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

Weekly Summary Tables

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TABLE OF CONTENTS

1. Summary of Study Results for Post-Authorization COVID-19 Vaccine Effectiveness[#]

(Detailed methods available on VIEW-hub Resources page: https://view-hub.org/resources)

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
96#	Andrews et al (September 14, 2021)	England	Test-negative case control	1,475,391 symptomatic cases and 3,299,344 test-negative control patients among adults (16+)	Alpha^	Excluded	BNT162b2	Symptomatic disease	45.7 (44-47.3)	28+	95 (93.8-95.9)	14+	~33.5 weeks
									—		95 (93.8-96)	14-69	~8 weeks
									—		94.8 (88.4-97.7)	70+	~33.5 weeks
								Hospitalization	85.2 (81.6-88.1)	28+	97.9 (91.4-99.5)	14+	~33.5 weeks
								Death	73.1 (65-79.3)	28+	96.3 (89.9-98.6)	14+	~33.5 weeks
							AZD1222	Symptomatic disease	44.5 (42.9-46.1)	28+	81.7 (79-84)	14+	~20.5 weeks
									—		81.9 (79.2-84.3)	14-69	~8 weeks
									—		76.2 (49.8-88.7)	70+	~20.5 weeks
								Hospitalization	82.5 (78.7-85.7)	28+	93.9 (84.9-97.5)	14+	~20.5 weeks
									—		93.8 (84.7-97.5)	70+	~20.5 weeks
								Death	79.1 (68.8-86)	28+	100 (CI omitted, no deaths among vaccinated)	14+	~20.5 weeks
							mRNA-1273	Symptomatic disease	54.5 (8.5-77.3)	28+	—	—	—
					Delta^		BNT162b2	Symptomatic disease	51.9 (51.4-52.4)	28+	83.5 (83.3-83.6)	14+	~33.5 weeks
									—		89.8 (89.6-90)	14-69	~8 weeks
									—		69.7 (68.7-70.5)	140+	~33.5 weeks
								Hospitalization	91.8 (90.4-93)	28+	96.7 (96.3-97)	14+	~33.5 weeks
									—		98.4 (97.9-98.8)	14-69	~8 weeks
									—		92.7 (90.3-94.6)	140+	~33.5 weeks
								Death	88.6 (77.3-94.3)	28+	95.2 (93.7-96.4)	14+	~33.5 weeks
									—		98.2 (95.9-99.2)	14-69	~8 weeks
									—		90.4 (85.1-93.8)	140+	~33.5 weeks
							AZD1222	Symptomatic disease	43.3 (42.3-44.2)	28+	65.2 (64.9-65.6)	14+	~20.5 weeks
									—		66.7 (66.3-67)	14-69	~8 weeks
									—		47.3 (45-49.6)	140+	~20.5 weeks
								Hospitalization	81.4 (78.7-83.7)	28+	93 (92.4-93.5)	14+	~20.5 weeks
									—		95.2 (94.6-95.6)	14-69	~8 weeks
									—		77 (70.3-82.3)	140+	~20.5 weeks
								Death	88.4 (78.2-93.8)	28+	92.7 (90.7-94.3)	14+	~20.5 weeks
									—		94.1 (91.8-95.8)	14-69	~8 weeks
									—		78.7 (52.7-90.4)	140+	~20.5 weeks
							mRNA-1273	Symptomatic disease	65.9 (65-66.7)	28+	94.8 (94.4-95.2)	14+	~7 weeks
									—		94.5 (94.1-95)	14-69	
									—		90.3 (67.2-97.1)	70-104	

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
								Hospitalization	95.2 (91.8-97.1)	28+	100 (CI omitted, no events among vaccinated)	14-69	~7 weeks
95	Bajema et al(September 10,2021)	USA	Test-negative case control	388 case-patients and 787 controls from 5 Veterans Affair Medicals Centers	Alpha, Delta, Non-VOC††	Excluded	BNT162b2 & mRNA-1273	Hospitalization	—	—	86.1 (76.5-91.8)	<104 days	~13 weeks
								Hospitalization			87.2 (78.2-92.5)	≥104 days	~28.5 weeks
							BNT162b2	Hospitalization			83.4 (74.0-89.4)	14+	~28.5 weeks
							mRNA-1273	Hospitalization			91.6 (83.5-95.7)		~26.5 weeks
					Alpha^		BNT162b2 & mRNA-1273	February-June: Hospitalization			84.1 (74.1-90.2)		~23 weeks
					Delta^			July-August: Hospitalization			89.3 (80.1-94.3)		~28.5 weeks
94	Polinski et al (September 12, 2021)	USA	Retrospective Cohort	501,947 individuals ≥18 years	Alpha††	Excluded	Ad26.COV2.S	Documented infection	79 (77-80)	14+	—	—	~14 weeks
								Hospitalization	81 (79-84)				
								Immunocompromised: Documented infection	64 (57-70)				
								Immunocompromised: Hospitalization	68 (54-77)				
					Delta^			June-July: Documented infection	78 (73-82)				
								June-July: Hospitalization	85 (73-91)				
93	Grannis et al (September 10,2021)	USA	Test-negative	32,867 events from 187 hospitals and 221 emergency departments/urgent care visits	Delta^	Included	BNT162b2	Hospitalization	—	—	80 (73-85)	14+	4 weeks
								Emergency/Urgent care visit			77 (74–80)		
							mRNA-1273	Hospitalization			95 (92-97)		
								Emergency/Urgent care visit			92 (89-93)		
							Ad26.COV2.S	Hospitalization	60 (31-77)	14+	—	—	
								Emergency/Urgent care visit	65 (56-72)				
92	Dagan et al* (September 7,2021)	Israel	Prospective Cohort	10,861 vaccinated pregnant females matched with 10,861 controls	Alpha^	Excluded	BNT162b2 & mRNA-1273	Documented infection	71 (33-94)	21-27	96 (89-100)	7-56	~11 weeks
								Symptomatic infection	76 (30-100)		97 (91-100)		
								Hospitalization	—		89 (43-100)		
91	Thompson et al* (September 8, 2021)	USA	Test-negative case control	58,904 adults aged 50+ with Covid-like illness who were	Non-VOC, Alpha^††	Excluded	BNT162b2	Hospitalization	33 (18-46)	14+	87 (85-90)	14+	~22 weeks
								Emergency department or urgent care visit	58 (46-68)		89 (85-91)		
							mRNA-1273	Hospitalization	68 (59-75)		91 (89-93)		20 weeks

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
				hospitalized or visited emergency/ urgent care facilities				Emergency department or urgent care visit	73 (64-79)		92 (89-94)		
							Ad26.COV2.S	Hospitalization	68 (50-79)		—		14 weeks
								Emergency department or urgent care visit	73 (59-82)				
							BNT162b2 & mRNA-1273	Hospitalization, patients with ≥ 1 chronic respiratory condition	56 (47-64)	14+	90 (88-92)	14+	~22 weeks
								Hospitalization, patients with ≥ 1 chronic non-respiratory condition	54 (45-61)		88 (86-90)		
								Hospitalization, overall	—		88 (84-92)	14-27	~2 weeks
											86 (74-93)	112+	~22 weeks
								Emergency department or urgent care visit	—		92 (88-95)	14-27	~2 weeks
											86 (74-93)	112+	~22 weeks
90	Iliaki et al (September 6, 2021)	USA	Retrospective Cohort	4,317 HCWs	Alpha††	Excluded	BNT162b2 & mRNA-1273	Documented infection	80.2(57.5-90.8)	14+	95.2(80.0-98.8)	14+	~10 weeks
							Ad26.COV2.S		95.5 (88.2-98.3)		—		
89	Tande et al* (September 6,2021)	USA – Mayo Clinic, Minnesota	Retrospective Cohort	Asymptomatic screening of 46,008 patients: pre-surgical, pre-op PCR tests	Non-VOC^††	Included	BNT162b2 & mRNA-1273	Asymptomatic infection (January-March)	44 (-6-71)	20+ up to <14 post 2nd dose	91 (72-98)	14+	~10 weeks
					Alpha^††			Asymptomatic infection (April-May)	46 (53-83)		71 (53-83)		~19 weeks
					Delta^††			Asymptomatic infection (June-August)	63 (44-76)		63 (44-76)		~32 weeks
88	Barlow et al (September 3,2021)	USA	Test-negative case control	500 matched pairs aged 15 years and above	Delta^	Excluded	BNT162b2 and mRNA-1273	Documented infection	—	14+	74(65-82)	14+	~4 weeks
							Ad26.COV2.S		51(-2 – 76)		—		
87	Bruxvoort et al (September 2, 2021)	USA	Matched prospective cohort	352,878 vaccinated 352,878 unvaccinated individuals	Delta and Alpha^	Included	mRNA-1273	Documented infection	—	—	87.4 (85.6-89.1)	14+	~20 weeks
								Asymptomatic infection			72.7 (57.6-82.4)		
								Symptomatic infection			88.3 (86.5-89.9)		
								Hospitalization			95.8 (92.5-97.6)		
								Death			97.9 (84.5-99.7)		
86		Italy				Excluded		Documented infection	85.5(75.9-91.3)		84.8 (73.2-91.4)	14+	~16 weeks

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
	Giansante et al* (September 2, 2021)		Retrospective cohort	9839 staff and HCWs	Delta and Alpha^		BNT162b2 and mRNA-1273	Symptomatic infection	81.7(62.7-91)	14+ up to <7 post 2nd dose	87.1 (69.3-94.6)		
				Only 7190 HCWs				Documented infection	87.8 (76.5-93.7)		84.4 (69.7-92.0)		
								Symptomatic infection	83.1 (60.0-92.9)		86.5 (62.9-95.1)		
85	Katz et al (September 2,2021)	Israel	Prospective cohort	1,250 HCWs from six Israeli hospitals	Alpha^	Excluded	BNT162b2	Documented infection	—	—	91.9 (69.9-97.9)	14+	~18 weeks
								Symptomatic infection			96.2 (50.4-99.7)	7+	
84	Nunes et al (August 29, 2021)	Portugal	Retrospective cohort	1,880,351 older adults (65+) in Portugal	Alpha^ (Feb-Mar) then Delta^ (May-onward)	Excluded	BNT162b2 and mRNA-1273	Hospitalization, 65-79 y	78 (61-87)	14+ up to <14 post 2nd dose	94 (88-97)	14+	~14.5 weeks
								Death, 65-79 y	77 (56-88)		96 (92-98)		
								Hospitalization, 80+ y	55 (36-69)		82 (72-89)	14+	~22.5 weeks
								Death, 80+ y	56 (35-70)		81 (74-87)	14+	
83#	Chemaitelly et al (August 27, 2021) *Note: See Duration of Protection Table for further context*	Qatar	Test-negative case control	173,496 cases and 1,422,333 controls among residents of Qatar (12+)	Alpha^ then Beta^ (Jan-Jun), then Delta^ (Jul-Aug)	Included	BNT162b2	Documented infection	31.8 (28.8-34.7)	14+	77.2 (6.4-78.0)	35-63	7 weeks
											0.0 (0.0-0.0)	175+	~29 weeks
								Symptomatic infection	48.5 (44.9-51.8)		82.1 (80.7-83.3)	35-63	7 weeks
											0.0 (0.0-0.0)	175+	~29 weeks
								Asymptomatic infection	15.2 (8.0-21.8)		69.7 (67.9-71.4)	35-63	7 weeks
											0.0 (0.0-0.0)	175+	~29 weeks
								Severe, critical, or fatal disease	67.7 (59.1-74.7)		95.4 (93.4-96.9)	35-63	7 weeks
											71.5 (9.2-93.2)	175+	~29 weeks
					Alpha specifically^		BNT162b2	Documented infection	54.9 (28.0-72.4)	14+	82.2 (72.1-89.0)	35-63	7 weeks
											0.0 (0.0-57.3)	175+	~29 weeks
								Severe, critical, or fatal disease	100 (0.0-100)		100 (0.0-100)	35-63	7 weeks
											69.6 (0.0-99.4)	70-98	14 weeks
					Beta specifically^		BNT162b2	Documented infection	26.1 (0.0-45.7)		52.7 (40.3-62.7)	35-63	7 weeks
											71.5 (0.0-97.1)	175+	~29 weeks
								Severe, critical, or fatal disease	100 (25.4-100)		94.6 (63.5-99.9)	35-63	7 weeks
											100 (0.0-100)	175+	~29 weeks
					Delta specifically^		BNT162b2	Documented infection	67.4 (46.3-80.9)		72.0 (60.5-80.5)	35-63	7 weeks
											0.0 (0.0-21.3)	175+	~29 weeks
								Severe, critical, or fatal disease	100 (0.0-100)		100 (74.3-100)	35-63	7 weeks
											67.9 (0.0-99.4)	175+	~29 weeks
82	Goldberg et al (August 25, 2021)	Israel	Retrospective cohort	9,395,923 adults (16+) in Israel	Delta^	Excluded	BNT162b2	Documented infection, 16-39 y fully vaccinated May 2021 (~2 mos prior)	—	—	73 (67-78)	55-98	13 weeks

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	Note: See Duration of Protection Table for further context							Documented infection, 16-39 y fully vaccinated Jan 2021 (~6 mos prior)			50 (45-55)	168-203	28 weeks
								Documented infection, 40-59 y fully vaccinated May 2021 (~2 mos prior)			80 (71-86)	55-98	13 weeks
								Documented infection, 40-59 y fully vaccinated Jan 2021 (~6 mos prior)			58 (54-62)	168-203	28 weeks
								Documented infection, 60+ y fully vaccinated May 2021 (~2 mos prior)			75 (58-85)	55-98	13 weeks
								Documented infection, 60+ y fully vaccinated Jan 2021 (~6 mos prior)			57 (52-62)	168-203	28 weeks
								Severe disease, 40-59 y fully vaccinated Mar 2021 (~4 mos prior)			98 (94-99)	109-159	22 weeks
								Severe disease, 40-59 y fully vaccinated Jan 2021 (~6 mos prior)			94 (87-97)	168-203	28 weeks
								Severe disease, 60+ y fully vaccinated Mar 2021 (~4 mos prior)			91 (85-95)	109-159	22 weeks
								Severe disease, 60+ y fully vaccinated Jan 2021 (~6 mos prior)			86 (82-90)	168-203	28 weeks
81#	Tartof et al (August 23, 2021)	USA	Retrospective cohort	3,436,957 members (12+) of Kaiser Permanente Southern California healthcare system	Epsilon (Jan-Mar), Alpha (Apr-May), Delta (Jun-Jul)^	Included	BNT162b2	Documented infection	—	—	73 (72-74)	7+	~29 weeks
								Hospitalization			90 (89-92)		
					Delta specifically^			Documented infection			75 (71-78)		
								Hospitalization			93 (84-96)		
					Non-Delta variants^			Documented infection			91 (88-92)		
								Hospitalization			95 (90-98)		
80	Prasad et al (August 19,2021)	USA	Retrospective cohort	3,104 surgery patients and 7,438 propensity-matched controls	Non-VOC††	Included	BNT162b2 or mRNA-1273	Post-operative documented infection	—	—	91 (56-99)	14+	~8 weeks

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
79	Pouwels et al (August 18,2021)	UK	Prospective cohort	384,543 individuals aged 18 years or older	Alpha^ (December - May)	Included	BNT162b2	Documented infection	59 (52-65)	21+	78 (68-84)	14+	~28 weeks
								Ct<30	70 (65-74)		94 (91-96)		
							AZD1222	Documented infection	63 (55-69)		79 (56-90)		
								Ct<30	74 (69-79)		86 (71-93)		
				358,983 individuals	Delta^ (May - August)		BNT162b2	Documented infection	57 (50-63)		80 (77-83)		
								Ct<30	62(56-68)		84 (82-86)		
							AZD1222	Documented infection	46(35-55)		67 (62-71)		
								Ct<30	50(41-59)		70 (65-73)		
78	Tenforde et al (August 18, 2021)	USA	Case control	1,194 cases and 1,895 controls	Alpha and Delta^ (March-July)	Unknown	BNT162b2 or mRNA-1273	Hospitalization, all	—	—	86 (82-88)	14+	~24 weeks
								Hospitalization, Non-immuno-compromised			90 (87-92)		
								Hospitalization, Immuno-compromised			63 (44-76)		
					Alpha^ (March-May)			Hospitalization, all			87 (83-90)		
					Delta^ (June-July)			Hospitalization, all			84 (79-89)		
77	Chin et al (August 18, 2021)	USA	Retrospective cohort	60,707 incarcerated people in California prisons	Non-VOC^	Excluded	BNT162b2 or mRNA-1273	Documented infection, all	74 (64-82)	14+	97 (88-99)	14+	~5 weeks
								Documented infection, cohort at moderate/high risk for severe COVID-19	74 (62-82)		92 (74-98)		
							mRNA-1273	Documented infection, all	71 (58-80)		96 (67-99)		
76	Nanduri et al (August 18,2021)	USA	Retrospective cohort	10,428,783 residents of skilled nursing facilities	Non-VOC and Alpha†† (Pre-Delta circulation) ^	Unknown	BNT162b2	Documented infection	—	—	74.2 (69–78.7)	14+	~16 weeks
							mRNA-1273				74.7(66.2-81.1)		
					Alpha†† (Delta circulating but not dominant) ^		BNT162b2	Documented infection			66.5 (58.3-73.1)		~22 weeks
							mRNA-1273				70.4 (60.1-78.0)		
					Delta^		BNT162b2	Documented infection			52.4 (48–56.4)		~28 weeks
							mRNA-1273				50.6 (45–55.7)		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
75#	Tang et al (August 11, 2021)	Qatar	Test-negative case control	2,175 cases with confirmed Delta infection and matched controls (aged 12+)	Delta^	Included	BNT162b2	Documented infection	65.5 (40.9-79.9)	14+	59.6 (50.7-66.9)	14+	~25 weeks
							mRNA-1273		79.7 (60.8-89.5)		86.1 (78.0-91.3)		
							BNT162b2	Severe, critical, or fatal disease	100.0 (CI omitted since there were no events among vaccinated)		97.3 (84.4-99.5)		
							mRNA-1273		100.0 (CI omitted, no events among vaccinated)		100.0 (CI omitted, no events among vaccinated)		
							BNT162b2	Symptomatic COVID-19	76.3 (46.7-90.7)		56.1 (41.4-67.2)		
							mRNA-1273		85.7 (62.7-95.7)		85.8 (70.6-93.9)		
							BNT162b2	Asymptomatic COVID-19	25.2 (0.0-78.7)		35.9 (11.1-53.9)		
							mRNA-1273		57.4 (0.0-92.9)		80.2 (54.2-92.6)		
74	Chemaitelly et al (August 9, 2021)	Qatar	Retrospective cohort	782 kidney transplant recipients	Alpha and Beta^	Excluded	BNT162b2 and mRNA-1273	Documented infection	—	—	46.6 (0.0-73.7)	14+	~17 weeks
											66.0 (21.3-85.3)	42+	
											73.9 (33-89.9)	56+	
								Severe infection			72.3 (0.0-90.9)	14+	
											85.0 (35.7-96.5)	42+	
											83.8 (31.3-96.2)	56+	
73	Puranik et al (August 9, 2021)	USA	Retrospective cohort	77,607 adults	Alpha and Delta ^	Excluded	BNT162b2	Documented infection	16 (-20-42)	1-7	76 (69-81)	14+	~ 26 weeks
								Hospitalization	75 (-30-97.4)		85 (73-93)		
								ICU admission	100 (-430-100)		87 (46-98.6)		
							mRNA-1273	Documented infection	-10 (-50-24)		86 (81-90.6)		
								Hospitalization	25 (-150-79)		91.6 (81-97)		
								ICU admission	100 (-430-100)		93.3 (57-99.8)		
72	de Gier et al* (August 5, 2021)	Netherlands	Retrospective cohort	184,672 household and other close contacts (aged 18+) of 113,582 index cases (aged 18+)	Alpha^	Unknown	AZD1222	Documented infection among household contacts (adj. for vaccination status of index case)	2 (-11-14)	14+	87 (77-93)	7+	~15 weeks
							BNT162b2		-18 (-43-2)		65 (60-70)		
							mRNA-1273		33 (-27-64)		91 (79-97)		
							Ad26.COV2.S		12 (-71-54)		—		
71		France			Beta^	Included	BNT162b2	Documented infection	55 (13-76)		49 (14-69)	7+	~16 weeks

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
	Lefèvre et al (July 31,2021)		Retrospective cohort	378 LTCF residents				Hospitalization and death	86 (32-97)	14+ up to 6 days after 2nd dose	86 (67-94)		
70	Alali et al (July 29,2021)	Kuwait	Retrospective cohort	3,246 HCWs	Alpha^	Excluded	BNT162b2	Documented infection	91.4 (65.1-97.9)	14+	94.5(89.4-97.2)	7+	~18 weeks
							AZD1222	Documented infection	75.4 (67.2-81.6)	28+	—		
69	Gram et al (July 28, 2021)	Denmark	Retrospective cohort	5,542,079 adults	Alpha^	Excluded	Heterologous: AZD1222 (1st dose) BNT162b2 or mRNA-1273(2nd dose)	Documented infection	31 (14-44)	77-83	88 (83-92)	14+	~7.5 weeks
								Hospitalization	93 (80-98)	14+	not calculated due to no events in vaccinated group		
68	Amirthalingam et al (July 28,2021)	UK	Test-negative case control	69,545 cases and 229,662 test negative controls aged 50+	Alpha^	Excluded	BNT162b2	Documented infection, 80 y+	42 (31-52)	28+	77 (56-88)	14+, dose interval 19-29 days	~16 weeks
											90 (83-94)	14+, dose interval 65-84 days	
								Documented infection, 65-79 y	53 (48-58)		77 (66-85)	14+, dose interval 19-29 days	
											89 (86-92)	14+, dose interval 65-84 days	
								Documented infection, 50-64 y	51 (47-55)		88 (67-96)	14+, dose interval 19-29 days	
											92 (91-94)	14+, dose interval 65-84 days	
							AZD1222	Documented infection, 80 y+	42 (29-53)		—		
											82 (68-89)	14+, dose interval 65-84 days	
								Documented infection, 65-79 y	52 (46-56)		73 (25-90)	14+, dose interval 30-44 days	
											74 (69-79)	14+, dose interval 65-84 days:	

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
								Documented infection, 50-64 y	42 (39-46)		55 (34-69)	14+, dose interval 30-44 days	
											77 (74-79)	14+, dose interval 65-84 days	
67	Kissling et al (July 22,2021)	UK, France, Ireland, Netherlands, Portugal, Scotland, Spain, Sweden	Test-negative	592 cases and 4,372 controls aged 65+	Alpha^	Excluded	BNT162b2	Symptomatic COVID-19	61(39-75)	14+	87(74-93)	14+	~16 weeks
							AZD1222	Symptomatic COVID-19	68(39-83)		—		
66#	Carazo et al* (August 30, 2021) *[Update to July 22 preprint]*	Canada	Test-negative case control	5316 cases and 53,160 test negative controls among HCWs	Non-VOC and Alpha^	Excluded	BNT162b2	Documented infection	70.3 (68.1-72.4)	14+	85.5 (80.4-89.3)	7+	~20 weeks
								Symptomatic COVID-19	72.8 (70.5-74.9)		92.2 (87.8-95.1)		
							mRNA-1273	Documented infection	68.7 (59.5-75.9)	14+	84.1 (34.9-96.1)	7+	
								Symptomatic COVID-19	80.9 (74.3-85.8)		—		
							BNT162b2 and mRNA-1273	Hospitalization	97.2 (92.3-99.0)	14+	—	7+	
					Alpha^	Excluded	BNT162b2 and mRNA-1273	Documented infection	60.0 (53.6-65.5)	14+	92.6 (87.1-95.8)	7+	
					Non-VOC^	Excluded	BNT162b2 and mRNA-1273	Documented infection	77.0 (72.6-80.7)		86.5 (56.8-95.8)		
65	Hitchings et al (July 22, 2021)	Brazil	Test-negative case control	30,680 matched pairs of adults aged 60+ in Sao Paolo, Brazil	Gamma^	Included (except in previous 90 days)	AZD1222	Symptomatic COVID-19	33.4 (26.4-39.7)	28+	77.9 (69.2-84.2)	14+	~9.5 weeks
								Hospitalization	55.1 (46.6-62.2)		87.6 (78.2-92.9)		
								Death	61.8 (48.9-71.4)		93.6 (81.9-97.7)		
64	Kim et al* (September 8, 2021) [*Update to July 22 preprint]*	USA	Test-negative case control	812 US adults aged 16+ with COVID-19-like illness	Non-VOC and Alpha††	Unknown	BNT162b2 and mRNA-1273	Symptomatic COVID-19	75 (55-87)	14+ up to 14 days post 2nd dose	91 (83-95)	14+	~18.5 weeks
63#	Lopez Bernal et al* (July 21, 2021)	UK	Test-negative case control	19,109 cases and 171,834 test negative controls aged 16+	Alpha^	Excluded	BNT162b2	Symptomatic COVID-19	47.5 (41.6–52.8)	21+	93.7 (91.6–95.3)	14+	~17 weeks
							AZD1222	Symptomatic COVID-19	48.7 (45.2–51.9)		74.5 (68.4–79.4)		
					Delta^		BNT162b2	Symptomatic COVID-19	35.6 (22.7–46.4)		88.0 (85.3–90.1)		
							AZD1222	Symptomatic COVID-19	30.0 (24.3–35.3)		67.0 (61.3–71.8)		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
62	Butt et al* (July 20, 2021)	USA	Test-negative case control	54,360 propensity-matched pairs of veterans	Original and Alpha ††	Excluded	BNT162b2 and mRNA-1273	Documented infection	85.0 (84.2-85.8)	0+	97.1 (96.6-97.5)	7+	~6.5 weeks
							BNT162b2	Documented infection	84.0 (82.7-85.1)		96.2 (95.5-96.9)		
							mRNA-1273	Documented infection	85.7 (84.6-86.8)		98.2 (97.5-98.6)		
61	Layan, Maylis et al (July 16,2021)	Israel	Prospective cohort	687 household contacts (HHCs) of 215 index cases from 210 households	Original and Alpha¶	Included	BNT162b2	Documented infection among HHCs vaccinated and not isolated (relative to HHCs not vaccinated and not isolated)	—	—	81 (60-93)	7+	~12 weeks
60	Balicer et al* (September 7,2021) *[Update to July 12 preprint]*	Israel	Prospective Cohort	21722 pregnant women	Original and Alpha^	Excluded	BNT162b2	Documented infection	67 (40-84)	14-20	96 (89-100)	7-56	~18 weeks
									71 (33-94)	21-27‡			
								Symptomatic COVID-19	66 (32-86)	14-20	97 (91-100)		
									76 (30-100)	21-27‡			
								Hospitalization	—	—	89 (43-100)		
59	Butt et al (June 22,2021)	Qatar	Test-negative case control	1255 pregnant women	Alpha and Beta^	Excluded	BNT162b2 and mRNA-1273	Documented infection	40.3 (0.0-80.4)	14+	67.7 (30.5-86.9)	14+	~17 weeks
58	Prunas et al (July 16, 2021)	Israel	Retrospective cohort	253,564 Israeli individuals from 65,264 households with at least 1 infected individual and at least 2 members	Original and Alpha¶	Unknown	BNT162b2	Documented infection among household contacts	—	—	80.5 (78.9-82.1)	10+	~8.5 weeks
57	Whitaker et al (July 9,2021)	UK	Prospective cohort	5,642,687 patients reporting to 718 English general practices	Original and Alpha¥	Included	BNT162b2	Symptomatic COVID-19	48.6 (27.9-63.3)	28-90‡	93.3 (85.8-96.8)	14+	~20 weeks
							AZD1222		50.2 (40.8-58.2)		78.0 (69.7-84.0)		
56	John et al (July 13,2021)	USA	Retrospective cohort	40,074 patients with cirrhosis within Veterans Health Administration, propensity matched	Original and Alpha ††	Excluded	BNT162b2 and mRNA-1273	Documented infection	64.8 (10.9-86.1)	28+ (including some with dose 2)	78.6 (25.5-93.8)	7+	~10 weeks
								Hospitalization	100.0 (99.3-100.0)		100.0 (99-100)		
								COVID-19 related death	100.0 (99.3-100.0)		100.0 (99-100)		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
55	Bertollini et al (July 13, 2021)	Qatar	Prospective cohort	10,092 matched pairs of Qatari adults arriving at an international airport.	Original, Alpha and Beta^	Included	BNT162b2 and mRNA-1273	Documented infection	—		78 (72-83)	14+	~4 weeks
54	Goldshtein et al* (July 12,2021)	Israel	Retrospective cohort	15060 pregnant Israeli women	Original and Alpha¶	Excluded	BNT162b2	Documented infection	54 (33-69)	11-27, including some with dose 2	—		~5 weeks
									78 (57-89)	28+, includes some with dose 2			
53#	Chemaitelly et al* (July 9, 2021)	Qatar	Test-negative case-control	25,034 matched pairs of adults	Alpha^	Unknown	mRNA-1273	Documented infection	88.2 (83.8-91.4)	14+ days	100.0 (CI omitted since there were no events among vaccinated persons)	14+	13 weeks
				52,442 matched pairs of adults	Beta^	Unknown	mRNA-1273	Documented infection	68.2(64.3-71.7)		96.0 (90.9-98.2)		
				4,497 matched pairs of adults	Alpha and Beta^	Unknown	mRNA-1273	Severe, critical or fatal disease	83.7(74.1-89.7)		89.5 (18.8-98.7)		
								Symptomatic infection	66.0(60.6-70.7)		98.6 (92.0-100)		
								Asymptomatic infection	47.3(37.6-55.5)		92.5 (84.8-96.9)		
			Retrospective cohort	2520 vaccinated and 73,853 unvaccinated, antibody-negative controls	Alpha^	Excluded	mRNA-1273	Documented infection	—		100.0 (82.5-100.)	14+	13 weeks
					Beta^	Excluded	mRNA-1273	Documented infection	—		87.8 (73.4-95.5)		
					Variants of unknown status	Excluded	mRNA-1273	Documented infection	—		93.5 (76.6-99.2)		
52#	Tenforde et al* (August 6, 2021) *[Update to July 8 preprint]*	USA	Test-negative case-control	1212 hospitalized adults from 18 hospitals	Original and Alpha^	Included	BNT162b2/ mRNA-1273	Hospitalization	75.4(60.4-84.7)	14+ up to 14 days post 2nd dose	86.6 (79.0-91.4)	14+	~2 weeks
							BNT162b2		—		84.7 (74.1-91.0)		
							mRNA-1273		—		88.9 (78.7-94.)		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
					Alpha^	Included	BNT162b2/ mRNA-1273		—		92.1 (82.3-96.5)		
51	Jara et al (July 7,2021)	Chile	Prospective cohort	10,187,720 adults	Alpha and Gamma^	Excluded	CoronaVac	Documented infection	15.5 (14.2-16.8)	14+ days	65.9 (65.2-66.6)	14+	8 weeks
								Hospitalization	37.4 (34.9-39.9)		87.5 (86.7-88.2)		
								ICU admission	44.7 (40.8-48.3)		90.3 (89.1-91.4)		
								Death	45.7 (40.9-50.2)		86.3 (84.5-87.9)		
50#	Nasreen et al (July 16, 2021) *[Update to July 3, 2021 preprint]*	Canada	Test-negative Case Control	421073 community dwelling individuals	Non-VOC	Unknown	BNT162b2	Symptomatic infection	61 (54, 68)	14+ days	93 (88, 96)	7+	18 weeks
								Hospitalization or death	68 (54,78)		96 (82, 99)		
							mRNA-1273	Symptomatic infection	54 (28, 70)		89 (65, 96)		
								Hospitalization or death	57 (28, 75)		96 (70, 99)		
							AZD1222	Symptomatic infection	67 (38, 82)		—		
					Alpha^	Unknown	BNT162b2	Symptomatic infection	66 (64, 68)		89 (86, 91)		
								Hospitalization or death	80 (78, 82)		95 (92, 97)		
							mRNA-1273	Symptomatic infection	83 (80, 86)		92 (86, 96)		
								Hospitalization or death	79 (74, 83)		94 (89, 97)		
							AZD1222	Symptomatic infection	64 (60, 68)		—		
								Hospitalization or death	85 (81, 88)		—		
					Beta/Gamma^	Unknown	BNT162b2	Symptomatic infection	60 (52,67)		84 (69, 92)		
								Hospitalization or death	77 (69, 83)		95 (81, 99)		
							mRNA-1273	Symptomatic infection	77 (63, 86)		—		
								Hospitalization or death	89 (73, 95)		—		
							AZD1222	Symptomatic infection	48 (28, 63)		—		
								Hospitalization or death	83 (66, 92)		—		
					Delta^	Unknown	BNT162b2	Symptomatic infection	56 (45, 64)		87 (64, 95)		
								Hospitalization or death	78 (65, 86)		—		
							mRNA-1273	Symptomatic infection	72 (57, 82)		—		
								Hospitalization or death	96 (72, 99)		—		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
							AZD1222	Symptomatic infection	67 (44, 80)		—		
								Hospitalization or death	88 (60, 96)		—		
49	Baum et al (June 28,2021)	Finland	Prospective cohort	Two study cohorts: 901,092 Finnish elderly aged 70 years and 774,526 chronically ill aged 16-69 years	Original and Alpha^	Excluded	BNT162b2 & mRNA-1273 (elderly cohort)	Documented infection	45 (36-53)	21+ days	75 (65-82)	7+	16 weeks
								Hospitalization	63 (49-74)		93 (70-98)		
							BNT162b2 & mRNA-1273 (Chronically ill cohort)	Documented infection	40 (26-51)		77 (65-85)		
								Hospitalization	82 (56-93)		90 (29-99)		
							AZD1222 (chronically ill cohort)	Documented infection	42 (32-50)		—		
								Hospitalization	62 (42-75)		—		
48	Saciuk et al (June 27, 2021)	Israel	Retrospective cohort	1.6 million members of Maccabi HealthCare HMO ≥16	Original and Alpha¶	Excluded	BNT162b2	Documented infection	—		93.0 (92.6-93.4)	7+	14 weeks
								Hospitalization	—		93.4 (91.9-94.7)	7+	
								Death	—		91.1 (86.5-94.1)	7+	
47	Pawlowski et al.* (Jun 17, 2021) *[Update to Feb. 18, 2021 preprint]*	USA – Mayo Clinic	Retrospective Cohort	68,266 – propensity matched on, zip, # of PCRs, demographics	Original & Alpha ¥	Excluded	BNT162b2	Documented Infection	61.0 (50.8-69.2)	≥14	88.0 (84.2-91.0)	≥14	~17 weeks (120 days)
								Hospitalization	—		88.3 (72.6-95.9)	≥14	
								ICU Admission	—		100.0 (18.7-100)	≥14	
							mRNA-1273	Documented Infection	66.6 (51.9-77.3)	≥14	92.3 (82.4-97.3)	≥14	
								Hospitalization	—		90.6 (76.5-97.1)	≥14	
								ICU Admission	—		100.0 (17.9-100)	≥14	
46	Young-Xu et al (July 14,2021) *[Update to Jun 22 preprint]*	USA	Test negative case control	77014 veterans within Veterans Health Administration	Original and Alpha ††	Excluded	BNT162b2 & mRNA-1273	Documented infection	58 (54-62)	7+	94 (92-95)	7+	~8 weeks
								Hospitalization	40 (27-50)		89 (81-93)		
								Death	55 (21- 74)		98.5 (86.6-99.8)		
								Asymptomatic infection	58.0 (41.7-69.7)		69.7 (47.7-82.5)		
								Hospitalization	53.0 (25.7-70.3)		88.4 (74.9-94.7)		
								Deaths	55.6 (26.6-73.2)		97.0 (91.7-98.9)		
45	Azamgarhi et al (June 17, 2021)*	UK-London	Retrospective cohort	2235 HCWs working at one hospital	Original and Alpha£	Excluded	BNT162b2	Documented infection	70.0 (6.0-91.0)	>14	—		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
	[*Update to Azamgarhi et al below*]												
44	Gupta et al (June 16, 2021)*	USA	Retrospective cohort	4028 HCWs in Boston, Massachusetts	Original and Alpha	Unknown	mRNA-1273	Documented infection	95.0 (86-98.2)	>14 days post dose 1 to 13 days post dose 2	—		
43#	Stowe et al (June 14, 2021)	UK	TND Case-control	Patients seeking emergency care services with subsequent hospitalization	Alpha	Included	BNT162b2	Hospitalization	83 (62-93)	21+ to <13 days post dose 2	95 (78-99)	14+	~20 weeks (but most much less)
							AZD1222		76 (61-85)		86 (53-96)		
					Delta		BNT162b2		94 (46-99)		96 (86-99)		
							AZD1222		71 (51-83)		92 (75-97)		
42#	Sheikh et al (June 14, 2021)	Scotland	TND	Scottish population	Alpha	Unknown	BNT162b2	Documented infection	38 (29-45)	28+	92 (90–93)	14+	~20 weeks (but most much less)
						Unknown	AZD1222	Documented infection	37 (32-42)	28+	73 (66–78)	14+	
					Delta	Unknown	BNT162b2	Documented infection	30 (17-41)	28+	79 (75–82)	14+	
						Unknown	AZD1222	Documented infection	18 (9-25)	28+	60 (53–66)	14+	
41	Flacco, Maria et al* (June 10, 2021)	Italy	Retrospective cohort	245,226 individuals	Original and Alpha††	Unknown	BNT162b2	Documented infection	55 (40-66)	14+	98 (97-99)	14+	~14 weeks
								Hospitalization	—		99 (96-100)	14+	
								Death	—		98 (87-100)	14+	
							mRNA-1273	Documented infection	93 (74-98)	14+	—		
							AZD1222	Documented infection	95 (92-97)	21+	—		
40	Skowronski et al* (July 9, 2021) [Update to June 9 preprint]	Canada	TND	≥70-year olds living in community	Alpha	Included	BNT162b2 & mRNA-1273	Documented infection	67 (95% CI 57-75)	21+	—		~6 weeks
					Gamma				61 (95% CI 45-72)	21+			
					Non-VOC				72 (95% CI 58-81)	21+			
39	Emborg et al. (June 2, 2021) [Update of Houston-Melms below]	Denmark	Cohort	46,101 long-term care facility (LTCF) residents, 61,805 individuals 65 years and older living at home but requiring practical help and personal care (65PHC), 98,533 individuals ≥85 years of age (+85), 425,799	original & Alpha¶¶	Excluded	BNT162b2	Documented infection	7 (-1-15)	>14	82 (79-84)	>7	10 weeks
								COVID-Hospitalization	35 (18-49)	>14	93 (89-96)	>7	
								COVID-Mortality	7 (-15-25)	>14	94 (90-96)	>7	

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
				health-care workers (HCWs), and 231,858 individuals with comorbidities that predispose for severe COVID-19 disease (SCD)									
38	Thompson et al* [updated on June 30,2021]	USA	Cohort	3975 health care personnel, first responders, and other essential and frontline workers in 8 locations in US	Original	Excluded	BNT162b2	Documented infection	80 (60-90)	≥14 days post dose 1 to 13 days post dose 2	93 (78-98)	≥14	13 weeks
							mRNA-1273	Documented infection	83 (40-95)	≥14 days post dose 1 to 13 days post dose 2	82 (20-96)	≥14	
37	Salo et al (July 10, 2021) *[Update to May 30 preprint]*	Finland	Retrospective cohort	HCW and their unvaccinated spouses	Alpha††	Excluded	BNT162b2 & mRNA-1273	Documented infection in HCW	26.8 (7.5-42.1)	2 weeks	—		*10 weeks since dose 1
								Documented infection in HCW	69 (59.2-76.3)	10 weeks (includes 2 dose recipients)	—		
36	Khan et al (May 31, 2021)	USA	Retrospective cohort	14,697 IBD patients in VA hospitals	Unknown	Included	BNT162b2 & mRNA-1273	Documented infection	-1 (-50-32)	14+ up to 7 days post dose 2	69 (44-83)	7+	14 weeks
								Hospitalization/death	9 (-114-61)		49 (-36-81)	7+	
35	Martinez-Bas et al* (May 27, 2021)	Spain	Prospective Cohort	20,961 close contacts of confirmed cases	Alpha	Excluded	BNT162b2	Documented infection	21 (3-36%)	14+	65 (56-73)	14+	12 weeks
								Symptomatic infection	30 (10-45)	14+	82 (73-88)	14+	
								Hospitalization	65 (25-83)	14+	94 (60-99)	14+	
							AZD1222	Documented infection	44 (31-54)	14+	—		n/a
								Symptomatic infection	50 (37-61)	14+	—		
								Hospitalization	92 (46-99)	14+	—		
34#	Chung et al* (Aug 20, 2021) *[Update to July 26 preprint]*	Canada	Test negative design case control	Adults (16+) in Ontario: 53,270 cases 270,763 controls	Non-VOC^	Excluded	BNT162b2	Symptomatic infection	59 (55-62)	14+	91 (88-93)	7+	15 weeks
								Hospitalization and Death	69 (59-77)		96 (82-99)	0+	
							mRNA-1273	Symptomatic infection	72 (63-80)		94 (86-97)	7+	
								Hospitalization and Death	73 (42-87)		96 (74-100)	0+	
								Symptomatic infection	61 (56-66)		90 (85-94)	7+	

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
					Alpha specifically^		BNT162b2 & mRNA-1273	Hospitalization and Death	59 (39-73)		94 (59-99)	0+	
					Beta or Gamma specifically^		BNT162b2 & mRNA-1273	Symptomatic infection	43 (22-59)		88 (61-96)	7+	
							BNT162b2 & mRNA-1273	Hospitalization and Death	56(-9-82)		100	0+	
33	PHE (May 20, 2021)	UK	Test-negative case control	≥65 years	Alpha	Excluded	BNT162b2	Symptomatic infection	54 (50-58)	28+	90 (82-95)	≥14	
							AZD1222	Symptomatic infection	53 (49-57)	28+	89 (78-94)	≥14	
32#	Ranzani et al.* (Aug 20, 2021) *[update to Jul 21 preprint]*	Brazil	Test-negative case control	22,177 70+ year olds in Sao Paulo	Gamma^	Included	Coronavac	Symptomatic infection	12.5 (3.7-20.6)	≥14	46.8 (38.7-53.8)	≥14	~10.5 weeks
								Hospitalization	16.9 (5.7-26.8)		55.5 (46.5-62.9)		
								Death	31.2 (17.6-42.5)		61.2 (48.9-70.5)		
31	Ismail et al. (May 12, 2021)	UK	Screening method	13,907 ≥70	Alpha	Included	AZD1222	Hospitalization in 70-79	84 (74-89)	28+	—		
								Hospitalization I n 80+	73 (60-81)	28+	—		
							BNT162b2	Hospitalization in 70-79	81 (73-87)	28+	—		
								Hospitalization I n 80+	81 (76-85)	28+	93 (89-95)	≥14	
30	Pilishvili et al.* (May 14, 2021)	US	Test-negative case control	HCP at 33 U.S. sites across 25 U.S. states	Unknown	Excluded	BNT162b2 & mRNA-1273	Symptomatic infection	82 (74-87)	≥14 days post dose 1 to 6 days post dose 2	94 (87-97)	≥7	
29	Lopez-Bernal et al.* (May 13, 2021) *[Update to Mar 1 preprint]*	UK	Test-negative case control	156,930 UK population over age 70	Alpha^	Included	BNT162b2	Over 80 years: Symptomatic infection	—		79 (68-86)	≥7	
								Over 70 years: Symptomatic infection	61 (51-69)	28-34 days post dose 1 including some with dose 2	—		
							AZD1222	Over 70 years: Symptomatic infection	60 (41-73)	28-34 days post dose 1 including some with dose 2	—		
28	Angel et al.* (May 6, 2021)	Israel	Retrospective cohort	6710 HCWs at a single tertiary care center in	Alpha¶	Excluded	BNT162b2	Symptomatic	89 (83-94)	>7 days post dose 1 to 7 days post dose 2	97 (94-99)	>7 days	
								Asymptomatic	36 (-51-69)		86 (69-97)		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
27#	Abu-Raddad et al.* (July 8, 2021)	Qatar	Test-negative case-control	Qatari adults	Alpha & Beta^	Unknown	BNT162b2	CC Alpha documented infection	65.5 (58.2-71.5)	15-21 days	90 (86-92)	≥14	
								CC Alpha severe/fatal infection	72 (32-90)		100 (82-100)		
								CC Beta documented infection	46.5 (38.7-53.3)		75 (71-79)		
								CC Beta severe/fatal infection	56.5 (0-82.8)		100 (74-100)		
			Retrospective cohort	Qatari adults	Alpha & Beta^	Unknown	BNT162b2	Cohort documented infection Alpha	—		87 (82-91)		
								Cohort documented infection Beta	—		72 (66-77)		
26	Haas et al. * (May 5, 2021) *[Update to Mar 24 preprint]*	Israel	Retrospective cohort	Israeli population ≥16 years	Alpha^	Excluded	BNT162b2	Documented infection	—		95.3 (94.9-95.7)	≥7 days	
								Asymptomatic infection			91.5 (90.7-92.2)		
								Symptomatic infection			97.0 (96.7-97.2)		
								Hospitalization			97.2 (96.8-97.5)		
								Severe/ critical hospitalization			97.5 (97.1-97.8)		
								Death			96.7 (96.0-97.3)		
25	Corchado-Garcia et al. (April 30, 2021)	USA	Retrospective cohort	24,145 adults in the Mayo Clinic Network	Original & Alpha¥	Excluded	Ad26.COV2.S	Documented infection	77 (30-95)	≥15	—		
24	Fabiani et al.* (Apr 29, 2021)	Italy	Retrospective cohort	9,878 HCWs	Unknown	Excluded	BNT162b2	Documented infection	84 (40-96)	14-21	95 (62-99)	≥7 days	
								Symptomatic infection	83 (15-97)		94 (51-99)		
23	Gras-Valenti et al.*(Apr 29, 2021)	Spain	Case-control	268 HCWs	Original & Alpha¥¥	Included	BNT162b2	Documented infection	53 (1-77)	>12	—		
22	Tenforde et al.* (Apr 28, 2021)	USA	Test-negative case-control	Hospitalized adults ≥65 years	Original and Alpha¥	Unknown	BNT162b2 & mRNA-1273	Hospitalization	64 (28-82)	≥14 days post dose 1 to 14 days post dose 2	94 (49-99)	≥14 days	
21	Goldberg et al. (Apr 24, 2021)	Israel	Prospective cohort	5,600,000+ individuals ≥16 years	Original and Alpha^	Included	BNT162b2	Documented infection	58 (57-59)	>14 days post dose 1 to <7 days post dose 2	93 (93-93)	≥7 days	
								Hospitalization	69 (68-71)		94 (94-95)		
								Severe disease	66 (63-69)		94 (94-95)		
								Death	63 (58-67)		94 (93-95)		

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
20	Pritchard et al.* (Jun 9, 2021) *[Update to Apr 23 preprint]*	UK	Prospective cohort	373,402 individuals ≥16 years	Alpha & Original^	Excluded	BNT162b2	Documented infection	66 (60-71)	≥21	80 (74-85)	≥0 days	
								Symptomatic disease	78 (72-83)		95 (91-98)		
							AZD1222	Documented infection	61 (54-68)		79 (65-88)		
								Symptomatic disease	71 (62-78)		92 (78-97)		
19	Vasileiou et al.* (Apr 23, 2021) *[Update to Feb 21 preprint]*	UK – Scotland	Prospective Cohort (Person-time)	Scotland population: 5.4 million	Original & Alpha£	Excluded	BNT162b2	Hospitalization	91 (85-94)	28-34	—		
							AZD1222	Hospitalization	88 (75-94)	28-34			
18	Hall et al.* (Apr 23, 2021) *[Update to Feb 21 preprint]*	UK – SIREN study	Prospective Cohort (Person-time)	23,324 healthcare workers	Alpha^	Excluded	BNT162b2	Documented infection	72 (58-86)	≥21	86 (76-97)	≥7	
17	Mason et al. (Apr 22, 2021)	UK - England	Case-control	170,226 80-83-year-olds	Alpha^	Excluded	BNT162b2	Documented infection[4]	55 (40-66)	21-27	70 (55- 80)	35-41	
								Hospitalization[4]	50 (19-69)	21-27	75 (52-87)	35-41	
16	Bjork et al. (Apr 21, 2021)	Sweden	Retrospective cohort	805,741 Swedish adults aged 18-64 years	Original & Alpha^	Unknown	BNT162b2	Documented infection	42 (14-63)	≥14	86 (72-94)	≥7	
15	Glampson et al.* (Jul 15, 2021) *[Update to Apr 10 preprint]*	UK	Retrospective cohort	2 million adults ≥16 in Northwest London	Alpha^	Included	BNT162b2	Documented infection	78 (73-82)	22-28	—		
							AZD1222	Documented infection	74 (65-81)	22-28			
14	Andrejko et al.* (Jul 20, 2021) [update to May 25 preprint]	USA	Test-negative case control	1023 California adults ≥18 years	B.1.427/ B.1.429 & Alpha^	Excluded	BNT162b2 & mRNA-1273	Documented infection	66.9 (28.7--84.6)	≥15	87.4 (77.2-93.1)	≥15	~14 weeks
								Asymptomatic infection	—		68.3 (27.9-85.7)	≥15	
								Symptomatic infection	—		91.3 (79.3-96.3)	≥15	
								Hospitalization	—		100	≥15	
							BNT162b2	Documented infection	—		87.0 (68.6-94.6)	≥15	
							mRNA-1273	Documented infection	—		86.2 (68.4-93.9)	≥15	

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
13	Regev-Yochay et al.* (July 7,2021) [*Update to April 9 preprint*]	Israel	Prospective cohort	3578 HCWs in one Israeli health system	Alpha¶	Included	BNT162b2	Asymptomatic infection	—		65 (45-79)	≥11	
								Asymptomatic infection presumed infectious (Ct< 30)			70 (43-84)	≥11	
								Symptomatic infection			90 (84-94)	≥11	
								Symptomatic infection presumed infectious (CT<30)			88 (80-94)	≥11	
12	Bouton et al. (Mar 30, 2021)	USA – MA	Prospective Cohort	10,950 healthcare workers in Boston	Original^	included	BNT162b2 & mRNA-1273	Documented infection	82 (68-90) >14 days post dose 1 including some with dose 2 starting day 0				
11	Thompson et al.* (Mar 29, 2021)	USA	Prospective cohort	3,950 healthcare workers in eight US sites	Original¥	Excluded	BNT162b2 & mRNA1273	Documented infection	80 (59-90)	≥14	90 (68-97)	≥14	
10	Shrotri et al.* (Jun 23, 2021) *[Update to Mar 26 preprint]*	UK	Prospective cohort	10,412 care home residents aged ≥65 years from 310 LTCFs in England	Original and Alpha^	Stratified	BNT162b2	Documented infection	65 (29-83)	35-48	—		
							AZD1222	Documented infection	68 (34-85)	35-48			
9	Public Health England – March (Mar 17, 2021)	UK - England	Test Negative Case-Control	Adults in England over 70 years	Alpha^	Unknown	BNT162b2	Symptomatic infection	58 (49-65)	≥28	—		
							AZD1222	Symptomatic infection	58 (38-72)	≥35			
			Retrospective Cohort	Adults in England over 80 years		Included	BNT162b2	Hospitalization[1]	42 (32-51)	≥14	—		
								Death[1]	54 (41-64)	≥14			
							AZD1222	Hospitalization[1]	35 (4-56)	14-21			
8	Yelin et al. (Mar 17, 2021)	Israel – Maccabi System	Retrospective Cohort	1.79 million enrollees, adults <90 years	Alpha^	Excluded	BNT162b2	Documented infection	91 (89-93) ≥35 days post dose 1 most with dose 2				
								Symptomatic infection	99 (95-99) ≥35 days post dose 1 most with dose 2				
7	Britton et al.* (Mar 15, 2021)	USA – CT	Retrospective Cohort	463 residents of two skilled nursing facilities experiencing outbreaks	Original¥	Stratified	BNT162b2	Include Hx of COVID: Documented infection	63 (33-79) ≥14 days post dose 1 including some with dose 2 through day 7				
								Exclude Hx of COVID: Documented infection	60 (30-77) ≥14 days post dose 1 including some with dose 2 through day 7				
6	Tande et al.* (Mar 11, 2021)	USA – Mayo Clinic	Retrospective Cohort	Asymptomatic screening of 39,156 patients: pre-surgical, pre-op PCR tests	original¥	Included	BNT162b2 & mRNA-1273	Asymptomatic infection	79 (63-88) >10 days post dose 1, including some with dose 2		80 (56-91)	>0	
							BNT162b2	Asymptomatic infection	79 (62-89)	>10	80 (56-91)	>0	

No.	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose±	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
5	Mousten-Helms et al. (Mar 9, 2021)	Denmark	Retrospective Cohort	Long term care facilities in Denmark - 39,040 residents, 331,039 staff	original & Alpha¶¶	Excluded	BNT162b2	LTCF Resident: Documented Infection	21 (-11-44)	>14	64 (14-84)	>7	
								LTCF Staff: Documented Infection	17 (4-28)	>14	90 (82-95)	>7	
4	Hyams et al.* (Jun 23, 2021) *[Update to Mar 3 preprint]*	UK – University of Bristol	Test Negative Case-Control	466 tests: ≥80 years hospitalized with respiratory symptoms	Alpha£	Included	BNT162b2	Hospitalization	79 (47-93)	>14	—		
							AZD1222	Hospitalization	80 (36-95)	>14			
3	Dagan et al.* (Feb. 24, 2021)	Israel – Clalit Health System	Retrospective Cohort	596,618 – matched on demographics, residence, clinical characteristics	original & Alpha^	Excluded	BNT162b2	Documented infection	46 (40-51)	14-21	92 (88-95)	>7	
								Symptomatic infection	57 (50-63)	14-21	94 (87-98)	>7	
								Hospitalization	74 (56-86)	14-21	87 (55-100)	>7	
								Severe disease	62 (39-80)	14-21	92 (75-100)	>7	
2	Public Health England – Feb. (Feb. 22, 2021)	UK - England	Screening Method	43,294 cases, with England as source population	Alpha^	Included	BNT162b2	Over 80 years: Symptomatic infection	57 (48-63)	>28	88 (84-90)	7	
1	Amit et al.* (Feb 18, 2021)	Israel	Prospective Cohort	9,109 healthcare workers	original & Alpha¶	Excluded	BNT162b2	Documented infection	75 (72-84) ≥15 days post dose 1 including some with dose 2 through day 7				
								Symptomatic infection	85 (71-92) ≥15 days post dose 1 including some with dose 2 through day 7				

Purple text indicates new or updated study.
Product Manufacturers: BNT162b2 (Pfizer), mRNA-1273 (Moderna), AZD1222 (Astra-Zeneca), Ad26.COV2.S (Janssen), Coronavac
±Unless noted otherwise, days post 1st dose are prior to receiving dose 2.
‡Unclear if 1st dose VE estimates includes any individuals who received a second dose.
*Manuscripts with an asterisk (*) are peer-reviewed publications.
^Indicates predominant variant identified by study authors. If no ^ then variants identified through secondary source when possible. Please see additional footnotes.
¶The rise of SARS-CoV-2 variant Alpha in Israel intensifies the role of surveillance and vaccination in elderly | medRxiv
¥CDC Says More Virulent British Strain Of Coronavirus Now Dominant In U.S. : Coronavirus Updates : NPR
£Coronavirus (COVID-19) Infection Survey, UK - Office for National Statistics
¶¶Denmark logs more contagious COVID variant in 45% of positive tests | Reuters
¥¥COVID variant first detected in UK now dominant strain in Spain
££Reporte-circulacion-variantes-al-9.04.21-PUBLICADO-FINAL.pdf (minsal.cl)
††Based on https://outbreak.info/location-reports
ψhttps://www.gov.uk/government/publications/covid-19-variants-genomically-confirmed-case-numbers/variants-distribution-of-cases-data
#Manuscripts that are cited in the WHO COVID-19 Weekly Epidemiological Updates (see Special Focus Update on SARS-CoV-2 Variants of Interest and Variants of Concern, Table 3, included in every other Weekly Epidemiological Update): https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.

1.1 Inclusion criteria for VE studies

Note: All VE studies now must meet these criteria to be in the VE table:

- Published or preprint studies (not press release, presentations, media)
- Must have confidence intervals around VE, except in instances where it is not possible to calculate
- Needs to include persons with & without infection or disease and with and without vaccination (ie a proper comparison group). This excludes case only studies (e.g., impact studies, risk of progression to severe disease (i.e. PHE)).
- No modeled comparison group nor comparison to historical cohort
- The study design should account for confounding and/or VE estimate should be adjusted or state adjustment made no difference
- Outcomes must be lab confirmed, not syndromic
- At least 90% of participants must have documented vaccination status rather than relying on recall
- VE must be for one vaccine, not for >1 vaccine combined (with exception for studies accessing Pfizer + Moderna vaccines and studies of heterologous schedules, but all participants included in a VE estimate should receive same brands of vaccines in the same order
- No significant bias that likely affects results
- Cannot include day 0-12 in unvaccinated definition
- Cannot compare to early post vaccination to calculate VE (e.g. day 0-12 vs day 12-21)

1.2 VE Studies that do not meet criteria are listed below in case of interest:

1. Hunter P and Brainard J. Estimating the effectiveness of the Pfizer COVID-19 BNT162b2 vaccine after a single dose. A reanalysis of a study of 'real-world' vaccination outcomes from Israel. *medRxiv*. Published online 2021:2021.02.01.21250957. doi: 10.1101/2021.02.01.21250957
2. Institut National de Santé Publique du Québec. Preliminary Data on Vaccine Effectiveness and Supplementary Opinion on the Strategy for Vaccination Against COVID-19 in Quebec in a Context of Shortage. Gouvernement du Québec. 2021:Publication No 3111. Available at: https://www.inspq.qc.ca/sites/default/files/publications/3111-vaccine-effectiveness-strategy-vaccination-shortage-covid19.pdf.
3. Weekes M, Jones NK, Rivett L, et al. Single-dose BNT162b2 vaccine protects against asymptomatic SARS-CoV-2 infection. *Authorea*. Published online Feb 24, 2021. doi: 10.22541/au.161420511.12987747/v1
4. Aran D. Estimating real-world COVID-19 vaccine effectiveness in Israel using aggregated counts. Published online Mar 4, 2021. Available at: https://github.com/dviraran/covid_analyses/blob/master/Aran_letter.pdf.
5. Shah ASV, Gribben C, Bishop J, et al. Effect of vaccination on transmission of COVID-19: an observational study in healthcare workers and their households. *medRxiv*. Published online 2021:2021.03.11.21253275. doi: 10.1101/2021.03.11.21253275
6. Monge S, Olmedo C, Alejos B, et al. Direct and indirect effectiveness of mRNA vaccination against SARS-CoV-2 infection in long-term care facilities in Spain. *medRxiv*. Published online 2021:2021.04.08.21255055 doi: 10.1101/2021.04.08.21255055
7. Vahidy FS, Pischel L, Tano ME, et al. Real World Effectiveness of COVID-19 mRNA Vaccines against Hospitalizations and Deaths in the United States. *medRxiv*. Published online 2021:2021.04.21.21255873 doi: 10.1101/2021.04.21.21255873

8. Swift MD, Breeher LE, Tande AJ, et al. Effectiveness of Messenger RNA Coronavirus Disease 2019 (COVID-19) Vaccines Against Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection in a Cohort of Healthcare Personnel. *Clin Inf Dis.* Published online Apr 26, 2021:2021;ciab361. doi: 10.1093/cid/ciab361
9. Zaqout A, Daghfal J, Alaqad I, et al. The initial impact of a national BNT162b2 mRNA COVID-19 vaccine rollout. *medRxiv*. Published online 2021:2021.04.26.21256087 doi: 10.1101/2021.04.26.21256087
10. Cavanaugh AM, Fortier S, Lewis P, et al. COVID-19 Outbreak Associated with a SARS-CoV-2 R.1 Lineage Variant in a Skilled Nursing Facility After Vaccination Program – Kentucky, March 2021. *MMWR Morb Mortal Wkly Rep.* 2021;70:639-643. doi: 10.15585/mmwr.mm7017e2
11. Menni C, Klaser K, May A, et al. Vaccine side-effects and SARS-CoV-2 infection after vaccination in users of the COVID Symptom Study app in the UK: a prospective observational study. *Lancet Infect Dis.* 2021; 21; 939-49. Published online April 27, 2021. doi: 10.1016/S1473-3099(21)00224-3.
12. Tang L, Hijano DR, Gaur AH, et al. Asymptomatic and Symptomatic SARS-CoV-2 Infections After BNT162b2 Vaccination in a Routinely Screened Workforce. *JAMA.* Published online May 6, 2021:2021;325(24):2500-2502. doi: 10.1001/jama.2021.6564
13. Chodick G, Tene L, Rotem Ran S, et al. The Effectiveness of the Two-Dose BNT162b2 Vaccine: Analysis of Real-World Data. *Clin Infect Dis.* Published online May 17, 2021:2021;ciab438. doi: 10.1093/cid/ciab438
14. Lopez Bernal J, Andrews N, Gower C, et al. Effectiveness of BNT162b2 mRNA vaccine and ChAdOx1 adenovirus vector vaccine on mortality following COVID-19. *medRxiv*. Published online 2021:2021.05.14.21257600 doi: 10.1101/2021.05.14.21257218
15. Bianchi FB, Germinario CA, Migliore G, et al. BNT162b2 mRNA COVID-19 Vaccine Effectiveness in the Prevention of SARS-CoV-2 Infection: A Preliminary Report. *J Infect Dis.* Published online May 19, 2021:2021;jiab262. doi: 10.1093/infdis/jiab262
16. Walsh J, Skally M, Traynor L, et al. Impact of first dose of BNT162b2 vaccine on COVID-19 infection among healthcare workers in an Irish hospital. *Ir J Med Sci*. Published online May 2021:1-2. doi:10.1007/s11845-021-02658-4
17. Yassi A, Grant JM, Lockhart K, et al. Infection control, occupational and public health measures including mRNA-based vaccination against SARS-CoV-2 infections to protect healthcare workers from variants of concern: a 14-month observational study using surveillance data. *PLoS ONE*. 2021;16(7):e0254920. doi:10.1371/journal.pone.0254920
18. Kumar S, Saxena S, Atri M, Chamola SK. Effectiveness of the Covid-19 vaccine in preventing infection in dental practitioners: results of a cross-sectional questionnaire-based survey. *medRxiv*. Published online 2021:2021.05.28.21257967. doi:10.1101/2021.05.28.21257967
19. Shrestha NK, Nowacki AS, Burke PC, Terpeluk P, Gordon SM. Effectiveness of mRNA COVID-19 Vaccines among Employees in an American Healthcare System. *medRxiv*. Published online 2021:2021.06.02.21258231. doi:10.1101/2021.06.02.21258231
20. Riley S, Wang H, Eales O, et al. *REACT-1 Round 12 Report: Resurgence of SARS-CoV-2 Infections in England Associated with Increased Frequency of the Delta Variant*.; 2021. https://spiral.imperial.ac.uk/bitstream/10044/1/89629/2/react1_r12_preprint.pdf
21. Ben-Dov IZ, Oster Y, Tzukert K, et al. The 5-months impact of tozinameran (BNT162b2) mRNA vaccine on kidney transplant and chronic dialysis patients. *medRxiv*. Published online June 16, 2021:2021.06.12.21258813. doi:10.1101/2021.06.12.21258813

22. Victor PJ, Mathews KP, Paul H, Murugesan M, Mammen JJ. Protective Effect of COVID-19 Vaccine Among Health Care Workers During the Second Wave of the Pandemic in India. *Mayo Clin Proc*. Published online 2021.
23. Chodick G, Tene L, Patalon T, et al. Assessment of Effectiveness of 1 Dose of BNT162b2 Vaccine for SARS-CoV-2 Infection 13 to 24 Days After Immunization. *JAMA Netw Open.* Published online Jun 7, 2021:2021;4(6):e2115985. doi: 10.1001/jamanetworkopen.2021.15985
24. Bahl A, Johnson S, Maine G, et al. Vaccination reduces need for emergency care in breakthrough COVID-19 infections: A multicenter cohort study. *medRxiv*. Published online 2021:2021.06.09.21258617. doi:10.1101/2021.06.09.21258617
25. Zacay G, Shasha D, Bareket R, et al. BNT162b2 Vaccine Effectiveness in Preventing Asymptomatic Infection with SARS-CoV-2 Virus: A Nationwide Historical Cohort Study. *Open Forum Infect Dis*. Published online June 9, 2021:2021;8(6). doi: 10.1093/ofid/ofab262
26. Ross C, Spector O, Tsadok MA, Weiss Y, Barnea R. BNT162b2 mRNA vaccinations in Israel: understanding the impact and improving the vaccination policies by redefining the immunized population. *medRxiv*. Published online 2021:2021.06.08.21258471. doi:10.1101/2021.06.08.21258471
27. Malinis M, Cohen E, Azar MM. Effectiveness of SARS-CoV-2 vaccination in fully-vaccinated solid organ transplant recipients. *Am J Transplant*. Published online June 2021. doi:10.1111/ajt.16713
28. Ramakrishnan, M., & Subbarayan, P. Impact of vaccination in reducing Hospital expenses, Mortality and Average length of stay among COVID 19 patients. A retrospective cohort study from India. *medRxiv*, Published online 2021: 2021.06.18.21258798. doi:10.1101/2021.06.18.21258798
29. Sansone E, Sala E, Tiraboschi M, et al. Effectiveness of BNT162b2 vaccine against SARS-CoV-2 among healthcare workers. *Med Lav*. Published online 15 June 2021. doi: 10.23749/mdl.v112i3.11747.
30. Mazagatos C, Monge S, Olmedo C, et al. Effectiveness of mRNA COVID-19 vaccines in preventing SARS-CoV-2 infections and COVID-19 hospitalizations and deaths in elderly long-term care facility residents, Spain, weeks 53 2020 to 13 2021. *Euro Surveill.* 2021;26(24):pii=2100452. doi: 10.2807/1560-7917.ES.2021.26.24.2100452.
31. Tanislav C, Ansari TE, Meyer M, et al. Effect of SARS-CoV-2 vaccination among health care workers in a geriatric care unit after a B.1.1.7-variant outbreak [published online ahead of print, 2021 Jun 19]. *Public Health.* 2021. doi: 10.1016/j.puhe.2021.06.003
32. Jaiswal A, Subbaraj V, Wesley J, et al. COVID-19 vaccine effectiveness in preventing deaths among high-risk groups in Tamil Nadu, India. *Indian J Med Res*. Accessed online ahead of print 23 June 2021. doi: 10.4103/ijmr.ijmr_1671_21.
33. Harris RJ, Hall JA, Zaidi A, et al. Effect of Vaccination on Household Transmission of SARS-CoV-2 in England. *N Engl J Med.* Published online Jun 23, 2021. doi: 10.1056/NEJMc2107717
34. Hitchings MDT, Ranzani OT, Torres MSS et al. Effectiveness of CoronaVac among healthcare workers in the setting of high SARS-CoV-2 Gamma variant transmission in Manaus, Brazil: A test-negative case-control study. *medRxiv*, Published online 2021: 2021.04.07.21255081 .21258798. doi:10.1101/2021.04.07.21255081
35. Knobel P, Serra C, Grau S, et al. COVID-19 mRNA vaccine effectiveness in asymptomatic healthcare workers [published online ahead of print, 2021 Jun 24]. *Infect Control Hosp Epidemiol*. 2021;1-7. doi:10.1017/ice.2021.287

36. Kale P, Bihari C, Patel N, et al. Clinicogenomic analysis of breakthrough infections by SARS CoV2 variants after ChAdOx1 nCoV-19 vaccination in healthcare workers. *medRxiv*, Published online 2021:2021.06.28.21259546. doi: 10.1101/2021.06.28.21259546
37. Mateo-Urdiales A, Alegiani SS, Fabiani M, et al. Risk of SARS-CoV-2 infection and subsequent hospital admission and death at different time intervals since first dose of COVID-19 vaccine administration, Italy, 27 December 2020 to mid-April 2021. *Euro Surveill.* 2021;26(25):pii=2100507. doi: 10.2807/1560-7917.ES.2021.26.25.2100507
38. Gazit S, Mizrahi B, Kalkstein N, et al. BNT162b2 mRNA Vaccine Effectiveness Given Confirmed Exposure; Analysis of Household Members of COVID-19 Patients. *medRxiv*, published online 2021.06.29.21259579. doi:10.1101/2021.06.29.21259579
39. Paris C, Perrin S, Hamonic S, et al. Effectivness of mRNA-BNT162b2, mRNA-1273, and ChAdOx1 nCoV-19 vaccines against COVID-19 in health care workers: an observational study using surveillance data. *Clin Microbiol Infect*. Published online Jun 29, 2021. doi: 10.1016/j.cmi.2021.06.043
40. Kojima N, Roshani A, Brobeck M, et al. Incidence of Severe Acute Respiratory Syndrome Coronavirus-2 infection among previously infected or vaccinated employees. *medRxiv*, Published online 2021:2021.07.03.21259976. doi: 10.1101/2021.07.03.21259976
41. Lumley SF, Rodger G, Constantinides B, et al. An observational cohort study on the incidence of SARS-CoV-2 infection and B.1.1.7 variant infection in healthcare workers by antibody and vaccination status. *Clin Inf Dis.* Published online Jul 12, 2021:2021;ciab608. doi: 10.1093/cid/ciab608
42. Rovida F, Cassaniti I, Paolucci S, et al. SARS-CoV-2 vaccine breakthrough infections are asymptomatic or mildly symptomatic and are infrequently transmitted. *medRxiv*, Published online 2021.06.29.21259500. doi:10.1101/2021.06.29.21259500
43. Williams C, Al-Bargash D, Macalintal C, et al. COVID-19 Outbreak Associated with a SARS-CoV-2 P.1 Lineage in a Long-Term Care Home after Implementation of a Vaccination Program – Ontario, April-May 2021. *Clin Inf Dis.* Published online Jul 8, 2021:2021;ciab617. doi: 10.1093/cid/ciab617
44. Bailly B, Guilpain L, Bouiller K, et al. BNT162b2 mRNA vaccination did not prevent an outbreak of SARS COV-2 variant 501Y.V2 in an elderly nursing home but reduced transmission and disease severity [published online ahead of print, 2021 May 16]. *Clin Infect Dis*. 2021;ciab446. doi:10.1093/cid/ciab446
45. Charmet T, Schaeffer L, Grant R, et al. Impact of original, B.1.1.7, and B.1.351/P.1 SARS-CoV-2 lineages on vaccine effectiveness of two doses of COVID-19 mRNA vaccines: Results from a nationwide case-control study in France [published online ahead of print, 2021 Jul 13]. *Lancet Regional Health—Eur.* 2021;8:100171. doi: 10.1016/j.lanepe.2021.100171
46. Bermingham CR, Morgan J, Ayoubkhani D, et al. Estimating the effectiveness of the first dose of COVID-19 vaccine against mortality in England: a quasi-experimental study. *medRxiv*, Published online 2021.07.12.21260385. doi:10.1101/2021.07.12.21260385
47. Alencar CH, de Goes Cavalcanti LP, de Almeida MM, et al. High Effectiveness of SARS-CoV-2 Vaccines in Reducing COVID-19-Related Deaths in over 75-Year-Olds, Ceará State, Brazil. *Trop Med Infect Dis.* 2021;6(3):129. doi: 10.3390/tropicalmed6030129
48. Waldman SE, Adams JY, Albertson TE, et al. Real-world impact of vaccination on COVID-19 incidence in health care personnel at an academic medical center. *Infect Control Hosp Epidemiol*. Published online Jul 21, 2021:2021;1-21. doi: 10.1017/ice.2021.336

49. Vignier N, Bérot V, Bonnave N, et al. Breakthrough infections of SARS-CoV-2 gamma variant in fully vaccinated gold miners, French Guiana, 2021 [published online ahead of print, 2021 Jul 21]. *Emerg Infect Dis*. 2021;27(10). doi: 10.3201/eid2710.211427
50. Pramod S, Govindan D, Ramasubramani P, et al. Effectiveness of Covishield vaccine in preventing Covid-19 – A test-negative case-control study. *medRxiv*, Published online 2021.07.19.21260693. doi:10.1101/2021.07.19.21260693
51. Rubin D, Eisen M, Collins S, et al. SARS-CoV-2 Infection in Public School District Employees Following a District-Wide Vaccination Program – Philadelphia County, Pennsylvania, March 21-April 23, 2021. *MMWR Morb Mortal Wkly Rep.* Published online 2021 Jul 23. doi: 10.15585/mmwr.mm7030e1
52. Mor O, Zuckerman NS, Hazan I, et al. BNT162b2 Vaccination efficacy is marginally affected by the SARS-CoV-2 B.1.351 variant in fully vaccinated individuals. *medRxiv*, Published online 2021.07.20.21260833. doi:10.1101/2021.07.20.21260833
53. Thiruvengadam, R et al. Cellular Immune Responses are Preserved and May Contribute to Chadox1 ChAdOx1 nCoV-19 Vaccine Effectiveness Against Infection Due to SARS-CoV-2 B·1·617·2 Delta Variant Despite Reduced Virus Neutralisation. *SSRN*, Published online 2021 Jul 16. https://ssrn.com/abstract=3884946.
54. Blanco, S et al. Evaluation of the Gam-COVID-Vac and Vaccine-Induced Neutralizing Response Against SARS-CoV-2 Lineage P.1 (Manaus) Variant in an Argentinean Cohort. *SSRN*, Published online 2021 Jul 27. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3893461.
55. Aslam, S, Adler, E, Mekeel, K, Little, SJ. Clinical effectiveness of COVID-19 vaccination in solid organ transplant recipients. *Transpl Infect Dis*. Published online 2021 Jul 29. doi: 10.1111/tid.13705.
56. Cserep G, Morrow D, Latchford K, Jesset R, Dosa A, Kirmizis D. The effect of a single dose of BNT162b2 vaccine on the incidence of severe COVID-19 infection in patients on chronic hemodialysis: a single-centre study [published online ahead of print, 2021 Jul 29]. *Clin Exp Nephrol*. 2021;1-5. doi:10.1007/s10157-021-02118-4
57. Hetemäki Iivo, et al. An outbreak caused by the SARS-CoV-2 Delta variant (B.1.617.2) in a secondary care hospital in Finland, May 2021. *Euro Surveill.* Published online 2021 Jul 28. doi: https://doi.org/10.2807/1560-7917.ES.2021.26.30.2100636
58. Ghosh S, Shankar S, Chatterjee K, et al. COVIDSHIELD (AZD1222) VaccINe effectiveness among healthcare and frontline Workers of Indian Armed Forces: Interim results of VIN-WIN cohort study. *Med J Armed Forces India.* 2021;77(2):S264-S270. doi: 10.1016/j.mjafi.2021.06.032
59. Muthukrishnan J, Vardhan V, Mangalesh S, et al. Vaccination status and COVID-19 related mortality: A hospital based cross sectional study. *Med J Armed Forces India.* 2021;77(2):S278-S282. doi: 10.1016/j.mjafi.2021.06.034
60. Sakre M, Agrawal S, Ravi R, et al. COVID 19 vaccination: Saviour or unfounded reliance? A cross sectional study among the air warriors. *Med J Armed Forces India.* 2021;77(2):S502-S504. doi: 10.1016/j.mjafi.2021.06.017
61. Bobdey S, Kaushik SK, Sahu R, et al. Effectiveness of ChAdOx1 nCOV-19 Vaccine: Experience of a tertiary care institute. *Med J Armed Forces India.* 2021;77(2):S271-S277. doi: 10.1016/j.mjafi.2021.06.006
62. Vaishya R, Sibal A, Malani A, Prasad KH. SARS-CoV-2 infection after COVID-19 immunization in healthcare workers: A retrospective, pilot study. *Indian J Med Res.* Published online 2021 Aug 3. doi: 10.4103/ijmr.ijmr_1485_21

63. Bhattacharya A, Ranjan P, Ghosh T, et al. Evaluation of the dose-effect association between the number of doses and duration since the last dose of COVID-19 vaccine, and its efficacy in preventing the disease and reducing disease severity: A single centre, cross-sectional analytical study from India [published online ahead of print, 2021 Jul 30]. *Diabetes Metab Syndr.* 2021;15(5). doi: 10.1016/j.eimc.2021.06.021
64. Lakhia RT, Trivedi JR. The CT Scan Lung Severity Score and Vaccination Status in COVID-19 patients in India: Perspective of an Independent Radiology Practice. *medRxiv*, Published online 2021 Aug 3. doi:10.1101/2021.07.15.21260597
65. Elliott P, Haw D, Wang H, Eales O. REACT-1 round 13 final report: exponential growth, high prevalence of SARS-CoV-2 and vaccine effectiveness associated with Delta variant in England during May to July 2021. *medRxiv*, Published online 2021 Sep 10. doi: 10.1101/2021.09.02.21262979
66. Mizrahi B, Lotan R, Kalkstein N, et al. Correlation of SARS-CoV-2 Breakthrough Infections to Time-from-vaccine; Preliminary Study. *medRxiv*, Published online 2021 July 31. doi: 10.1101/2021.07.29.21261317.
67. Riemersma K, Grogan E, Kita-Yarbro A, et al. Vaccinated and unvaccinated individuals have similar viral loads in communities with a high prevalence of the SARS-CoV-2 delta variant. *medRxiv*, Published online 2021 July 31. doi: 10.1101/2021.07.31.21261387.
68. Wickert D P, Almand E A, Baldovich K J, et al. Estimates of Single Dose and Full Dose BNT162b2 Vaccine Effectiveness among USAF Academy cadets, 1 Mar - 1 May 2021. *medRxiv*, Published online 2021 July 31. doi: 10.1101/2021.07.28.21261138.
69. Chia P Y, Ong S W X, Chiew C J, et al. Virological and serological kinetics of SARS-CoV-2 Delta variant vaccine-breakthrough infections: a multi-center cohort study. *medRxiv*, Published online 2021 July 31. doi: 10.1101/2021.07.28.21261295.
70. Keegan L, Truelove SA, Lessler J, et al. Progress of the Delta variant and erosion of vaccine effectiveness, a warning from Utah. *medRxiv*, Published online 2021 August 09. doi: 10.1101/2021.08.09.21261554
71. Ye P, Fry L , Liu L,COVID outbreak after the 1st dose of COVID vaccine among the nursing home residents: What happened? *Geriatric Nursing.* Published online 2021 June 25. doi: 10.1016/j.gerinurse.2021.06.022
72. Tregoning, J.S., Flight, K.E., Higham, S.L. *et al.* Progress of the COVID-19 vaccine effort: viruses, vaccines and variants versus efficacy, effectiveness and escape. *Nat Rev Immunol*. Published online 2021 August 09. doi: 10.1038/s41577-021-00592-1.
73. Starrfelt J, Danielsen A.S, et al. High vaccine effectiveness against COVID-19 infection and severe disease among residents and staff of long-term care facilities in Norway, November – June 2021. *medRxiv.* Published online 2021 August 09. doi: doi.org/10.1101/2021.08.08.21261357
74. Herlihy R, Bamberg W, Burakoff A, et al. Rapid Increase in Circulation of the SARS-CoV-2 B.1.617.2 (Delta) Variant — Mesa County, Colorado, April–June 2021. MMWR Morb Mortal Wkly Rep. ePub: 6 August 2021. doi: 10.15585/mmwr.mm7032e2
75. Brown CM, Vostok J, Johnson H, et al. Outbreak of SARS-CoV-2 Infections, Including COVID-19 Vaccine Breakthrough Infections, Associated with Large Public Gatherings — Barnstable County, Massachusetts, July 2021. MMWR Morb Mortal Wkly Rep 2021;70:1059-1062. doi: 10.15585/mmwr.mm7031e2external icon

76. North C, Barczak A et al. Determining the Incidence of Asymptomatic SARS-CoV-2 among Early Recipients of COVID-19 Vaccines: A Prospective Cohort Study of Healthcare Workers before, during and after Vaccination [DISCOVER-COVID-19], *Clinical Infectious Diseases*, Published online 2021 August 07. doi: 10.1093/cid/ciab643
77. Israel A, Merzon E, Schaffer AA, et al. Elapsed time since BNT 162b2 vaccine and risk of SARS-CoV-2 infection in a large cohort. *medRxiv*, Published online 2021 August 05. doi: 10.1101/2021.08.03.21261496
78. Issac A, Kochuparambil JJ, Elizabeth L. SARS-CoV-2 Breakthrough Infections among the Healthcare Workers Post-Vaccination with ChAdOx1 nCoV-19 Vaccine in the South Indian State of Kerala. *medRxiv*, Published online 2021 August 08. doi: 10.1101/2021.08.07.21261587
79. Marco A, Teixido N, Guerrero RA, et al. Outbreak of SARS-CoV-2 in a prison: Low effectiveness of a single dose of the adenovirus vector ChAdOx1 vaccine in recently vaccinated inmates. *medRxiv*, Published online 2021 August 05. doi: 10.1101/2021.08.03.21258337
80. Bitan DT, Kridin K, Cohen AD, Weinstein O. COVID-19 hospitalization, mortality, vaccination, and postvaccination trends among people with schizophrenia in Israel: a longitudinal cohort study. *Lancet Psychiatry.* Published online 2021 Aug 5. doi: 10.1016/S2215-0366(21)00256-X
81. Public Health England. SARS-CoV-2 variants of concern and variants under investigation in England: Technical briefing 20. Published online 2021 Aug 6. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009243/Technical_Briefing_20.pdf
82. Pezzotti P, Fabiani M et al. Impact of vaccination on the risk of SARS-CoV-2 infection and hospitalization and death in Italy(27.12.2020-14.07.2021). *Ministere della Salute*. Published online 2021 July 27. Available from: https://www.epicentro.iss.it/vaccini/covid-19-report-valutazione-vaccinazione.
83. Moline HL, Whitaker M, Deng L, et al. Effectiveness of COVID-19 Vaccines in Preventing Hospitalization Among Adults Aged ≥65 Years — COVID-NET, 13 States, February–April 2021. *MMWR Morb Mortal Wkly Rep.* 2021;70:1088-1093. doi: http://dx.doi.org/10.15585/mmwr.mm7032e3.
84. Kang M, Yi Y, Limei S, et al. Effectiveness of Inactivated COVID-19 Vaccines Against COVID-19 Pneumonia and Severe Illness Caused by the B.1.617.2 (Delta) Variant: Evidence from an Outbreak in Guangdong, China. *SSRN*. Published online 2021 Aug 5. Available from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3895639.
85. Elavarasi A, Sagiraju HKR, Garg RK, et al. Clinical features, demography and predictors of outcomes of SARS-CoV-2 infection in a tertiary care hospital in India-A cohort study. *medRxiv*, Published online 2021 August 12. doi: 10.1101/2021.08.10.21261855
86. Singer SR, Angulo FJ, Swerdlow DL et al. Vaccine Against SARS-CoV-2 Variant Beta (B.1.351) Among Persons Identified Through Contact Tracing in Israel. *SSRN.* Published online 2021 Aug 13. Available from: https://ssrn.com/abstract=3904701
87. Kang M, Xin H, Yuan J, et al. Transmission dynamics and epidemiological characteristics of Delta variant infections in China. *medRxiv*, Published online 2021 August 13. doi: 10.1101/2021.08.12.21261991.

88. Cavanaugh AM, Spicer KB, Thoroughman D, Glick C, Winter K. Reduced Risk of Reinfection with SARS-CoV-2 After COVID-19 Vaccination — Kentucky, May–June 2021. *MMWR Morb Mortal Wkly Rep.* 2021;70:1081-1083. doi: http://dx.doi.org/10.15585/mmwr.mm7032e1
89. Li XN, Huang Y, Wang W, et al. Efficacy of inactivated SARS-CoV-2 vaccines against the Delta variant infection in Guangzhou: A test-negative case-control real-world study [published online ahead of print, 2021 Aug 14]. *Emerg Microbes Infect*. 2021;1-32. doi:10.1080/22221751.2021.1969291.
90. Cabezas C, Coma E, Mora-Fernandez N, et al. Associations of BNT162b2 vaccination with SARS-CoV-2 infection and hospital admission and death with covid-19 in nursing homes and healthcare workers in Catalonia: prospective cohort study. *BMJ.* 2021;374:n1868. doi: 10.1136/bmj.n1868
91. Rosenberg ES, Holtgrave DR, Dorabawila V, et al. New COVID-19 Cases and Hospitalizations Among Adults, by Vaccination Status – New York, May 3-July 25, 2021. *MMWR Morb Mortal Wkly Rep.* Published online 2021 Aug 18. doi: http://dx.doi.org/10.15585/mmwr.mm7034e1.
92. Baltas I, Boshier FAT, Williams CA, et al. Post-vaccination COVID-19: A case-control study and genomic anlysis of 119 breakthrough infections in partially vaccinated individuals. *Clin Infect Dis*. Published online 2021 Aug 19;ciab714. doi: 10.1093/cid/ciab714
93. Braeye T, Cornelissen L, Catteau L, et al. Vaccine effectiveness against infection and onwards transmission of COVID-19: Analysis of Belgian contact tracing data, January-June 2021, Vaccine, 2021. Published online Aug 19, 2021. doi: https://doi.org/10.1016/j.vaccine.2021.08.060.
94. Theiler RN, Wick M, Mehta R, et al. Pregnancy and birth outcomes after SARS-CoV-2 vaccination in pregnancy. *Am J Obstet Gynecol.* Published online 2021 Aug 20. doi: 10.1016/j.ajogmf.2021.100467
95. Gomes D, Beyerlein A, Katz K, et al. Is the BioNTech-Pfizer COVID-19 vaccination effective in elderly populations? Results from population data from Bavaria, Germany. *medRxiv*. Published online 2021 August 21. doi: 10.1101/2021.08.19.21262266
96. Kislaya I, Rodrigues EF, Borges V, et al. Delta variant and mRNA Covid-19 vaccines effectiveness: higher odds of vaccine infection breakthroughs. *medRxiv*. Published online 2021 August 22. doi: 10.1101/2021.08.14.21262020
97. Cerqueira-Silva T, Oliveira VA, Pescarini J, et al. Influence of age on the effectiveness and duration of protection in Vaxzevria and CoronaVac vaccines. *medRxiv*. Published online 2021 August 27. doi: 10.1101/2021.08.21.21261501
98. Servillita V, Morris MK, Sotomayor-Gonzalez A, et al. Predominance of antibody-resistant SARS-CoV-2 variants in vaccine breakthrough cases from the San Francisco Bay Area, California. *medRxiv*. Published online 2021 August 25. doi: 10.1101/2021.08.19.21262139
99. Barchuk A, Cherkashin M, Bulina A. Vaccine Effectiveness against Referral to hospital and Severe Lung Injury Associated with COVID-19: A Population-Based Case-Control Study in St. Petersburg, Russia. *medRxiv*. Published online 2021 August 26. doi: 10.1101/2021.08.18.21262065

100. Fowlkes, A., Gaglani, M., Groover, K., Thiese, M. S., Tyner, H., & Ellingson, K. (2021). Effectiveness of COVID-19 Vaccines in Preventing SARS-CoV-2 Infection Among Frontline Workers Before and During B.1.617.2 (Delta) Variant Predominance — Eight U.S. Locations, December 2020–August 2021. *MMWR. Morbidity and Mortality Weekly Report*, *70*(34). https://doi.org/10.15585/mmwr.mm7034e4
101. Ujjainiya R, Tyagi A, Sardana V, et al. High failure rate of ChAdOx1-nCoV19 immunization against asymptomatic infection in healthcare workers during a Delta variant surge: a case for continued use of masks post-vaccination. *medRxiv*. Published online 2021 August 28. doi: 10.1101/2021.02.28.21252621
102. Sagiraju HKR, Elavarasi A, Gupta N, et al. The effectiveness of SARS-CoV-2 vaccination in preventing severe illness and death – real-world data from a cohort of patients hospitalized with COVID-19. *medRxiv*. Published online 2021 August 29. doi: 10.1101/2021.08.26.21262705
103. Seppälä Elina, Veneti Lamprini, Starrfelt Jostein, Danielsen Anders Skyrud, Bragstad Karoline, Hungnes Olav, Taxt Arne Michael, Watle Sara Viksmoen, Meijerink Hinta. Vaccine effectiveness against infection with the Delta (B.1.617.2) variant, Norway, April to August 2021. *Euro Surveill.* Published 2021 September 2. doi: https://doi.org/10.2807/1560-7917.ES.2021.26.35.2100793
104. Keehner J, Binkin N, Laurent L. Resurgence of SARS-CoV-2 Infection in a Highly Vaccinated Health System Workforce. *N Engl J Med.* Published online Sep 1, 2021. doi: 10.1056/NEJMc2112981.
105. Tareq AM, Emran TB, Dhama K, et al. Impact of SARS-CoV-2 delta variant (B.1.617.2) in surging second wave of COVID-19 and efficacy of vaccines in tackling the ongoing pandemic. *Hum Vaccin Immunother.* Published online September 2, 2021. doi: 10.1080/21645515.2021.1963601
106. Hu Z, Tao B, Li Z, et al. Effectiveness of inactive COVID-19 vaccines against severe illness in B.1.617.2 (Delta) variant-infected patients in Jiangsu, China. *medRxiv*. Published online 2021 September 5. doi: 10.1101/2021.09.02.21263010
107. Veneti L, Salamanca BV, Seppala E, et al. No difference in risk of hospitalization between reported cases of the SARS-CoV-2 Delta variant and Alpha variant in Norway. *medRxiv*. Published online 2021 September 5. doi: 10.1101/2021.09.02.21263014
108. Kertes J, Gez SB, Saciuk Y, et al. Effectiveness of the mRNA BNT162b2 vaccine six months after vaccination: findings from a large Israeli HMO. *medRxiv*. Published online 2021 September 7. doi: 10.1101/2021.09.01.21262957
109. Puranik A, Lenehan PJ, O'Horo JC, et al. Durability analysis of the highly effective BNT162b2 vaccine against COVID-19. *medRxiv*. Published online 2021 September 7. doi: 10.1101/2021.09.04.21263115
110. Murugesan M, Mathews P, Paul H, et al. Protective Effect Conferred by Prior Infection and Vaccination on COVID-19 in a Healthcare Worker Cohort in South India. *SSRN*, Published online 2021 Aug 31. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3914633.
111. Villela DAM, de Noronha TG, Bastos LS, et al. Effectiveness of mass vaccination in Brazil against severe COVID-19 cases. *medRxiv*. Published online 2021 September 15. doi: 10.1101/2021.09.10.21263084
112. McKeigue PM, McAllister D, Hutchinson SJ, et al. Efficacy of vaccination against severe COVID-19 in relation to Delta variant and time since second dose: the REACT-SCOT case-control study. m*edRxiv*. Published online 2021 September 15. doi: 10.1101/2021.09.12.21263448

2. Summary of Study Results for Post-Authorization COVID-19 Booster Dose Vaccine Effectiveness

#	Reference (date)	Country	Design	Population	Dominant Variants	History of COVID	Vaccine Product	Outcome Measure	Reference group	Booster Dose VE relative to Dose 2* % (95%CI)	Days post Booster dose	Max Duration of follow up after fully vaccinated
1	Patalon et al (August 31,2021)	Israel	Test-negative case control	149, 379 individuals ≥ 40 years with two doses only 32,697 individuals ≥ 40 years and above with three-doses	Delta^	Excluded	BNT162b2	Documented infection	Complete vaccination with two doses	79 (72-84)	14-20	3 weeks
			Matched case-control							84 (79-88)	14-20	
2	Bar-On et al (August 31,2021)	Israel	1,144,690	1,144,690	Delta^	Excluded	BNT162b2	Documented infection	Complete vaccination with two doses	92 (90- 93)	12+	3 weeks
								Severe disease		94 (91-96)		

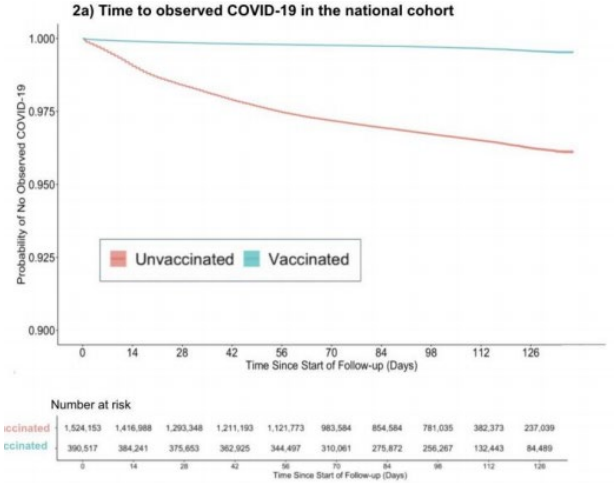
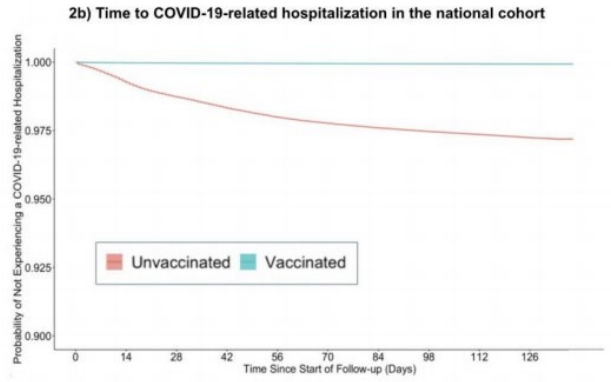
*Values >0 indicate greater effectiveness with booster dose compared to full primary series.

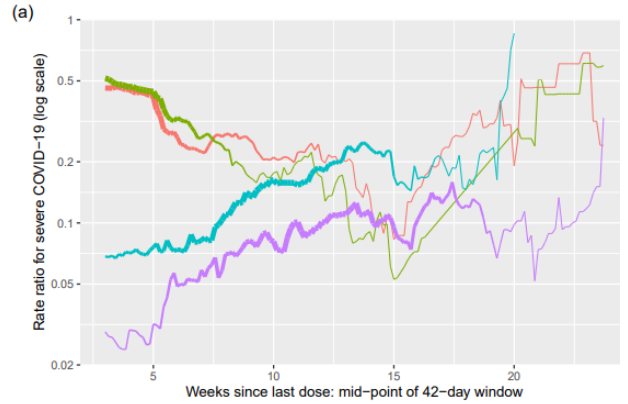
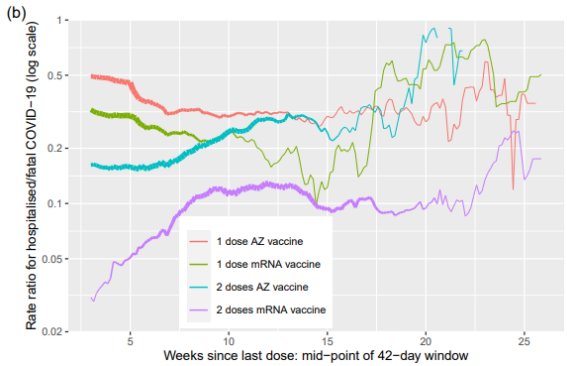
3. Duration of Protection Studies

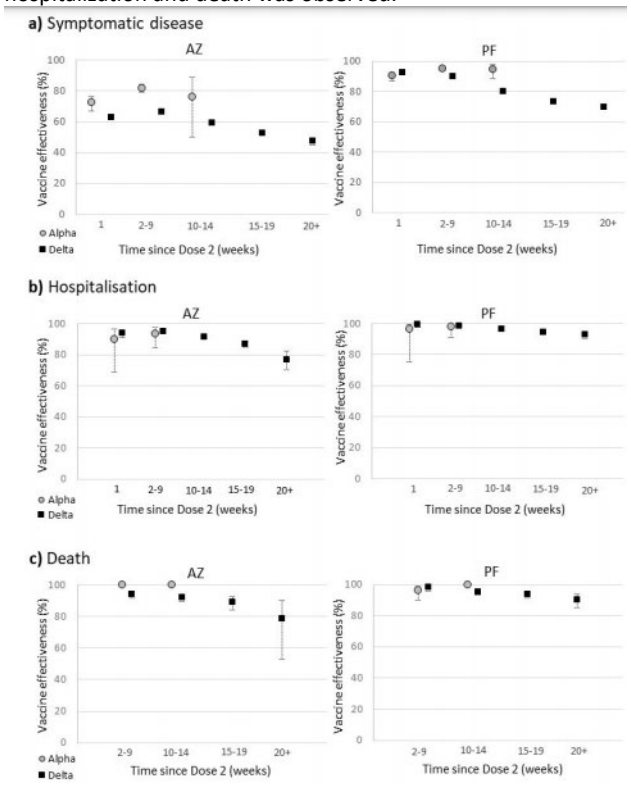
These are studies that assess duration of protection criteria as outlined above along with those studies that do not meet aforementioned criteria that are relevant to evaluating duration of protection. Some of these studies are also in the above table but duplicated here for ease.

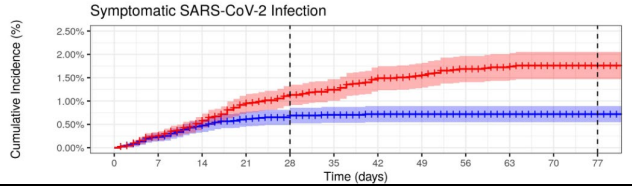
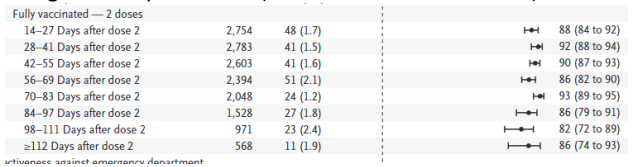
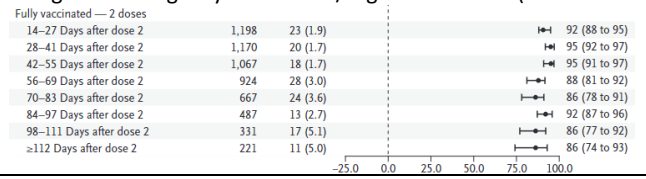
We would like to highlight

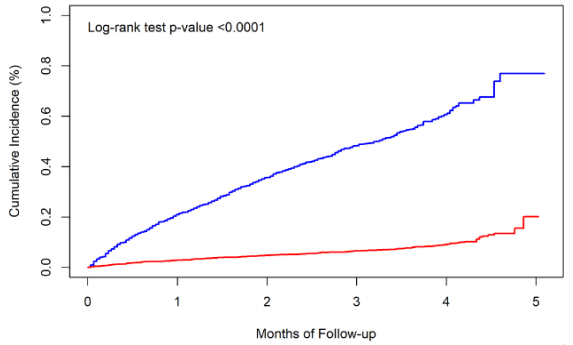
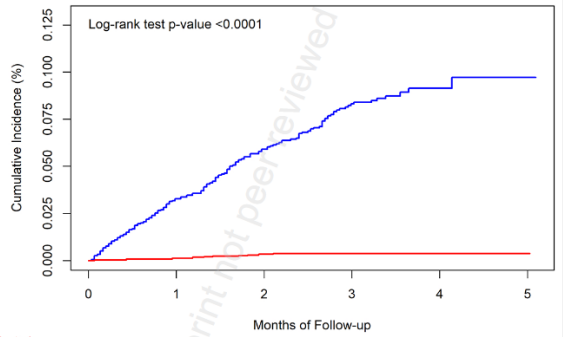
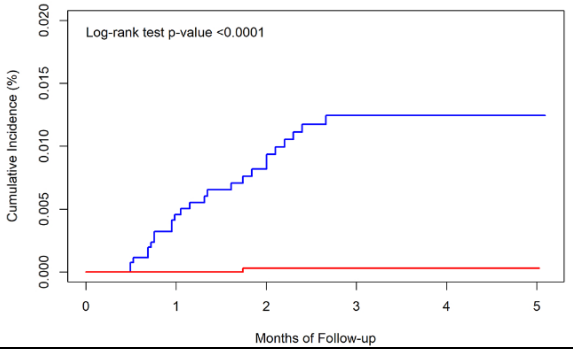
- It is currently challenging to disentangle any apparent reduction in VE over time due to waning immunity from reduction due to immune escape by the Delta variant.
- Countries have implemented different dose intervals and vaccination strategies that can make comparisons across studies challenging.
- 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.

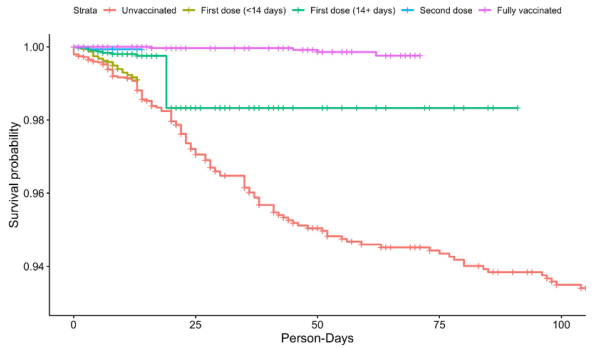
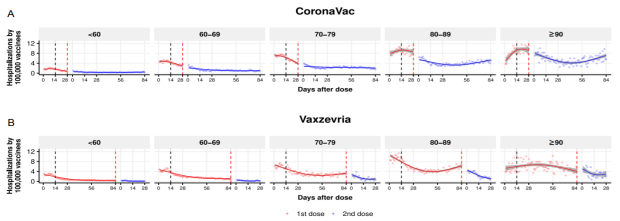
#	Reference (date)	Country	Population	Dominant Variants	Vaccine product	Study Period	Descriptive Findings
29	Polinski et al (September 12, 2021)	USA	≥18 years of age	Alpha/Delta	Ad26.COV2.S	March 1, 2021-July 31, 2021	Retrospective cohort study used insurance claims data linked to health data sources 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.  

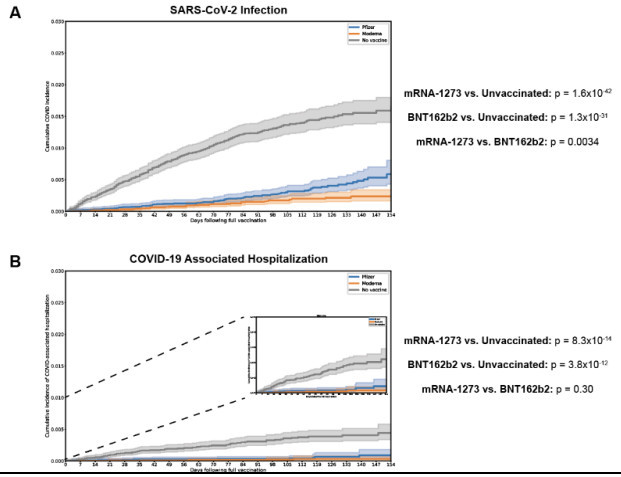
28	McKeigue et al (September 15, 2021)	Scotland	Population of Scotland	Alpha/Delta	Comirnaty mRNA-1273 AZD1222	December 1, 2020-August 19, 2021	Matched case-control study (REACT-SCOT) assessed rate ratios over time comparing rate of severe COVID-19 and the rate of hospitalization or death among thoswe full vaccinated with Comirnaty, mRNA-1273, and AZD1222 to unvaccinated persons. Rate ratios increased (effectiveness decreased) in first 2 months after second dose for all vaccines but then flattened out through 20-25 weeks post second dose:  
27	Bajeema 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 (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.  Waning was also greater for those 65+ years compared to 40-64 year-olds. Data for mRNA-1273 was only available thorugh 10-14 weeks post 2nd dose for symptomatic disease and shows high VE (90.3%) at 10-14 weeks.

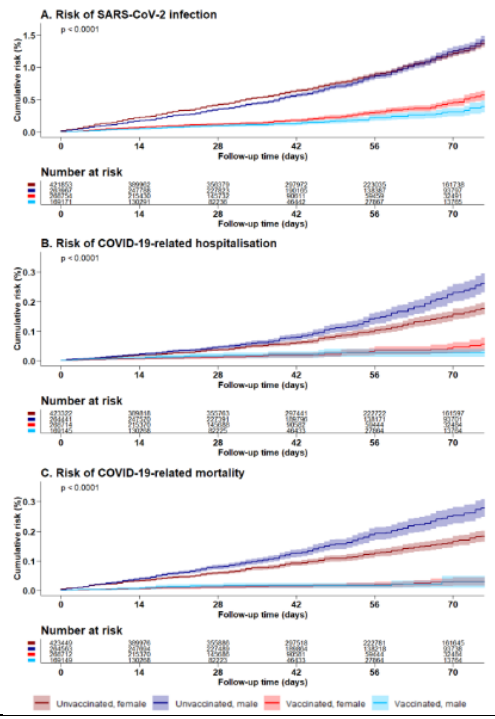
25	Dagan et al (September 9, 2021)	Israel	Pregnant women	Alpha/Delta	Comirnaty	December 20, 2020-June 3, 2021	Cohort study of pregnant women that showed no drop in VE through 56 days post dose 2 
24	Thompson et al (September 9, 2021)	USA	≥50 years of age	Multiple including alpha/delta	Comirnaty mRNA-1273 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.

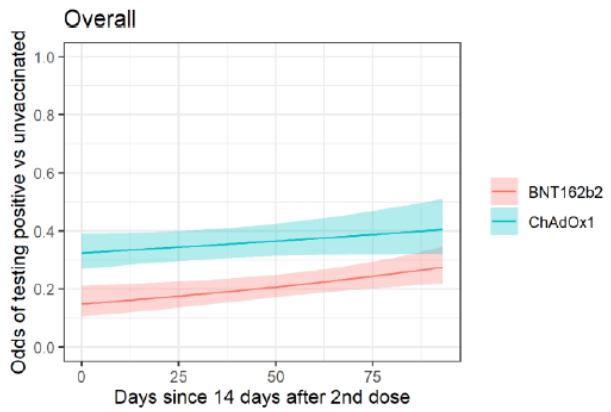
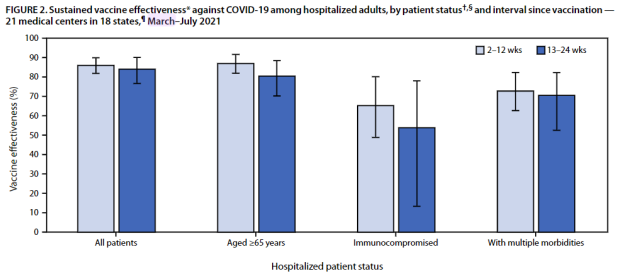
21	Bruxvoort et al (September 2, 2021)	USA	General population	Delta/alpha	mRNA-1273	December 18-June 30, 2021	Cohort study among Kaiser insurance clients. KM curves for disease, hospitalization, and death, where red are fully vaccinated and blue and unvaccinated. A. COVID-19 diagnosis  B. COVID-19 hospitalization  C. COVID-19 hospital death 
20	Iliaki et al	USA	HCW		Comirnaty mRNA-1273	December-March 31, 2021	Cohort study among HCWs. For KM curve, defintions used include 1) unvaccinated 2) "first dose <14 days" within 14 days after the 1st dose (except for those receiving

	(September 6, 2021)				Ad26.COV2.S		J&J/Janssen), 3) "first dose 14+" 14+ days after the 1st dose and prior to the 2nd dose (except for those receiving J&J/Janssen), 4) "2nd dose" < 14 days after the 2nd dose; or < 14 days after the single dose (for those receiving J&J/Janssen), and 5) "fully vaccinated" – 14+ days after receiving full course (1 or 2 doses depending on brand). 
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 (August 26, 2021)	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 wit no difference by those older/younger than 60. They do not see a difference in protection over time against severe, critical, or fatal COVID-19. VOC-specific (alpha, beta, delta) VE against severe disease is preserved across all time points. **Supplementary Table 2. Effectiveness of the BNT162b2 vaccine against any SARS-CoV-2 infection and against any severe, critical, or fatal COVID-19 disease, stratified by age (<60 years or ≥60 years).** Effectiveness against infection: Cases[1] (PCR-positive) Vaccinated / Unvaccinated; Controls[1] (PCR-negative) Vaccinated / Unvaccinated; Effectiveness in % (95% CI)[2] Effectiveness against severity: Cases[1] (Severe, critical, or fatal disease)[2] Vaccinated / Unvaccinated; Controls[1] (PCR-negative) Vaccinated / Unvaccinated; Effectiveness in % (95% CI)[2] **Age <60 years** 0-13 days after first dose: 3,997 / 137,429 / 3,819 / 137,607 / 0.0 (0.0-0.0) / 200 / 3,630 / 212 / 3,618 / 6.0 (0.0-23.3) ≥14 days after first dose and no second dose: 2,182 / 137,862 / 3,474 / 136,570 / 37.8 (34.3-41.1) / 65 / 3,651 / 235 / 3,481 / 73.6 (65.0-80.4) 0-4 weeks after the second dose: 2,925 / 139,313 / 10,139 / 132,099 / 72.6 (71.5-73.8) / 18 / 3,681 / 481 / 3,218 / 96.7 (94.8-98.1) 5-9 weeks after the second dose: 1,377 / 138,053 / 4,077 / 135,353 / 66.9 (64.8-68.9) / 9 / 3,650 / 212 / 3,447 / 96.0 (92.7-98.2) 10-14 weeks after the second dose: 833 / 137,664 / 1,909 / 136,588 / 56.7 (53.0-60.1) / 3 / 3,624 / 89 / 3,538 / 96.7 (90.1-99.3) 15-19 weeks after the second dose: 531 / 137,338 / 734 / 137,135 / 27.8 (19.1-35.5) / 4 / 3,626 / 30 / 3,600 / 86.8 (62.4-96.6) 20-24 weeks after the second dose: 575 / 137,219 / 478 / 137,316 / 0.0 (0.0-0.0) / 1 / 3,623 / 14 / 3,610 / 92.9 (53.2-99.8) ≥25 weeks after the second dose: 416 / 137,245 / 369 / 137,292 / 0.0 (0.0-2.2) / 1 / 3,631 / 7 / 3,625 / 85.7 (0.0-99.7) **Age ≥60 years** 0-13 days after first dose: 197 / 1,471 / 157 / 1,511 / 0.0 (0.0-0.0) / 49 / 352 / 39 / 362 / 0.0 (0.0-19.1) ≥14 days after first dose and no second dose: 163 / 1,487 / 185 / 1,465 / 13.9 (0.0-31.0) / 33 / 366 / 54 / 345 / 42.4 (7.0-64.7) 0-4 weeks after the second dose: 216 / 1,621 / 520 / 1,317 / 66.3 (59.7-71.8) / 14 / 397 / 117 / 294 / 91.1 (84.1-95.4) 5-9 weeks after the second dose: 235 / 1,641 / 533 / 1,343 / 63.9 (57.1-69.7) / 12 / 400 / 122 / 290 / 92.9 (86.7-96.5) 10-14 weeks after the second dose: 173 / 1,566 / 333 / 1,406 / 53.4 (42.9-61.9) / 12 / 376 / 86 / 302 / 88.8 (78.9-94.5) 15-19 weeks after the second dose: 50 / 1,490 / 91 / 1,440 / 46.6 (23.1-63.2) / 3 / 358 / 21 / 340 / 80.4 (53.8-97.4) 20-24 weeks after the second dose: 33 / 1,457 / 45 / 1,445 / 27.3 (0.0-55.3) / 0 / 348 / 7 / 341 / 100.0 (46.0-100.0) ≥25 weeks after the second dose: 67 / 1,457 / 56 / 1,468 / 0.0 (0.0-17.4) / 3 / 348 / 7 / 344 / 57.6 (0.0-93.0) Abbreviations: CI, confidence interval; PCR, polymerase chain reaction. [1]Cases and controls were matched one-to-one by sex, 10-year age group, nationality, reason for PCR testing, and calendar week of PCR test. [2]Vaccine effectiveness was estimated using the test-negative, case-control study design.[25,26] [3]Severity,[27] criticality,[1] and fatality[28] were defined as per World Health Organization guidelines.
15	Puranik et al (August 8, 2021)	USA	25K vaccinated+ 25K unvaccinated Mayo Clinic Health System clients	Alpha→Delta	BNT162b2 mRNA-1273	January-July 2021	Cohort study evaluating vaccine effectiveness against infection by month of outcome. While they did not do a true duration of protection analysis, they provided these KM curves showing cumulative incidence of infection and hospitalization over time. 
13	Tartof et al (August 23, 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]).

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Among fully vaccinated persons of all ages, protection against 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].</td></tr>
<tr><td>12</td><td>Goldberg et al (August 24, 2021)</td><td>Israel</td><td>4.8 million fully vaccinated persons; >16 and ≥40 (depending on analysis) +unvaccinated in israel</td><td>Delta</td><td>BNT162b2</td><td>July 11-July 31 2021</td><td>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 unvaccinated to calculate VE by age group and month of vaccination.
OUTCOME = Positive SARS-CoV-2 PCR test
<table><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>OUTCOME = Severe COVID-19
<table><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>11</td><td>Gomes et al (August 21, 2021)</td><td>Germany</td><td>≥80 years</td><td>Alpha</td><td>BNT162b2</td><td>January 9-April 11, 2021</td><td>Cohort study of all ≥80-year-olds living in Bavaria. Kaplan-Meier curves were generated though no VE estimate is given by time since vaccination.</td></tr>
</table>

							Fig 3. Risk of SARS-CoV-2 infection and related outcomes after two BNT162b2 vac doses in Bavarian persons aged 80 years and above. 
10	Pouwels et al (August 19, 2021)	UK	General adult population	Alpha, Delta	BNT162b2 mRNA-1273	December 1, 2020-August 1, 2020	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).

							
9	Tenforde et al (August 18, 2021)	USA	Hospitalized patients	Alpha > Delta	BNT162b2 mRNA-1273	March 11-July 14, 2021	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. 
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.

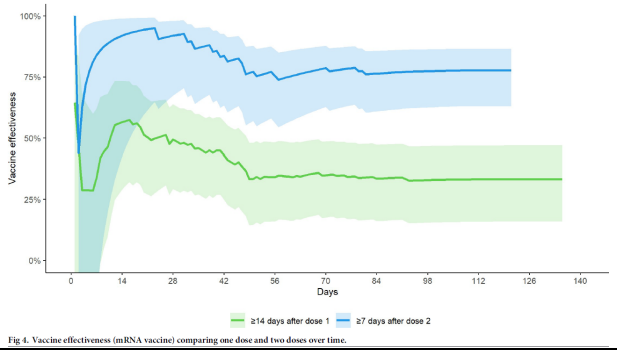
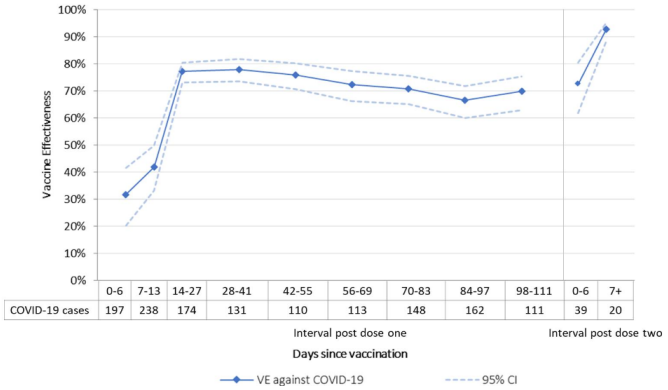
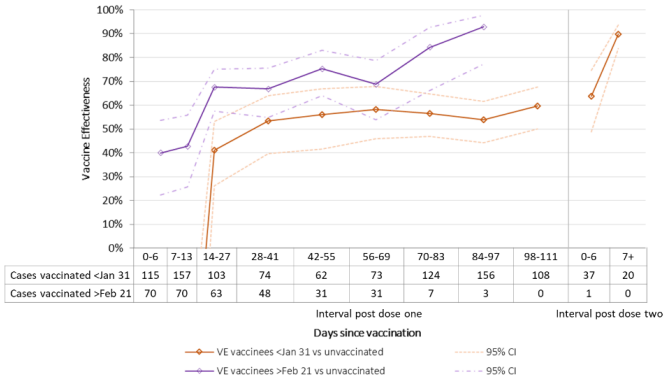
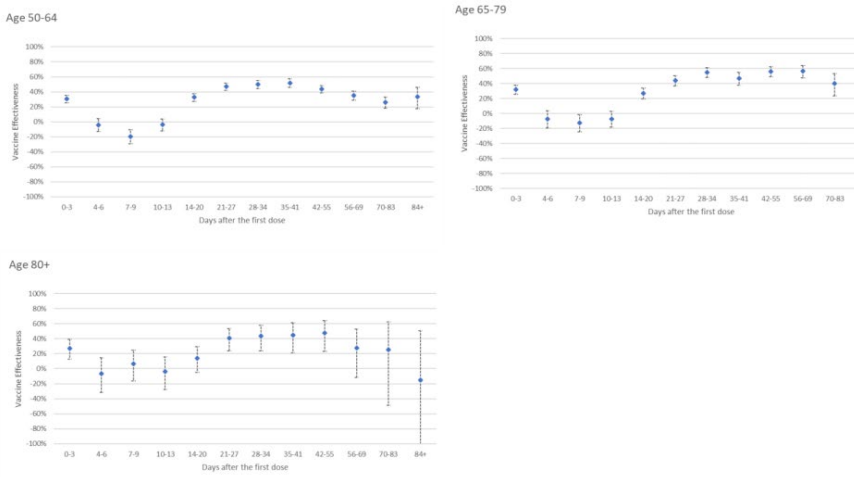
							 Fig 4. Vaccine effectiveness (mRNA vaccine) comparing one dose and two doses over time.
7	Chemaitelly et al (August 9, 2021)	Qatar	Immunosuppressed kidney transplant patients	Alpha/Beta	BNT162b2 mRNA-1273	February 1-July 21, 2021	Retrospective cohort study finding VE against infection was 73.9% (95% 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  0-6 7-13 14-27 28-41 42-55 56-69 70-83 84-97 98-111 0-6 7+ Cases vaccinated <Jan 31 115 157 103 74 62 73 124 156 108 37 20 Cases vaccinated >Feb 21 70 70 63 48 31 31 7 3 0 1 0
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 

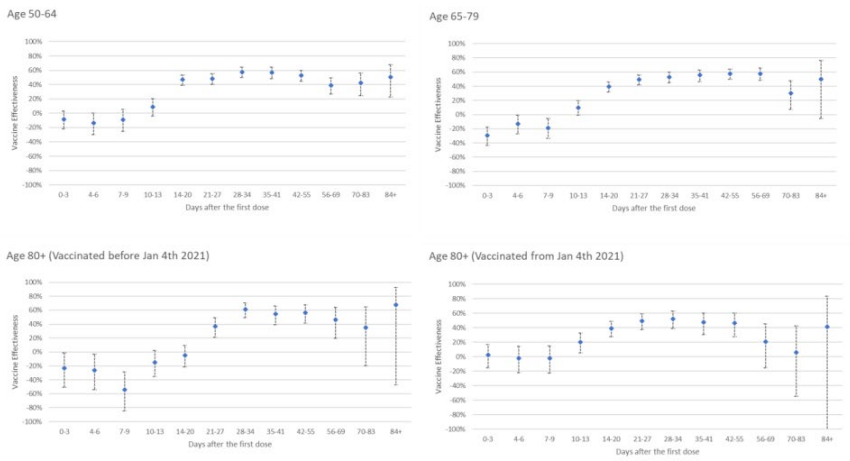
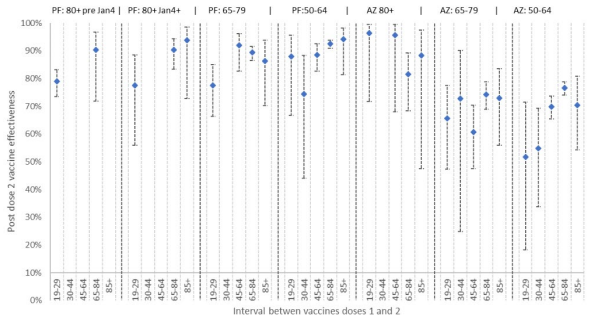
							(b) Pfizer  **Figure 4: Two dose vaccine effectiveness by age group, vaccine type and interval between doses** 
4	Public Health England Week 20 (May 20, 2021)	UK	65+ year old population	Alpha/Delta	BNT162b2 AZD1222	December-May 2021	This is a test-negative case control study linking surveillance and vaccination data from administrative databases. Comparisons for the first dose are made to unvaccinated, while comparisons for the second dose are made to 4-13 days post dose 2 to account for underlying differential risk between unvaccinated and vaccinated groups. AZD1222 post dose 1 not have any evidence of waning, while for BNT162b2 there is a slight increase in the odds of symptomatic disease at day 70+.

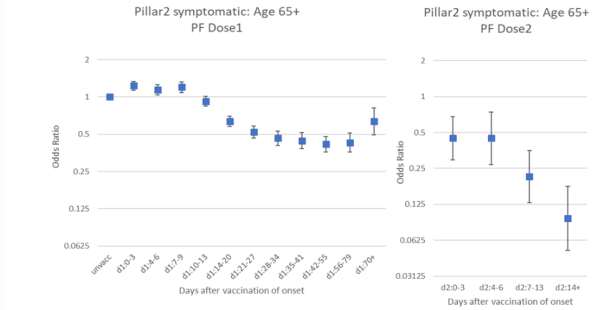
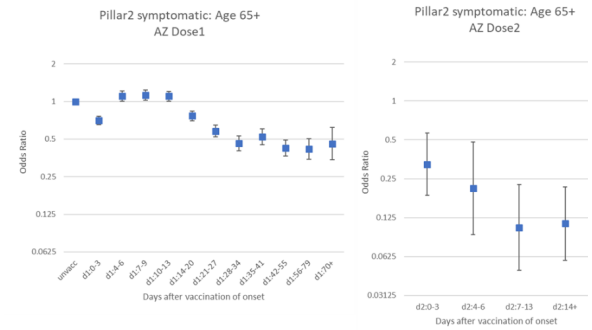
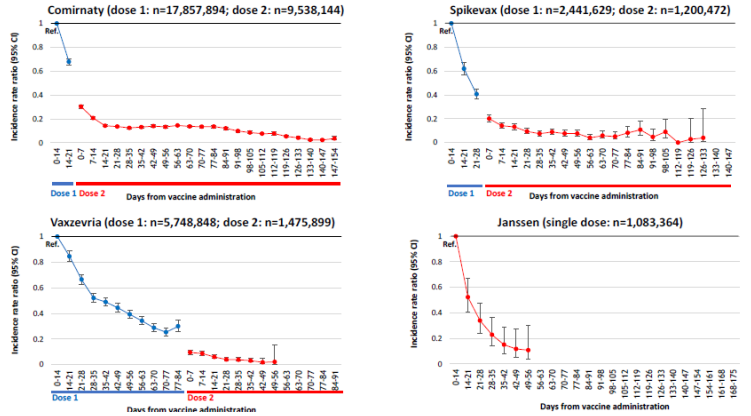
							Figure 1: Odds ratios for becoming a case by days after vaccination – Dose 1 and Dose 2 (Pfizer-BioNTech) among individuals aged 65 years and older  **Figure 2: Odds ratios for becoming a case by days after vaccination – Dose 1 and Dose 2 (AstraZeneca) among individuals aged 65 years and older** 
3	Italian 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

4. Summary of Study Results for Post-Authorization COVID-19 Vaccine Effectiveness Against Transmission§

#	Reference (date)	Country	Design	Population	Dominant Variants (Alpha=B.1.1.7 Beta=B.1351 Gamma=P.1 Delta=B.1617.2	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
7	Braeye et al (August 19,2021)	Belgium	Retrospective cohort	131,283 index cases	Alpha^	Included	BNT162b2 mRNA-1273	Transmission	— —	—	62(57-67) 52(33-69)	14+	~20 weeks
6	de Gier et al* (August 5, 2021)	Netherlands	Retrospective cohort	113,582 index cases (aged 18+) and 253,168 household and other close contacts (all ages)	Alpha^	Unknown	AZD1222 BNT162b2 mRNA-1273 Ad26.COV2.S	Transmission to any household contacts (adjusted for contact vaccination status)	15 (4-26) 26 (12-37) 51 (8-74) 77 (6-94)	14+‡	58 (−12-84) 70 (61-77) 88 (50-97) —	7+	~15 weeks
5	Layan, Gilboa et al (July 16,2021)	Israel	Prospective cohort	215 index cases and 687 household contacts from 210 Israeli households	Original and Alpha¶	Included	BNT162b2	Transmission to HHC by vaccinated vs. unvaccinated cases	—		78(30-94)	7+	~12 weeks
4	Prunas et al (July 16, 2021)	Israel	Retrospective cohort	253,564 Israeli individuals from 65,264 households with at least 1 infected individual and at least 2 members	Original and Alpha¶	Unknown	BNT162b2	Infectiousness given Infection Transmission	—	—	41.3(9.5-73.0) 88.5(82.3-94.8)	10+	
3	Harris et al* (June 23, 2021) *[Update to Apr 28 preprint]*	UK	Retrospective cohort, case-control	970,128 household contacts of index case (unvaccinated, vaccinated with AZD1222 or BNT162b)	Alpha£	Unknown	AZD1222 BNT162b2	Documented infection	48(38-57) 46(38-53	>21 days after dose 1, including some with dose 2	—		

#	Reference (date)	Country	Design	Population	Dominant Variants (Alpha=B.1.1.7 Beta=B.1351 Gamma=P.1 Delta=B.1617.2	History of COVID	Vaccine Product	Outcome Measure	1st Dose VE % (95%CI)	Days post 1st dose	2nd Dose VE % (95% CI)	Days post 2nd dose	Max Duration of follow up after fully vaccinated
2	Salo et al (July 10, 2021) *[Update to May 30 preprint]*	Finland	Retrospective cohort	HCW and their unvaccinated spouses	Alpha††	Excluded	BNT162b2 & mRNA-1273	Documented infection in HCW's unvaccinated spouses	8.7 (-28.9-35.4)	2 weeks	—		*10 weeks since dose 1
								Documented infection in HCW's unvaccinated spouses	42.9 (22.3-58.1)	10 weeks (combo of 1+2 dose recipients)	—		
1	Shah et al. (Mar 11, 2021)	UK - Scotland	Retrospective Cohort	144,525 healthcare workers (HCWs) and 194,362 household members	original & Alpha£	excluded	BNT162b2 & AZD1222	Household members of HCWs: Documented infection[2]	30 (22-37)	≥14	54 (30-70)	≥14	

§Study results captured during literature search of vaccine effectiveness studies. Note this is not an exhaustive list of transmission studies.
Purple text indicates new or updated study.
Product Manufacturers: BNT162b2 (Pfizer), mRNA-1273 (Moderna), AZD1222 (Astra-Zeneca), Ad26.COV2.S (Janssen), Coronavac
±Unless noted otherwise, days post 1st dose are prior to receiving dose 2.
‡Unclear if 1st dose VE estimates includes any individuals who received a second dose.
*Manuscripts with an asterisk (*) are peer-reviewed publications.
^Indicates predominant variant identified by study authors. If no ^ then variants identified through secondary source when possible. Please see additional footnotes.
¶The rise of SARS-CoV-2 variant Alpha in Israel intensifies the role of surveillance and vaccination in elderly | medRxiv
£Coronavirus (COVID-19) Infection Survey, UK - Office for National Statistics
††Based on https://outbreak.info/location-reports

5. Vaccine Impact: Summary of Ecologic Study Results for Post-Authorization COVID-19 Vaccine Products[#]

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
51	Scobie et al (September 10,2021)	USA	Retrospective cohort	Adults ≥18 years from 13 US jurisdictions.	Delta^	BNT162b2, mRNA-1273, and Ad26.COV2.S	This study analyzed rates of COVID-19 cases, hospitalizations and deaths in adults ≥ 18 years during the period of April 4 to July 17, 2021 across 13 US jurisdictions. The weekly prevalence of the SARS-CoV-2 Delta variant increased from <1% to 90% during the study period. Averaged weekly, age-standardized rates (per 100,000) were higher among unvaccinated and partially vaccinated than among fully vaccinated persons for reported cases (112.3 versus 10.1), hospitalizations (9.1 versus 0.7), and deaths (1.6 versus 0.1) during April 4–June 19, as well as during June 20–July 17 (89.1 versus 19.4; 7.0 versus 0.7; 1.1 versus 0.1, respectively). Higher hospitalization and death rates were observed in older age groups, regardless of vaccination status, resulting in a larger impact of age-standardization on overall incidence for these outcomes.
50	Delahoy et al (September 10, 2021)	USA	Retrospective cohort	Hospitalized children and adolescents aged 0-17 years from 14 US states	Delta^	BNT162b2	This retrospective cohort study analyzed data from the COVID-NET surveillance system to describe COVID-19–associated hospitalizations from March 1, 2020 to August 14, 2021. The cumulative incidence of hospitalization during the entire study period was 49.7 per 100,000 children and adolescents. During June 20–July 31, 2021 which coincided with a rising prevalence of the Delta variant, the hospitalization rate among unvaccinated adolescents (aged 12–17 years) was 10.1 times higher than that among fully vaccinated adolescents. Hospitalization rates were comparatively higher among children aged 0-4 years. Among all hospitalized children and adolescents with COVID-19, the proportions with indicators of severe disease (such as intensive care unit [ICU] admission) during the period of Delta variant were similar to those earlier in the pandemic (March 1, 2020–June 19, 2021).
49	Isitt et al (September 7, 2021)	Sweden	Retrospective cohort	58,174 Long Term Care Facility (LTCF) residents, 62,306 adults aged 80+, and 1,748,657 adults aged 18-79 in Region Stockholm	Alpha††	BNT162b2, mRNA-1273, and AZD1222	This study compared pre- and post-vaccination incidence rate ratios (IRR) of SARS-CoV-2 infections and deaths among groups of adults in Region Stockholm and estimated infections and deaths prevented by vaccination through May 2, 2021. The vaccinated groups included LTCF residents or adults receiving home care (beginning December 27, 2020),

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							and adults aged 80+ (beginning March 8). At least 80% of these groups had received at least one dose by 4 weeks after the start of vaccination, and the majority received mRNA vaccines. Compared to the unvaccinated control group (adults aged 18-79), the IRR for infection in the LTCF/home care group fell from 1.70 in the pre-vaccination period (95% CI 1.54-1.88) to 0.59 postvaccination (0.49-0.71), while the IRR in the 80+ cohort fell from 0.38 (0.33-0.44) to 0.17 (0.09-0.27) (3112 infections prevented).. The IRR for death also decreased in both groups compared to the control group: from 179 pre-vaccination (146-221) to 45 postvaccination (35-59) in the LTCF/home care group, and from 20 pre-vaccination (16-26) to 9 post-vaccination (5-18) in the 80+ cohort (808 deaths prevented).
48	Pritchard et al (September 5, 2021)	United Kingdom	Longitudinal household survey	482,677 individuals (aged 2+) from a randomly selected, representative sample of private households in the UK	Non-VOC^ (before December 2020), Alpha^ (December 2020-May 2021), and Delta^ (June-July 2021)	AZD1222, BNT162b2, mRNA-1273	This longitudinal household survey included PCR results from swabs and questionnaires collected between 19 July 2020 and 17 July 2021 in the UK's national COVID-19 Infection Survey. The authors estimated associations between test positivity and 60 demographic and behavioral characteristics—including vaccination—using logistic regression. After national vaccine rollout began in December 2020, there was a large, sustained reduction in positivity among vaccinated individuals relative to unvaccinated individuals (no OR available). Positivity rates in June-July 2021 (Delta predominance) were higher among unvaccinated relative to vaccinated groups.
47	Jablonska et al (September 3, 2021)	Europe/Israel	Time-series analysis	General populations of 32 countries in Europe/Israel	Alpha^	AZD1222 and BNT162b2	This study is a time-series analysis that aimed at estimating the real-life impact of vaccination on COVID-19 mortality with adjustment for variants and other factors in 32 countries across Europe and Israel. The time-series analysis, performed using non-linear Poisson mixed regression models, revealed that vaccination efficacy regarding protection against death was 72% with a lower reduction for variants (70% reduction and 78% reduction for Alpha and other non-alpha variants, respectively). Neutralization titers against the Alpha variant were 3.3-fold and 2.5-fold lower for Pfizer and AstraZeneca vaccines, respectively.

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
46	Esquenazi et al (September 2, 2021)	USA	Retrospective cohort	Healthcare workers in an inpatient rehabilitation facility	Alpha and Beta^	BNT162b2	This report summaries the comparative results and experiences of an inpatient rehabilitation facility during the COVID-19 pandemic before and after the Pfizer vaccine was given to staff. This report demonstrated the rate of infection and protective advantage of healthcare workers, with a significant reduction in the rate of infection. Prior to vaccination, the infection rate among inpatient staff was reported as 23% and dropped to 2.5% after vaccination.
45	Havers et al (August 29,2021)	USA	Retrospective Cohort	General population	Delta^	BNT162b2, mRNA-1273, and Ad26.COV2.S	This study is a cohort study that utilizes surveillance data from COVID-NET to examine characteristics associated with breakthrough cases. Multivariable logistic regression was used to examine the factors associated with vaccine breakthrough cases; the models included age, race, Hispanic ethnicity, long-term care facility residence, and prevalence of underlying medical conditions. The association between vaccination and severe COVID-19 (defined as ICU admission or in-hospital death) was also examined. From January 1, 2021 to June 30, 2021 fully vaccinated cases increased from 1 (.01%) to 321 (16.1%) per month. Among 4,732 sampled cases, fully vaccinated persons admitted with COVID-19 were older compared to unvaccinated persons, more likely to have 3 or more underlying medical conditions, and be residents of long-term care facilities.
44	Griffin et al(August 27,2021)	USA	Retrospective cohort	9,651,332 Los Angeles County residents	Delta^	BNT162b2, mRNA-1273, and Ad26.COV2.S	This study estimated the age-adjusted infection and hospitalization rates amongst vaccinated and unvaccinated residents of Los Angeles county from May 1- July 25 2021. Overall, the proportion of individuals hospitalized, required admission to intensive care and required ventilation were lower in fully vaccinated individuals compared to partially vaccinated and unvaccinated individuals. Among all Los Angeles County residents, the age-adjusted 7-day incidence and hospitalization rates increased exponentially among unvaccinated, fully vaccinated, and partially vaccinated persons, with the highest rates among unvaccinated persons in late June. The authors noted that in the month of July with a predominance of Delta variant, the cycle threshold values were similar for unvaccinated, partially vaccinated and fully vaccinated.

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
43	Kissler et al (Aug 25, 2021)	USA	Convenience sample (prospective)	173 individuals with SARS-CoV-2 infection among staff and players affiliated with the National Basketball Association (NBA)	Alpha, Delta, Non-VOC^	BNT162b2, mRNA-1273, and Ad26.COV2.S	This study evaluated SARS-CoV-2 infections among players and staff affiliated with the NBA between November 28, 2020 and August 11, 2021. The authors compared viral proliferation, viral clearance, and peak viral concentration between vaccinated and unvaccinated cases, as well as among other subgroups. There was no observed significant difference in mean peak viral concentration or viral proliferation duration between vaccinated and unvaccinated individuals. Breakthrough infections (among fully vaccinated) had a faster viral clearance time relative to unvaccinated cases [5.5 days (95% CI 4.6-6.5) vs. 7.5 days (95% CI 6.8-8.2)], resulting in a shorter duration of infection (8.7 days vs. 11 days). The authors found no difference in viral trajectories between those who received BNT162b2 and those who received Ad26.COV2.S (viral trajectories of mRNA-1273 were not assessed due to small sample size).
42	Harris et al (Aug 20, 2021)	USA	Ecologic	General populations of the 112 most populous counties in the US (147 million persons total)	Delta^	BNT162b2, mRNA-1273, and Ad26.COV2.S	This study looked at the relationship between vaccination coverage—using the percent of the county population that was fully vaccinated as of mid-July—and COVID-19 incidence and hospitalization between July 30-August 12. When comparing the 50% of counties with the lowest vaccination coverage to the 50% of counties with the highest (mean coverage 42.61% versus 57.3%), counties with lower coverage experienced significantly higher COVID-19 incidence and hospitalization rates (incidence: 543.8 versus 280.7 per 100,000; hospitalizations: 55.37 versus 20.48 per 100,000). Log-linear regression analysis revealed that an increase of 10 percentage points in vaccination coverage was associated with a 28.3% decrease in COVID-19 incidence, a 44.9% decrease in hospitalizations, and a 16.6% decrease in hospitalizations per 100 cases.
41	Escobar-Agreda et al (August 5, 2021)	Peru	Survival analysis	998,295 adults aged 18-59 with SARS-CoV-2 infection in Peru	Non-VOC††	Sinopharm	This study assessed the survival of healthcare workers (HCWs) infected with SARS-CoV-2 in periods before and after vaccination by comparing the hazard of death in the second wave of SARS-CoV-2 transmission (2021, just before and during vaccination) to the first wave (2020, pre-vaccination). At the start of the second wave (before vaccination), the hazard of

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							death among infected HCW was twice the hazard of death in the first wave (HR=2). After vaccination began in February, the hazard ratio decreased over time, reaching 0.125 as of 3.5 months after the start of vaccination among HCW. The authors also compared survival among infected HCW to survival of infected members of the general population (who were unvaccinated at the time) during the second wave. Survival was greater among infected HCW than those infected in the general population, particularly starting 14 days after the administration of dose 2 among HCW began (March 15 onward).
40	Lakhia et al (August 3, 2021)	India	Retrospective cohort	229 adult patients (>17 y) with confirmed or suspected COVID-19 who received a high-resolution CT scan at a radiology practice in Ahmedabad, India	Delta^	AZD1222 (SII) and COVAXIN	This study evaluated the impact of vaccination on lung involvement among 205 confirmed COVID-19 cases (positive RT-PCR or antigen test) and 24 suspected cases (classic symptoms but negative RT-PCR) who received a CT scan between April-July, 2021 at an independent radiology practice. Lung involvement was assessed by CT severity score (CT-SS), with higher scores corresponding to more severe cases. Of confirmed cases (n=205), 14% were fully vaccinated, 15% were partially vaccinated, and 71% were unvaccinated or within 14 days of dose 1. The CT-SS was significantly lower in fully vaccinated confirmed cases relative to partially or unvaccinated confirmed cases (median 0 vs. 4 vs. 11, p=0.02). Multivariable linear regression revealed that higher age and a positive RT-PCR test were associated with higher CT-SS, while partial or full vaccination was associated with lower CT-SS compared to unvaccinated patients.
39	Banho et al (July 31,2021)	Brazil	Retrospective cohort	Residents of São José do Rio Preto, northeast region of the state of São Paulo	Gamma	AZD1222 and CoronaVac	This retrospective study was conducted between October 2020 to June 2021 to report the spread of the P.1(Gamma) variant in São José do Rio Preto, Brazil, and study the association of the Gamma variant with a change in the epidemiological profile, with increased numbers of severe COVID-19 cases and deaths, especially in the unvaccinated population. Following P.1 introduction, a rapid increase in prevalence was observed, reaching more than 96% of the sequenced genomes from March to June. There was a marked increase in mortality as variant P.1 became dominant increasing by 162% (95% CI: 127,

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							214) when comparing July-September 2020 to March-April 2021. Vaccination with CoronaVac vaccine and AstraZeneca was associated with a moderate reduction in the number of cases (best-fit slope –0.21, 95% CI: –0.03, –0.39). However, it was associated with a pronounced reduction in severe cases (–0.55, 95% CI: –0.34, –0.76) and deaths (–0.58, 95% CI: –0.39, –0.77)
38	Pezzotti et al (July 27, 2021)	Italy	Retrospective cohort	General population	Unknown	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This study was undertaken by obtaining data from the National Vaccination Registry of the Ministry of Health for Italy, and included all Italian persons receiving one dose of any authorized COVID-19 vaccine from 27the December, 2020. The study estimated the incidence rate of SARS-CoV-2 infection and subsequent hospitalizations, admission to an ICU, and death. It is observed that the the incidence of COVID-19 diagnoses declined from 1.19 per 10,000 person-days in the first 14 days after the first dose to 0.28 in completely vaccinated persons. The hospitalization rate in vaccinated persons before 16 May 2021 decreased from 0.27 per 10,000 person-days in the first 14 days after the first dose to 0.03 in those completely vaccinated. The mortality rate in vaccinated persons before 16 May 2021 varied from 0.08 per 10,000 person-days in the first 14 days after the first dose to 0.01 in completely vaccinated persons.
37	Núñez López et al (July 27, 2021)	Spain	Prospective cohort	8329 HCW from La Paz University Hospital in Madrid	Non-VOC, Alpha††	BNT162b2	This prospective observational study was conducted between January 12, 2020 and July 3, 2021, comparing the incidence and prevalence of COVID-19 infections among HCW from the hospital before and after vaccination of the cohort. Vaccination occurred between January 10-19, 2021 (dose 1) and February 1-9 (dose 2) for about 90% of the HCW. Starting about 2 weeks after the first round of vaccinations, daily incidence of COVID-19 among HCW dropped substantially and reached 0 as of 8 days after the administration period of the second dose. Further positive cases among HCW during the study period occurred only among partially vaccinated or unvaccinated HCWs, and were minimal. Additionally, prior to vaccination of HCWs, the trend in the prevalence of COVID-19 infection among HCWs was

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							approximately parallel to the trend in the prevalence of COVID-19 patients hospitalized in the same hospital. As of two weeks after the first round of vaccination, the curves began to diverge.
36	Bobdey et al (July 26, 2021)	India	Retrospective cohort	3196 employees and students of a tertiary care institute in Maharashtra	Non-VOC, Delta††	AZD1222 (SII)	One analysis in this study compared the secondary attack rates of COVID-19 among High Risk Contacts of cases during the pre-vaccination period (Jun-Oct 2020) versus during the post-vaccination study period (1 Feb-25 April, 2021). High Risk Contacts included people from the institute who live in the same dormitory and use the same bathrooms as confirmed cases. There were three cases from three different dormitories during the study period considered for the analysis. Two secondary cases occurred, resulting in a Secondary Attack Rate (SAR) of 4.25% during the post-vaccination period, significantly lower than the SAR of 21.42% in the pre-vaccination period ($p<0.05$).
35	Sakre et al* (July 26, 2021)	India	Ecologic	179,215 Healthcare Workers (HCW) and Frontline Workers (FLW) of the Indian Air Force	Delta††	AZD1222 (SII)	This cross-sectional study compared SARS-CoV-2 outcomes in fully vaccinated, partially vaccinated, and unvaccinated HCW/FLW from the Indian Air Force from April 1-30, 2021, a period of high transmission. By April 30, 87.6% of HCWs/FLWs in this population had received both doses of Covishield (AZD122- SII), while 10.4% had received one dose and 1.99% had received no dose. April 1-30, 2021. Prevalence of infection was much higher among the unvaccinated compared to fully vaccinated (42.05 vs. 5.41 per 1000 people). Of the recorded COVID-19 related deaths, (n=10), 60% were among unvaccinated HCW/FLW, while 20% were among partially and fully vaccinated HCW/FLW respectively. Of the 22 severe COVID-19 cases, 9% were fully vaccinated while 77% were unvaccinated.93% of fully vaccinated cases remained asymptomatic compared to only 18.7% of unvaccinated cases.
34	Paetzold et al (July 24, 2021)	Austria	Retrospective cohort	General population aged 16 years and above.	Alpha and Beta^	BNT162b2	This study used Synthetic Control Method(SC) and difference-in-difference (DID) design to measure the impact of a rapid mass vaccination campaign on the number of infections, circulation of VoCs, hospitalizations, and intensive care unit admissions. The study reported that after four months post dose 1, there is a statistically significant difference in daily infections accounting for a reduction of 53.6%. The

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							incidence of documented infections by age group followed the age gradient of the vaccination plan in an inverse relationship. In cases of hospitalization, the authors noted a 78% reduction after 11 weeks amongst recipients of Dose 1. For ICU admissions, the reduction noted was 31%.
33	Pastorino et al (July 23, 2021)	Multiple	Ecologic	General population from 40 countries	Unknown	Not specified	This study collected data on COVID-19 deaths reported from countries that had publicly available age-stratified data till end of May,2021 to estimate the proportion of COVID-19 deaths in the age group 0-69 compared to two pre-vaccination control periods. In total, 40 countries were included for the analysis. The proportions of COVID-19 deaths that occurred in people 0-69 years old were relatively lower in high-income countries. The data showed that the use of COVID-19 vaccines was associated with a marked change in the age distribution of COVID-19 deaths in the first 5 months of 2021.
32	Liang et al (July 17, 2021)	Multiple	Ecologic (Quasi-experimental)	General populations of 90 countries (about 6.4 billion people)	Unknown	Not specified	This study explored how vaccination coverage impacts COVID-19 case fatality ratios (CFRs, defined as total deaths attributed to COVID-19 per 100 confirmed cases) using a longitudinal dataset of 90 countries from November 2020 through the third week of April 2021. On average, it found that a 10% increase in vaccination coverage (total number of people who received at least one vaccine dose per 10 in the total population) was associated with a 7.6% reduction in CFR (95% CI -12.6- -2.7) after adjusting for country characteristics and nonpharmaceutical interventions. Further analyses showed that this relationship was significant only in countries with high government effectiveness and high-quality transportation infrastructure, and only after coverage reached 0.8 per 10 people.
31	Yassi et al* (July 16, 2021)	Canada	Ecologic	25,558 HCW and general adult population of Vancouver, Canada	Alpha and Gamma^	BNT162b2 and mRNA-1273	This study aimed to assess the risk of COVID-19 infection in HCWs compared to the general population and the impact of vaccination on COVID-19 infection in HCWs in Vancouver throughout the pandemic (March 2020-May 13, 2021). Vaccination began in mid-December and was available and rolled out much faster for HCWs than for the general population. By the end of the study period, 86.5% of HCWs had received at least one dose of vaccine and

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							28.7% had received both doses, whereas only about 50% of the general public had received at least one dose. Before the rollout of vaccination, infection rates among HCWs and the general population were similar. After vaccination began, however, infection rates and positivity rates among HCWs dropped well below those of the public, even as VOCs became dominant (by mid-May, Alpha and Gamma comprised more than 92% of cases in Vancouver compared to <1% in February). Additionally, adjusted infection rates among partially and fully vaccinated HCWs were 37.2% and 79.2% lower respectively relative to unvaccinated HCWs (Dec-May).
30	Mor et al (July 23,2021)	Israel	Retrospective cohort	596 cases and 2515 controls	Beta	BNT162b2	This study was undertaken from information retrieved from the Israeli Ministry of Health database, and included vaccinated and unvaccinated cases that were positive for either the B.1.1.7 variant or B.1.351 variant. The matching was done with one single vaccinated case matched to one or up to 10 unvaccinated cases on a number of key variables. The study calculated the VE against Beta variant, assuming that the vaccine efficacy against the Alpha variant is 95%. The VE against the beta variant was estimated to be 93%(CI: 87%-97%).
29	Alencar et al (July 13,2021)	Brazil	Retrospective cohort	313,328 elderly people(75+) from Ceara, north-east Brazil	Unknown	AZD1222 and CoronaVac	This study used data from National Mortality System (SIM) and from the Immunization Program (SIPNI) between 17 January and 11 May 2021, for people aged 75 years and above to evaluate the impact of COVID-19 vaccinations on reducing the total number of deaths. The mortality rate among the unvaccinated elderly was more than 132 times higher, as compared to those who had received two doses of a vaccine, with a protection ratio for deaths of 99.2%.
28	Visci et al (July 20,2021)	Italy	Retrospective cohort	20,109 HCWs and 4,474,292 residents	Unknown	BNT162b2 (majority) and mRNA-1273 and AZD1222(limited)	This retrospective cohort study included HCWs in Italy from March 9, 2020 to April 4, 2021. The study aimed to assess the patterns of SARS-CoV-2 infections in HCWs compared to the general population and to evaluate the impact of vaccination. In order to calculate the change in test positivity ratios amongst the general population and HCWs for each week, the authors conducted Joinpoint analyses. The results show a significant decrease in the ratio of positive tests in the general population from the end of

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							January and amongst HCWs from the end of December 2020, indicating the impact of vaccination.
27	Mateo-Urdiales et al (July 7,2021)	Italy	Retrospective cohort	Healthcare workers	Unknown	BNT162b2 (majority) and mRNA-1273 and AZD1222(limited)	This retrospective cohort study was undertaken to describe the impact of vaccination on SARS-CoV-2 infections among HCWs aged 20-65 years. From 21st of December to 28th March, 2,977,506 doses of vaccines were administered in the study population. The total proportion of cases and symptomatic cases reported amongst HCWs, after adjusting, showed a sustained decrease beginning approximately one month after vaccination started. By the end of March 2021, there was a 74% reduction in the proportion of all cases amongst HCWs and an 81% reduction in the proportion of symptomatic cases amongst HCWs compared to September 2020.
26	Waldman et al* (July 21, 2021)	USA	Retrospective cohort	16,156 faculty, students, and staff at an academic medical center	Original and Alpha ††	BNT162b2 and mRNA-1273	This retrospective cohort study assessed the impact of vaccination on the incidence of SARS-CoV-2 infection, hospitalization, and mortality among faculty, students, and staff at the University of California Davis medical center. COVID-19 incidence decreased from 3.2% during the 8 weeks before vaccination began to 0.38% 4 weeks after the start of vaccination. A single dose of either vaccine reduced the hazard of testing positive by 48% (HR=0.52, CI 0.40-0.68) and the positivity rate for SARS-CoV-2 14+ days after the second dose was 0.04%. There were no hospitalizations or deaths among fully vaccinated (14+ days after dose 2) HCWs who tested positive.
25	Shacham et al (July 5, 2021)	USA	Ecologic	Residents of 115 counties and 2 cities in Missouri	Unknown	Unspecified (BNT162b2, mRNA-1273, Ad26.COV2.S available)	Ecologic study evaluating the relationship between the cumulative proportion of residents vaccinated and weekly incidence of COVID-19 by location in 115 counties and 2 cities in Missouri (total n=117 locations) from January 4 to June 26, 2021 (25 weeks). The relationship was found to likely be linear during the study period and was adjusted for other variables related to COVID-19 (population, proportion of nonwhite residents, median household income, proportion of residents in public-facing occupations). The final adjusted linear model showed the relationship was significant, with every percent increase in population vaccinated resulting in 3 fewer weekly COVID-19 cases (β -3.74, p<0.001). Locations with higher proportions of nonwhite residents were

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							also likely to experience lower weekly incidence of COVID-19 after adjusted for other variables (β -1.48, p=0.037).
24	Greene, Sharon et al (July 5,2021)	USA	Regression discontinuity	1,101,467 65-84-year-old NYC residents	Unknown	BNT162b2 and mRNA-1273	A regression discontinuity study comparing the rate of hospitalization and deaths among 65-84 year-olds during an 8-week post-implementation phase of SARS-CoV-2 vaccines in New York City with the pre-implementation period, controlling for the epidemic trend among 45-64-year-olds, a group without concurrent age-based vaccine eligibility. It is observed that hospitalization rates among 65-84 year-olds during the post-implementation period had a statistically significant decrease as compared to the pre-implementation period with a RR of 0.85(95% CI 0.74-0.97). Similar decrease in death rates was observed during the post-implementation period but this finding was not statistically significant (RR 0.85, 95% CI: 0.66–1.10, P = 0.22).
23	Victora et al (July 15,2021) [*Update to June 19 preprint]*	Brazil	Ecologic	Brazilian population	Gamma	AZD1222 and CoronaVac	Calculated proportionate mortality of COVID-19 deaths at ages 70-79 and 80+ and COVID-19 age-specific mortality rates using Brazilian Ministry of Health data from January 3- May 15, 2021 in a setting of predominant Gamma variant transmission. The proportion of all COVID-19 deaths for ages 80+ years in weeks 1-6 was 25% which subsequently reduced to 12.4% in week 19 following the vaccination program. For individuals aged 70-79 years, the proportionate mortality showed a substantial decline in April-May. The mortality rate ratio for persons aged 80+ relative to those aged 0-69 reduced from 13.3 in January to 8.0 in week 19, and a gradual decline in the rate ratios was observed for ages 70-79 from 13.8 in week 1 to 5.0 in week 19.
22	Christie et al (June 7, 2021)	USA	Impact	US population	Unknown	Unspecified (BNT162b2, mRNA-1273	Calculated rates of COVID-19 cases, emergency department (ED) visits, hospital admissions, and deaths by age group during November 29–December 12, 2020 (pre-vaccine) and April 18–May 1, 2021. The rate ratios comparing the oldest age groups (≥70 years for hospital admissions; ≥65 years for other measures) with adults aged 18–49 years were 40%, 59%, 65%, and 66% lower, respectively, in the latter period

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
21	Guijarro et al (June 28, 2021) *[Update to Jun 3 preprint]*	Spain	Impact	HCW compared to community	Unknown	BNT162b2	Incidence rates of SARS-CoV-2 infection after the first dose of mRNA SARS-CoV-2 vaccine declined by 71% (Incidence Rate Ratio (IRR) 0.286 , 95% confidence interval (CI) 0.174-0.468) and by 97% (IRR 0.03 95% CI 0.013-0.068,) after the second dose as compared to the perivaccine time. SARS-CoV-2 incidence rates in the community (with a negligible vaccination rate) had a much lower decline: 2% (IRR 0.984; 95% CI 0.943-1.028) and 61% (IRR 0.390, 95% CI 0.375-0.406) for equivalent periods. Adjusting for the decline in the community, the reduction in the incident rates among HCW were 73% (IRR 0.272; 95% CI 0.164-0.451) after the first dose of the vaccine and 92 % (IRR 0.176, 95% CI 0.033-0.174;) after the second dose.
20	Sansone et al (May 13, 2021)	Italy	Impact	HCW	Alpha	BNT162b2	Community cases increased during the study period while cases in vaccinated HCWs only minimally increased and then stabilized.
19	White et al. (May 19, 2021)	USA	Impact	LTCF	Unknown	BNT162b2 and mRNA-1273	Evaluated an administrative database of a large LTCF company across USA. Evaluated 21,815 persons, . 80% Pfizer+20% Moderna; 60% 2 dose +24% 1 dose. Disease incidence goes down in vaccinated/unvaccinated.
18	Munitz et al (May 18, 2021)	Israel	Ecologic	Israeli Population	Alpha	BNT162b2	Evaluated the transmission dynamics of B.1.1.7(Alpha) variant and to study the impact of the national vaccination program on the general population and the elderly. The study analysed 292,268 RT-PCR samples collected from December 6,2020 to February 10,2021. In the first week of February, B.1.1.7 variant was the predominant variant identified in more than 90% of the positive tests. The B.1.1.7 variant was 1.45 more transmissible than the wild-type strain (95% confidence interval [CI]: 1.20–1.60). The effective reproduction number for B.1.1.7 was estimated to be 1.71 (95% CI: 1.59– 1.85) compared with 1.12 (95% CI: 1.10–1.15) observed for the wild-type. To evaluate the impact of preventive policies against the B.1.1.7 variant, the authors stratified the distribution of new COVID-19 cases in different age groups. It was observed that an increase in the incidence of the variant was noted in the 60+ years aged group through January 13,2021, following which the incidence plateaued and subsequently

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							declined, which coincided with the rapid uptake of vaccine in this age group.
17	Domi et al (May 6,2021)	USA	Impact	LTCF	unknown	BNT162b2	Evaluated data from 2501 nursing homes in the US in 17 states. Used zero-inflated negative binomial mixed effects regressions to model the associations of time since the vaccine clinic ending the week of December 27, 2020 (cohort 1), January 3, 2021 (cohort 2) or January 10, 2021 (cohort 3) controlling for county rate of COVID-19, bed size, urban location, racial and ethnic census, and level of registered nurses with resident cases and deaths of COVID-19 and staff cases of COVID-19. Resident and staff cases trended downward in all three cohorts following the vaccine clinics. Time following the first clinic at five and six weeks was consistently associated with fewer resident cases (IRR: 0.68 [95% CI: 0.54-0.84], IRR: 0.64 [95% CI: 0.48-0.86], respectively); resident deaths (IRR: 0.59 [95% CI: 0.45-0.77], IRR: 0.45 [95% CI: 0.31-0.65], respectively); and staff cases (IRR: 0.64 [95% CI: 0.56-0.73], IRR: 0.51 [95% CI: 0.42-0.62], respectively). Other factors associated with fewer resident and staff cases included facilities with less than 50 certified beds and high nurse staffing per resident day (>0.987). Contrary to prior research, higher Hispanic non-white resident census was associated with fewer resident cases (IRR: 0.42, 95% CI: 0.31-0.56) and deaths (IRR: 0.18, 95% CI: 0.12-0.27).
16	Haas et al. (May 13, 2021)	Israel	Impact	Israeli population	Alpha[¶]	BNT162b2	Used national surveillance data from the first 112 days (Dec 20, 2020 – Apr 10, 2021) of Israel's vaccination campaign to estimate averted burden of four outcomes: SARS-CoV-2 infections and COVID-19-related hospitalizations, severe or critical hospitalizations, and deaths. Estimated that Israel's vaccination campaign averted 158,665 (95% CI: 115,899–201,431) SARS-CoV-2 infections, 24,597 (6,622–42,571) hospitalizations, 17,432 (3,065–31,799) severe and critical hospitalizations, and 5,533 (-1,146–12,213) deaths. Of these, 66% of hospitalizations and 91% of deaths averted were among those ≥65 years of age. 73% of SARS-CoV-2 infections and 79% of COVID-19-related hospitalizations and deaths averted stemmed from the protective effects in fully vaccinated persons.

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
15	Ackland et al. (Apr 22, 2021)	UK	ecologic	UK adults	Alpha^	BNT162b2, mRNA-1273, AZD1222	Used national data on cases and deaths to estimate CFR. Found that from the second half of January, the CFRs for older age groups show a marked decline. Since the fraction of the VOC has not decreased, this decline is likely to be the result of the rollout of vaccination.
14	Lillie et al.* (Apr 24, 2021)	UK	ecologic	Healthcare workers	Alpha^	BNT162b2	Symptomatic staff underwent routine testing together with routine (asymptomatic) Lateral Flow Device (LFD) testing of all clinical staff. Starting Jan 2021 827 (8.3%) of staff had received their first dose of vaccine, increasing to 8243 (82.5%) by the end of February. Cases of SARS-CoV-2 amongst staff reduced from 120 cases to 10 cases over the same period.
13	Rossman et al.* (Apr 19, 2021) *Update to Feb 9 preprint)*	Israel	Impact	Israeli population	Alpha^	BNT162b2	Analysis of data from the Israeli Ministry of Health collected between 28 August 2020 and 24 February 2021. Compared: (1) individuals aged 60 years and older prioritized to receive the vaccine first versus younger age groups; (2) the January lockdown versus the September lockdown; and (3) early-vaccinated versus late-vaccinated cities. A larger and earlier decrease in COVID-19 cases and hospitalization was observed in individuals older than 60 years, followed by younger age groups, by the order of vaccination prioritization. This pattern was not observed in the previous lockdown and was more pronounced in early-vaccinated cities.
12	Mor et al. (Apr 16, 2021)	USA	Impact	80 nursing homes located across 21 states.	unknown	BNT162b2 & mRNA-1273	Matched pairs analysis of 280 nursing homes in 21 states owned and operated by the largest long-term care provider in the United States. Compared data from nursing homes that had their initial vaccine clinics between December 18, 2020 and January 2, 2021, versus between January 3, 2021 and January 18, 2021. Outcomes were incident SARS-CoV-2 infections per 100 at-risk residents per week and hospital transfers and/or deaths per 100 residents with confirmed SARS-CoV-2 infection per day, averaged over a week. Adjusted for facility infection rates in the fall. After 1 week, early vaccinated facilities had a predicted 2.5 fewer incident SARS-CoV-2 infections per 100 at-risk residents per week (95% CI: 1.2–4.0).

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
11	PHE (Apr 8, 2021)	UK	Impact	UK adults	Alpha^	BNT162b2 & mRNA-1273	Daily impact of vaccination on deaths was estimated based on vaccine effectiveness against mortality multiplied by vaccine coverage. Observed deaths were then divided by the impact to estimate the expected deaths in the absence of vaccination. By the end of March 2021, they estimated that 9,100 deaths were averted in individuals aged 80 years and older, 1,200 in individuals aged 70 to 79, and 100 in individuals aged 60 to 69 years giving a total of 10,400 deaths averted in individuals aged 60 years or older.
10	Jones et al. (Apr 8, 2021)	UK	Ecologic	Cambridge University healthcare workers	Alpha^	BNT162b2	Screened vaccinated and unvaccinated HCWs for two weeks then compared proportion of positive tests in unvaccinated vs. vaccinated groups. Found four-fold decrease in risk of asymptomatic SARS-Cov-2 infection among HCWs ≥12 days post-vaccination compared to unvaccinated HCWs.
9	Rivkees et al. (Apr 7, 2021)	US - FL	Ecologic	Florida population	original and Alpha¥	BNT162b2 & mRNA-1273	Ecologic analysis of vaccinations in Florida. Through March 15, 2021, 4,338,099 individuals received COVID-19 vaccine, including 2,431,540 individuals who completed their vaccination series. Of all those vaccinated, 70% were 65 years of age and older, and 63% of those 65 years of age and older. Beginning February 1, 2021, the decline in the number of new cases per week became greater in those 65 years of age and older than those younger. By March 15, 2021, the number of new cases, hospitalizations, and deaths per day for those 65 years of age and older relative to mid-January, were 82%, 80%, and 92% lower respectively. In comparison, the number of new cases, hospitalizations, and deaths per day for those younger than 65 years of age were 70%, 60%, and 87% lower respectively. Reductions in rates in those 65 year of age and older, were thus greater than in those who were younger (p-value <0.01, Wilcoxon test).
8	Milman et al. (Jun 11, 2021) *[Update to Mar 23 preprint]*	Israel	Ecologic	Maccabi Healthcare Services, 644,609 individuals in 177 communities	original & Alpha¶	BNT162b2	Rates of vaccination in each community are highly correlated with a later decline in infections among a cohort of under 16 years old which are unvaccinated. These results provide observational evidence that vaccination not only protects individual vaccinees but also provides cross-protection to unvaccinated individuals in the community.

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
7	Daniel et al. (Mar 23, 2021)	US - TX	Ecologic	Healthcare workers from the UTSW	original¥	BNT162b2 & mRNA-1273	After vaccination, they observed a greater than 90% decrease in the number of employees who are either in isolation or quarantine.
6	Benenson et al. (Mar 23, 2021)	Israel	Ecologic	Healthcare workers at Hadassah Hebrew University Medical Center	Alpha^	BNT162b2	Among vaccinated workers, the weekly incidence of COVID-19 since the first dose declined notably after the second week; the incidence of infection continued to decrease dramatically and then remained low after the fourth week.
5	Roghani (Mar 17, 2021)	US – TN	Ecologic	Residents of Tennessee	original¥	BNT162b2 & mRNA-1273	Between 12/17/20 and 3/3/21 found that the daily incidence among the entire population over 71 dropped from 0.1% to 0.01% of the age group (90% reduction) while for younger ages incidence dropped from 0.2% to 0.05% (75% reduction).
4	Puranik et al. (March 8, 2021)	US	Ecologic	87 million individuals from 580 counties in the United States	original¥	BNT162b2 & mRNA-1273	Compares the cumulative county-level vaccination rates with the corresponding COVID-19 incidence rates among 87 million individuals from 580 counties in the United States, including 12 million individuals who have received at least one vaccine dose. Found that cumulative county-level vaccination rate through March 1, 2021 is significantly associated with a concomitant decline in COVID-19, with stronger negative correlations in the Midwestern counties and Southern counties.
3	Rinott et al (March 8, 2021)	Israel	Ecologic	Persons needing ventilation	Orginal & alpha	BNT162b2	The number of COVID-19 patients aged ≥70 years (who had the highest 2-dose vaccination coverage, 84.3%) requiring mechanical ventilation was compared with that of patients aged <50 years, who had the lowest 2-dose vaccination coverage (9.9%). Since implementation of the second dose of the vaccination campaign, the ratio of COVID-19 patients requiring mechanical ventilation aged ≥70 years to those aged <50 years has declined 67%, from 5.8:1 during October–December 2020 to 1.9:1 in February 2021.
2	Dunbar et al. (Feb 10, 2021)	US - VA	Ecologic	Healthcare workers in an academic hospital	original¥	BNT162b2 & mRNA-1273	After 60% of employees received the 1st vaccine dose, the HCW COVID-19 infection rate decreased by 50%. HCWs who were 14-28 days and > 28 days post-first vaccine dose were less likely COVID-19 infected than non-vaccine recipients.
1	Domi et al. (Feb 4, 2021)	US	Ecologic	LTCF residents and staff	original¥	BNT162b2 & mRNA-1273	Used CMS NHSN Public File data and Tiberius data and created an analytic cohort based on the schedule of the vaccination clinics taking place during the first week of the program (12/18/20 to 12/27/20). Created

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							a comparison group, composed of facilities located in the same county that did not have a first vaccination clinic during that period. Found that COVID-19 cases decreased at a faster rate among both residents and staff associated with nursing homes that had completed their first clinic. Vaccinated nursing homes experienced a 48% decline in new resident cases three weeks after the first clinic, compared to a 21% decline among non-vaccinated nursing homes located in the same county. Similarly, new staff cases declined by 33% in vaccinated nursing homes compared to 18% in non-vaccinated facilities.

#Includes studies published/posted up through Wednesday of current week.

^Indicates predominant variant identified by study authors. If no ^ then variants identified through secondary source when possible. Please see additional footnotes.

¶The rise of SARS-CoV-2 variant Alpha in Israel intensifies the role of surveillance and vaccination in elderly | medRxiv

¥CDC Says More Virulent British Strain Of Coronavirus Now Dominant In U.S. : Coronavirus Updates : NPR

£Coronavirus (COVID-19) Infection Survey, UK - Office for National Statistics

††Based on https://outbreak.info/location-reports

6. Review Papers and Meta-analyses

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8266992/pdf/10787_2021_Article_839.pdf
2. https://www.medrxiv.org/content/10.1101/2021.05.20.21257461v2
3. https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2021.26.28.2100563
4. https://www.nature.com/articles/s41577-021-00592-1
5. https://www.cell.com/immunity/fulltext/S1074-7613(21)00303-4
6. https://www.medrxiv.org/content/10.1101/2021.08.23.21262500v1
7. https://www.medrxiv.org/content/10.1101/2021.08.25.21262529v1
8. https://www.sciencedirect.com/science/article/pii/S0141813021017359?via%3Dihub
9. https://www.scielo.br/j/ramb/a/gLN9kTh8kpghHGjdWY7z6ML/?lang=en

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