CoronaVac vaccine against confirmed SARS-CoV-2 infection, by length of time (in days) since two-dose vaccination or BNT162b2 booster dose, stratified by age group** **Table 4 | Effectiveness of CoronaVac vaccine against COVID-19 hospitalization or death, by length of time (in days) since two-dose vaccination or BNT162b2 booster dose, stratified by age group**

							Extended Data Table 4 | Vaccine effectiveness against death due to COVID-19 using RT-PCR, by length of time (in days) since two-dose vaccination or BNT162b2 booster dose Period post vaccine (days) | Overall | 18-59 | 60-79 | ≥80 Second dose 0-13 | 67.3% (65.6-68.9) | 86.4% (82.5-89.4) | 69.6% (67.6-71.6) | 56.0% (51.6-60.0) 14-30 | 82.7% (81.7-83.6) | 91.4% (88.7-93.5) | 84.5% (83.3-85.6) | 72.7% (69.8-75.4) 31-60 | 83.6% (82.8-84.3) | 91.9% (89.7-93.6) | 84.8% (83.8-85.7) | 70.0% (67.2-72.5) 61-90 | 81.4% (80.5-82.2) | 92.2% (89.8-94.0) | 82.5% (81.3-83.7) | 67.2% (64.2-69.9) 91-120 | 79.8% (78.7-80.8) | 95.0% (93.1-96.4) | 81.7% (80.3-83.0) | 63.5% (59.9-66.7) 121-150 | 78.3% (77.0-79.6) | 93.7% (90.9-95.7) | 82.0% (80.3-83.5) | 58.7% (54.3-62.7) 151-180 | 76.8% (75.1-78.4) | 92.1% (88.2-94.7) | 81.9% (79.7-83.8) | 53.9% (48.3-58.9) >180 | 74.8% (72.2-77.2) | 90.3% (85.5-93.5) | 81.5% (77.6-84.7) | 45.5% (37.1-52.8) Booster (BNT162b2) 0-6 | 80.3% (73.1-85.6) | 100% (*) | 81.4% (71.3-87.9) | 59.9% (39.3-73.5) 7-13 | 92.2% (87.4-95.2) | 100% (*) | 92.3% (83.8-96.3) | 80.7% (65.3-89.2) 14-30 | 98.3% (96.3-99.2) | 81.9% (-31.6-97.5) | 99.1% (93.6-99.9) | 95.4% (88.7-98.1) >30 | 97.1% (90.5-99.1) | 100% (*) | 94.3% (58.3-99.2) | 93.5% (73.2-98.4)
109	Andeweg et al (February 8, 2022) (updated May 12, 2022)	Netherlands	General population	**Omicron (BA.1 and BA.2)** Delta	Comirnaty ChAdOx1 mRNA-1273 Ad26.COV2.S	November 22, 2021-January 19, 2022	TND study linking administrative databases evaluating VE/risk reduction from prior infection and/or vaccination. 

108	Chemaitelly et al (February 8, 2022)	Qatar	General population	**Omicron**	Comirnaty mRNA-1273	December 23, 2021-February 2, 2022	Matched TND study based on linking adminsitrative databases. **Figure 1. Effectiveness of the BNT162b2 vaccine against A) symptomatic SARS-CoV-2 Omicron infection and B) severe, critical, or fatal COVID-19 due to Omicron infection. C) Effectiveness of the mRNA-1273 vaccine against symptomatic SARS-CoV-2 Omicron infection. Data are presented as effectiveness point estimates. Error bars indicate the corresponding 95% confidence intervals.**  The time-since-vaccination categories were chosen to maximize statistical precision in each analysis as the number of cases was small for some of the time-since-vaccination strata. Therefore, the time-since-vaccination categories were different for the BNT162b2 and mRNA-1273 analyses and for the analysis against any severe, critical, or fatal COVID-19. **Sub-studies[*]** / **mRNA-1273** / **Cases[†] (Severe, critical, or fatal disease)[‡]** / **Controls[†] (PCR-negative)** / **Effectiveness in % (95% CI)[§]** Vaccinated / Vaccinated Yes / No / Yes / No **Dose 1** Dose 1 and no Dose 2: 0 / 103 / 2 / 280 / 100.0 (Omitted)[¶] **Dose 2** 1-6 months after Dose 2 and no Dose 3: 3 / 105 / 35 / 265 / 76.9 (19.2 to 93.4) ≥7 months after Dose 2 and no Dose 3: 23 / 117 / 139 / 257 / 64.0 (39.1 to 78.7) **Dose 3 (booster dose)** 1-6 weeks after Dose 3: 1 / 103 / 19 / 270 / 80.8 (-51.9 to 97.6) ≥7 weeks after Dose 3: 0 / 102 / 5 / 278 / 100.0 (Omitted)[¶]
107	Lauring et al (February 7, 2022)	USA	≥18 years	Delta (for the duration analysis	Comirnaty mRNA-1273	July 4-December 25, 2021 (for the Delta analysis)	TND case control study in 21 hospitals in the US (IVY Network). For Delta, VE against hospitalization 88% (95% CI: 86 to 90%) 14-150 days post 2nd dose; >150 days, VE was 81% (78 to 84%).

	(updated March 9, 2022)						
106	Kislaya et al (January 31, 2022)	Portugal	≥12 years	Delta→ **Omicron**	Comirnaty ChAdOx1 mRNA-1273 Ad26.COV2.S	December 6-21, 2021	Compared the odds of vaccination in Delta versus Omicron cases. (higher odds =lower VE of Omicron). Omicron : Delta aOR Complete primary vaccination <113 days 2.3(1.9 to 2.8) Complete primary vaccination 113-168 days 2.0 (1.7 to 2.4) Complete primary vaccination 169+ days 1.9(1.6 to 2.3)
105	Corrao et al (January 27, 2022)	Italy	≥12 years	Alpha → Delta	Comirnaty ChAdOx1 mRNA-1273 Ad26.COV2.S	January 17-October 20, 2021	Cohort study   *Figure 1:* Influence of time since complete vaccination on rates of SARS-CoV-2 infection and severe COVID-19 illness Estimates based on the cohort of 5 351 085 individuals who received complete vaccination from January to July, 2021. The figure reports the trends in age-period-cohort modelled incidence rates (and 95% CI bands) according to time since complete vaccination. Estimates are adjusted for the month of vaccine completion (cohort effect), and the month of outcome occurrence (period effect). *Figure 2:* Influence of time since complete vaccination on vaccine effectiveness against SARS-CoV-2 infection and severe COVID-19 illness Estimates based on the cohort of 9 140 390 potential candidates who were to receive the vaccine as of Dec 27, 2020. Cox proportional hazard models were fitted for estimating hazard ratio and 95% CI. Vaccine effectiveness was directly calculated as 1-hazard ratio.  *Figure 3:* Influence of time since complete vaccination on rates of SARS-CoV-2 infection (top boxes) and severe COVID-19 illness (bottom boxes) in the entire cohort and according to age and vaccine type Estimates based on the cohort of 5 351 085 individuals who received complete vaccination from January to July, 2021. The figure reports the trends in age-period-cohort modelled incidence rates (and 95% CI bands) according to time since complete vaccination. Estimates are adjusted for the month of vaccine completion (cohort effect), and the month of outcome occurrence (period effect).

104	Roberts et al (January 31, 2022)	USA	Adults	Multiple	Comirnaty mRNA-1273 (for duration)	January 1-December 31, 2021	TND study evaluating VE against infection (top) and hospitaliation/death (bottom). Note that this is a combination of primary and booster dose VE in quarter 4. 
103	Belayachi et al (January 27, 2022)	Morocco	≥18 year olds	Unknown→ Delta	BBIBP-CorV	February 1-October 1, 20221	TND linking adminsitrative databases to evaluate VE against severe disease. As a function of time after vaccination of second dose vaccination, vaccine effectiveness among persons who had received the second dose 1–30 days earlier was 88% (95% CI, 84-91), 87% (95% CI: 83-90) among those who had received it 31–90 days earlier, 75% (95% CI: 67-80) among those who had received it 91–120 days earlier, 61% (95% CI: 54-67) among those who had received it 121–150 days earlier, 64% (95% CI: 59-69) among those who had received it ≥150 days earlier. Note they attempted to stratify by age (>/< 60 years) showing a trend towards a lower VE gainst severe/critical disease in those over 60 but confidence intervals were overlapping.
102	Lytras et al (January 29, 2022) (updated June 14, 2022)	Greece	≥15 year olds	Alpha→Delta	Comirnaty ChAdOx1 mRNA-1273 Ad26.COV2.S	January-December 2021	Cohort study linking administrative databases evaluating VE against intubation and death. VE provided for 6 months

							
101	Goldhaber-Fiebert et al (January 23, 2022)	USA	Prison population and staff	Delta	Comirnaty mRNA-1273	June 1-November 5, 2021	Matched TND among cases evaluating duration of protection against infection of early vs late fully (primary series) vaccinated persons. Among staff, odds of infection increased 25% (Odds Ratio [OR], 1.25; 95% Confidence Interval [CI], 1.13 – 1.40) in each 28-day period post-vaccination; among residents, the odds increased by 21% (OR, 1.21; 95%CI 1.08 – 1.36) (Figure 1). Compared with individuals within 60 days of being fully vaccinated, odds of infection were over fourfold greater ≥181 days since full vaccination for staff (OR, 4.36; 95%CI 1.92 – 9.89) and nearly threefold greater for residents (OR, 2.89; 95%CI 1.40 – 5.98)
100	Bedston et al (January 20, 2022)	Wales	Healthcare Workers	Alpha→Delta	Comirnaty	December 7, 2020-September 30, 2021	Cohort study. 2 weeks after dose 2, VE against infection was 67% (aHR 0.33, 95 %CI 0.24–0.44). This increased in weeks 2–5 to 86% (aHR 0.14, 95 %CI 0.09–0.21), and decreased to 77% over weeks 6–13. After this, vaccine effectiveness decreased from 60% to 53% between weeks 14–25, and from week 26 vaccine effective was 45% (aHR 0.55, 95 %CI 0.49–0.61).
99	Accorsi et al (January 21, 2022)	USA	≥18 year olds	Delta→ **Omicron**	Comirnaty mRNA-1273	December 10-January 1, 2022	TND study in ICATT (free testing sites throughout US) against symptomatic disease. Note OR can be converted to VE by the formulate VE=1-OR

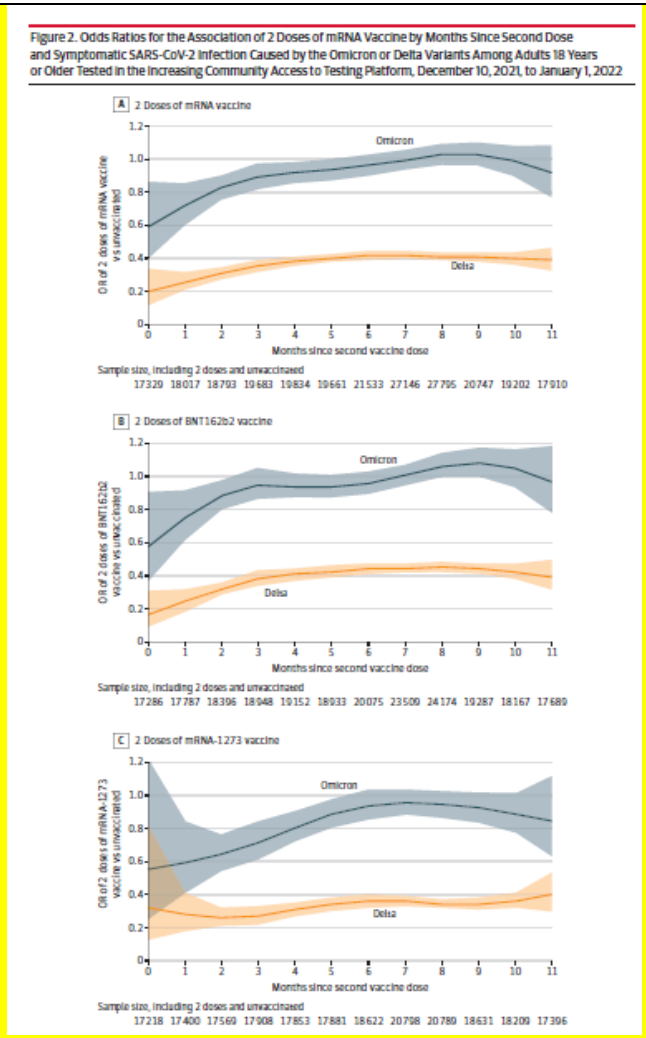
							 Figure 2. Odds Ratios for the Association of 2 Doses of mRNA Vaccine by Months Since Second Dose and Symptomatic SARS-CoV-2 Infection Caused by the Omicron or Delta Variants Among Adults 18 Years or Older Tested in the Increasing Community Access to Testing Platform, December 10, 2021, to January 1, 2022
98	Thompson et al (January 21, 2022)	USA	≥18 year olds	Delta→ **Omicron**	Comirnaty mRNA-1273	August 26, 2021-January 5, 2022	TND study in VISION network calculating VE against emergency department/urgent care visits and and hospitalizaiton among persons with symptoms consistent with COVID-19

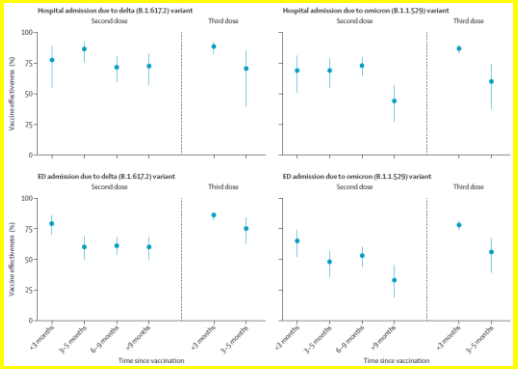
							TABLE 2. mRNA COVID-19 vaccine effectiveness* against laboratory-confirmed COVID-19–associated† emergency department and urgent care encounters and hospitalizations among adults aged ≥18 years, by number and timing of vaccine doses§ and vaccine product received — VISION Network, 10 states, August 2021–January 2022¶ Encounter/Predominant variant period/Vaccination status | Total | SARS-CoV-2 positive test result, no. (%) | VE, %* (95% CI) **ED or UC encounters** **Delta predominant** Unvaccinated (Ref) | 98,087 | 36,542 (37.2) | — **Any mRNA vaccine** 2 doses (14–179 days earlier) | 39,629 | 3,269 (8.2) | 86 (85–87) 2 doses (≥180 days earlier) | 52,506 | 6,893 (13.1) | 76 (75–77) 3 doses | 14,523 | 469 (3.2) | 94 (93–94) **Omicron predominant** Unvaccinated (Ref) | 6,996 | 3,398 (48.6) | — **Any mRNA vaccine** 2 doses (14–179 days earlier) | 1,746 | 591 (33.9) | 52 (46–58) 2 doses (≥180 days earlier) | 5,409 | 2,037 (37.7) | 38 (32–43) 3 doses | 3,876 | 520 (13.4) | 82 (79–84) **Hospitalizations** **Delta predominant** Unvaccinated (Ref) | 37,400 | 14,272 (38.2) | — **Any mRNA vaccine** 2 doses (14–179 days earlier) | 14,645 | 895 (6.1) | 90 (89–90) 2 doses (≥180 days earlier) | 26,190 | 2,563 (9.8) | 81 (80–82) 3 doses | 8,092 | 209 (2.6) | 94 (93–95) **Omicron predominant** Unvaccinated (Ref) | 460 | 174 (37.8) | — **Any mRNA vaccine** 2 doses (14–179 days earlier) | 115 | 14 (12.2) | 81 (65–90) 2 doses (≥180 days earlier) | 488 | 86 (17.6) | 57 (39–70) 3 doses | 514 | 24 (4.7) | 90 (80–94)
97	Tartof et al (January 19, 2022) *(updated April 22, 2022)*	USA	≥18 year olds enrolled in Kaiser insurance	Delta **Omicron**	Comirnaty	December 1, 2021-February 6, 2022	TND study of persons admitted to the emergency room or hospital with symptoms consistent with COVID-19. 
96	Amodio et al (January 19, 2022)	Italy	≥18 year olds	Alpha→Delta	Comirnaty mRNA-1273	January 1-September 30, 2021	Cohort study of 3.9 millions adults in Sicily conducted from administrative databases. Decreasing trends for vaccine effectiveness, measured as monthly percentage changes, were statistically significant for all the three evaluated outcomes (-4·76% per month, p<0·001 against SARS-CoV-2 infection; -2·27% per month, p=0·029 against severe COVID-19; 2·26% per month, p=0·028 against COVID-19 intubation/death, respectively).

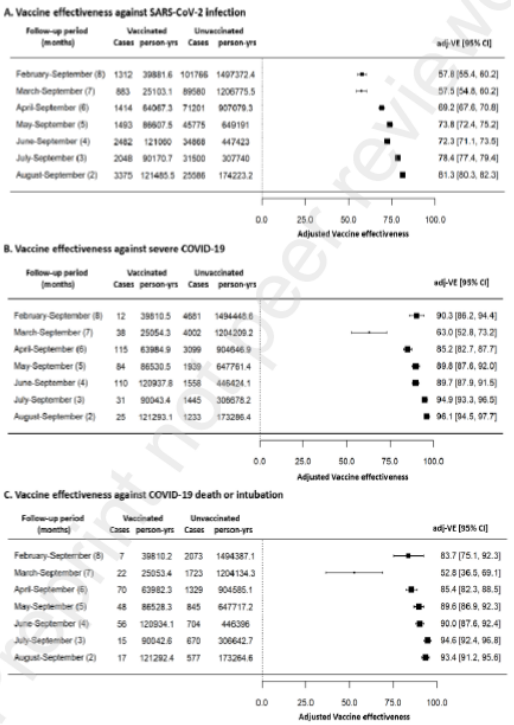
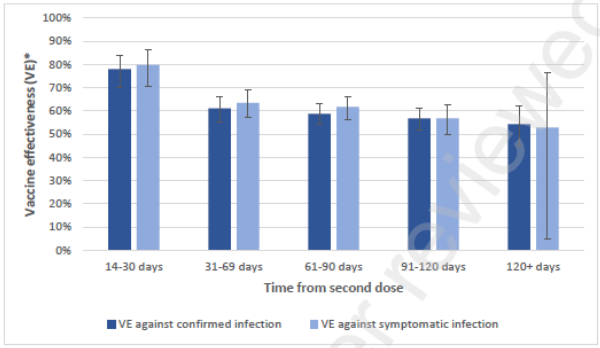
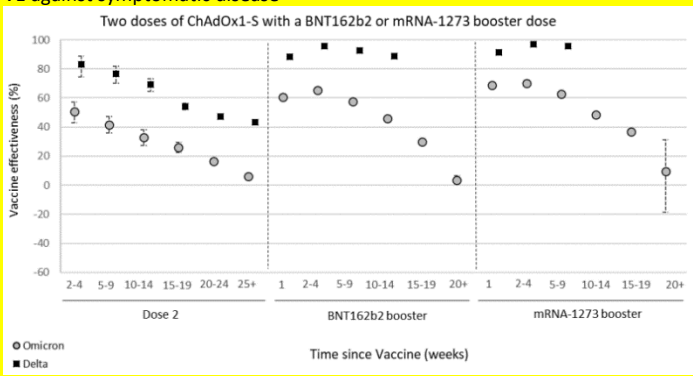
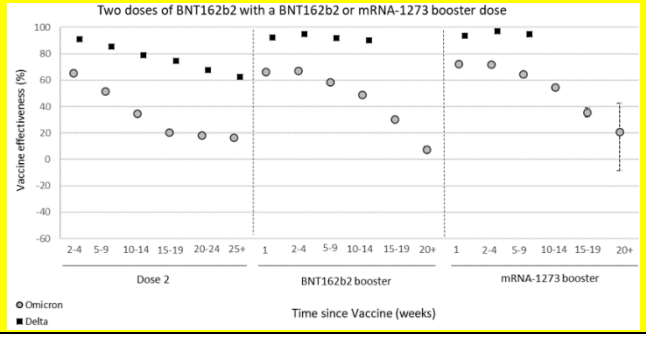
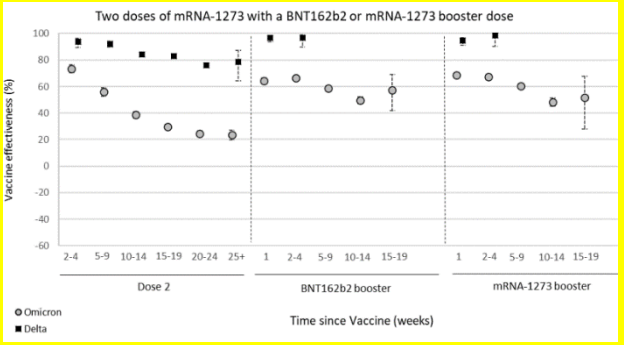
							Figure 4: Vaccine effectiveness estimates after adjustment for age and sex according to the different assessed outcomes and follow-up periods. 
95	Suah et al (January 16, 2022) (updated June 2022)	Malaysia	General population	Delta	Comirnaty CoronaVac	September 1-30, 2021	Compared early (April-June) vs late (July-August) vaccinated persons (comparing to unvaccinated based on census data). For BNT162b2, crude vaccine effectiveness against COVID-19 infections declined from 90.8% (95% CI 89.4, 92.0) in the late group to 79.1% (95% CI 75.8, 81.9) in the late group. Vaccine effectiveness for BNT162b2 against ICU admission and deaths were comparable between the two different periods. For CoronaVac, crude vaccine effectiveness waned against COVID-19 infections from 74.4% in the late group (95% CI 209 70.4, 77.8) to 30.0% (95% CI 18.4, 39.9) in the early group. It also declined significantly against ICU admission, dropping from 56.1% (95% CI 51.4, 60.2) to 29.9% (95% CI 13.9, 43.0) (adjusted). For deaths, however, CoronaVac's effectiveness did not wane after three to five months of full vaccination. Waning more prominent in 60+.
94	Chiew et al (January 8, 2022)	Singapore	12-18 year olds	Delta	Comirnaty	June 1-November 20, 2021	Cohort study evaluating VE against infection and disease.

							Figure 1. Vaccine effectiveness over time from completion of second dose.  **Vaccine effectiveness is adjusted for age group, gender, ethnicity, housing type, time from second vaccination dose (in months) and date of notification using Poisson regression. Reference group is unvaccinated.*
93	UKHSA (April 28, 2022) Update of #83/Dec 31st analysis (Note Andrews et al published March 2 with data through mid-January in case you're interested in the methods).	UK		Delta, **Omicron**	Comirnaty ChAdOx1 mRNA-1273	November 27- April, 2021	TND case control VE against symptomatic disease  

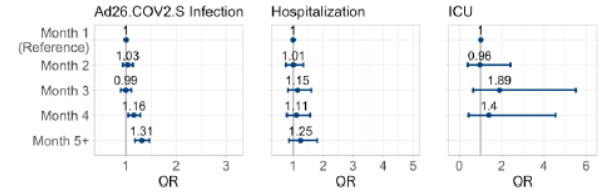
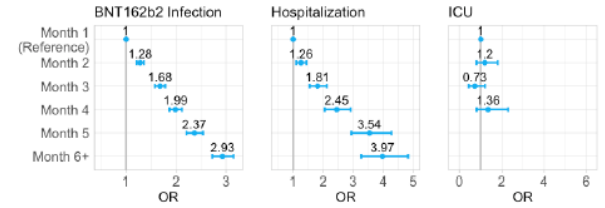
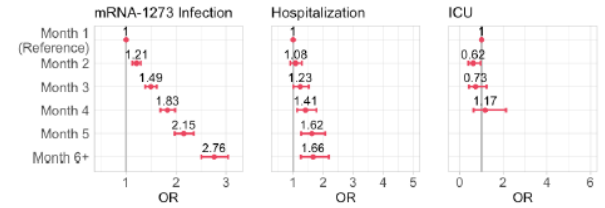
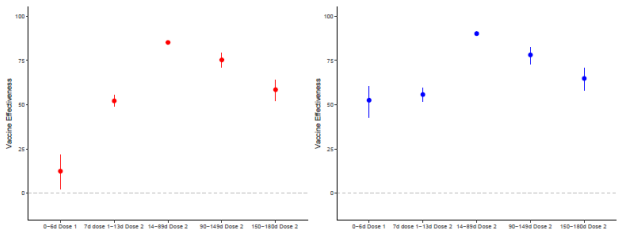


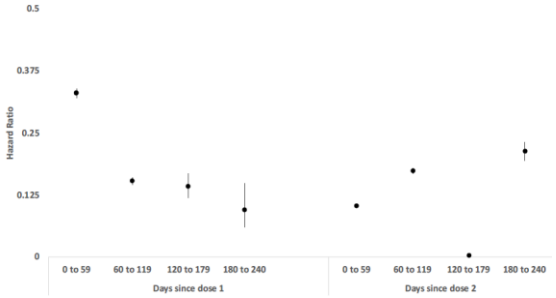
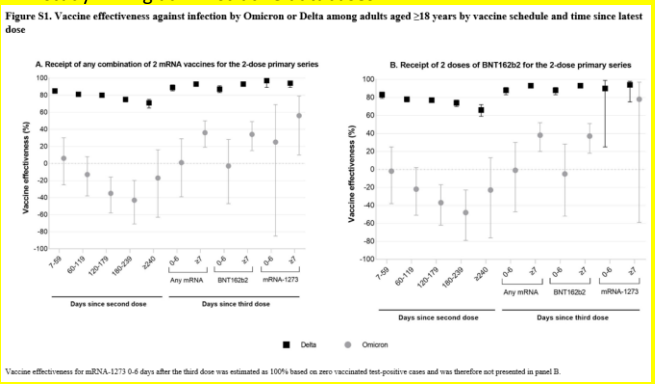
Combined for AZ, Pfizer, Moderna vaccines: VE against hospitalization (with different defintions)

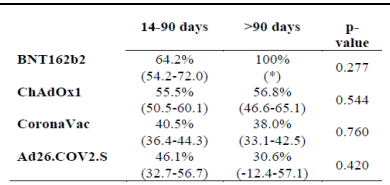
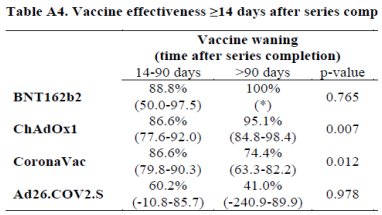
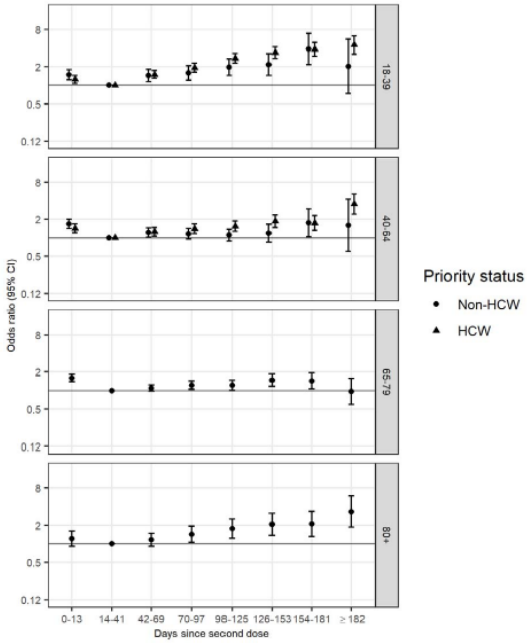
		ECDS symptomatic with onset date	SUS at least 2 days with ARI code in primary field	SUS at least 2 days and either oxygen, ventilation or ICU with ARI code in primary field
18 to 64				
	Interval	**VE**	**VE**	**VE**
Dose 1	0 to 27	48.5 (12.3 to 69.7)	36.2 (-33.9 to 69.6)	
	28+	48.7 (32.8 to 60.8)	44.1 (25.6 to 58)	75 (42.4 to 89.1)
Dose 2	0 to 13	39.6 (-31.5 to 72.2)	88.9 (58.4 to 97)	
	14 to 174	54.7 (45.3 to 62.4)	69 (58.1 to 77)	86.7 (63.6 to 95.1)
	175+	34.6 (21.7 to 45.4)	56.1 (46.4 to 64)	82.3 (67.7 to 90.3)
Booster	0 to 6	63.9 (52.2 to 72.8)	74.3 (55.9 to 85)	90.7 (56 to 98.1)
	7 to 13	80.1 (73.5 to 85.1)	90.9 (83.2 to 95.1)	
	14 to 34	82.4 (78.6 to 85.6)	88.6 (84.9 to 91.5)	97.1 (92.2 to 98.9)
	35 to 69	72.7 (67.2 to 77.2)	85.8 (82.4 to 88.5)	94.3 (88.9 to 97.1)
	70 to 104	66.9 (59.1 to 73.3)	80.2 (74.9 to 84.4)	89.9 (78.3 to 95.3)
	105+	53.6 (36.9 to 65.9)	67.4 (53.1 to 77.4)	75.9 (15.8 to 93.1)
65+				
	Interval	**VE**	**VE**	**VE**
Dose 1	0 to 27		43.9 (-41 to 77.7)	
	28+		53.4 (36.3 to 65.9)	78.3 (43.7 to 91.7)
Dose 2	0 to 13			
	14 to 174	77.8 (45 to 91)	82.3 (74.3 to 87.8)	90.9 (72.6 to 97)
	175+	66.7 (43.4 to 80.4)	57.7 (49.6 to 64.4)	73.4 (55.1 to 84.3)
Booster	0 to 6	85.8 (61.5 to 94.7)	77.9 (65.3 to 85.9)	89.2 (63.1 to 96.8)
	7 to 13	92.3 (76.3 to 97.5)	84.7 (76 to 90.2)	94.7 (71.6 to 99)
	14 to 34	92.4 (86 to 95.8)	91.3 (89.1 to 93.1)	95.8 (91.3 to 97.9)
	35 to 69	87 (79.2 to 91.8)	89.3 (87.3 to 90.9)	92.8 (88.4 to 95.6)
	70 to 104	84 (74.6 to 89.9)	88.1 (86.1 to 89.9)	92.5 (88.1 to 95.2)
	105+	76.9 (60.6 to 86.4)	85.3 (82.4 to 87.6)	86.8 (77.1 to 92.3)

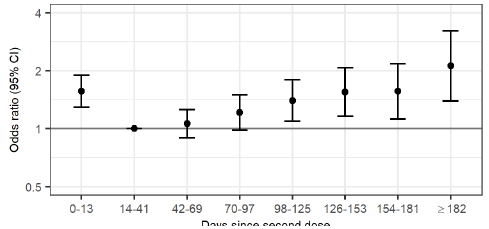
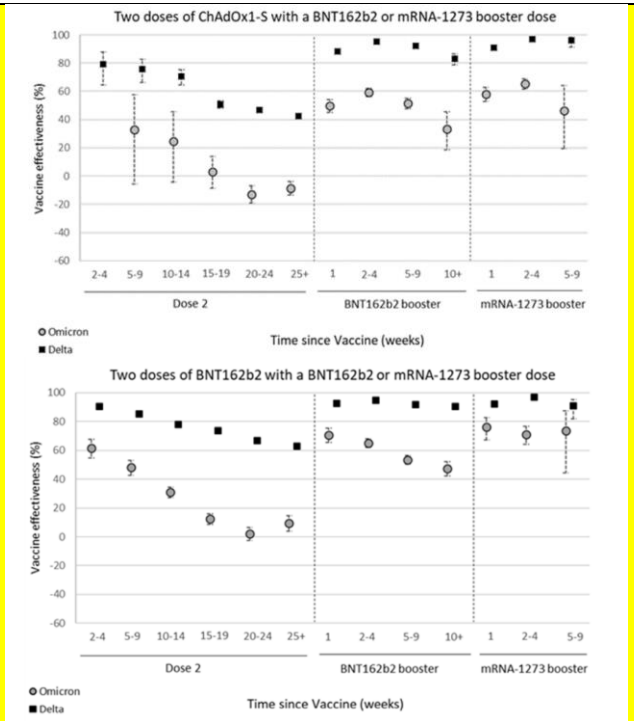
Combined for AZ, Pfizer, Moderna vaccines: VE against mortality

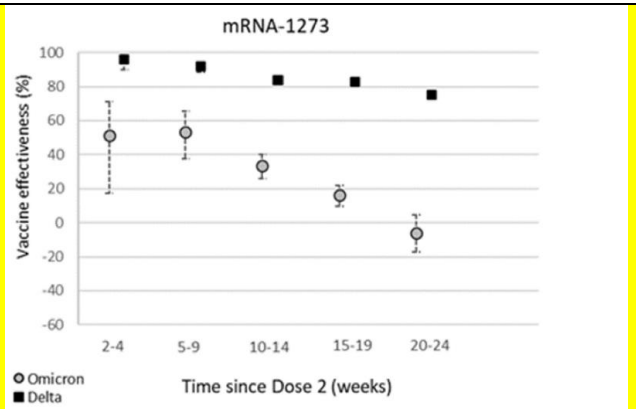
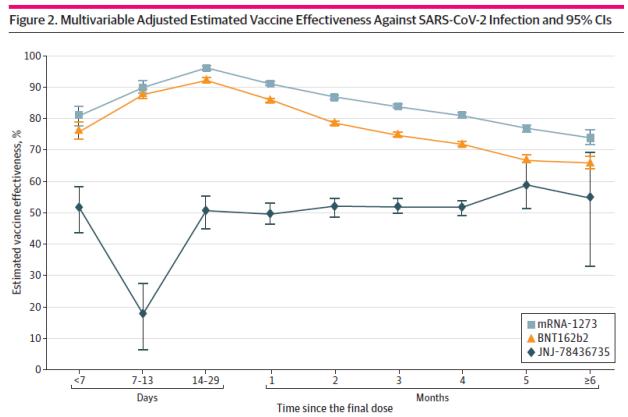
							<table><tr><th>Dose</th><th>Interval after dose</th><th>Odds Ratio</th><th>VE (95% CI)</th></tr><tr><td>2</td><td>25+ weeks</td><td>0.52 (0.34-0.81)</td><td>47.9 (19.3 to 66.4)</td></tr><tr><td>3</td><td>2-4 weeks</td><td>0.06 (0.03-0.12)</td><td>93.6 (88 to 96.6)</td></tr><tr><td>3</td><td>5-9 weeks</td><td>0.11 (0.07-0.17)</td><td>88.9 (83.4 to 92.6)</td></tr><tr><td>3</td><td>10+ weeks</td><td>0.12 (0.09-0.18)</td><td>87.6 (81.9 to 91.5)</td></tr></table>
92	Tseng et al* (February 21, 2022) *[update from January 21 preprint]*	USA	18+ year olds enrolled in Kaiser insurance	Delta, **Omicron**	mRNA-1273	December 6-23, 2021	TND case control study done by linking administrative databases. <table><tr><th></th><th>Delta VE (95% CI)</th><th>Omicron VE (95% CI)</th></tr><tr><td>VE against infection</td><td></td><td></td></tr><tr><td>2 dose (14+)</td><td>60.7 (56.5-64.5)</td><td>0 (0-3.1)</td></tr><tr><td>14-90 days</td><td>82.8 (69.6-90.3)</td><td>30.4 (5-49)</td></tr><tr><td>91-180 days</td><td>63.6 (51.8-72.5)</td><td>15.2 (0-30.7)</td></tr><tr><td>181-270 days</td><td>61.4 (56.8-65.5)</td><td>0 (0-1.2)</td></tr><tr><td>>270 days</td><td>52.9 (43.7-60.5)</td><td>0 (0-1.7)</td></tr><tr><td>3 dose</td><td>95.2 (93.4-96.4)</td><td>62.5 (56.2-67.9)</td></tr><tr><td>3rd dose on or after 10/21</td><td>95.7 (94.2-96.9)</td><td>63.6 (57.4-68.9)</td></tr><tr><td>3rd dose prior to 10/21</td><td>90.7 (81.4-95.3)</td><td>39.1 (3.8-61.5)</td></tr><tr><td>3 dose (immunocompetent)</td><td>95.7 (94.2-96.8)</td><td>63.6 (57.4-68.9)</td></tr><tr><td>3rd dose on or after 10/21</td><td>95.9 (94.4-97.0)</td><td>64.1 (57.9-69.4)</td></tr><tr><td>3rd dose prior to 10/21</td><td>93.1 (83.9-97)</td><td>49.0 (12.6-70.2)</td></tr></table>
91	Grgič Vitek et al (January 6, 2022)	Slovenia	18+ year olds	Delta	Comirnaty mRNA-1273	October 2021	Cohort study using administrative databases specifically evaluated VE against SARI hospitalization. Note results are unadjusted. <table><tr><th>Age group (years)</th><th>Ful</th><th colspan="2">Vaccine effectiveness</th></tr><tr><th></th><th></th><th>%</th><th>95% CI</th></tr><tr><td colspan="4">Vaccinated ≤ 3 months ago</td></tr><tr><td>18–49</td><td></td><td>97</td><td>90–99</td></tr><tr><td>50–64</td><td></td><td>94</td><td>91–97</td></tr><tr><td>≥ 65</td><td></td><td>93</td><td>88–96</td></tr><tr><td colspan="4">Vaccinated 4–5 months ago</td></tr><tr><td>18–49</td><td></td><td>NA</td><td>NA</td></tr><tr><td>50–64</td><td></td><td>90</td><td>79–95</td></tr><tr><td>≥ 65</td><td></td><td>85</td><td>81–88</td></tr><tr><td colspan="4">Vaccinated ≥ 6 months ago</td></tr><tr><td>18–49</td><td></td><td>23</td><td>0–69</td></tr><tr><td>50–64</td><td></td><td>89</td><td>56–97</td></tr><tr><td>≥ 65</td><td></td><td>43</td><td>30–54</td></tr></table>
90	Zheutlin et al (January 6, 2022)	USA	18+ year olds who had been fully vaccinated	Alpha, Delta, nonVOC	Comirnaty mRNA-1273 Ad26.COV2.S	January 1-September 7, 2021	Matched case control using an administrative dataset among vaccinated persons, comparing the odds of infection, hospitalization, and ICU admission at 28 day intervals post dose 2 relative to the 1st month after full vaccination. Note outcomes defined by COVID-19 ICD10 codes or SARS-CoV-2 PCR testing.

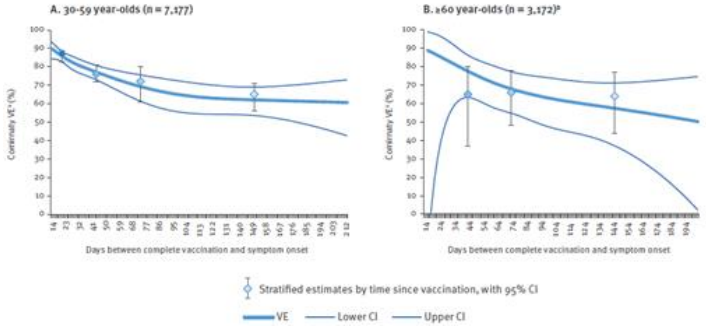
							Figure 2. Odds ratios (OR) and 95% CI assessing durability of baseline vaccine protection against COVID-19 breakthrough infections, hospitalizations, and ICU admissions. **a) Ad26.COV2.S**  **b) BNT162b2**  **c) mRNA-1273** 
89	Lyngse et al (January 6, 2022)	Denmark	General population	Delta	Comirnaty ChAdOx1 mRNA-1273	June 21-October 26, 2021	HH transmission study. The VE against susceptibility and VE against transmission decreased from 71% (95%CI: 69-72) and 57% (95%CI: 53-61), respectively, to 32% (95%CI: 16-45) and 29% (95%CI: 14-41), respectively, between time points corresponding to 0-1 months and 7-8 months after vaccination
88	Prunas et al (January 5, 2022)	Israel	12-16 year olds enrolled in Maccabi health services	Delta	Comirnaty	June 15-December 8, 2021	Matched case control evaluating association between time since vaccination and infection (red) and disease (blue). 

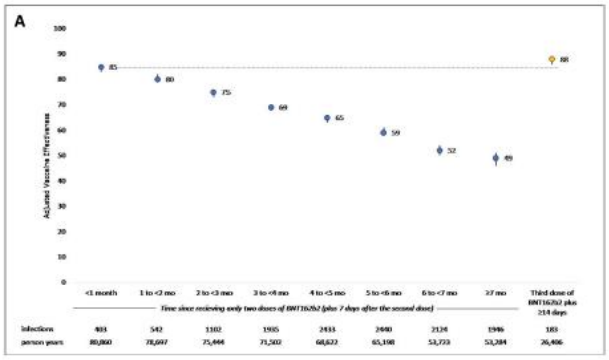
87	Fisman et al (January 5, 2022)	Canada	5+ year olds	Alpha, Beta, Gamma, Delta, nonVOCs	Comirnaty ChAdOx1 mRNA-1273 (homologous and heterologous)	December 2020-October 2021	Case-Cohort study looking at VE against infection combined across the different platforms over time since vaccination as well as evaluated impact of dosing intervals. 
86	Buchan et al (January 28, 2022) [updated from January 1, 2022 version]	Canada	18+ year olds	Delta, **Omicron**	Comirnaty ChAdOx1 mRNA-1273 (vaccinated persons had at least 1 dose of an mrna vaccine)	December 6-December 26, 2021	TND study linking administrative databases. 
85	Cerqueria-Silva et al (December 27, 2021)	Brazil	18+ year olds with prior infection 90+ days prior to testing in study period	Gamma, Delta	Coronavac, Comirnaty ChAdOx1 Ad26.COV2.S	January 18, 2021, - November 11, 2021.	Matched TND study linking adminsitrative databases. VE against symptomatic disease on top; severe disease on bottom.

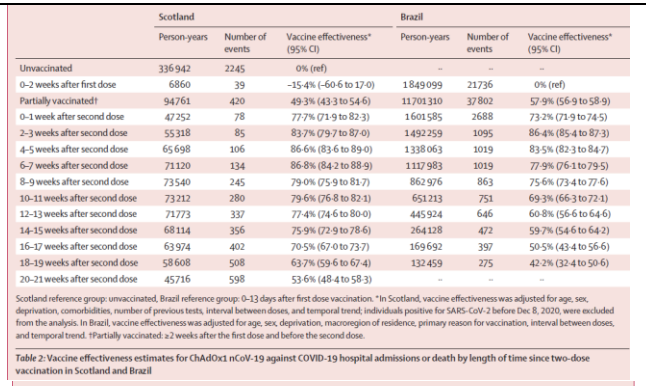
							 
84	Hitchings et al (December 24, 2021)	Brazil	18+ year olds living in Sao Paulo	Gamma, Delta	Coronavac	January 17-September 30, 2021	TND based on linking adminsitrative databases among persons with 2 doses of coronavac (ref period day 14-41 post dose 2). OR for symptomatic disease. 

							OR against hospitalization or death 
83	UK HSA (December 24, 2021) (update of Andrews et al publication)	UK	General population	Delta, **Omicron**	Comirnaty ChAdOx1 mRNA-1273	November 27-December 17, 2021	

							 *Numbers were too low to estimate booster vaccine effectiveness amongst recipients of a primary course of the Moderna vaccine.
82	Tabak et al (December 22, 2021)	USA	18+ year olds	NonVOC, Alpha, Delta	Comirnaty mRNA-1273 Ad26.COV2.S	May 1-August 7, 2021	TND study on patients presenting to CVS with symptoms for testing. (final dose in primary series) 
81	Kissling et al (December 22, 2021) (updated May 26, 2022)	8 European countries	30+ years	Delta	Comirnaty mRNA-1273 ChAdOx1 Ad26.COV2.S	July-August 2021	TND study in primary care sites evaluating VE against symptomatic disease

							
80	Tartof et al (December 21, 2021) (updated February 14, 2022)	USA	3 million Kaiser Permanente members, 18+ years	Non-VOC, Alpha, Delta,	Comirnaty	December 14, 2020-December 5, 2021	Cohort study looking at booster dose VE and duration of protection of 2 doses. Manuscript has stratification by age group and immunocompromised status, with similar patterns as seen below though immunocompromised has a trend towards more waning against hospitalization but not significant.

							 **Figure 1.** *Vaccine effectiveness of 2- and 3-doses of BNT162b2 against* **(A)** SARS-CoV-2 infections and **(B)** COVID-19 hospital admissions — December 14, 2020 to December 5, 2021. *Blue circles represent 2-dose VE estimates, and the yellow circles represent 3-dose VE estimates. The bars represent 95% confidence intervals. Estimates are adjusted for age, sex, race/ethnicity, body mass index, comorbidities, Charlson comorbidity index, previous SARS-CoV-2 PCR, previous positive SARS-CoV-2 serology, influenza vaccine in year prior, pneumococcal vaccine in prior 5 years, neighborhood deprivation index, prior healthcare utilization (Tables 1, *Appendix* 2).
79	Katikireddi et al (December 20, 2021)	Scotland and Brazil	≥18 year old general population	Scotland: Delta; Brazil: Gamma/Delta	ChAdOx1	Scotland: May 19-October 25, 2021 Brazil: January 18-October 25, 2021	Scotland: administrative database linkage study Brazil: evaluated VE by comparing fully vaccinated persons at day 0-13 and persons 14+ days post dose 2.

							
78	Abu-Raddad et al (December 16, 2021 *Updated January 26,2022)*	Qatar	General population	Alpha→Beta →Delta	mRNA-1273	January 1 and December 5, 2021	TND study linking adminsitrative databases.

	Scotland			Brazil		
	Person-years	Number of events	Vaccine effectiveness* (95% CI)	Person-years	Number of events	Vaccine effectiveness* (95% CI)
Unvaccinated	336 942	2245	0% (ref)	..	..	..
0–2 weeks after first dose	6860	39	−15·4% (−60·6 to 17·0)	1 849 099	21 736	0% (ref)
Partially vaccinated†	94 761	420	49·3% (43·3 to 54·6)	11 701 310	37 802	57·9% (56·9 to 58·9)
0–1 week after second dose	47 252	78	77·7% (71·9 to 82·3)	1 601 585	2688	73·2% (71·9 to 74·5)
2–3 weeks after second dose	55 318	85	83·7% (79·7 to 87·0)	1 492 259	1095	86·4% (85·4 to 87·3)
4–5 weeks after second dose	65 698	106	86·6% (83·6 to 89·0)	1 338 063	1019	83·5% (82·3 to 84·7)
6–7 weeks after second dose	71 120	134	86·8% (84·2 to 88·9)	1 117 983	1019	77·9% (76·1 to 79·5)
8–9 weeks after second dose	73 540	245	79·0% (75·9 to 81·7)	862 976	863	75·6% (73·4 to 77·6)
10–11 weeks after second dose	73 212	280	79·6% (76·8 to 82·1)	651 213	751	69·3% (66·3 to 72·1)
12–13 weeks after second dose	71 773	337	77·4% (74·6 to 80·0)	445 924	646	60·8% (56·6 to 64·6)
14–15 weeks after second dose	68 114	356	75·9% (72·9 to 78·6)	264 128	472	59·7% (54·6 to 64·2)
16–17 weeks after second dose	63 974	402	70·5% (67·0 to 73·7)	169 692	397	50·5% (43·4 to 56·6)
18–19 weeks after second dose	58 608	508	63·7% (59·6 to 67·4)	132 459	275	42·2% (32·4 to 50·6)
20–21 weeks after second dose	45 716	598	53·6% (48·4 to 58·3)	..	..	..

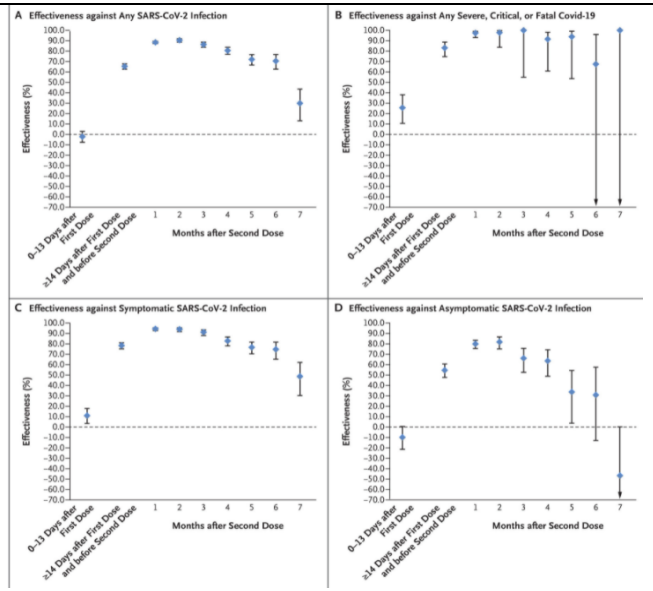
Scotland reference group: unvaccinated, Brazil reference group: 0–13 days after first dose vaccination. *In Scotland, vaccine effectiveness was adjusted for age, sex, deprivation, comorbidities, number of previous tests, interval between doses, and temporal trend; individuals positive for SARS-CoV-2 before Dec 8, 2020, were excluded from the analysis. In Brazil, vaccine effectiveness was adjusted for age, sex, deprivation, macroregion of residence, primary reason for vaccination, interval between doses, and temporal trend. †Partially vaccinated: ≥2 weeks after the first dose and before the second dose.

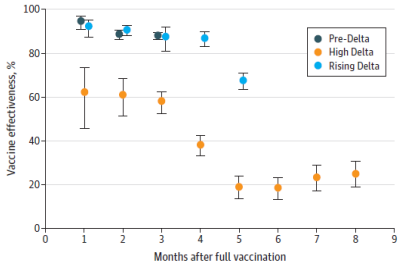
Table 2: **Vaccine effectiveness estimates for ChAdOx1 nCoV-19 against COVID-19 hospital admissions or death by length of time since two-dose vaccination in Scotland and Brazil**

	Scotland			Brazil		
	Total samples	Positive samples	Vaccine effectiveness* (95% CI)	Total samples	Positive samples	Vaccine effectiveness* (95% CI)
Unvaccinated	26 130	13 698	0% (ref)	9 852 053	4 920 001	0% (ref)
0–1 week after first dose	911	374	20·9% (8·2 to 31·9)	286 322	151 328	−9·6% (−10·5 to −8·8)
Partially vaccinated†	15 714	7176	37·6% (34·6 to 40·5)	1 143 423	398 717	37·6% (37·3 to 37·9)
0–1 week after second dose	5027	2025	50·2% (46·7 to 53·5)	112 391	30 550	51·3% (50·6 to 52·0)
2–3 weeks after second dose	7141	2429	67·9% (65·9 to 69·8)	95 671	7963	69·8% (69·3 to 70·4)
4–5 weeks after second dose	8947	3387	67·3% (65·3 to 69·1)	79 298	15 568	68·4% (67·8 to 68·9)
6–7 weeks after second dose	10 622	4346	63·8% (61·7 to 65·7)	60 301	12 401	66·8% (66·1 to 67·5)
8–9 weeks after second dose	11 258	4633	63·3% (61·3 to 65·3)	44 351	9424	65·4% (64·6 to 66·2)
10–11 weeks after second dose	14 043	6319	59·3% (57·2 to 61·4)	32 832	7103	63·2% (62·2 to 64·2)
12–13 weeks after second dose	17 300	7966	55·3% (53·0 to 57·5)	22 454	5177	58·8% (57·4 to 60·1)
14–15 weeks after second dose	17 421	7670	52·9% (50·4 to 55·2)	15 305	3435	59·8% (58·2 to 61·4)
16–17 weeks after second dose	15 442	6554	48·7% (45·9 to 51·4)	10 822	2529	58·7% (56·7 to 60·5)
18–19 weeks after second dose	14 403	6248	44·6% (41·5 to 47·6)	7458	1852	57·7% (55·4 to 60·0)
20–21 weeks after second dose	10 596	4718	39·1% (35·4 to 42·6)	..	..	..

*In Scotland, vaccine effectiveness was adjusted for age, sex, deprivation, comorbidities, number of at-risk groups, smoking status, blood pressure, body-mass index, health board, interval between doses, and temporal trend. In Brazil, vaccine effectiveness was adjusted for age, sex, deprivation, macroregion of residence, diabetes, obesity, immunosuppression, cardiac disease, pregnancy, puerperal period, chronic kidney disease, and temporal trend. Descriptive characteristics for the sample are available in appendix 2 (pp 11–15). †Partially vaccinated: ≥2 weeks after the first dose and before the second dose.

Table 3: **Vaccine effectiveness estimates for ChAdOx1 nCoV-19 against confirmed SARS-CoV-2 symptomatic infection by length of time since two-dose vaccination in Scotland and Brazil using a test-negative design case-control study**

							
77	Young-Xu et al (December 15, 2021)	USA	Male 65+ year old veterans in VA system	NonVOC, Alpha, Delta	Comirnaty mRNA-1273	January-September 2021	Matched case control study

<table>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>
Table. Change in Estimated Messenger RNA Vaccine Effectiveness Against Laboratory-Confirmed SARS-CoV-2 Infections, January to September 2021
<table>
<tr><th rowspan="2">Month</th><th colspan="3">Adjusted vaccine effectiveness by month from full vaccination, % (95% CI)[a]</th></tr>
<tr><th>Pre-Delta (January to April)</th><th>Rising Delta (May to June)</th><th>High Delta (July to September)</th></tr>
<tr><td>1</td><td>94.5 (90.7-96.7)</td><td>92.1 (87.2-95.1)</td><td>62.0 (45.6-73.5)</td></tr>
<tr><td>2</td><td>88.5 (86.1-90.5)</td><td>90.6 (87.8-92.7)</td><td>60.9 (51.5-68.4)</td></tr>
<tr><td>3</td><td>87.9 (85.9-89.5)</td><td>87.3 (80.8-91.7)</td><td>57.8 (52.5-62.5)</td></tr>
<tr><td>4</td><td>NA</td><td>86.6 (83.0-89.5)</td><td>38.3 (33.5-42.7)</td></tr>
<tr><td>5</td><td>NA</td><td>67.3 (63.2-70.9)</td><td>18.9 (13.7-23.8)</td></tr>
<tr><td>6</td><td>NA</td><td>NA</td><td>18.4 (13.3-23.3)</td></tr>
<tr><td>7</td><td>NA</td><td>NA</td><td>23.4 (17.3-29.0)</td></tr>
<tr><td>8</td><td>NA</td><td>NA</td><td>24.8 (18.8-30.4)</td></tr>
</table>
Figure. Estimated Messenger RNA Vaccine Effectiveness Against SARS-CoV-2 Infection by Delta Variant Period, January to September 2021


</td>
</tr>
<tr>
<td>76</td>
<td>Machado et al (December 14, 2021)</td>
<td>Portugal</td>
<td>Non-institutionalized 65-<110 year olds</td>
<td>Alpha, Delta</td>
<td>Comirnaty mRNA-1273 ChAdOx1</td>
<td>February 2 (80+) or March 30 (65-79) - August 2021</td>
<td>
Cohort study linking administrative databases.
<table>
<tr><th rowspan="2">timing post dose 2</th><th colspan="2">disease</th><th colspan="2">hospitalization</th><th colspan="2">deaths</th></tr>
<tr><th>65-79 years</th><th>80-<110 years</th><th>65-79 years</th><th>80-<110 years</th><th>65-79 years</th><th>80-<110 years</th></tr>
<tr><td>14-41 days</td><td>79 (76-83)</td><td>72 (61-79)</td><td>95 (90-97)</td><td>83 (68-91)</td><td>95 (88-98)</td><td>87 (71-93)</td></tr>
<tr><td>42-69 days</td><td>68 (64-71)</td><td>64 (53-72)</td><td>97 (94-98)</td><td>81 (66-90)</td><td>97 (92-98)</td><td>88 (78-94)</td></tr>
<tr><td>70+ days</td><td></td><td></td><td>93 (86-96)</td><td></td><td>93 (87-96)</td><td></td></tr>
<tr><td>70-97 days</td><td>59 (53-64)</td><td>53 (43-62)</td><td></td><td>74 (60-84)</td><td></td><td>86 (78-91)</td></tr>
<tr><td>98+ days</td><td>39 (29-48)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>98-123 days</td><td></td><td>50 (40-59)</td><td></td><td>74 (58-83)</td><td></td><td>80 (71-86)</td></tr>
<tr><td>124+days</td><td></td><td>34 (29-48)</td><td></td><td>63 (37-78)</td><td></td><td>75 (64-82)</td></tr>
</table>
<table>
<tr><th>timing post dose 2</th><th>AZ disease in 65-79 year olds</th></tr>
<tr><td>14-41 days</td><td>48 (42-54)</td></tr>
<tr><td>42-69</td><td>33 (23-42)</td></tr>
<tr><td>70+</td><td>34 (10-52)</td></tr>
</table>
</td>
</tr>
<tr>
<td>75</td>
<td>Florea et al (December 14, 2021)

(updated April 28, 2022)</td>
<td>USA</td>
<td>≥18 year olds Kaiser Permanente insured patients</td>
<td>NonVOC, Alpha, Delta</td>
<td>mRNA-1273</td>
<td>December 18, 2020-September 30, 2021</td>
<td>Cohort study</td>
</tr>
</table>

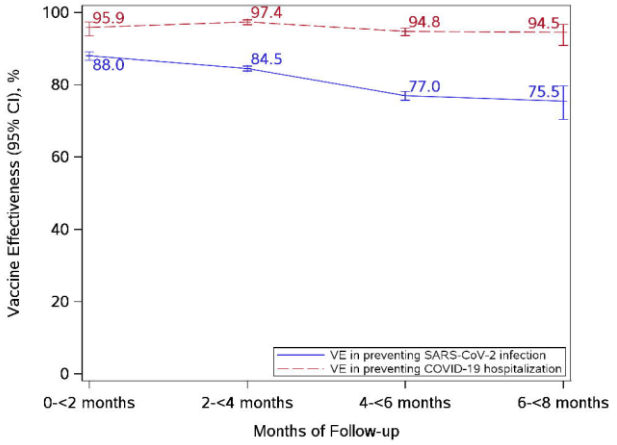
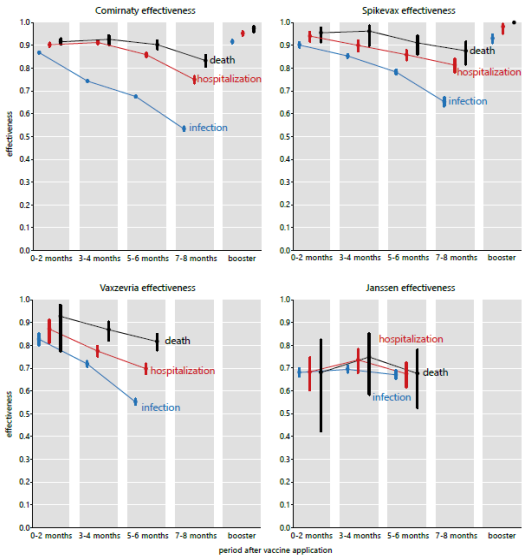
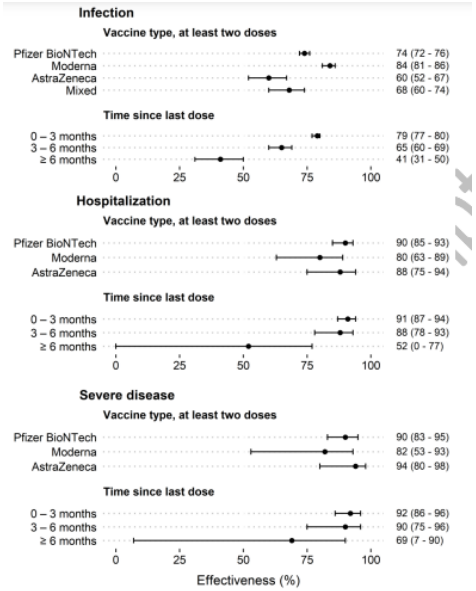
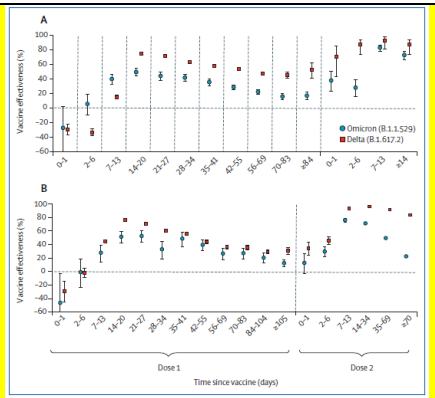
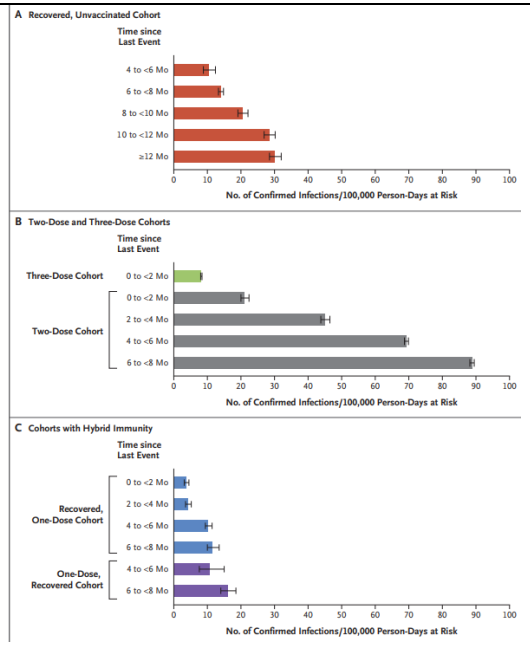
							
73	Berec et al (December 12, 2021) (updated to final publication on July 8, 2022)	Czech Republic	General population	Alpha, Delta	Comirnaty mRNA-1273 ChAdOx1 Ad26.COV2.S	December 27, 2020-November 21, 2021	Cohort study of population of Czech Republic using adminsitrative databases, evaluating duraiton of protection of primary and ve of boosted mRNA.  Fig. 2. Vaccine-acquired immunity against infection with respect to the delay from the full vaccine application, including the effect of a booster vaccine dose.

							Table 1. Estimated increase of breakthrough infection hazard ratios (HRs) in times of the SARS-CoV-2 delta variant dominance for age groups having started vaccination in the same month. Vaccine | March (age 70-80y) HR 95% CI | April (age 55-69y) HR 95% CI | May (age 35-54y) HR 95% CI Comirnaty 1.28 1.09-1.52 1.04 0.95-1.14 1.33 1.27-1.40 Spikevax 0.82 0.41-1.67 1.56 1.08-2.25 1.59 1.29-1.98 Vaxzevria 1.64 1.05-2.57 1.12 0.74-1.70 1.24 0.82-1.86 Janssen 2.70 0.37-19.63 0.40 0.20-0.78 0.91 0.34-2.43
72	Bjork et al (December 9, 2021) (Updated March 2, 2022)	Sweden	General population	Alpha, Delta	Comirnaty mRNA-1273 ChAdOx1	March 8-November 7, 2021	Case-control study based on surveillance data, matching on age/sex and no adjustment for other confounders. 
71	Kshirsagar et al (December 9, 2021)	USA	Fully vaccinated persons	NonVOCs, Alpha, Delta	Comirnaty mRNA-1273 Ad26.COV2.S	March 10-October 14, 2021	Cohort study of fully vaccinated persons evaluating risk of reinfection by vaccination. There was an increase in the rate of hospitalization starting ~110-125 days after full vaccination for all three vaccines depending on age group, with a steeper increase for Janssen.
70	Powell et al (February 18, 2022) *(updated May 2022)*	UK	General population with a focus on adolescents	Delta, **Omicron**	Comirnaty	Week 32 (~Aug 15) (16-17 yo) and Week 37 (12-15 yo) - January 12, 2022	TND study among adolescents against symptomatic disease

							 Figure: Vaccine effectiveness in 12-15-year-olds (A) and 16-17-year-olds (B) with symptomatic, PCR-confirmed COVID-19
69	Bajema et al (December 9, 2021)	USA	Veterans	nonVOCs, Alpha, Delta	Comirnaty mRNA-1273	February 1–September 30, 2021	TND among 1,896 U.S. veterans. Adjusted VE against hospitalization 14–119 days following 2nd dose of Moderna vaccine dose was 89.6% (95% CI = 80.1%–94.5%) and after the 2nd Pfizer-BioNTech dose was 86.0% (95% CI = 77.6%–91.3%); at ≥120 days VE was 86.1% (95% CI = 77.7%–91.3%) for Moderna and 75.1% (95% CI = 64.6%–82.4%) for Pfizer-BioNTech.
67	Goldberg et al (December 5, 2021) (updated to final publication May 26, 2022)	Israel	General population	Delta	Comirnaty	August 1-September 31, 2021	Analysis of surveillance data comparing the following groups: Recovered: Previously infected individuals 90 or more days after confirmed infection who had never been vaccinated; Recovered then Vaccinated: Previously infected individuals who later were 7 or more days after receiving a single vaccine dose; Vaccinated then Recovered: Individuals who had been vaccinated with one or two doses and were later infected; Vaccinated: Individuals seven days or more after receiving the second dose, and who had not been infected before the start of the study period; Booster: Individuals who received a third (booster) dose 12 or more days previously and had not been infected before the start of the study period.

							
64	Hall et al* (February 16, 2022) *[Update to (December 1, 2021 preprint]*	UK	18+ year HCWs	Alpha→Delta	Comirnaty AZD2222	December 7, 2020-September 21, 2021	Cohort study of HCWs looking a VE against infection over time in those with and without prior infection. Pfizer long interval is doses separated by ≥6 weeks; short interval by <6 weeks

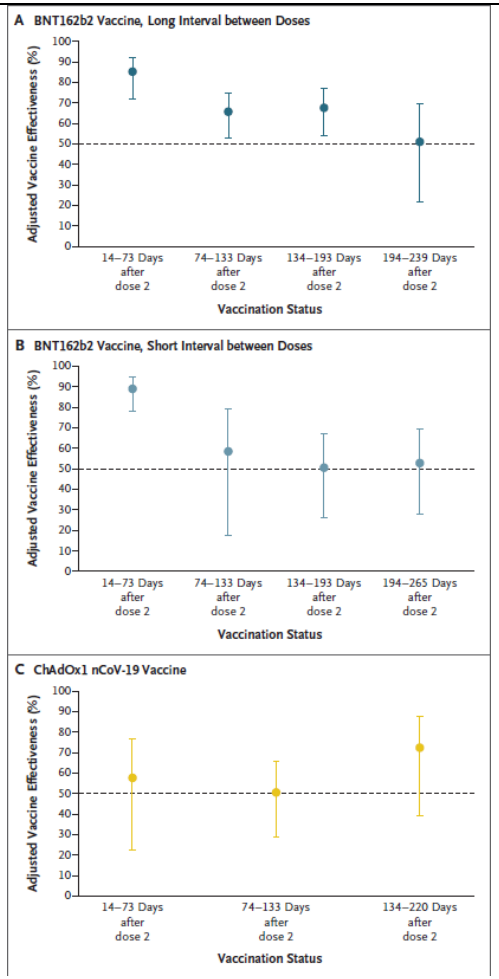
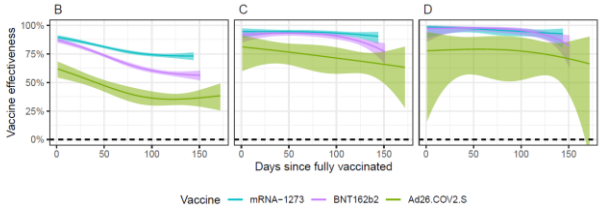
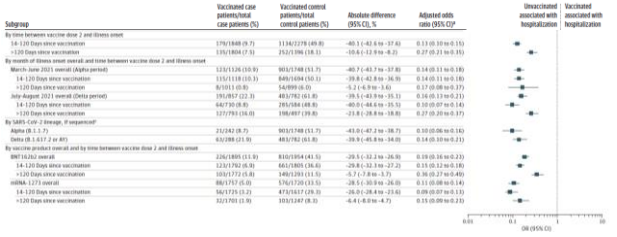
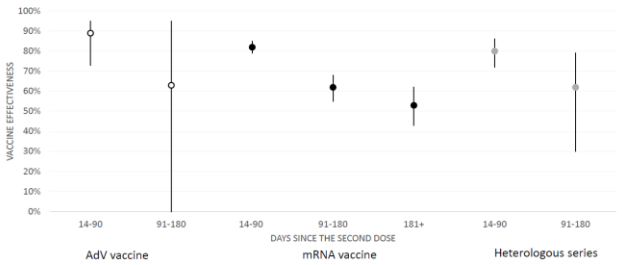
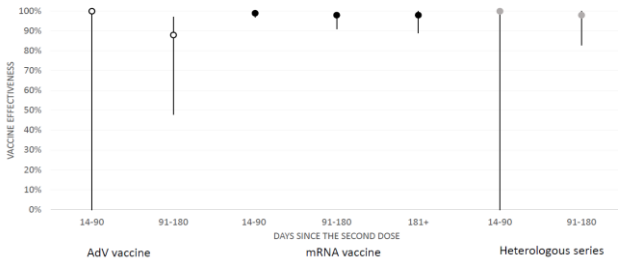
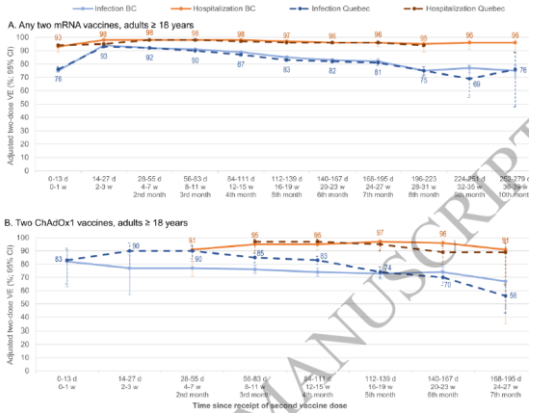
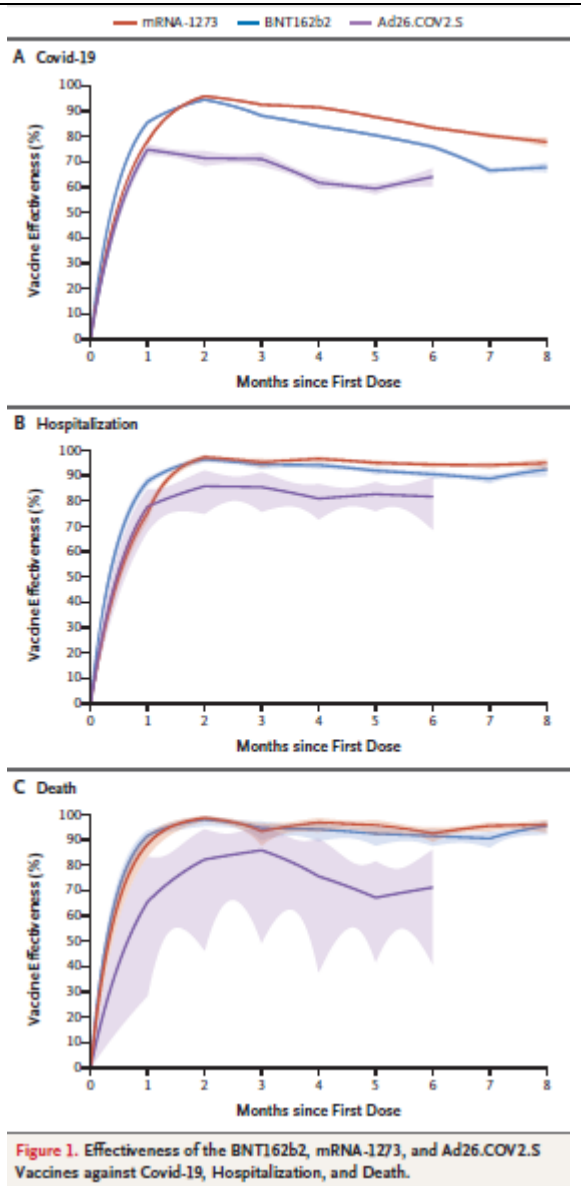
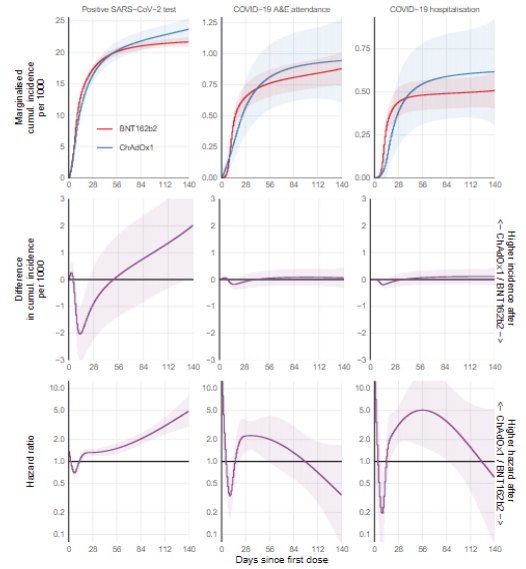
							
2	Israel et al (November 25, 2021) (updated with results from publication, see ref 2 below)	Israel	18+ years	Delta	Comirnaty	May 15-September 17, 2021	Test-negative design case control using administrative database of Leumit Health Services among 2-dose vaccine recipients. Compared with the initial 90 days after the vaccine, they found an increased risk of infection with time elapsed since vaccination.

							Table 4 | Adjusted odds ratios for risk of SARS-CoV-2 in matched cohort Adjusted odds ratio (95% CI) / P value Time since second vaccine (days): 21-89: Reference / — 90-119: 2.37 (1.67 to 3.36) / <0.001 120-149: 2.66 (1.94 to 3.66) / <0.001 150-179: 2.82 (2.07 to 3.84) / <0.001 ≥180: 2.82 (2.07 to 3.85) / <0.001 Age (continuous in years): 1.01 (1.00 to 1.01) / 0.008 Male sex: 1.05 (0.99 to 1.11) / 0.08 Socioeconomic status (continuous 1-20): 0.97 (0.96 to 0.98) / <0.001 Based on a conditional regression model fitted in a cohort matched for week of testing, age category (<18-39, 40-59, ≥60 years), and demographic group.
63	Irizarry et al (November 19, 2021)	USA (Puerto Rico)	12+ years	Predelta and delta	Comirnaty mRNA-1273 Ad26.COV2.S	December 15, 2020-October 15, 2021	Analysis of surveillance data linked to immunization registry data. VE against B) Infection c) Hospitalizations D) death by time since 2 weeks post complete series completion. Shading represents 99% CI. 
61	Andrews et al (November 15, 2021)	UK	50+	Delta	Comirnaty AZD2222	September 13-November 1, 2021	TND booster dose study that also calculated the VE of a 2nd dose >140 days after receipt of the 2nd dose. VE against symptomatic diseaes for two doses of ChAdOx1-S and BNT162b2 ≥20 weeks after being given were 44.1% (41.9 to 46.1) and 62.5% (61.0 to 63.9), respectively.
59	Tenforde et al (November 4, 2021)	USA	Hospitalized patients	Mix, alpha, and delta	Comirnaty mRNA-1273	March 11-August 15, 2021	Case-control study among hospitalized patients. When the mRNA-1273 and BNT162b2 vaccines were compared, estimated vaccine effectiveness was similar within 120 days of vaccination. In contrast, beyond 120 days, the results corresponded to an estimated effectiveness of 85% for the mRNA-1273 and 64% for the BNT162b2 vaccine to prevent COVID-19 hospitalizations. 
58	Poukka et al (November 4, 2021)	Finland	16-69 year old HCWs	Mix and delta	Comirnaty mRNA-1273 AZD2222 heterologous	December 27,2020-August 26 (infection) October 26 (hospitalization), 2021	HCW cohort study based on registries. No difference seen between delta and pre-delta periods. VE against infection

							 VE against hospitalization 
56	Skowronski et al (October 26, 2021) (updated April 19, 2022)	Canada	General population	Alpha, Gamma, Delta	AZD1222 Comirnaty mRNA-1273 And heterologous schedules of the above	May 30, 2021 - November 27, 2021	TND study in BC and Quebec. In both provinces, all homologous or heterologous mRNA and/or ChAdOx1 two-dose 12 schedules were associated with ≥90% reduction in SARS-CoV-2 hospitalization risk for at least 7 13 months. With slight decline from a peak of >90%, VE against infection was ≥80% for at least 6 14 months following homologous mRNA vaccination, lower by ~10% when both doses were 15 ChAdOx1 but comparably-high following heterologous ChAdOx1+mRNA receipt. 

55	Lin et al (October 26, 2021) *[updated with final publication on January 12, 2022}*	USA	General population	multiple	Comirnaty mRNA-1273 Ad26.COV2.S	December 13, 2020-Sept 8, 2021	Administrative database cohort study in North Carolina. For Pfizer two-dose,VE peaks at 94.5% (95% CI, 94.1 to 94.9) at 2 months (post the first dose). VE starts to decline after 2 months and drops to 66.6% (95% CI, 65.2 to 67.8) at 7 months. For Moderna two-dose,VE peaks at 95.9% (95% CI, 95.5 to 96.2) at 2 months. Effectiveness started to decline after 2 months and was maintained at 80.3% (95% CI, 79.3 to 81.2) at 7 months. For the Janssen one-dose regimen, vaccine effectiveness ramps to a peak level of 74.8% (95% CI, 72.5 to 76.9) at 1 month. Effectiveness started to decline after 1 month and decreased to 59.4% (95% CI, 57.2 to 61.5) at 5 months.

							 Figure 1. Effectiveness of the BNT162b2, mRNA-1273, and Ad26.COV2.S Vaccines against Covid-19, Hospitalization, and Death.

54	Nordstrom et al (October 25, 2021) *[Updated February 4, 2022}*	Sweden	General population	Alpha, Delta,	AZD1222 Comirnaty mRNA-1273 And AZD1222à mRNA-1273	January 12-October 4, 2021	National cohort study based on database linkage. Vaccine effectiveness of BNT162b2 against infection waned progressively from 92% (95% CI, 92-93, P<0·001) at day 15-30 to 47% (95% CI, 39-55, P<0·001) at day 121-180, and from day 211 and onwards no effectiveness could be detected (23%; 95% CI, -2-41, P=0·07). The effectiveness waned slightly slower for mRNA-1273, being estimated to 59% (95% CI, 18-79) from day 181 and onwards. In contrast, effectiveness of ChAdOx1 nCoV-19 was generally lower and waned faster, with no effectiveness detected from day 121 and onwards (-19%, 95% CI, -97-28), whereas effectiveness from heterologous ChAdOx1 nCoV-19 / mRNA was maintained from 121 days and onwards (66%; 95% CI, 41-80). Overall, vaccine effectiveness was lower and waned faster among men and older individuals. For the outcome severe Covid-19, effectiveness waned from 89% (95% CI, 82-93, P<0·001) at day 15-30 to 42% (95% CI, -35-75, P=0·21) from day 181 and onwards, with sensitivity analyses showing notable waning among men, older frail individuals, and individuals with comorbidities.
52	Hulme et al (October 18, 2021)	UK	HCW	Alpha, delta	Comirnaty AZD1222	January 4-June 13	Comparative VE Cohort study of HCWs based on linking databases who were vaccinated with AZD1222 or Comirnaty between January 4-February 28, 2021 who were followed for 20 weeks. **Figure 2: Comparative effectiveness** For each outcome based on the fully adjusted model, the marginal cumulative incidence for ChAdOx1 and BNT162b2, their difference, and the hazard ratio are shown. Models that assumed piecewise-constant hazards gave similar effect estimates (supplementary Figure S2). The models with less extensive confounder adjustment gave very similar estimates (supplementary Figure S1) suggesting that recipients of each vaccine were similar after accounting for differences in vaccine allocation over space and time (as did all models). 
51	Robles-Fontan et al (October 18, 2021)	USA (Puerto Rico)	General population	Multiple, with delta time frame analysis	Comirnaty mRNA-1273 Ad26.COV2.S	December 15,2020-October 15, 2021	Cohort study of Puerto Rican population.

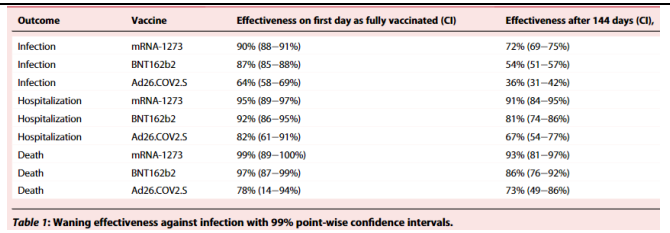
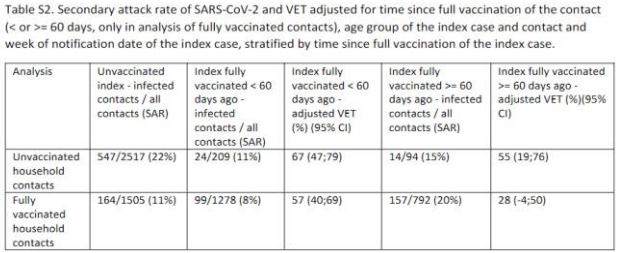
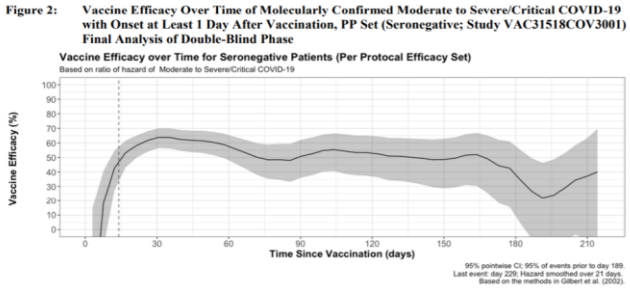
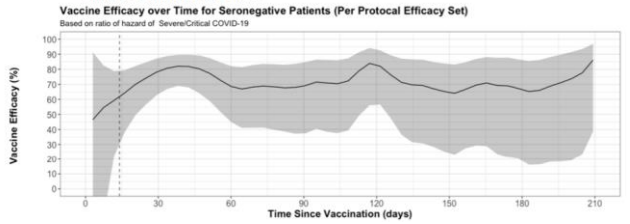
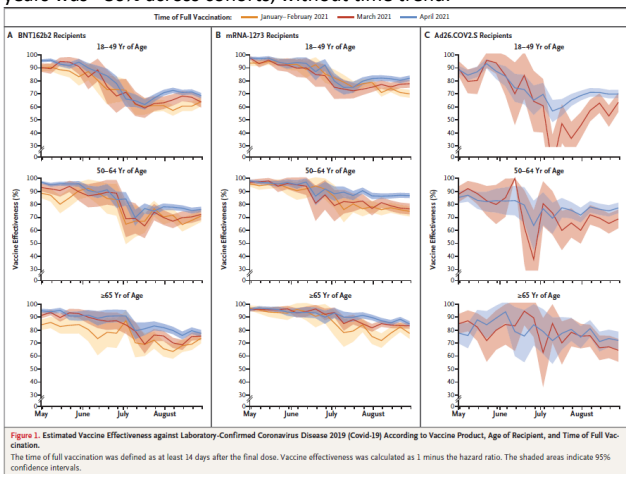
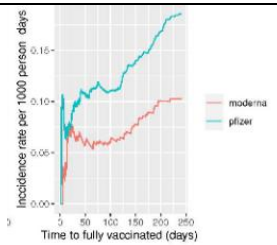
	(updated March 2, 2022)						 **Table 1: Waning effectiveness against infection with 99% point-wise confidence intervals.**
50	De Gier et al (October 14, 2021)	Netherlands	General population	Delta	Comirnaty mRNA-1273 Ad26.COV2.S AZD1222	August 9-September 24, 2021	Study of unvaccinated and vaccinated index cases and their contacts to evaluate transmission. They did not have sufficent sample size but evaluated if VE against transmission differed by time since vaccination of the index case 
49	Janssen Briefing document for US FDA (October 14, 2021)	multiple	General population	Multiple	Ad26.COV2.S	September 21, 2020-July 9, 2021	Final results from RCT 

Table S2. Secondary attack rate of SARS-CoV-2 and VET adjusted for time since full vaccination of the contact (< or >= 60 days, only in analysis of fully vaccinated contacts), age group of the index case and contact and week of notification date of the index case, stratified by time since full vaccination of the index case.

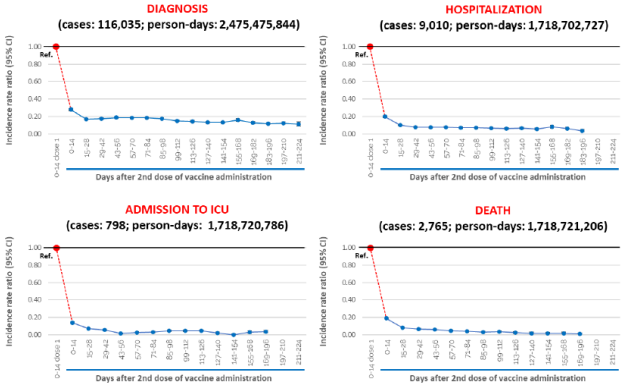
Analysis	Unvaccinated index - infected contacts / all contacts (SAR)	Index fully vaccinated < 60 days ago - infected contacts / all contacts (SAR)	Index fully vaccinated < 60 days ago - adjusted VET (%) (95% CI)	Index fully vaccinated >= 60 days ago - infected contacts / all contacts (SAR)	Index fully vaccinated >= 60 days ago - adjusted VET (%)(95% CI)
Unvaccinated household contacts	547/2517 (22%)	24/209 (11%)	67 (47;79)	14/94 (15%)	55 (19;76)
Fully vaccinated household contacts	164/1505 (11%)	99/1278 (8%)	57 (40;69)	157/792 (20%)	28 (-4;50)

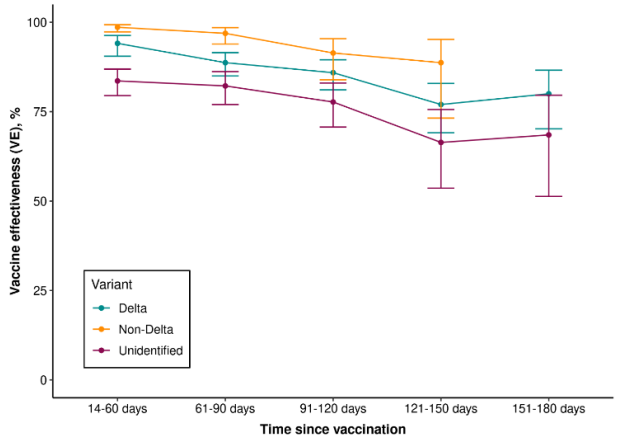
Figure 2: Vaccine Efficacy Over Time of Molecularly Confirmed Moderate to Severe/Critical COVID-19 with Onset at Least 1 Day After Vaccination, PP Set (Seronegative; Study VAC31518COV3001) Final Analysis of Double-Blind Phase

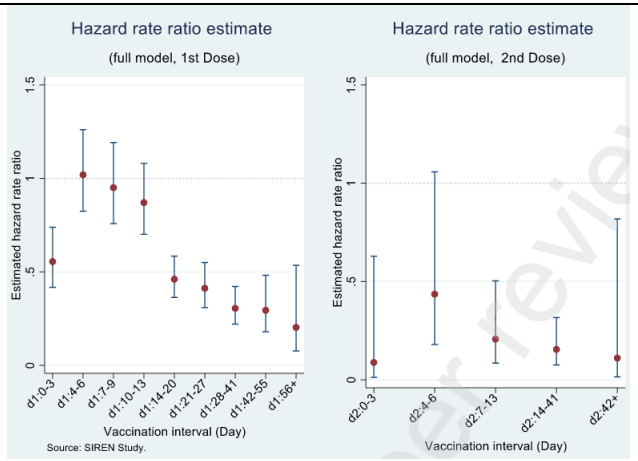
							Table 3: Vaccine Efficacy of Molecularly Confirmed Moderate to Severe/Critical COVID-19 with Onset at Least 1 Day After Vaccination; Per Protocol Set Final Analysis of Double-Blind Phase Study (VAC31518COV3001) Ad26 5e10 vp: #Cases (N) PY; Placebo: #Cases (N) PY; VE% (95% CI) Analysis set: PP (19577) (19608) Moderate to severe/critical[a] Day 2 to Day 14: 82 (19577) 748.66; 88 (19608) 749.83; 6.7% (-27.54; 31.77) Day 15 to Day 28: 51 (19400) 1483.44; 184 (19398) 1480.09; 72.3% (62.10; 80.13) Day 29 to Day 56: 119 (19113) 2877.42; 306 (18924) 2837.44; 61.7% (52.46; 69.23) Day 57 to end DB Phase: 314 (17586) 6460.98; 573 (17090) 6158.91; 47.8% (39.95; 54.62) Day 57 to Day 112: 157 (17586) 5040.02; 308 (17090) 4860.10; 50.8% (40.24; 59.70) Day 113 to end DB Phase: 157 (11379) 4900.35; 265 (10572) 4529.34; 45.2% (33.04; 55.34) **Figure 4: Vaccine Efficacy Over Time of Molecularly Confirmed Severe/Critical COVID-19 with Onset at Least 1 Day After Vaccination, PP Set (Seronegative; Study VAC31518COV3001) Final Analysis of Double-Blind Phase** 
48	Rosenberg et al (October 9, 2021) *Updated with final publication on December 1, 2021*	USA	General adult population of New York	Delta for part of study period	Comirnaty mRNA-1273 Ad26.COV2.S	May 1-September 3, 2021	Cohort study based on adminsitrative datbases. Estimated VE for cases declined contemporaneously across age, products, and time-cohorts. VE for hospitalization for adults 18-64 years was >86% across cohorts, without time trend.  Figure 1. Estimated Vaccine Effectiveness against Laboratory-Confirmed Coronavirus Disease 2019 (Covid-19) According to Vaccine Product, Age of Recipient, and Time of Full Vaccination. The time of full vaccination was defined as at least 14 days after the final dose. Vaccine effectiveness was calculated as 1 minus the hazard ratio. The shaded areas indicate 95% confidence intervals.
47	Liu et al (October 7, 2021)	USA	General population of NYC	Alpha, Delta, others	Comirnaty mRNA-1273	January 18-September 21, 2021	Hospital database cohort study. They found that there was an increased incidence rate with the increased time from vaccination, especially 120 days after vaccination.

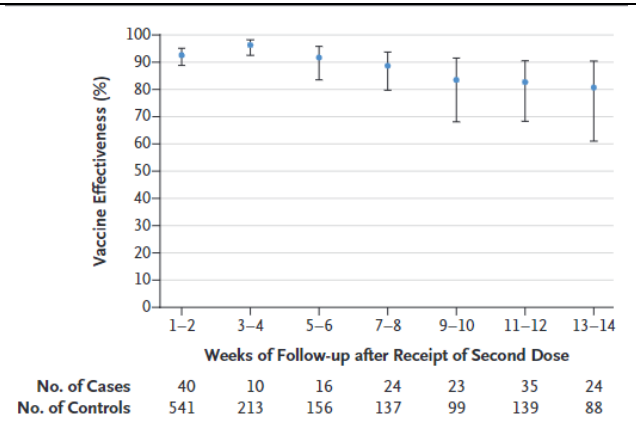


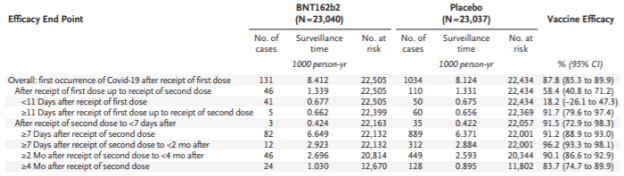
Time to fully vaccination	Pfizer/BNT162b2 Total person-days at risk[1]	Pfizer/BNT162b2 Incidence	Pfizer/BNT162b2 Incident rate / 1000 person-days	Moderna/mRNA-1273 Total person-days at risk	Moderna/mRNA-1273 Incidence	Moderna/mRNA-1273 Incident rate / 1000 person-days
210-240 days	3074	6	1.952	443	1	2.257
180-210 days	16811	24	1.428	5543	5	0.902
150-180 days	34847	16	0.459	16525	6	0.363
120-150 days	66486	27	0.406	32243	7	0.217
90-120 days	105697	15	0.142	52162	5	0.096
60-90 days	150864	16	0.106	74806	5	0.067
30-60 days	203392	26	0.128	100706	5	0.050
0-30 days	259596	26	0.100	126977	8	0.063

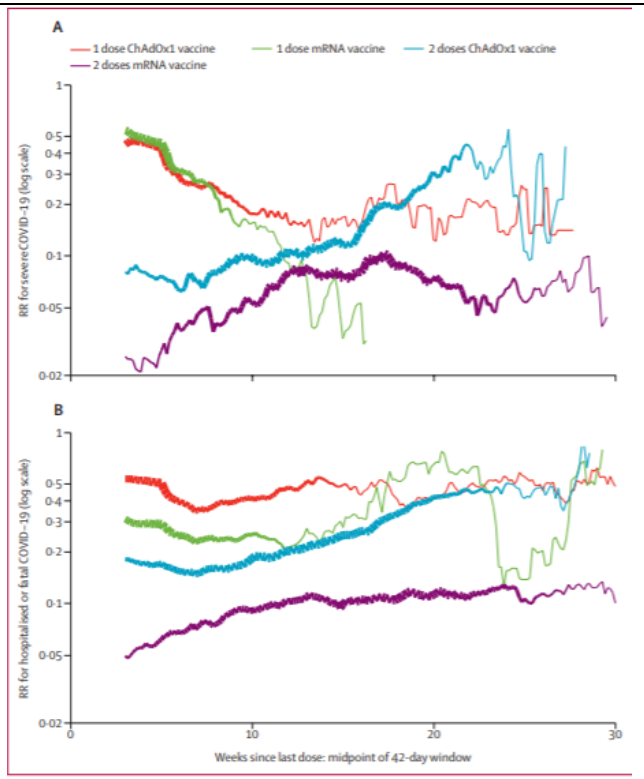
46	Italian Instituo Superiore di Sanita (September 30, 2021)	Italy	≥16 year old general population who received at least 1 dose of mRNA vaccine	Alpha, Delta	Comirnaty mRNA-1273	December 27, 2020-August 29, 2021	Compared different time points post vaccination dose 2 to day 0-14 post dose 1. They did not observe a reduction of the protective effect of vaccination, against symptomatic or asymptomatic COVID-19 diagnosis, after about seven months since the 2nd dose (VE 89%), nor against diagnosis with subsequent hospitalization (VE 96%), admission to ICU (VE 96%), or death (VE 99%) after about 6 months. Persons >80+, nursing home residents, persons with comorbidities or immunocompromised did see a decline in VE against infection though confidence intervals are wide for the latter. 
45	Martinez Bas et al (September 30, 2021)	Spain	≥18 year old general population	Alpha, Delta	Comirnaty mRNA-1273 AZD1222	April 1-August 31, 2021	Cohort study of contacts of cases.

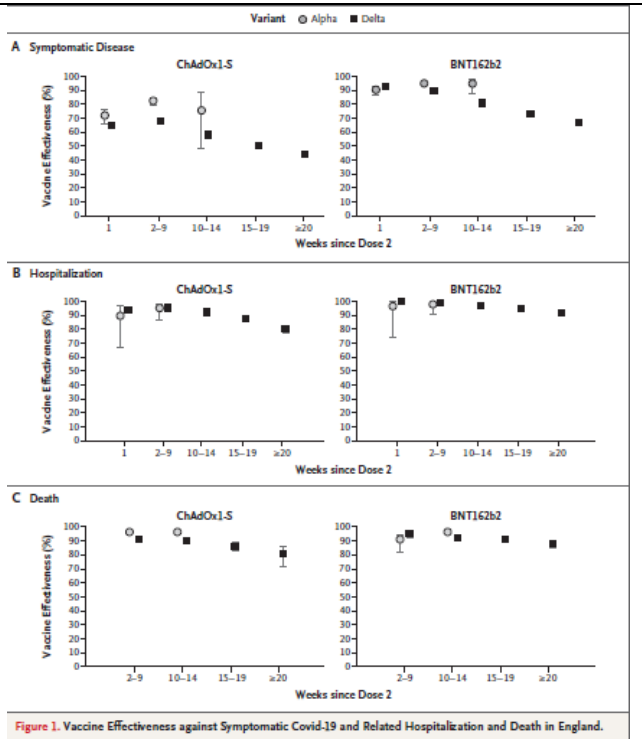
<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>Ad26.COV2.S</td><td></td><td><table>
<tr><td></td><td colspan="2">Adjust VE (95% CI)</td></tr>
<tr><td></td><td><90 days since last dose</td><td>≥90 days since last dose</td></tr>
<tr><td>unvaccinated</td><td>REF</td><td>REF</td></tr>
<tr><td>1 dose of Janssen</td><td>52 (44-59)</td><td>28 (-8-53)</td></tr>
<tr><td>1 dose of Spikevax</td><td>65 (56-73)</td><td>NA</td></tr>
<tr><td>2 doses of Spikevax</td><td>85(80-88)</td><td>67 (50-78)</td></tr>
<tr><td>1 dose of Comirnaty</td><td>57 (51-61)</td><td>NA</td></tr>
<tr><td>2 doses of Comirnaty</td><td>70 (67-73)</td><td>63 (58-68)</td></tr>
<tr><td>1 dose of Vaxzervia</td><td>40 (31-47)</td><td>52 (37-64)</td></tr>
<tr><td>2 doses of Vaxzervia</td><td>54 (47-60)</td><td>NA</td></tr>
<tr><td>1 dose of Vaxzervia+1 dose of Comirnaty</td><td>85 (69-93)</td><td>NA</td></tr>
</table></td></tr>
<tr><td>44</td><td>Bruxvoort et al (October 1, 2021)</td><td>USA</td><td>General population</td><td>Delta, Alpha+others</td><td>mRNA-1273</td><td>March 1-July 27, 2021</td><td>TND study among persons insured by Kaiser Permante Southern California.
 
</td></tr>
<tr><td>43</td><td>Payne et al (July 21, 2021)</td><td>UK</td><td>HCWs</td><td>Alpha</td><td>Comirnaty</td><td>December 7, 2020-March 12, 2021</td><td>Cohort study of HCWs</td></tr>
</table>

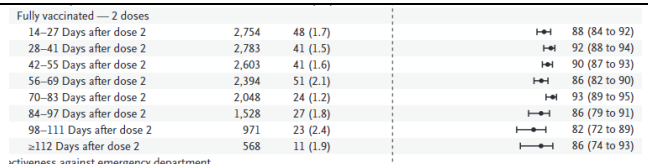
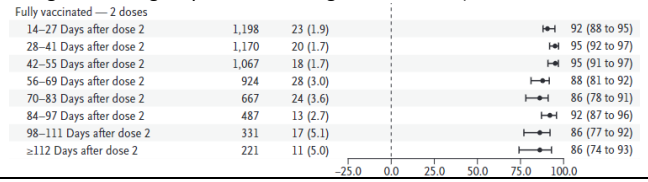
							
41	Eyre et al* (January 5, 2022) *[Update to September 29, 2021 preprint]*	UK	contacts of symptomatic and asymptomatic SARS-CoV-2-infected index cases	Alpha/Delta	Comirnaty AZD1222	January 1-July 31, 2021	Transmission study. Independently of contact vaccination status, for each doubling of weeks since 14 days after second vaccinationin index cases, the odds of a contact testing PCR-positive increased 1.13-fold (95%CI 1.09-1.17) for ChAdOx1 and 1.20-fold (1.10-1.31) for BNT162b2 with no evidence of a difference between vaccines (p=0.19). Higher probabilities of PCR-positive results in contacts 14 days after second vaccination for Delta vs. Alpha meant that by 12 weeks post second ChAdOx1 dose there was no evidence that onward Delta transmission rates differed between those not vaccinated and those having received two ChAdOx1dosesand the impact of BNT162b2had also attenuatedsubstantially
40	Nunes et al (September 23, 2021)	Portugal	Cohort of 80-109 year olds	Multiple	Comirnaty mRNA-1273	February 2-August 13, 2021	Cohort study done by linking adminsitrative records. VE against hospitalization in persons ≥ 98 days post dose 2 was 89% (71–96) compared to 14-41 days post dose 2 was 81% (64–91). VE against COVID-19-related deaths in persons ≥ 98 days post dose 2 was 74% (60–83) compared to 14-41 days post dose 2 was 86% (68–93). Neither were statisically different. Outcome by vaccine status / Person-years / Events (n) / Rate / Rate ratio / 95% CI / Confounder-adjusted HR / 95% CI / VE / 95% CI Hospitalisation 14 to 41 days: 32,505 / 10 / 0.31 / 0.03 / 0.01–0.05 / 0.18 / 0.09–0.36 / 82 / 64–91 42 to 69 days: 32,059 / 11 / 0.34 / 0.03 / 0.02–0.05 / 0.19 / 0.09–0.39 / 81 / 61–91 70 to 97 days: 31,161 / 16 / 0.51 / 0.04 / 0.03–0.07 / 0.22 / 0.12–0.43 / 78 / 57–88 ≥98 days: 33,321 / 6 / 0.18 / 0.02 / 0.01–0.03 / 0.11 / 0.04–0.29 / 89 / 71–96 Death 14–41 days: 32,506 / 7 / 0.22 / 0.02 / 0.01–0.05 / 0.14 / 0.07–0.32 / 86 / 68–93 42–69 days: 32,062 / 13 / 0.41 / 0.05 / 0.03–0.08 / 0.16 / 0.09–0.30 / 84 / 70–91 70–97 days: 31,164 / 20 / 0.64 / 0.07 / 0.05–0.11 / 0.13 / 0.08–0.23 / 87 / 77–92 ≥98 days: 33,326 / 51 / 1.53 / 0.17 / 0.13–0.22 / 0.26 / 0.17–0.40 / 74 / 60–83
37	Pilishvili et al (September 22, 2021)	USA	HCW	Multiple	Comirnaty mRNA-1273	December 28-May 19, 2021	TND case control among HCWs evaluated VE every 2 weeks for 14 weeks.

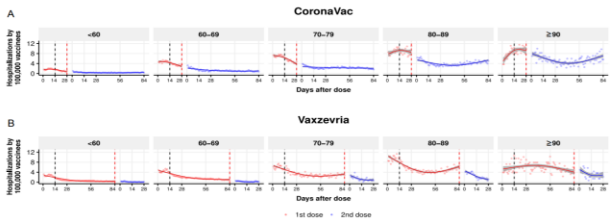
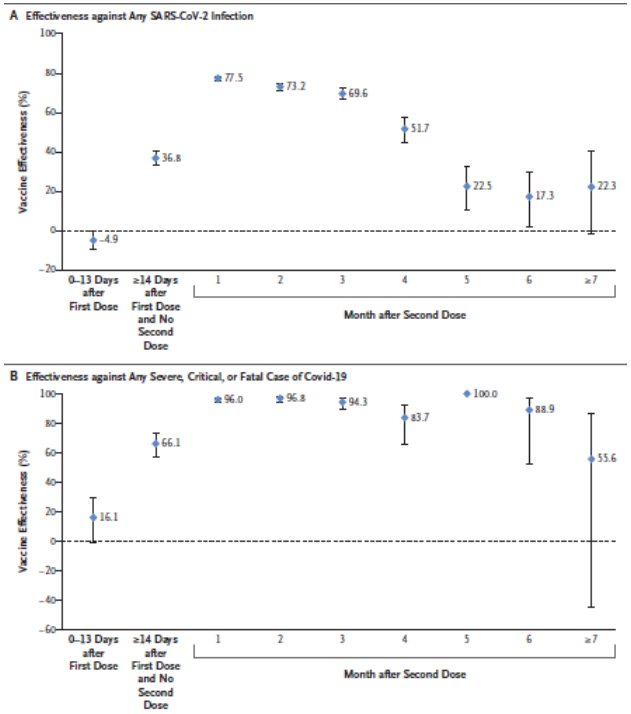
							
36	El Sahly et al (September 22, 2021)	USA	RCT participants	Multiple	mRNA-1273	July 27, 2020-March 26, 2021	Findings from the double blinded placebo controlled RCT. VE against disease was similar at 2 weeks-<2 months (91.8%), 2 months-<4 months (94%), and ≥4 months (92.4%) post dose 2
35	Baden et al (September 22, 2021)	USA	≥18-year-old RCT participants	Delta	mRNA-1273	July 1-August 27, 2021	RCT participants were followed after unblinding. Initial vaccine recipients (mRNA-1273e) were vaccinated between 7/27/20-12/16/20 while those vaccinated after unblinding (mRNA-1273p) were vaccianted between 12/29/20-4/30/21. Median follow-up times from the first dose were 13 months in the mRNA-1273e (including double-blind and open-label phases) and 7.9 months in the mRNA-1273p (only open-label phase) groups. While there was a significant difference in disease incidence rates between the groups, there was no difference in severe disease incidence rates though numbers are small. mRNA-1273e N=14746 / mRNA-1273p* N=11431 / mRNA-1273p vs mRNA-1273e Covid-19 Cases† — Cases n / Person-yr / Rate/1000 Person-yr / Cases n / Person-yr / Rate/1000 Person-yr / Reduction of observed incidence rate % (95% CI) All cases 162 2102 77.1 88 1796 49.0 36.4 (17.1-51.5) ≥18-<65 yr 136 1558 87.3 68 1289 52.8 39.6 (18.6-55.5) ≥65 yr 26 544 47.8 20 507 39.5 17.4 (-53.9-56.3) Severe 13 2102 6.2 6 1796 3.3 46.0 (-52.4-83.2) ≥18-<65 yr 7 1558 4.5 4 1289 3.1 30.9 (-171.7- 85.2) ≥65 yr 6 544 11.0 2 507 3.9 64.2 (-100.2-96.5)
34	Hagan et al (September 21, 2021)	USA	Incarcerated persons	Delta	Comirnaty mRNA-1273 Ad26.COV2.S	July 11-August 14, 2021	Outbreak investigation in a prison found that the attack rate among fully vaccinated persons was significantly higher in those vaccinated 4-6 months ago (89%) compared to those vaccinated 2 weeks-2 months ago (61%). This was combined for 3 vaccines used in the population.
33	Thomas et al (September 15, 2021)	Multiple	≥12-year-old RCT participants	Multiple	Comirnaty	July 27, 2020-March 13, 2021	Findings from the double blinded placebo controlled RCT. VE against disease was 96.2% (93.3-98.1) at 7 days-<2 months, 90.1% (86.6-92.9) at 2 months-<4 months, and 83.7% (74.7-89.9) at ≥4 months post dose 2.

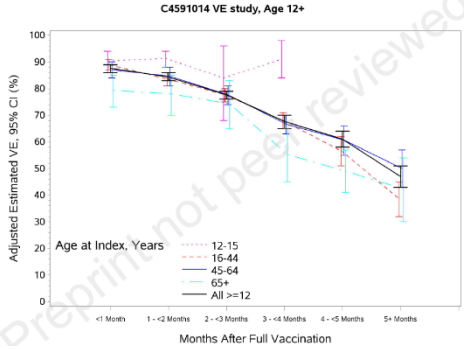
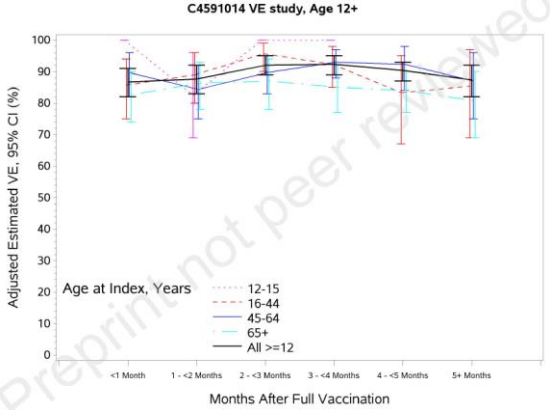
							
32	Pfizer (September 17, 2021)	Multiple	≥16-year-old RCT participants	Delta	Comirnaty	July 1-August 31, 2021	RCT participants were evaluated for duration of protection against symptomatic disease, with the original placebo recipients receiving the vaccine after unblinding. The mean time from Dose 2 of Comirnaty to 01 July 2021 was approximately 5 months for the crossover group and 10 months for the original group. There was a 26.3% (7.4%- 41.4%) relative vaccine efficacy for the group vaccinated later (crossover group) compared to the group vaccinated earlier (original group), with a difference in incidence rates of -18.6 per 1000 person-years of follow-up.
31	de Gier et al (September 17, 2021)	Netherlands	Hospitalized patients	Delta (just for duration of protection)	Comirnaty mRNA-1273 Ad26.COV2.S AZD1222	July 4-August 29, 2021 (just for duration of protection)	Incidence rate ratios were calculated based on national coverage and vaccination status of hospitalized cases. All 4 vaccines were combined in calculating the VE by time since vacciantion, and VE was only calculated during the delta dominant period when 99% of sequenced isolates were delta. No drop in VE against hospitalization nor in VE against ICU admission was seen between those vaccinated up to 20 weeks since full vacciantion among 15-49, 50-69, ≥70 year olds.
30	Self et al (September 17, 2021)	USA	≥18 years who were hospitalized at 21 U.S. hospitals across 18 states	Alpha, Delta, Non-VOC	Comirnaty mRNA-1273 Ad26.COV2.S	March 11–August 15, 2021	This case-control study found that the for mRNA-1273 vaccine, there was no difference in VE against hospitalization among those were 14-120 days post full vaccination and those who were >120 days post full vaccination. For Comirnaty, VE against hopsitalization was 91% (88-93) for those 14-120 days post full vaccination while it was 77% (67-84) for those >120 das post full vaccination. Ad26.COV2.S did not have enough data to stratify by more than 28 days post full vaccination.
29	Polinski et al (September 12, 2021) (updated March 17, 2022)	USA	≥18 years of age	Alpha/Delta	Ad26.COV2.S	March 1, 2021-August 31, 2021	Retrospective cohort study used insurance claims data linked to health data sources to evaluate VE of Ad26.COV2.S against COVID-19 diagnosis and hospitalization among vaccinated individuals and matched unvaccinated individuals (matched on age, sex, comorbid-risk, calendar date, location, and other risk factors for COVID-19 severity). VE was stable over time up to 152 days after vaccination.
28	McKeigue et al (September 15, 2021) (updated February 25, 2022)	Scotland	Population of Scotland	Alpha/Delta	Comirnaty mRNA-1273 AZD1222	December 1, 2020-September 8, 2021	Matched case-control study (REACT-SCOT) assessed rate ratios over time comparing rate of severe COVID-19 and the rate of hospitalization or death among thoswe full vaccinated with Comirnaty, mRNA-1273, and AZD1222 to unvaccinated persons.

							 ***Figure 2:* Association between vaccine efficacy and time since last vaccine dose** (A) Severe COVID-19. RRs in conditional logistic regression model, adjusted for covariates. (B) Hospitalised or fatal COVID-19 cases. RRs in the 42-day time window centred on 20 weeks from the most recent vaccine dose are presented. The efficacy of vaccination is 1 minus the RR. For each effect, line thickness is proportional to precision (inverse variance) of estimate, scaled to the same maximum thickness for each effect. RR=rate ratio.
27	Bajema et al (September 10, 2021)	USA	Veterans ≥ 18 years	Alpha/Delta	BNT162b2 & mRNA-1273	February 1, 2021-August 6, 2021	Test-negative case-control study of adults hospitalized at 5 Veterans Affairs with COVID-like illness. No difference was found in VE against hospitalization <90 days vs. ≥ 90 days post second dose of BNT162b2 or mRNA-1273: 86.1% (76.5-91.8%) vs. 87.2 (78.2-92.5%).
26	Andrews et al With updated data through August 20th here (September 14, 2021)	UK	Symptomatic cases and test-negative controls 16 years and older	Alpha/Delta	Comirnaty mRNA-1273 AZD1222	December 8, 2020-September 3, 2021	This test-negative case-control study assessed VE of 2 doses of Comirnaty, mRNA-1273, and AZD1222 against symptomatic disease, hospitalization, and death over time separately for Alpha and Delta variants. VE against symptomatic disease peaked in early weeks post 2nd dose and then declined for Comirnaty and mRNA-1273 for both Alpha and Delta. Waning was greater for Delta than Alpha. Only limited waning against hospitalization and death was observed.

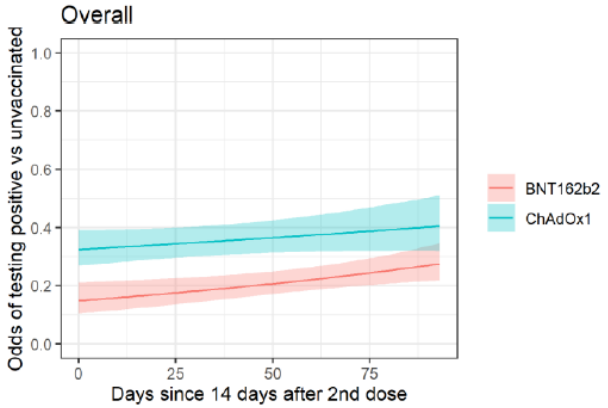
	Updated with final publication on January 12, 2022						 Figure 1. Vaccine Effectiveness against Symptomatic Covid-19 and Related Hospitalization and Death in England. Waning was also greater for those 65+ years compared to 40-64 year-olds and in those in a clinical risk group and clinically extremely vulnerable group. Data for mRNA-1273 was only available thorugh 10-14 weeks post 2nd dose for symptomatic disease and shows high VE (85.6%) at 10-14 weeks.
25	Dagan et al (September 9, 2021)	Israel	Pregnant women	Alpha/Delta	Comirnaty	December 20, 2020-June 3, 2021	Cohort study of pregnant women that showed no drop in VE through 56 days post dose 2
24	Thompson et al (September 9, 2021)	USA	≥50 years of age	Multiple including alpha/delta	Comirnaty mRNA-1273 Ad26.COV2.S	January 1-June 22, 2021	Test negative case control study that found that VE against hospitalization remained >80% through at least 112 days post the dose 2 for Comirnaty and mRNA-1273. For Ad26.COV2.S, VE stayed high at time point ≥56 days after vaccination. VE against ER/urgent care visit is >80% through at least 112 days post dose 2 for Comirnaty and mRNA-1273. For Ad26.COV2.S, VE stayed high at time point ≥56 days after vaccination. VE against hospitalization (for all 3 vaccines combined)

							 VE against emergency room visits/urgent care visits (for all 3 vaccines combined) 
23	Puranik et al (September 7, 2021)	USA	Persons ≥14 days post dose 2 ("full vaccination") who received first dose after January 1	Multiple including alpha/delta	Comirnaty	January 1-August 8, 2021	Test negative case control study to assess duration of protection against symptomatic disease. Adjusted OR start showing waning at day 60 after full vaccination. **Covariate** / **Level/Category** / **Symptomatic Infection [N = 974 positive events]** Time Relative to Full vaccination: Day 0 — 1 (Reference); Day 30 — 2.19 (0.89, 5.36); Day 60 — 3.65 (1.78, 7.46); Day 90 — 5.58 (2.72, 11.46); Day 120 — 7.25 (3.47, 15.18); Day 150 — 10.33 (5.03, 21.24)
22	Kertes et al (September 7, 2021)	Israel	Fully vaccinated population	Delta	Comirnaty	June 9-July 18, 2021	Study of Maccabi HMO clients who were 7 days post dose 2 by June 9 and had no history of prior infection. Found that those vaccinated in January-February had odds of infection of 1.61 (1.45-1.79) compared to those vaccinated in March-May of testing positive for SARS-CoV-2.
19	Keehner et al (September 1, 2021)	USA	~19,000 employees of University of California San Diego Health	Delta	BNT162b2 mRNA-1273	July -August 26, 2021	Cohort study of HCWs showed that among symptomatic cases occurring in July, HCW vaccinated in January or February had an attack rate of 6.7 per 1000 persons (95% CI, 5.9 to 7.8), whereas the attack rate was 3.7 per 1000 persons (95% CI, 2.5 to 5.7) among those who completed vaccination during the period from March through May. Among unvaccinated persons, the July attack rate was 16.4 per 1000 persons (95% CI, 11.8 to 22.9).
18	Nunes et al (August 29, 2021)	Portugal	1.5 million ≥65 year olds (duration of protection on only those 80+)	Alpha→Delta	BNT162b2 mRNA-1273	?February-August 13, 2021	Cohort study using electronic databases. For those 80+, VE against hospitalization was 82 (64-91) at day 14-41 and 89% (71-96) at day 98+. For COVID related mortality, it was 86% (68-93) at day 14-41 and 74 (60-83) at day 98+. Noted limitations are that data delays could mean that outcomes such as hospitalization/mortality have not been recorded for more recent cases. Additionally, only 6% of the 80+ cohort remained unvaccinated during the study period, making these unvaccinated individuals probably quite different from the vaccinated.
17	Cerqueria-Silva et al (August 27, 2021)	Brazil	75.9 million vaccinated in Brazil	Gamma	CoronaVac AZD1222	January 18-July 24, 2021	This was a retrospective cohort study that calculated VE, as well as evaluated the daily hospitalization incidence per 100,000 vaccinees. For CoronaVac, there was low hospitalization incidence up to 84 days in vaccinees up to 79 years old. 80-89 and ≥90 age groups lowest incidence 28 days post dose 2 but then increased but were still lower than 1 dose recipients

							
16	Chemaitelly et al* (October 6, 2021) *[Update to Aug 27 preprint]*	Qatar		Alpha→Beta →Delta	BNT162b2	January 1-August 15, 2021	Test-negative case-control study evaluating VE by time since vaccination stratified by age, VOC, and outcome. They see a drop in VE against infection over time since vaccination with no difference by those older/younger than 60. VE against severe disease is preserved (until sample size is insufficient). 
13	Tartof et al* (October 16, 2021)	USA	3.4 million Kaiser Permanante Southern California members ≥12 years	Delta for latter months of study	BNT162b2	December 14, 2020-August 8, 2021	Retrospective cohort study. VE against infection for the fully vaccinated decreased with increasing time since vaccination, declining from 88% (86–89) during the first month after full vaccination to 47% (43–51) after ≥5 months. Individuals ≥65 years of age had lower overall effectiveness against infections but declined at a similar rate (VE at <1 month after being fully vaccinated: 80% [73–85]; VE at ≥5 months: 43% [30–54]). Among fully vaccinated persons of all ages, protection against

	[Update to Aug 23 preprint]						COVID-19-related hospitalization did not wane over time, with overall adjusted VE estimates of 87% (82–91) at < 1 month after being fully vaccinated, and 88% (82–92) at ≥5 months after full vaccination. At <1 month, VE against Delta: 93% [85–97] and VE against other variants: 97% [95–99]). At ≥4 months, VE against Delta infections: 53% [39–65] and VE against other variants: 67% [45–80]. VE against infection:  VE against hospitalization: 
12	Goldberg et al (August 24, 2021)	Israel	4.8 million fully vaccinated persons; >16 and ≥40 (depending on analysis) +unvaccinated in israel	Delta	BNT162b2	July 11-July 31 2021	The study compared the rate of breakthrough infection in July, when Delta was the dominant strain, between individuals who received 2 doses of the vaccine earlier this year to individuals who received two doses of the vaccine more recently, while adjusting for confounders. Rates of infection decline the more recently one was vaccinated; with severe disease, this is seen in those ≥60 years. A second analysis was done among the general population cohort of vaccinated and

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>unvaccinated to calculate VE by age group and month of vaccination.
<table>
<tr><th colspan="8">OUTCOME = Positive SARS-CoV-2 PCR test</th></tr>
<tr><th>Age</th><th>JanB</th><th>FebA</th><th>FebB</th><th>MarA</th><th>MarB</th><th>Apr</th><th>May</th></tr>
<tr><td>16-39</td><td>50% [45, 55]</td><td>47% [42, 52]</td><td>58% [55, 62]</td><td>62% [59, 64]</td><td>68% [65, 70]</td><td>74% [71, 77]</td><td>73% [67, 78]</td></tr>
<tr><td>40-59</td><td>58% [54, 62]</td><td>61% [58, 65]</td><td>63% [59, 66]</td><td>67% [63, 70]</td><td>74% [70, 77]</td><td>78% [73, 82]</td><td>80% [71, 86]</td></tr>
<tr><td>60+</td><td>57% [52, 62]</td><td>63% [57, 67]</td><td>65% [57, 71]</td><td>73% [66, 78]</td><td>72% [64, 77]</td><td>73% [63, 81]</td><td>75% [58, 85]</td></tr>
</table>
<table>
<tr><th colspan="4">OUTCOME = Severe COVID-19</th></tr>
<tr><th>Age</th><th>Jan</th><th>Feb</th><th>Mar</th></tr>
<tr><td>40-59</td><td>94% [87, 97]</td><td>98% [95, 99]</td><td>98% [94, 99]</td></tr>
<tr><td>60+</td><td>86% [82, 90]</td><td>88% [84, 91]</td><td>91% [85, 95]</td></tr>
</table></td></tr>
<tr><td>10</td><td>Pouwels et al* (October 14, 2021)

[Update to Aug 18 preprint]</td><td>UK</td><td>General adult population</td><td>Alpha, Delta</td><td>BNT162b2
AZD1222</td><td>December 1, 2020-August 1, 2020</td><td>COVID-19 infection survey is a household longitudinal survey with testing. During the delta dominant period, in those 18 to 64 years, VE of BNT162b2 against new PCR-positives reduced by 22% (95% CI 6% to 41%) for every 30 days from second vaccination. Reductions were numerically smaller for ChAdOx1 (change -7% per 30 days, 95% CI -18% to +2%) but there was no formal evidence of heterogeneity (p=0.14).
 
</td></tr>
<tr><td>9</td><td>Tenforde et al (August 18, 2021)</td><td>USA</td><td>Hospitalized patients</td><td>Alpha→Delta</td><td>BNT162b2
mRNA-1273</td><td>March 11-July 14, 2021</td><td>Test-negative design case control study of hospitalized patients. VE against COVID-19– associated hospitalization was 86% (95% CI = 82%–90%) 2–12 weeks and 84% (95% CI = 77%–90%) 13–24 weeks from receipt of the 2nd dose, with no significant change between these periods (p = 0.854). There was no difference in VE by timing since vaccine among those ≥/< 65 years, immunocompromised versus not and among those with ≥/< 3 chronic conditions.</td></tr>
</table>

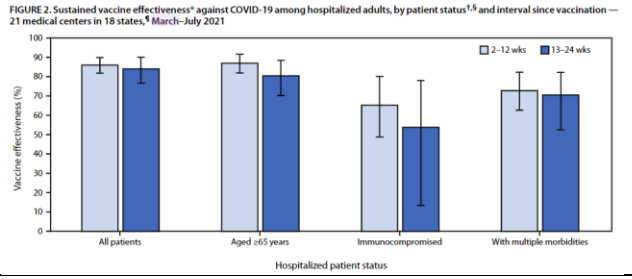
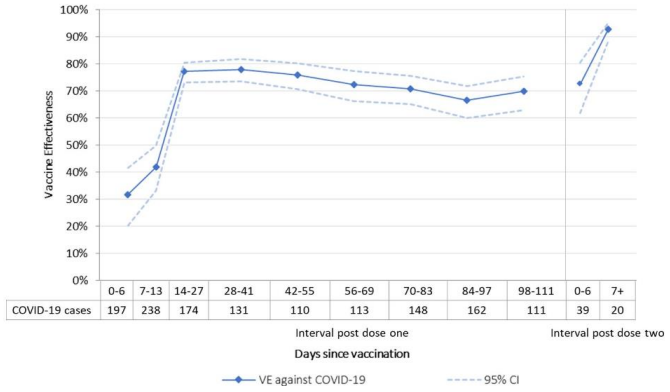
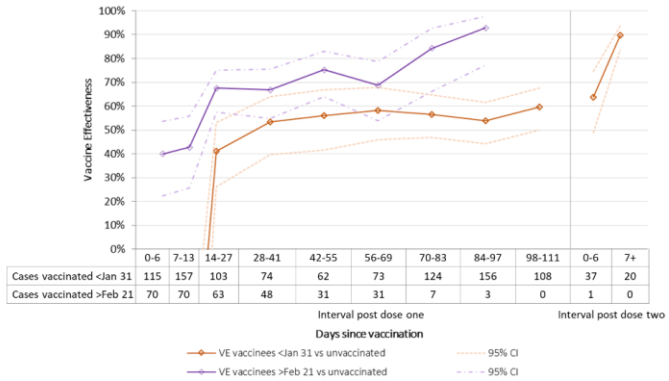
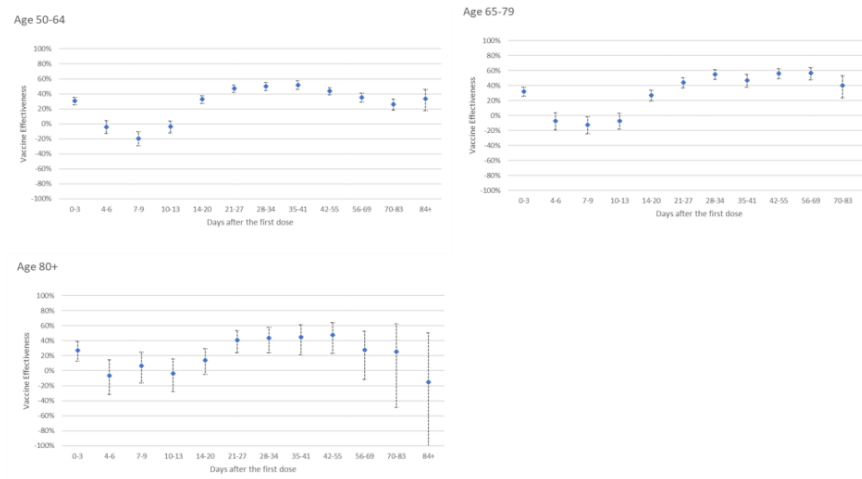
							
8	Yassi et al (July 16, 2021)	Canada	HCWs in Vancouver	Alpha/Gamma	BNT162b2 mRNA-1273	December 15-May 13, 2021	Retrospective cohort study of HCWs linking administrative databases. At 16 weeks (day 112) post dose 1 and 2 they don't see a decline in VE. Note that day 0-13 post dose 1 is included in the unvaccinated comparison group.
7	Chemaitelly et al (August 9, 2021)	Qatar	Immunosuppressed kidney transplant patients	Alpha/Beta	BNT162b2 mRNA-1273	February 1-July 21, 2021	Retrospective cohort study finding VE against infection was 73.9% (95% CI: 33.0-89.9%) at day 56+ post dose 2; VE against severe/critical/fatal disease was 83.8% (95% CI: 31.3-96.2) at day 56+ post dose 2.
6	Carazo et al (July 22, 2021)	Canada	HCWs in Quebec	Alpha	BNT162b2 mRNA-1273	January 17-June 5, 2021	This is a test-negative case control linking surveillance and vaccination data from administrative databases for HCWs. Across 16 weeks, no decline in single-dose VE against infection was observed with appropriate stratification based upon prioritized vaccination determined by higher versus lower likelihood of direct patient contact. Figure 2. Vaccine effectiveness against COVID-19 by interval since vaccination 

							Figure 3. Vaccine effectiveness against COVID-19 in healthcare workers vaccinated before January 31st 2021 (highest contacts with patients) and those vaccinated after February 20th 2021 (fewer contacts with patients) by interval since vaccination 
5	Amirthalingam et al (July 28, 2021)	UK	50+ year old population	Alpha/Delta	BNT162b2 AZD1222	January 4-June 18, 2021	This is a test-negative case control study linking surveillance and vaccination data from administrative databases. In summary, VE against disease potentially declines post dose 1 at day 70+ for AZD1222 and at day 56+ for BNT162b2 but there are wide/overlapping confidence intervals making conclusions challenging. Higher two-dose VE was observed with > 6-week intervals between BNT162b2 doses compared to the authorized 3-week schedule, including ≥ 80-year-olds. (This paper also includes information on GMTs at different time points post vaccination.) (a) AZ Vaccine 

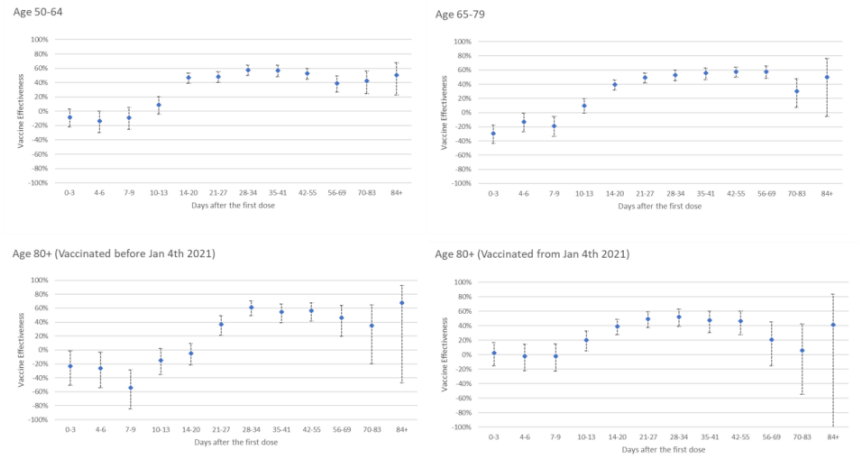
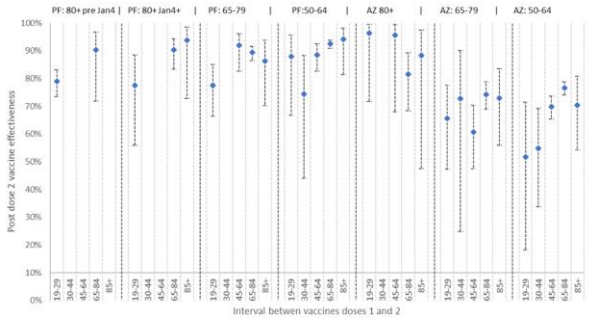
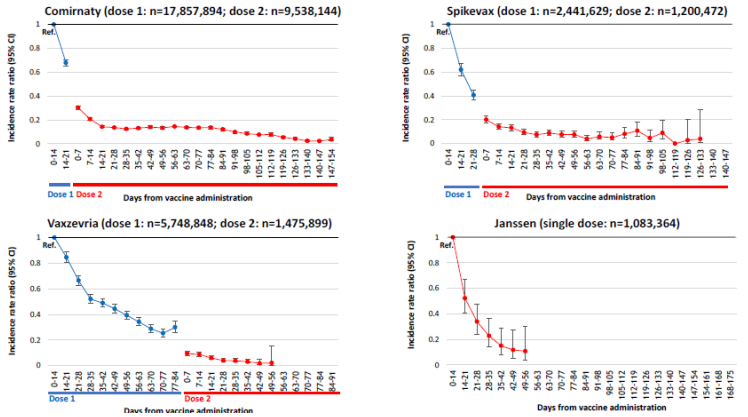
							(b) Pfizer  **Figure 4: Two dose vaccine effectiveness by age group, vaccine type and interval between doses** 
3	Italian Instituo Superiore di Sanita (July 30, 2021)	Italy	Italian general adult population with at least 1 dose of vaccine	Alpha	BNT162b2 AZD1222 mRNA-1273 Ad26.COV2.S	December 27, 2020-July 14, 2021	This study linked Italy's national vaccination registry with their surveillance data. For each of the outcomes evaluated, a multivariable negative binomial model was used to estimate the incidence rate ratio at different time intervals post dose 1 and 2, compared to the time period of 0-14 days after the first dose. VE is preserved against infection post complete vaccination for BNT162b2 at day 147-154, for mRNA-1273 at day 126-133, for AZD1222 at day 49-56, and for Ad26.COV2.S at day 49-56. VE against hospitalization, ICU admission, and mortality also do not change significantly over time.

							Figure 16. Adjusted estimates of the Incidence Rate Ratio of diagnosis at different time intervals from the administration of the first and second dose compared to the reference period (0-14 days from the first dose) by vaccine brand 
2	Israel et al (August 5, 2021)	Israel	All fully vaccinated persons enrolled in Leumit Health Services	Delta	BNT162b2	May 15-July 26, 2021	There was a significantly higher rate of positive results among patients who received their second vaccine dose at least 146 days before the RT-PCR test compared to patients who have received their vaccine less than 146 days before: adjusted odds ratio for infection was 2.76 (95% CI 1.62-3.08) for ≥ 60-year-old patients; 2.22 (95% CI 1.62-3.08) for patients 40-59-years; and 1.67 (95% CI 1.21-2.29) for 18-39-year-old patients.
1	Mizrahi et al (July 31, 2021)	Israel	16+ year olds enrolled at Maccabi Health Services	Delta	BNT162b2	June 1-July 27, 2021	The study compared the rate of breakthrough infection during June and July, when Delta was the dominant strain, between individuals who received 2 doses of the vaccine earlier this year to individuals who received two doses of the vaccine more recently, while adjusting for confounders. The authors report that persons vaccinated between January and February 2021 had a 53% (95% CI: 40-68%) increased risk of breakthrough infection in June and July compared to individuals vaccinated between March and April 2021. There was no difference by age groups 16-39, 40-59, ≥60 years. No unvaccinated persons were included in the study; thus, vaccine effectiveness was not evaluated.

Other data of interest:

- https://www.gov.il/BlobFolder/reports/vpb-12082021/he/files_publications_corona_vpb-12082021-01.pdf
- Salo et al HH transmission study in Finland, showing VE 10 weeks after 1 dose of an mRNA vaccine but is a mix of 1 and 2 dose recipients.
- Pfizer's press announcement of 4 month efficacy in adolescents https://www.pfizer.com/news/press-release/press-release-detail/follow-data-phase-3-trial-pfizer-biontech-covid-19-vaccine

Note as of January 7, 2022 version, only true duration of protection analyses are included. Please look at the update from December 30, 2021 if you wish to see full list of previously included studies with other data such as Kaplan-Meier curves. Missing reference numbers in table above indicate studies that have been removed.