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

Weekly Summary Table

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Prepared by:

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

and

World Health Organization

Vaccine Impact: Summary of Ecologic Study Results for Post-Authorization COVID-19 Vaccine Products# (since June 1, 2021)

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

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
139	Leon et al* (January 19, 2022)	USA	Retrospective cohort	39,557,514 residents of California and 10,816,466 residents of New York 18+ years	Alpha, Delta^	BNT162b2, mRNA-1273, Ad26.COV2.	This study used state-wide surveillance data and immunization data from California and New York States to assess the impact of COVID-19 vaccination and prior infection on COVID-19 incidence and hospitalization rates from May 30 – November 20, 2021. During the week of May 30, infection rates were 19.9 times (California) and 18.4 times (New York) lower among vaccinated persons without previous infection relative to unvaccinated persons without previous infection. This association changed when Delta became dominant. By the week of October 3, the infection rate was 6.2 times (California) and 4.5 times (New York) lower compared to the unvaccinated group. Hospitalization rates showed similar pattern showing that vaccination as well as prior infection protects against infection and hospitalization due to COVID-19. The protection of prior infection was higher after Delta became dominant when vaccine-induced immunity for many had decreased due to immune waning and immune evasion.
138	Verma et al* (January 12, 2022)	India	Cross-sectional	826 COVID-19 patients at Banaras Hindu University Hospital, Varanasi	Delta††	Covaxin, AZD1222	This retrospective cross-sectional study compared severity between vaccinated and unvaccinated COVID-19 patients by high-resolution computed tomography (HRCT) chest scan between April 12-30, 2021. Included scans occurred between 5-8 days following symptom onset, and a 40-point scoring system was used to assess severity, with a score >=20 corresponding to severe disease. Of the 826 included patients, 581 were unvaccinated, 196 had received one dose of either Covaxin or AZD122 (partially vaccinated), and 49 had received both doses of either vaccine (completely vaccinated). The mean HRCT score was significantly lower in completely vaccinated patients (3.5 ± 6.3) compared to partially vaccinated (10.1 ± 10.5) and unvaccinated patients (10.1 ±11.4) (p<0.001). Patients who had received their second dose more than two weeks prior had an even lower

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							mean score (2.1 ±4.4). AZD1222 recipients (one or two doses) had a significantly lower mean HRCT score compared to Covaxin recipients (7.7 ±9.4 vs. 14.5 ±12.6, p=0.012). Logistic regression analysis found that completely vaccinated patients were 14.29 times less likely to get severe disease (HRCT>=20). Lower age and receipt of AZD122 were also significantly associated with decreased odds of severe disease.
137	Shmuelian et al (January 8, 2022)	Israel	Retrospective cohort	23,380 Israeli residents	Non-VOC, Alpha and Delta[††]	BNT162b2	This study was conducted in Israel to evaluate the impact of BNT162b2 vaccine as a post-exposure prophylaxis in individuals aged ≥15 years who were identified as PCR positive for SARS-CoV-2 for the first period. The study compared primary and secondary endpoints of COVID-19 related death or hospitalization amongst two groups- :recently injected" test group and "unvaccinated" control group. The study reported a lower proportion of deaths (10.12%) in the recently injected group compared to 19.82% in the unvaccinated group amongst patients ≥ 65 years. The highest reduction in the death toll was observed in the age group of 55-64 age group. The study concluded that COVID-19 vaccination is effective as a post-exposure prophylaxis against death in COVID-19 infection.
136	Hoque et al (January 6, 2022)	Bangladesh	Prospective cohort	20 patients with Long Covid after breakthrough infections	Non-VOC, Alpha, Beta[††]	AZD1222 (SII) primary series + BNT162b2 booster	This study included 20 patients who contracted a breakthrough infection within one month of complete vaccination with AZD1222 then subsequently developed Long Covid diagnosed at Sheikh Hasina National Institute of Burn & Plastic Surgery in Dhaka. Levels of the inflammatory marker C-Reactive Protein (CRP) were measured in sera of participants before and 14 days after receiving a third vaccine dose (BNT162b2). CRP levels were significantly reduced following receipt of the BNT162b2 dose. The study also assessed the change in Anti S1 RBD IgG before and after receipt of the third dose, finding a significant boosting effect.
135	Bradley et al* (December 18, 2021)	UK	Ecological	33,421 residents and staff of 480 operational care homes in Northern Ireland	Alpha, Delta[††]	BNT162b2 (most), AZD1222	This ecological study used national data from Northern Ireland to evaluate the relationship between COVID-19 vaccination and the frequency and duration of COVID-19 outbreaks in care homes. Most care homes administered the first doses of vaccine (predominantly BNT162b2) in December 2020. There

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							were 501 observed outbreaks in care homes during the period after vaccination began (Dec 7 2020-Oct 28, 2021), a reduction of over two thirds compared to the expected frequency of outbreaks in the absence of vaccination (1625, 95% CI 1553-1694). In a Cox proportional hazards analysis 179 outbreaks between December 7, 2020 and April 8, 2021, the study found a significantly higher hazard ratio of outbreaks ending over time in vaccinated homes compared to homes where vaccination had not yet been implemented after adjusting for care home size and community prevalence (aHR 2.53, 95%CI 1.88-4.31 assuming a 21 day lag for immunity after first vaccination).
134	Reynolds et al (January 11, 2022)	USA	Retrospective cohort	10,412 adult community-based participants	Non-VOC, Alpha, Delta[††]	BNT162b2, mRNA-1273, Ad26.COV2.S	This study assessed impact of vaccines against experience of severe symptoms using self-reported data from the COVID-19 Active Registry Experience (CARE) between December 15, 2020 and September 16, 2021. Among those who reported a positive COVID-19 test, fully vaccinated participants had a lower mean number of symptoms compared to partially vaccinated and unvaccinated groups (4.1 vs. 5.8 vs. 5.3). They also had a higher proportion of cases with no reported symptoms (26% vs. 14% vs. 16%), and a higher proportion reporting only mild symptoms (97.3% vs. 92.4% vs. 89.3%).
133	Subhramanian et al (January 11,2022)	USA	Ecological	US adults	Non-VOC, Alpha, Delta[††]	BNT162b2, mRNA-1273, Ad26.COV2.S	This study evaluated the impact of COVID-19 vaccination in the US using a triple-difference test approach. The study analysed data from CDC to determine the causal impact of vaccination on health outcomes. The primary findings of the study are a reduction in total number of symptomatic cases and ICU admissions or hospitalizations due to vaccination. Secondly, the highest impact of vaccines was observed in reducing overall mortality due to COVID-19. Thirdly, this effect of reduction in death rates is more pronounced in the elderly group. Fourthly, the effect of vaccination on total cases and symptomatic cases are comparatively large in elderlies.
132	Fillmore et al (January 11,2022)	USA	Retrospective cohort	38,508 patients admitted to VA hospitals	Non-VOC, Alpha[††]	BNT162b2, mRNA-1273, Ad26.COV2.S	This retrospective cohort study analysed data from Veterans Affair(VA) database from March 2020 to June 2021 to measure trends in severity of respiratory disease in patients admitted with SARS-CoV-2 and how vaccination has impacted these trends. The study

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							reported that the proportion of hospitalized patients with moderate-to-severe disease declined from 64% to 52%, following the implementation of the vaccination program. Among unvaccinated inpatients during this period, 55.0% (95% CI, 53.7–56.4%) had at least one documentedSpO2 < 94%, versus 42.6% (95% CI, 40.6–44.8%) in vaccinated inpatients. Proportions of COVID-19 cases receiving treatment with dexamethasone also dropped in parallel with reduction in disease severity as measured by vital signs.
131	Herman et al (January 11,2022)	Indonesia	Retrospective cohort	442 adults	Delta^	Inactivated vaccines	This study utilized the Indonesian POST-COVID retrospective longitudinal data, involving participants from the entire provinces of Indonesia, collected until December 2021 to assess the impact of vaccination in preventing post-COVID olfactory dysfunction. The prevalence of olfactory dysfunction in two weeks was 9.95% and 5.43% after four weeks.For people who still get infected after being fully inoculated for more than 14 days, the chance of developing olfactory dysfunction was 69% lower.
130	Puhach et al (January 18,2022) [Update to Jan 11, 2022 preprint]	Switzerland	Prospective cohort	384 patients	Non-VOC, Delta, Omicron^	BNT162b2, mRNA-1273, Ad26.COV2.S and AZD1222	This study compares the RNA and infectious viral load between pre-VOC and Delta VOC in unvaccinated patients as well as in vaccination breakthrough infections due to Delta and Omicron up to 5 days post onset of symptoms. The study observed that overall, pre-VOC samples had significantly higher genome copies compared to Delta VOC, but infectious viral titres were significantly higher in Delta VOC infected individuals. Overall, genome copies did not significantly differ between vaccinated and unvaccinated patients, while infectious viral load was significantly decreased in vaccinated patients.
129	Arjun et al (January 8, 2022)	India		487 adults (18+) with prior SARS-CoV-2 infection		Covaxin	This study assessed prevalence, characteristics, and predictors of self-reported Long COVID among patients aged 18+ who had PCR-confirmed SARS-CoV-2 infection between April and September 2021 at the All India Institute of Medical Sciences (AIIMS) Bhubaneswar. The study found that 29.2% of participants had Long COVID, and vaccination with two doses compared to no doses was significantly associated with Long COVID (adjusted OR 2.32, 95% CI 1.17-4.58).

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128	Peña-Hernández et al (January 8, 2022)	USA	Retrospective cohort	72 vaccinated and 53 unvaccinated patients	Delta^	mRNA-1273, BNT162b2, Ad26.COV2.S	This study evaluated infectivity of vaccinated versus unvaccinated individuals infected with SARS-CoV-2 by using conventional plaque assays and assessing culturable virus of nasopharyngeal samples. Samples were collected from 72 fully vaccinated and 53 unvaccinated infected patients in the Yale New Haven Health System between July 6-August 13, 2021. Vaccinated and unvaccinated samples were matched on age, sex, and Ct value. No significant difference was found between vaccinated and unvaccinated groups by quantitative plaque assays. However, there was a significantly lower proportion of culturable samples among the vaccinated compared to the unvaccinated group, indicating a 51% reduction of infectious virus (adjusted RR 0.49, 95%CI 0.27-0.91). This protection was found to wane starting at 5 months after full vaccination for mRNA vaccines.
127	Mielke et al (January 5, 2022)	USA	Retrospective cohort	3000 patients hospitalized with COVID-19 in Michigan	Delta††	mRNA-1273, BNT162b2, Ad26.COV2.S	This retrospective cohort study assessed demographic characteristics and outcomes of hospitalized COVID-19 patients in Southeastern Michigan from August 12-December 6, 2021. Of the 3000 included patients, 2,935 were completely unvaccinated and 65 had received a booster dose plus a full primary series vaccine (FV&B). Compared to those unvaccinated, FV&B patients had a significantly higher median age (74 vs. 58 years), a greater proportion of immunocompromised patients (32.3% vs. 10.4%) and end-stage renal disease patients (18.5% vs. 1.8%), and a higher Elixhauser comorbidity score (16 vs. 8). Despite this, the mortality rate was lower among FB&V patients (7.7% vs. 12.1%, p=0.38), as was the need for mechanical ventilation (7.7% vs. 11.1%, p=0.5). When restricting to patients aged 65+ the differences were larger (mortality rate 6.5% vs. 20.2%, p=0.08), though still did not reach a statistical significance level of p=0.05.
126	Blumberg et al (January 2, 2022)	Israel	Cross-sectional	15 vaccinated and 28 unvaccinated previously infected adults (aged 18-65)	Alpha, Delta††	BNT162b2	This cross-sectional study assessed the impact of vaccination on aerobic capacity of individuals after mild to moderate SARS-CoV-2 infection—an indication of Long COVID—between March-December 2021. All included vaccinated participants were vaccinated prior to infection. Previously infected individuals performed a cardio-pulmonary exercise

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							test (CPET), and results among the vaccinated and unvaccinated groups were compared to participants' predicted values and between the groups using chi-square and t-tests. Vaccinated individuals had a higher mean oxygen consumption, a higher mean and maximum heart rate, and higher mean ventilation at peak exercise compared to unvaccinated participants. Mean oxygen consumption at peak exercise was 95% of the predicted value in the vaccinated group compared to 83% in the unvaccinated group (p<0.05), and unvaccinated participants had a higher proportion of peak oxygen consumption <80% of their predicted value (50% in unvaccinated versus 14% in vaccinated). These results suggest vaccination may be protective against decreased aerobic capacity following SARS-CoV-2 infection.
125	Islam et al (January 1, 2022)	Bangladesh	Ecological	404 reinfected COVID-19 patients	Beta, Delta[††]	Not specified (Assumed mainly AZD1222 based on availability at the time)	This cross-sectional study evaluated the severity and associated risk factors of COVID-19 reinfections during May 2021 in Bangladesh based on phone interviews and medical records. 39.1% of the 404 included patients had received at least one dose of vaccine (vaccinated group), and vaccine status was found to be significantly associated with severity of disease. The proportion of severe infections was significantly lower in the vaccinated compared to unvaccinated group (6.3% vs. 15.4%), though the proportion of moderate disease was higher in the vaccinated group (87.3% vs. 52.8%).
124	Antonini et al (December 24,2021)	France, Israel, Italy, Spain	Ecological	Adults residing in France, Israel, Italy and Spain	Non-VOC, Alpha, Delta[††]	BNT162b2, mRNA-1273, Ad26.COV2.S and AZD1222	This study analysed primary data from four countries to evaluate the impact of vaccination roll-out and its impact with COVID-19 health outcomes including hospitalizations and number of daily fatalities. The study observed a common trend in all the four countries with a marked lower scale for Israel. A pronounced reduction in the total number of deaths is observed with the introduction of the vaccine in 2021, compared to the first quarter of 2020. Secondly, the trend in ICU admissions shows a positive impact due to the vaccine. In all countries the study reported a decline in case fatality as the number of fully vaccinated people increases, indicating that vaccination has a positive effect.

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123	Caban- Martinez et al (November 26,2021)	USA	Prospective cohort	1415 first responders across six states in the US.	Non-VOC, Alpha, Delta††	BNT162b2, mRNA-1273, Ad26.COV2.S	This observational cohort study was conducted across six states in the US amongst first responders to evaluate the burden of COVID-19 among unvaccinated first responders. From January through September 2021, among unvaccinated individuals, the incidence of COVID-19 was 11.9 per 1,000 person-weeks (95%CI=7.0- 20.1) compared to only 0.6 (95%CI=0.2-2.5) among vaccinated individuals. During the study period, LEOs and firefighters who remained unvaccinated were 20- and 5-times more likely, respectively to become sick with COVID-19 than their colleagues who were fully vaccinated against COVID-19.
122	Whittaker et al (December 23, 2021)	Norway	Retrospective cohort	3,203 SARS-CoV-2 positive hospitalized patients 18+ years	Alpha^	BNT162b2, mRNA-1273	This retrospective cohort study used data from national registries to assess differences in length of stay, ICU admission, and death between fully vaccinated and unvaccinated patients hospitalized between February 1, 2021 and November 30, 2021. Results of logistic regression show that fully vaccinated patients had a 38% shorter overall length of stay and 50% lower risk of ICU admission compared to unvaccinated patients. No difference was observed in the length of stay in ICU or in risk of in-hospital death.
121	Coggiola et al* (December 23, 2021)	Italy	Prospective cohort	13,787 HCW	Non-VOC, Alpha††	BNT162b2	This prospective cohort study assessed the impact of vaccination with BNT162b2 among healthcare workers (HCW) in a hospital in Turin (Città della Salute e della Scienza) during the second pandemic wave in Italy. The period before effective vaccination (October 1, 2020 to January 14, 2021) was compared to the post-vaccination situation (January 15 to April 30, 2021), and incidence of infection among HCWs was compared to incidence among the general population (for whom vaccination was not yet widely available). In the earlier period, daily incidence of infection among HCWs was 79.58 per 100,000 (± 15.58; 95% CI), with a prevalence of 8.44%, while in the post-vaccination period the incidence fell to 14.23 per 100,000 (± 2.73; 95% CI), and prevalence dropped to 1.51%. Pre-vaccination incidence was significantly higher among HCWs than among the general population (+41.04 ±13.47/100,000; CI 95%; p<0.001), while in the post-vaccination period the incidence

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							among HCWs was significantly lower than in the general population (-17.32 ± 3.57; CI 95 %; p <0.001). The study also compares incidence among vaccinated versus unvaccinated HCWs during the second period to calculate unadjusted vaccine effectiveness.
120	Muhsen et al* (December 22, 2021)	Israel	Ecological	41,623 residents of LTCF (aged 60+), 1,521,340 adults aged 60+ in general population, 4,515,314 adults aged 20-59, 3,299,121 persons under 20 years	Delta^	BNT162b2 (booster)	This study evaluated the impact of the booster dose campaign among residents of long-term care facilities (conducted between August 1-22, 2021) on weekly incidence of COVID-19 outcomes in this population, comparing the 5 weeks prior to the 6 weeks following the start of the campaign, and compared to the general population. Relative to the first week of the booster campaign, LTCF residents experienced significantly lower incidence of infection and hospitalization starting in week 4 after the start of the booster campaign. By week 6 after the campaign began, the relative rate of infection and hospitalization had been reduced by 71% and 80% respectively (IRR 0.29 and 0.20 respectively), and COVID-19 death rates decreased from 0.3/1000 4 weeks after booster initiation to 0.1/1000 6 weeks after. For adults aged 60+ in the general population, booster uptake was lower, and this group experienced a smaller reduction in COVID-19 incidence, no significant reduction in hospitalization, and increasing death rates during the study period. No significant decreases in incidence of infection or hospitalization were found in the general population under 60 years during the study period.
119	Pierobon et al* (December 14, 2021)	Italy	Ecological	852,211 older adults (70-100 years) in Veneto, Italy	Non-VOC, Alpha††	Not specified	Among other investigations, this ecological study assessed the impact of vaccination in the elderly population (aged 70-100 years) of Veneto, Italy. To do so, it compared the risk ratio (RR) of SARS-CoV-2 infection, hospitalization, and death among nursing home residents versus the general elderly population (propensity score matched 1:1) during three COVID-19 waves between February 2020 and May 2021 (February 21-August 31, 2020; September 1, 2020-January 1, 2021; February 1-May 3, 2021). Vaccination began at the end of wave 2, prioritizing nursing home residents. During the first two waves, the risk of infection, hospitalization, and death were significantly higher in nursing home residents

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							compared to the general elderly population (RR of infection 14.54 in wave 1 and 7.93 in wave 2). In wave 3, however, after nearly all nursing home residents were at least partially vaccinated, the risk of infection, hospitalization, and death for nursing home residents was significantly lower than in the general elderly population (RR 0.69 for infection, 0.25 for hospitalization, and 0.48 for death).
118	McGarry et al* (December 8, 2021)	USA	Ecological	Staff and residents of 12,364 nursing homes	Delta††	BNT162b2, mRNA-1273, Ad26.COV2.S	This ecological study investigated the impact of vaccination coverage among staff of nursing homes on COVID-19 cases among nursing home residents and staff, and COVID-19 related deaths among residents from June 13-August 22, 2021 using national data and multivariable regression. In the 25% of counties with the highest COVID-19 prevalence, low staff vaccination coverage (the lowest 25%) was associated with increases of 1.56 COVID-19 cases per 100 beds among residents, 1.50 additional cases per 100 beds among staff, and 0.19 additional COVID-19 deaths among residents compared to facilities with high staff vaccination coverage (the highest 25%). In counties with low COVID-19 prevalence, there were little differences in COVID-19 outcomes by staff vaccination coverage. The authors found that if all nursing homes had had high staff vaccination coverage (defined as the highest quartile of coverage with an average of 82.7%), 4775 cases among residents, 7501 cases among staff, and 703 resident deaths could have been avoided during the study period.
117	Ronksley et al* (November 2021)	Canada	Ecological	30,361 international travelers arriving by air in Alberta, Canada	Non-VOC, Alpha††	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This study evaluated the impact of vaccination on importation of COVID-19 from international air travelers in arriving at the Calgary International Airport from January 6-May 23, 2021. During the first six weeks of this period, testing was conducted on a voluntary basis, while after February 21st all international travelers were required to undergo molecular testing 7-8 days after arrival. Test positivity for fully or partially vaccinated persons (receipt of at least one dose) was 0.02% (95% CI 0.00-0.10) compared to 1.42% (95% CI 1.27-1.58) among unvaccinated travelers.

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116	Scroggins et al(December 16,2021)	USA	Retrospective cohort	Missouri Nursing Home residents	Alpha and Delta[†]	BNT162b2, mRNA-1273 and Ad26.COV2.S	This retrospective cohort study analysed data from two publicly available sources to study the association of uptake of vaccines among nursing home staff and COVID-19 infections among the residents. The study reports a significantly decreased risk of acquiring COVID-19 among residents, with increase in the percent of staff getting vaccinated. Percent of residents vaccinated against COVID-19 was not significantly associated with whether COVID-19 cases were reported, nor the number of COVID-19 infections reported.
115	Damijan et al (December 14, 2021)	110 countries	Ecological	Populations of the included countries	Delta[^]	Multiple	This ecological study used daily data for 110 countries from August 1-November 14, 2021 to evaluate the relationship between vaccination coverage and new COVID-19 cases, hospitalizations, ICU admissions, and deaths. It found a negative correlation between the rates of full vaccination and the number of new COVID-19 cases, with a 10% increase in full vaccination rate associated with a 1.3-1.7% decrease in new cases. Additionally, a 10% increase in the vaccination rate was found to reduce the number of new hospitalizations by about 5%, new ICU patients by 12%, and new deaths by 2%. The study also found that countries with low vaccination coverage (<30%) did not experience a significant benefit from vaccination in terms of reducing deaths while countries with moderate (40-70%) and high (>70%) did, though all coverage levels were found to benefit from vaccination in terms of reduction in cases.
114	Wollschläger et al (December 12, 2021)	Germany	Ecological	All German adults residing in Rhineland-Palatinate	Alpha, and Delta[^]	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This study analysed data from Rhineland-Palatinate federal state of Germany to assess the association of age-specific vaccination coverage and age-specific decline in COVID-19 related fatalities and new SARS-CoV-2 infections. The study noted a steep decline in cases from week 1 to week 8 across all age groups in 2021, coinciding with the roll-out of vaccines. Similar trend was noted for COVID-19 fatalities in the age group of 80+ from week 6 onwards. The highest case-fatality rate was observed in the age group of 80+ followed by 60-79 years. The vaccination coverage time-lagged by 14 days was associated with both a lower proportion of COVID-19 fatalities formed by an age group (adjusted odds ratio (OR) per 5 percentage

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							points = 0.89, 95% confidence interval (CI) = 0.82–0.96, p = 0.001), and of reported SARS-CoV-2 infections (adjusted OR per 5 percentage points = 0.82, 95% CI 0.76–0.88, p < 0.0001). However, no such statistically significant association of all-cause mortality with vaccination coverage was observed in the study.
113	Ayoubkhani et al (December 9, 2021)	United Kingdom	Prospective cohort	28,356 adults aged 18-69	Alpha, Delta[†]	AZD1222, BNT162b2, and mRNA-1273	This prospective cohort study assessed the relationship between COVID-19 vaccination and the self-reported symptoms of Long Covid at least 12 weeks after infection among adults in the UK who became infected prior to vaccination. The follow-up period was February 3-September 5, 2021, and 28,356 participants were included from the Office for National Statistics COVID-19 Infection Survey – a community-based survey of randomly selected households. In total, Long Covid symptoms were reported by 23.7% of participants at least once during the monthly follow-up visits. Receipt of one vaccine dose (AZD1222, BNT162b2, or mRNA-1273) reduced the odds of Long Covid by 12.8% initially (95% CI -18.6 to -6.6). Each subsequent week following the first dose resulted in an increase of 0.3% per week in odds of reported Long Covid until receipt of the second dose. Receipt of two doses was found to decrease the odds of Long Covid by 8.8% initially (95% CI -14.1 to -3.1), with decreases of 0.8% per subsequent week. Reports of Long Covid resulting in limitation of activity followed a similar pattern, with one dose reducing the odds by an initial 12.3% followed by an increase of 0.9% per week, and two doses reducing the odds of activity-limiting Long Covid by 9.1% initially, followed by a 0.5% decrease per week.
112	Nicolay et al* (December 2,2021)	15 EU/EEA countries (Austria, Cyprus, Czechia, Finland, Ireland, Italy, Malta, Portugal, Sweden,	Ecologic	General population of 15 EU countries	Alpha and Delta^	BNT162b2 mRNA, mRNA-1273, ChAdOx1 nCoV-19, Ad26.COV 2.S	This study evaluated the impact of EU/EEA countries prioritizing elderly adults for vaccination on rates of COVID-19 cases, hospitalizations, and deaths in individuals 80 years and older, compared to individuals 25-29 years, between week 48 2020 and week 20 2021. Greatest impact on reduction of disease burden in elderly adults was seen among countries with >80% vaccine uptake. Compared to countries with vaccine uptake below 20%, the case notification rate ratio decreased 44% (IRR: 0.56; 95% CI: 0.34-0.93) among

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		Estonia, Greece, Latvia, Lithuania, Slovenia, Spain)					countries with vaccine uptake of 20-39% and 65% (IRR: 0.35; 95% CI: 0.12-0.99) among countries with >80% vaccine uptake. The incidence rate ratio for hospitalizations varied from 46% (IRR: 0.54; 95% CI: 0.45–0.65) to 78% (IRR: 0.22; 95%CI: 0.13–0.37) and the IRR for deaths varied from 47% (IRR: 0.53; 95%CI: 0.51–0.55) to 84% (IRR: 0.16; 95% CI 0.13–0.20).
111	Meo et al* (November 2021)	Saudi Arabia	Retrospective cohort	Population of Saudi Arabia (34.2 million persons)	Non-VOC, Alpha, Beta, Delta†	BNT162b2 and AZD1222	This national retrospective cohort study assessed the impact of vaccination (BNT162b2 and AZD1222) by comparing daily COVID-19 case and death counts in Saudi Arabia during two periods: before the introduction of vaccination (March 2-December 14, 2020) and after vaccine introduction (December 15-September 8, 2021). As of September 8, 2021, 45.65% of the population was fully vaccinated. The number of daily cases after vaccination were found to be significantly lower than before vaccination (692.08 ±1.21 vs. 1235.6 ±3.33, p=0.0001), as were daily deaths (9.48 ±0.01 vs. 22.7 ± 0.03, p=0.0001).
110	Muhsen et al* (October 28, 2021)	Israel	Prospective cohort	9162 HCWs (aged 16-65 y) working in long-term care facilities	Alpha^	BNT162b2	In addition to assessing vaccine effectiveness of BNT162b2 against infection, this prospective cohort study evaluated the difference in Cycle threshold (Ct) values between fully vaccinated and unvaccinated health care workers working in long term care facilities in Israel who tested positive for SARS-CoV-2 by RT-PCR during the study period (December 2020-April 2021). Data for Ct values were available for 20 fully vaccinated and 44 unvaccinated HCWs, and the study found that the median Ct value of fully vaccinated HCWs was significantly higher than in unvaccinated HCWs, indicating lower viral loads in those vaccinated (32.0 vs. 26.7, p=0.008).
109	Percio et al (December 8,2021)	Brazil	Ecological	All adults	Alpha, Gamma and Delta^	BNT162b2, AZD1222, Ad26.COV2.S and Sinopharm	This ecological study assessed mortality and morbidity trends from COVID-19 in two subgroups of Brazilian adults- 18 to 59 years and >60 years. The primary objective of the study was to compare pre and post-vaccination periods in Brazil and assess the impact of the COVID-19 vaccination program. The study observed that hospitalization rates increased in the pre-vaccination period and declined in the vaccination period. COVID-19 vaccination coverage was inversely associated with the weekly incidence of hospitalizations for the

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							disease in individuals aged 60 years and over (IRR: 0.97). Similarly, there was a mortality increase trend in the pre-vaccination period and declined in the post-vaccination period. The study showed that the indirect impact of vaccination was more intense in reducing indicators of morbidity and mortality trends for individuals aged 60 years and over compared to those aged 18 to 59 years, and for the latter group, vaccination coverage was lower in the period evaluated, as COVID-19 vaccination for this group started in immunocompromised individuals.
108	Reischig et al* (December 3, 2021)	Czechia	Retrospective cohort	420 adult kidney transplant recipients	Non-VOC, Alpha^	BNT162b2	Among other outcomes, this study assessed the impact of vaccination on COVID-19 disease severity, mortality, and the course of disease. Adult kidney transplant recipients from Charles University Teaching Hospital, Pilsen who were vaccinated in January 2021 (2 doses at 4-week intervals) were followed until June 2021, and were compared to unvaccinated patients during the previous COVID-19 wave (September-December 2020). The study found no significant difference between the vaccinated and unvaccinated groups in terms of what symptoms were present, treatments required, development of pneumonia, need for hospitalization, or death.
107	Raham (December 3, 2021)	16 countries/ territories	Ecological	Populations of the 16 countries/ territories (Israel, Chile, Jersey, UK, Guernsey, Bahrain, United States, Serbia, Qatar, Switzerland, Canada, Saudi Arabia, China, Russia, Costa Rica, Mexico)	Unknown	Multiple products	This study assessed the impact of vaccination on COVID-19 case fatality rates (CFR, calculated as cumulative deaths/cumulative cases since vaccine introduction x100) using data from 16 countries and territories that had been vaccinating people for at least 100 days as of April 3, 2021. The CFR on the day of vaccine introduction in each country was compared to the CFR on April 3, and results were stratified by level of vaccination coverage on April 3: >18 doses/100 people vs. ≤18 doses/100 people. The mean CFR in countries with higher coverage decreased to a greater extent than in countries with lower coverage: from 1.875 to 1.449 in countries with >18 doses/100 people versus from 3.315 to 3.283 in countries with ≤18 doses/100 people. This difference in reduction of CFR by dose coverage was found to be significant (p=0.033).

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
106	Borges et al (November 29, 2021)	Brazil	Stepped-wedge randomized trial	Adults (aged 18+) in Serrana, Brazil	Gamma^	CoronaVac	In this stepped-wedge randomized trial, the Serrana municipality of Sao Paolo, Brazil was divided into 25 subareas by land use, then the subareas were assigned to a color-coded group (Green, Yellow, Gray, or Blue), resulting in four groups of approximately equal population with no contiguous subareas in the same group. The intervention (COVID-19 vaccination with CoronaVac) was made available to each group at one-week intervals in a randomized order, and the study period covered epidemiological weeks 6-19 in 2021 (February-May). In addition to estimating vaccine effectiveness, the study investigated the impact of vaccination on incidence of infection in the entire urban population (pre and post vaccination) and on protection of unvaccinated persons. Incidence of symptomatic cases was reduced by 48.1% (95% CI 39.2-55.7) in the intervention period compared to the control period (6 weeks after the initial dose in each group, when full vaccination of participants is expected, versus before vaccination). Incidence of COVID-19 related hospitalization and death was also reduced by 48.1% when comparing these time periods (95% CI 13.2-69.0). The study also found that there was a significant indirect protective effect in unvaccinated persons when 52% of adults were fully vaccinated. Finally, the cumulative incidence of COVID-19 related hospitalization and death in Serrana was similar to other nearby cities from epidemiological weeks 6-13, but slowed relative to other cities beginning in week 13 (when most groups had received dose 2) and fell below all others by week 16 (when most were fully protected).
105	Cerio et al* (September 29, 2021)	USA	Ecological	Population of New York State	Non-VOC††	BNT162b2, mRNA-1273, Ad26.COV2.S	This ecological study evaluated the relationship between vaccination rates and population adjusted SARS-CoV-2 case counts across all 62 counties in New York State at a cross-sectional single point in time (March 31, 2021). On March 31, the mean vaccination coverage by county was 31% (range: 21.8-57.4%) for at least one dose and 18% (range: 12.3-41.8%) for full vaccination. In bivariate testing, one and two dose vaccination coverage rates were negatively correlated with cases per 100,000 population, though the relationship was not significant, while population size

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							was found to be strongly correlated with cases per 100,000 population (r=0.715, p<0.001). After controlling for county population in linear regression, the two-dose vaccination rate was significantly negatively associated with cases per 100,000 population, with each increase in percentage point of complete vaccination corresponding to a decrease of nearly one case per 100,000 people each day (correlation coefficient β= -0.866, p=0.031).
104	Gul et al* (July 2021)	Pakistan	Retrospective cohort	170 COVID-19 patients aged 20-80	Non-VOC, Alpha, Beta^	Not specified	This retrospective study assessed the impact of vaccination on disease severity among 170 COVID-19 patients at the Lady Reading Hospital, Peshawar and DHQ Category A Hospital, Batkhela between December 2020 and May 2021. Of the participants, 70 patients were vaccinated with at least one dose (40 had received the second dose). Frequency of adverse outcomes were substantially higher among unvaccinated patients compared to those vaccinated with at least one dose: Hospitalization occurred in 10% versus 4.3%, ICU admission in 14% versus 2.9%, and mortality in 40% versus 14.3% respectively.
103	Mattiuzzi et al (November 30, 2021)	Europe	Ecological	Adults in the WHO European Region	Alpha and Delta^	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This ecological study built on the analysis of Meslé et al to assess the relationship between COVID-19 vaccine uptake and deaths averted in European countries between December 2020 and November 2021 using univariate and multiple linear regression. The study found a significant linear association between the percentage of vaccine uptake and the corresponding percentage of averted deaths among older people across European countries (r=0.872, p<0.001). The fit was improved further using an exponential curve (r=0.881, p<0.001), indicating an almost exponential relationship between vaccine uptake and averted deaths of older people. In multiple linear regression, the percentage of deaths averted was independently associated with vaccine uptake (p<0.001), but not with the type of vaccine (p=0.264).
102	Zhao et al (November 27,2021)	England	Ecological	UK adults	Delta^	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This ecological study used the nation-wide COVID-19 surveillance data of cases and deaths and SARS-CoV-2 genetic sequences from April to July 2021 to compare the relationships between vaccine coverage and case fatality ratios(CFRs) of Delta or non-Delta variants. The CFR associated with non-Delta variant depicted a

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							gradual decline from 0.57% to 0.20% with IQR of (0.39%-0.23%), whereas the CFR of Delta remained relatively stable. The vaccine coverage increased to 52.4% in July 15, 2021 and the CFR of non-Delta was negatively associated with a lagged vaccine coverage. In addition, the negative association of CFR for Delta variant appeared weak and there was no statistical significance. This study is limited due to the ecological design, as heterogeneities in fatality rates and vaccination distribution for different subgroups of population cannot be adjusted.
101	Padovani et al (November 26, 2021)	Italy	Retrospective cohort	284 patients hospitalized with COVID-19 in Brescia, Italy	Alpha and Delta[††]	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2	This observational study compared disease progression and outcomes by vaccination status in 284 consecutive patients hospitalized for COVID-19 at ASST Spedali Civili Hospital, Brescia between March 1-October 15, 2021. Fifty of the patients had received at least one dose of vaccine, and most received an mRNA vaccine. Disease progression was measured using the WHO COVID-19 clinical progression scale, and unvaccinated patients experienced worse disease progression (5.3+1.6 vs. 5.0+1.4; p<.03), as well as significantly greater needs for oxygen (p=0.048) and steroids (p=0.002). After controlling for comorbidities and severity at admission in multivariate regression, unvaccinated patients also had a higher risk of death (OR 3.3, 95% CI 1.05-10.7), particularly when considering unvaccinated vs. vaccinated ventilated patients (OR 54.8, 3.5-852).
100	Sacco et al (November 25, 2021)	Italy	Ecological	Italian residents aged 12 and above	Alpha and Delta[††]	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2	This study evaluated the direct impact of the Italian vaccination programme on the number of cases, on hospitalisations, on admissions to intensive care units (ICU) and on deaths, by estimating the numbers of these outcomes prevented (averted events) by COVID-19 vaccination between January (week 2/2021) and the end of September 2021 (week 38/2021) by age groups and geographical area. By the end of September, a major proportion of adults aged 60 above had received the recommended number of doses of vaccine. A total of 445,193 (range: 331,059–616,054) cases, 79,152 (range: 53,209–148,756) hospitalisations, 9,839 (range: 6,434–16,276) ICU admissions and 22,067 (range: 13,571–48,026) deaths were estimated to have been averted by the

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							vaccination campaign, respectively. The study also estimated that 71% (69-79) of the overall deaths were averted for those aged 80 years and older.
99	Meslé et al (November 25, 2021)	33 countries in the WHO European Region	Ecological	Adults in the WHO European Region	Alpha and Delta^	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This study analysed age-specific mortality counts and vaccination coverage data from The European Surveillance System(TESSy) until week 45 of 2021 to estimate the number of deaths averted in 33 countries in the age group of 60+ since the start of the vaccination program. By week 45, 80% of adults over the age of 60 years were fully vaccinated and 84% had received at least one dose of licensed vaccines. The study estimated that 51%(n=469,186) of total expected deaths were averted by vaccination over the study period ranging from 93% deaths averted in Iceland to 6% in Ukraine. The direct impact is more heterogenous as it is contingent on the speed and extent of the vaccination programme in these eligible groups in individual countries.
98	Saban et al* (November 17, 2021)	Israel	Ecological	Population of Israel	Non-VOC, Alpha,[††] Delta^	BNT162b2	This study evaluated trends in COVID-19 incidence, morbidity, and mortality between February 27, 2020 and October 16, 2021 related to the rollout and coverage of vaccination and booster doses. Israel experienced three COVID waves between March 2020 and March 2021. Vaccination began in December 2020 and was available to all adults aged 16+ in February, and to children aged 12-15 in June. As a result, daily incidence of confirmed SARS-CoV-2 infection had dropped to less than 30 in May 2021. A fourth wave began in June with the rise of the Delta variant, by which time the majority of the population was fully vaccinated (66% as of July 6). Daily numbers of confirmed cases reached a higher peak in the fourth wave compared to previous waves, but the rate of test positivity (proportion of positive tests out of all those tested) was lower than peaks of previous waves, as was the number of severe hospitalized cases. During the first three months after vaccination started, unvaccinated persons had substantially higher daily rates of documented infection, hospitalizations, and deaths compared to vaccinated persons. Four months after vaccination began, the gap between vaccinated and unvaccinated individuals narrowed, with low rates of infections and

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							hospitalizations in both groups. Rates of infections, hospitalizations, and deaths rose in both groups at the start of the fourth wave with a relatively small gap but they diverged substantially in August and September after rollout of the booster dose of BNT162b2, with much higher rates among unvaccinated persons. The case fatality rate (CFR) was also substantially lower 2-3 months after booster shots began (September 20-October 20) (0.052%) compared to the CFR for the whole study period (0.052% vs. 0.61%).
97	Li et al (November 15,2021)	187 countries	Ecological	All adults eligible for vaccination	Non-VOC, Alpha, Beta, Gamma††	Multiple products	This ecological study estimated the relationship between daily vaccine coverage, the total number of new cases and deaths using data from Our World In Data website. The study reported that the daily new cases of COVID-19 would be reduced by 24.43% [95% CI: 18.89, 29.59] and 7.50% [95% CI: 6.18, 8.80] with 10,000 people per day becoming fully vaccinated and 10,000 people per day with at least one dose of vaccine. Similarly, the relationship between COVID-19 vaccines and deaths showed a decline of 13.2% [95% CI: 3.81, 21.89] and 2.02% [95% CI: 0.18, 4.16] with 10,000 people per day becoming fully vaccinated and 10,000 people per day with at least one dose of vaccine. For the analysis restricted to the United States, the study estimated that 10,000 fully vaccinated people per day and 10,000 people per day with at least one dose of vaccine would reduce the new COVID-19 cases by 4.84% [95% CI: 4.66, 5.02] and 2.02% [95% CI: 1.96, 2.07].
96	Linsenmeyer et al (November 10,2021)	USA	Prospective cohort	1973 Health care workers	Alpha^	BNT162b2, mRNA-1273 and Ad26.COV2.S	This cohort study was included HCPs from two health institutes in Boston to assess the association of vaccination with detection of SARS-CoV-2 asymptomatic infections. Lower case rates were detected in vaccinated vs unvaccinated staff during each monthly period. The detection rate declined toward zero in both groups in parallel with a drop in community transmission.
95	Desai et al (October 20,2021)	India	Retrospective cohort	569 patients admitted in a tertiary care centre	Delta††	AZD1222	The primary aim of this retrospective cohort study was to establish the association of partial vaccination with the ChAdOx1 nCoV-19 vaccine with clinical outcomes, such as comorbidity, ICU requirement, length of stay, and mortality in hospitalized COVID-19

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							patients. The study reported that the overall hospital stay for vaccinated patients was significantly lower than that for non-vaccinated patients. The vaccinated patients in the study showed a mean stay of 6.21 days in the ward, compared with 5.56 days for non-vaccinated patients, highlighting the impact of vaccines in preventing severe or critical outcomes in infected patients. The study also reported a mortality rate of 21.9% in the unvaccinated cohort compared to 2.9% in the vaccinated cohort. Overall, the requirement for mechanical ventilation was substantially lower in vaccinated patients compared to unvaccinated (42.85% vs 82.06%, respectively).
94	Safdar et al* (September 2021)	Pakistan	Prospective cohort	110 COVID-19 patients from two medical centers	Unknown	Sinopharm, Coronavac, Ad5-nCoV (CanSino), AZD1222	This prospective observational study assessed the impact of vaccination on disease severity, length of hospital stay, and mortality using Chi-square tests. The study was conducted from December 2020 to May 2021 among 45 vaccinated (receipt of at least one dose) and 65 unvaccinated COVID-19 patients at Fauji Foundation Hospital Rawalpindi and Pak International Medical College Hayatabad Peshwar. Unvaccinated patients were significantly more likely to experience severe disease compared to vaccinated patients (61.4% vs. 22.22%, p=0.0164), and also had significantly longer hospital stays than vaccinated patients (18.24 ±4.46 vs. 10.44±2.52 days, p=0.001). The mortality rate was also higher among unvaccinated (12.31%) compared to vaccinated patients (2.22%, p<0.05).
93	Strum et al (November 21, 2021)	USA	Prospective cohort	952 SARS-CoV-2 positive healthcare workers from an academic campus in Southern California	Non-VOC, Alpha††	BNT162b2	This study was conducted between December 2020 and July 2021. Healthcare workers (HCW) from a Southern California academic campus (2 large hospitals, outpatient clinics, and other facilities) who tested positive for SARS-CoV-2 during the study period were followed for two main outcomes by vaccination status: days until they returned to work and symptoms. Fully vaccinated was defined as >13 days post dose 2, and partially vaccinated as >3 days post dose 1 through 13 days post dose 2. The adjusted mean days until returning to work was significantly shorter among fully vaccinated compared to partially vaccinated HCWs (10.9 vs. 15.5 days), and the time among partially vaccinated HCWs was significantly

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							shorter than among unvaccinated HCWs (15.5 vs. 18 days). Fully vaccinated HCWs were most commonly asymptomatic (32%) or experienced nasal symptoms (28%), while partially vaccinated and unvaccinated HCWs experienced a wider variety and less mild symptoms.
92	Naleway et al (November 19, 2021)	USA	Retrospective cohort	482,464 participants (12+ years) enrolled in a Pacific Northwest health plan	Delta^	BNT162b2, mRNA-1273, Ad26.COV2.S	This study evaluated SARS-CoV-2 outcomes and severity in fully vaccinated versus unvaccinated members (aged 12+) of a large healthcare delivery plan (Kaiser Permanente Northwest) in Oregon and Washington from July-September 2021. Incidence of SARS-CoV-2 infection in fully vaccinated versus unvaccinated persons was 30.1 and 8.7 per 1000 people respectively (IRR 3.5). Unvaccinated persons were also more likely to visit an emergency department or be hospitalized (18.5% and 9%) compared to vaccinated persons (8.1% and 3.9%). Among those hospitalized for COVID-19, vaccinated persons had a shorter mean length of stay (7.4 days, SD 5.7) compared to unvaccinated persons (9.5 days, SD 9.6), and were less likely to be admitted to the ICU (15% vs. 27%), require intubation (8% vs. 16.1%), or require mechanical ventilation (<=5% vs. 8.6%). The crude mortality rate was also lower in fully vaccinated compared to unvaccinated persons (0.06 vs. 0.43 per 1000).
91	Salvatore et al (November 19, 2021)	USA	Outbreak investigation	95 incarcerated persons in a federal prison in Texas	Delta^	BNT162b2, mRNA-1273, Ad26.COV2.S	In this investigation of a Delta outbreak among incarcerated persons at a federal prison in Texas in July 2021, nasal specimens of a subset of infected people were used to assess the impact of vaccination on transmission potential, indicated by duration of PCR positivity, viral load (Ct value), and viral culture positivity. The study compared fully vaccinated persons (14+ days after completing recommended primary vaccine series) to those not fully vaccinated (including completely unvaccinated and partially vaccinated). The cumulative incidence of infection was 70% and 93% among those fully vaccinated and not, respectively. There was no significant difference in duration of PCR positivity between fully vaccinated and not fully vaccinated persons (medians: 13 days in each group, p=0.5), nor in duration of viral culture positivity (medians: 5 days in each, p=0.29) or Ct values. Among

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							fully vaccinated persons, median duration of PCR positivity among mRNA-1273 recipients (10 days) was slightly lower, though not significantly, than among BNT162b2 and Ad26.COV2.S recipients (13 days each; p=0.39). Median duration of positivity was also slightly lower among those who were fully vaccinated within 120 days before the outbreak compared to those fully vaccinated more than 120 days, but again this difference was not significant (11 vs. 13 days, p=0.32).
90	Simon et al (November 18, 2021)	USA	Retrospective cohort	240,648 COVID-19 infected persons	Non-VOC, Alpha[††]	BNT162b2, mRNA-1273, Ad26.COV2.S	This study investigated the relationship between the development of long-COVID and vaccination, along with other factors, using logistic and general linear regression among people in the Arcadia Data Research dataset from February 2020-May 2021. The vaccinated groups were anyone who received a first dose prior to being diagnosed with COVID-19, 0-4 weeks after diagnosis, 4-8 weeks after diagnosis, and 8-12 weeks post diagnosis. Long-COVID cases were those where the participant had one or more COVID-related symptoms between 12-20 weeks after the initial diagnosis. Results showed that, compared to unvaccinated persons with COVID-19, people who received at least one dose of any vaccine before diagnosis were 7-10 times less likely to report 2 or more long-COVID symptoms; those who received the first dose 0-4 weeks after diagnosis were 4-6 times less likely to report 2 or more long-COVID symptoms; and those who received the dose 4-8 weeks after diagnosis were 3 times less likely to report multiple long-COVID symptoms. The protective effect of one vaccine dose against long-COVID persisted even if it was received up to 12 weeks after COVID-19 diagnosis.
89	Giddings et al(November 18,2021)	England	Prospective cohort	330 LTCF staff and residents	Alpha and Delta[††]	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This prospective cohort study aimed to characterize COVID-19 outbreaks including outbreak duration and severity in 330 LTCFs across England during different time periods corresponding to the vaccination roll-out and pandemic waves. The study reported that the median vaccination rates among residents was consistently higher compared to the staff. Over 50% of the LTCF experienced a COVID-19 outbreak during the period when the uptake of first dose of the vaccine was low. A declining trend was noted in the number of outbreaks in the subsequent time periods which was

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							attributed to the rising proportion of staff and residents getting vaccinated. Outbreak severity decreased as LTCF vaccination coverage increased, with an 80.6% reduction in the number of infected cases per outbreak and a 45.9% reduction in outbreak duration when comparing outbreaks between November and December 2020 with outbreak between May and June 2021. The proportion of residents who died of COVID-19 or were infected with SARS-CoV-2 during an outbreak decreased over the study period; less than 5% of residents died of COVID-19 in LTCF experiencing outbreaks after March 2021. There were no large outbreaks from March 2021 to the end of the study period. The findings from this study provide evidence of the impact of vaccination on the risk of LTCF outbreaks.
88	Fang et al (November 17,2021)	USA	Ecological study	3,070 counties across 49 states	Delta^	BNT162b2, mRNA-1273,Ad26.COV2.S	This ecological study was undertaken to estimate the population-level impact of SARS-CoV-2 vaccination on community-wide COVID-19 cases and mortality rates during the period of Delta variant transmission. The study used negative binomial models to estimate the associations between county-level vaccination rates and county-wide COVID-19 incidence and mortality from April 23rd to September 30th 2021 and presented the rates adjusted for potential confounders. Overall, each percentage increase in a county's total population vaccination rate between April 23rd and September 30th was associated with a 0.9% reduction in county-wide COVID-19 cases (relative risk (RR) 0.9910 (95% CI: 0.9869, 0.9952)) and a 1.9% reduction in county-wide COVID-19 mortality (RR 0.9807 (95% CI: 0.9745, 0.9823)). County population vaccination was associated with greater protection against COVID-19 infection, RR of 0.9895 (95% CI: 0.9851, 0.9940), and mortality, RR 0.9742 (95% CI: 0.9670, 0.9804), when the analysis was limited to July 3rd to September 30th, corresponding to when Delta became the predominant SARS-CoV-2 176 variant in the U.S.
87	Magalis et al (November 11,2021)	USA	Retrospective cohort	4,439 SARS-CoV-2 samples from patients in Florida	Delta^	BNT162b2, mRNA-1273,Ad26.COV2.S	This study analyzed data generated as part of the SARS-CoV-2 genomic epidemiology surveillance program in Florida from October 2020 to August 2021. Multivariable linear regression analysis performed to evaluate associations between patient characteristics

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							and either viral load or RT-PCR cycle threshold (CT) levels. The study reported that unvaccinated individuals infected with the Delta variant exhibited the highest viral load compared to vaccinated Delta or non-Delta breakthrough infections. The study also reported that Delta-infected breakthrough cases had a statistically significant 38% reduction in viral load compared to unvaccinated Delta cases, and 34% compared to unvaccinated non-Delta cases. Particularly, the majority of vaccine breakthrough cases infected with the Delta variant (58.5%) exhibited a VL above the required threshold for potential transmission. There was also no correlation between distribution of VL over time elapsed since full vaccination, defined as the time interval between two weeks after 2nd vaccination dose.
86	Maltezou et al* (October 30, 2021)	Greece	Prospective cohort	7445 healthcare workers (HCW) from 5 hospitals	Non-VOC, Alpha††	BNT162b2	This prospective study investigated the impact of BNT162b2 vaccination on morbidity and absenteeism among HCW from 5 hospitals in Greece between November 15, 2020-April 18, 2021. After vaccinations began (January 4, 2021), instances and duration of absenteeism were significantly higher among unvaccinated HCW compared to those who received at least one dose (11.8 vs 4.7 instances of absenteeism per 100 HCW, p<0.001; mean duration 11.9 vs. 6.9 days, p<0.001). Vaccination prevented an estimated 163 COVID-19 cases, 177 cases of SARS-CoV-2 infection, and 342 instances of absenteeism among HCW. Respiratory infections, influenza-like illness, and COVID-19 disease were significantly more common among unvaccinated HCW than those who received at least one dose (p<0.001 in each case), though there was no significant difference in the incidence of febrile episode or asymptomatic SARS-CoV-2.
85	Arbel et al (October 28, 2021)	Israel	Ecological	Adults aged 70+	Alpha^	BNT162b2	This study evaluated the impact of mass vaccination with BNT162b2 on mortality among older adults (70+ years) from COVID-19 in Israel from March 15 through June 26, 2021 by comparing the expected number of deaths in the absence of vaccination and based on vaccine efficacy data to the actual number of deaths. During the study period, at least 90% of adults over 70 were vaccinated, and there were 370 COVID-19 related deaths in this group. This was lower than the expected

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							number of deaths based on vaccine efficacy alone (408), even with loosening non-pharmaceutical restrictions, indicating a possible herd immunity type effect. Actual recorded deaths were also much lower than the expected number of deaths in the absence of vaccination (370 versus 5120).
84	Rivasi et al* (October 13, 2021)	Italy	Ecological	3730 residents of nursing homes in Florence, Italy	Non-VOC, Alpha[††]	BNT162b2	This study assessed the impact of the BNT162b2 vaccine on the SARS-CoV-2 epidemic in nursing homes in the Florence Health District by comparing pre-vaccination) and post-vaccination periods (1 October-26 December 2020 vs. 27 December 2020-31 March 2021). The authors also analyzed symptoms, hospitalization, and mortality among cases by vaccination status in the post-vaccine period. In the pre-vaccination period, weekly infection rates ranged from 1.8% to 6.5%. Weekly infection rates fell progressively during the post-vaccination period, from 4.5% at the start to zero by late February, and remained at zero through the end of the study period. At the same time, infection rates among the general population of Tuscany (the region where Florence is located) were gradually rising. During the post-vaccination period, most fully vaccinated SARS-CoV-2 cases were asymptomatic (86%) or had mild symptoms, whereas symptoms were reported in 70% and 78% of partially vaccinated and unvaccinated cases respectively (p<0.001). Hospitalization and mortality rates were also significantly higher among unvaccinated than partially and fully vaccinated cases.
83	Stock et al (November 9,2021)	Scotland	Prospective cohort	16,229 pregnant women	Delta^	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This study used data from a national prospective dynamic cohort which included all women who were pregnant on, or became pregnant after March 1st 2020. The primary outcome of the study was to evaluate SARS-CoV-2 infection and severe COVID-19 outcomes in vaccinated and unvaccinated pregnant women. The study estimated that a 81.7% of COVID-19 cases, 93% of COVID-19 cases associated with hospital admissions and 98.9% of COVID-19 cases associated with critical care admissions occurred in women who were unvaccinated at the time of COVID-19 in pregnancy. The study also reported that complications known to be associated with COVID-19 in pregnancy (critical care admission, perinatal mortality) were far more common

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							in women who were unvaccinated at the time of SARS-CoV-2 diagnosis than in vaccinated pregnant women. Although COVID-19 rates were similar across all trimesters of pregnancy, and mirrored those in the general female population of reproductive age, associated hospital admissions and critical care admissions were higher in pregnant women than in the general female population of reproductive age, and highest in the third trimester.
82	Lim et al (November 8, 2021)	Malaysia	Ecological	Populations of 16 states of Malaysia	Delta††	BNT162b2, AZD1222, CoronaVac, Ad5-nCoV (CanSino)	This study aimed to assess the impact of COVID-19 vaccination on COVID-19 mortality rates using data from 16 states in Malaysia between February 24 (first day of vaccination in Malaysia) to October 2, 2021. The authors used an Autoregressive integrated Moving Average (ARIMA) model to evaluate differences in COVID-related mortality trends in each state among unvaccinated, partially vaccinated (one dose of BNT612b2, AZD1222 or CoronaVac), and fully vaccinated persons (14+ days after 2 doses of BNT162b2, AZD1222, or CoronaVac, or 28+ days after single dose of Ad5-nCoV). Compared to the unvaccinated populations, COVID-19 mortality rates of fully vaccinated persons were statistically significantly lower in all states. Mortality among partially vaccinated persons was also lower in 15 of 16 states, but the relationship was only statistically significant in 7 states.
81	Matos et al* (November 5, 2021)	Portugal	Prospective cohort	4617 patients with stage 5 chronic kidney disease (CKD-5D) in Portugal	Non-VOC††	BNT162b2	This prospective study investigated SARS-CoV-2 infection and mortality rates in patients with stage 5 chronic kidney disease undergoing dialysis (CKD-5D) at 38 NephroCare clinics (prioritized in phase 1 of vaccinations) compared to rates in the general population in the time periods before vaccination (3 Feb 2020-13 Feb 2021), during vaccination (24-27 Feb 2021), and after vaccination (28 Feb-15 Mar 2021). In the pre-vaccination period, the incidence of infection was significantly higher among the CKD-5D cohort than in the general population (14.9% vs. 7.9%, p<0.001). In the period starting 16 days after the first dose to 7 days after the second dose (during vaccination), there was no significant difference in the average daily incidence of infection between the CKD-5D cohort and the general population (13.68 vs. 14.09 per 100,000,

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							p=0.541). Starting the 8th day after dose 2 (full/post-vaccination), the average daily incidence rate in the CKD-5D cohort was significantly reduced compared to the general population (1.33 vs. 6.65 per 100,000, p<0.001). COVID-19 related mortality, on the other hand, remained significantly higher in the CKD-5D cohort.
80	McNamara et al*(November 3, 2021)	USA	Ecological	Adults aged 50+	Non-VOC, Alpha††	BNT162b2, mRNA-1273, Ad26.COV2.S	This national study aimed to assess the impact of COVID-19 vaccination on COVID-19 infections, emergency department visits, hospital admissions, and deaths by comparing the pre-vaccination period to the early post-roll-out period (November 1, 2020-April 10, 2021). Incidence rates for COVID-related outcomes among adults aged 65+ (who were among the groups initially prioritized for vaccination) were compared to those among adults aged 50-64 in the pre- and post-vaccination periods. Relative to those aged 50-64 and accounting for pre-vaccination differences, the incidence of infection during the post-vaccination period was reduced by 53% (95% CI 50-55) among those aged 65-74 and 62% (59-64) among those 75+, while emergency department visits were reduced by 61% (52-68) and 77% (71-81) respectively. Relative to adults aged 50-59, hospital admissions were reduced by 39% (29-48), 60% (54-66), and 68% (62-73) for adults aged 60-69, 70-79, and 80+ respectively. Deaths were reduced by 41% and 40% for adults aged 65-74 and 75+ respectively, though these results were not significant (95% CI -14-69 and -47-66 respectively).
79	Bouanane et al (November 2,2021)	France	Ecological	All adults	Delta††	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This study used data from Santé France to estimate the correlation between vaccination rates and hospitalizations, ICU admissions, and COVID-19 related deaths per 100,000 people across 100 territories. While the study reports a strong relationship between decreasing incidence and increasing vaccination rates averaged across the entire country during the month of September, authors reported a weak decreasing relationship between the incidence of COVID-19 and vaccination rate when accounting for varying vaccination levels by territory. Weak relationships with vaccination rates were also found for hospitalizations and ICU admissions, while no association was found between COVID-19 mortality and vaccination rates

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							across the 100 territories. When stratifying the analysis by most and least vaccinated territories, authors found no association between incidence and vaccination levels among the most vaccinated territories and a moderate decreasing association among the least vaccinated territories. Factors that the authors surmise may play a role in the results are: 1) gradual decline of vaccine efficacy 2) lower VE against newly emerging variants 3) improvement of medical care for COVID-19 patients and 4) probably a fairly significant development of natural immunity.
78	Evangelou et al (October 26,2021)	England	Retrospective cohort	41,208 patients in England with Multiple Sclerosis	Non VOC and Alpha[††]	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This study was undertaken in England to assess the impact of mass vaccination on the entire population of people with Multiple Sclerosis(MS) taking Disease-Modifying treatment(DMTs) in England in preventing asymptomatic and symptomatic COVID-19 infection, and compares their risk of infection to the general population during two distinct waves of the pandemic before and after implementation of SARS-CoV-2 vaccinations. The incidence of SARS-CoV-2 infection for people taking ocrelizumab or fingolimod increased following the lifting of COVID-19restrictions despite mass vaccination and a reduction in infections among the general population. The IRR (95% CI) of SARS-CoV-2 infection for people on ocrelizumab compared to the general population significantly increased from1.13 (0.97 – 1.31) during the pre-vaccination period to 1.79 (1.57 – 2.03) during the post-vaccination period .The IRR (95% CI) of SARS-CoV-2infection for people on fingolimod compared to the general population also significantly increased from 0.87 (0.73 – 1.02) to 1.40 (1.20 – 1.63) during the same periods.
77	Gyeltshen et al (October 21,2021)	Bhutan	Ecological	Individuals aged 12 and above	Delta^	BNT162b2, mRNA-1273, Sinopharm, AZD1222	This study summarises the impact of COVID-19 vaccination program in Bhutan on the rates of new infection. The authors note that with the onset of the second vaccination campaign in July 20,2021, there were 2455 total cases recorded with 328 active cases as compared to 889 total cases with 18 active cases as of April 2,2021. After the second dose, the country observed a steady decline in the cases with 123 active cases by August 2, 2021. This study highlights the impact of vaccination on the overall population of Bhutan.

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76	Levine-Tiefenbrun et al* (November 2, 2021)	Israel	Retrospective cohort	16,553 infected adults (aged 20+)	Delta^	BNT162b2	This study analyzed viral loads (cycle threshold/Ct) of 16,533 infected individuals, focusing on adults over 20 among patients of Maccabi Healthcare Services between June 28 and September 9, 2021. There were a total of 3100 infections among unvaccinated people, 12,934 infections among fully vaccinated people, and 519 infections among those who had received a booster dose. The authors used multivariable linear regression, adjusting for relevant covariates. The study found that infections in people who recently became fully vaccinated (within 7-30 days) have lower viral loads (higher Ct values) than infections in unvaccinated people, but that the effect begins to wane 2 months after vaccination and disappears completely 6 months or more after vaccination. Receipt of a booster dose of BNT162b2 was found to restore the effect of lowering the viral load of infections.
75	Taylor et al* (October 29, 2021)	US	Retrospective cohort	87,879 COVID-19 hospitalizations among US adults	Delta^	mRNA-1273, BNT162b2 and Ad26.COV2.S	The study utilised data from COVID-NET- a population based surveillance for laboratory confirmed COVID-19 associated hospitalisations across 99 counties in 14 states from January to August-2021. The study compared the study outcomes across two different time periods- the periods before and the period during the Delta variant predominance. There was a decreasing trend of hospital admissions among all adult age groups in the pre-Delta period, but hospitalizations subsequently increased during the months of July-August(corresponding to the high Delta variant transmission). The study noted that approximately 71.8% of COVID-19–associated hospitalizations in the Delta period were in unvaccinated adults. Adults aged 18–49 years accounted for 43.6% (95% CI = 39.1%–48.2%) of all hospitalizations among unvaccinated adults during the Delta period.
74	Xu et al*(October 29,2021)	US	Retrospective cohort	6.4 million COVID-19 vaccinees and 4.6 million unvaccinated persons	Non-VOC, Alpha and Delta††	mRNA-1273, BNT162b2 and Ad26.COV2.S	This retrospective cohort study was conducted across seven different sites in the US from December 2020-July 2021 to assess mortality not associated with COVID-19 ie. Non COVID-19 related deaths. After age and sex standardization, this study observed that the adjusted RR of non-COVID-19 mortality are significantly lower in vaccinated individuals compared

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							to unvaccinated across all the three vaccine groups. In children aged 12-17 years vaccinated with BNT162b2, mortality risk was similar after dose 1 and (aRR = 0.85; 95% CI = 0.38–1.90) and after dose 2 (aRR = 0.73; 95% CI = 0.33–1.64). Across vaccine type and dose, males and females had comparable aRRs. All vaccinated racial and ethnic groups had lower mortality risks than did unvaccinated comparison groups.
73	Coccia et al(October 25, 2021)	Italy	Retrospective cohort	All adults	Non- VOC, Alpha and Delta††	mRNA-1273, BNT162b2, Ad26.COV2.S and AZD1222	This retrospective cohort study analyses the impact of COVID-19 in Italy between April-September 2020 (without vaccinations and with non-pharmaceutical interventions) and April-September 2021 (with pharmaceutical interventions based on vaccination programs) to study the dynamics and impact of COVID-19 pandemic in society. The study reported that confirmed cases in 2020 is about 2.1%, whereas in 2021 is 2.5%. Number of hospitalizations, ICUs in 2020 has a slightly higher level, whereas fatality rate is lower in 2021 compared to 2021, likely because of a higher number of swab tests in 2021.
72	Subramanian et al *(September 30,2021)	68 countries and 2947 US counties	Ecological	Adults	Delta^	All	This study analysed country-level immunization data from online platforms, 'Our World in Data,' to investigate the association between the percentage of population fully vaccinated and new COVID-19 cases across 68 countries. Similar methodology was applied for extracting county-level data for the US from the 'White House COVID-19 Team' for 2,947 counties. At the country-level, there appears to be no significant relationship between percentage of population fully vaccinated and new COVID-19 cases in the last 7 days. Across the US counties, too, the median new COVID-19 cases per 100,000 people in the last 7 days is largely similar across the categories of percent population fully vaccinated.
71	Vahidy et al*(October 12, 2021)	US	Cross-sectional	27,291 employees of a healthcare system in Houston, Texas.	Alpha, Beta, Gamma and Delta^	mRNA-1273, BNT162b2 and Ad26.COV2.S	This study was conducted in Houston-Methodist health care system in Texas from December 2020 to June 2021, with the objective of evaluating reduction in SARS-CoV-2 infections, after the roll-out of COVID-19 vaccines. The study estimated that the mean SARS-CoV-2 weekly positivity rate prior to initiation of the HCW vaccination programme (11.8%) was

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							significantly higher compared with the positivity rate following vaccination initiation (2.4%, p<0.001). The infection rate amongst HCWs participating in surveillance testing has consistently remained below 3.1% since January. The short-term disability use utilisation by employees progressively declined by 69.8% during the most recent reporting period- 30th May to June 2021, with utilisation numbers approaching pre-pandemic levels.
70	Singh et al* (October 11, 2021)	India	Case control	577 cases and 1144 controls aged 45+ among patients of AIIMS in Patna, Bihar	Delta^	AZD1222 (SII) & COVAXIN	This case control study was conducted at the All India Institute of Medical Sciences (AIIMS) in Patna, Bihar. In addition to estimating vaccine effectiveness against infection, the study assessed the impact of vaccination on the length of hospital stay (LOS) and disease severity. The median LOS among partially vaccinated patients (9 days, IQR 5-13) was significantly lower than among unvaccinated patients (12 days, IQR 6-16) according to a Bonferroni post hoc test (p=0.028). Fully vaccinated patients had a median hospital stay of 10 days (IQR 6-15). Fully vaccinated cases were also less likely to experience severe disease (30.3% of fully vaccinated cases) compared to partially vaccinated (51.3%) and unvaccinated cases (54.1%) based on Chi-square tests (p=0.035).
69	Nordstrom et al* (October 11, 2021)	Sweden	Retrospective cohort	1,789,728 individuals from 814,806 families	Alpha^	mRNA-1273, BNT162b2, & AZD1222	This nationwide retrospective cohort study evaluated the association between the risk of SARS-CoV-2 infection in nonimmune individuals and the immunity status of their family members. Immune persons were those with either a previous SARS-CoV-2 infection or full vaccination by April 14, 2021, and only families with 2-5 members were included. Incidence of COVID-19 infection among nonimmune individuals between April 15-May 26 was assessed using Cox proportional hazards regression by family size, with the number of immune family members as the main variable of interest. The study found a significant inverse dose-response association wherein the risk of infection in nonimmune persons decreased as the number of immune family members increased, regardless of family size. Relative to families with no immune members, the risk of COVID-19 infection among nonimmune family members was reduced by 45-61%, 75-86%, 91-94%, and 97% in families with 1,

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							2, 3, or 4 immune members, respectively. The results were similar for the outcome of hospitalization for COVID-19 among nonimmune persons.
68	Paetzold (October 7, 2021)	Austria	Retrospective cohort	Austrian population	Beta^	BNT162b2	This nation-wide retrospective cohort study utilised data from the Austrian Epidemiological Reporting system to assess the impact of cross-protection to unvaccinated individuals during a period of Beta variant driven outbreak from January to May 2021. The primary findings from the study illustrate a stark difference in the vaccination coverage from March to April- from 5% to 60%, and the large scale rollout of the BNT162b2 vaccine was associated with a significant reduction in new SARS-CoV-2 infections among the age-cohort of unvaccinated children of around 40-65% relative to the same age-cohort from the control regions.
67	Liu et al (October 7, 2021)	USA	Test-negative case control	14,362 matched adult residents (18+) of New York City	Non-VOC, then Alpha, then Delta††	BNT162b2 & mRNA-1273	Among other analyses, this study assesses the impact of full vaccination on reducing SARS-CoV-2 infection rates and the risk of severe COVID-19 outcomes between January 18-September 21, 2021, using electronic health records from a quaternary care academic medical center in New York City. Monthly incidence were highest among unvaccinated persons throughout the study period compared to those fully vaccinated with either vaccine. Using logistic regression, the study found that vaccination reduced the odds of SARS-CoV-2 infection by 88.4% compared to a matched cohort from the pre-vaccination period (adj. OR 0.116, 95% CI 0.0998-0.135). A Cox regression analysis of infected persons comparing cases from pre- and post-vaccination periods found that vaccination significantly reduced the hazard of death by 80% (aHR 0.2, 0.0824-0.487). It also reduced the hazard of mechanical ventilation and tracheostomy, and increased the hazard of hospitalization, though these findings were not statistically significant. A similar analysis comparing vaccinated cases to contemporaneous unvaccinated cases found that vaccination significantly reduced the hazard of hospitalization by 27.7% (aHR 0.723, 0.6-0.872). The hazards of mechanical ventilation, tracheostomy, and death were also reduced, though these findings were not statistically significant.

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66	Samson et al (October 5, 2021)	USA	Retrospective cohort	25.3 million Medicare beneficiaries			This study was conducted from September 2020 to May 2021 to identify associations between COVID-19 infections, hospitalizations, and deaths among Medicare users and estimate the reduction in overall disease outcomes associated with the roll-out of vaccines in the US. The study reported that for the risk of COVID-19 infection, a 10% increase in COVID-19 vaccination rate among those 65 and older was associated with an 11% decrease in the odds of COVID-19 infection, with an estimated reduction between 9 and 12%.For COVID-related hospitalizations and deaths, a 10% increase in COVID-19 vaccinations in those ages 18-64 was associated with approximately an 11% (OR=0.989, 95% CI 0.982-0.995) and 12% (OR=0.988, 95% CI 0.978-0.999) decrease in the odds of COVID-19 hospitalizations and deaths, respectively, among Medicare beneficiaries infected with COVID-19.
65	Wisnivesky et al (October 5, 2021)	USA	Prospective cohort	464 New York City residents	Non-VOC, Alpha, Delta[††]	BNT162b2, mRNA-1273, Ad26.COV2.S	This prospective cohort study was undertaken to assess whether vaccination was associated with Post-Acute Sequelae of COVID(PASC) in New York City. A total 464 participants were recruited from the registry. The study did not find any significant differences in change in PASC symptoms from baseline to six months between vaccinated and unvaccinated participants.
64	Hollinghurst et al (October 3, 2021)	UK	Prospective cohort	14,786 older care home residents (aged 65+) living in Wales	Non-VOC, Alpha, Delta[††]	BNT162b2, mRNA-1273, AZD1222, Ad26.COV2.S	This longitudinal observational cohort study was undertaken to identify individual level risk factors for SARS-CoV-2 infection with the inclusion of community positive test rate of COVID-19, hospital admissions and vaccination status among residents of care home. Results indicated a high proportion of observations with a positive PCR test had not been vaccinated (96%), and of those with a positive test who were unvaccinated a significant proportion were hospital inpatients (19%).The estimated community positive test rate of COVID-19 was largely correlated with the positive test rate amongst care home residents, with peaks in November and January. There was a large decrease in testing and positive tests amongst care home residents after February when the vaccination program was ongoing.

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63	Ronchini et al. September 30th 2021)	Italy	Prospective cohort	2121 personnel working at a large cancer centre in Milan	Non-VOC, Alpha, Delta††	BNT162b2 & AZD122	This prospective surveillance program was conducted from April 2020 and monitoring was continued till June 2021. The study estimated that the probability of infection after vaccination was significantly lower than in non-vaccinated subjects. The time of acquiring an infection varied from few days 105 post-vaccination to >4 months after completion of the vaccination. Secondly, the study also reported that infections in individuals who had a serologically positive response to vaccination are of significantly shorter duration than the first infections in non-vaccinated individuals. Thirdly, the levels of anti-SARS-CoV-2 circulating IgGs were inversely correlated with the frequency and duration of viral detection.
62	Paredes et al (September 30th, 2021)	USA	Retrospective cohort	27,814 cases	Non-VOC, Alpha, Delta, Gamma, Beta	BNT162b2, mRNA-1273, Ad26.COV2.S	This retrospective cohort study estimated the risk of hospitalisation with 9 VOCs/VOIs using epidemiologic and genomic data from Washington. Overall, cases infected with any VOC presented a higher risk of hospitalization, compared to cases without a classified VOC/VOI. The highest risk of hospitalization were found in cases infected with the Gamma variant (HR 3.17, 95% CI 2.15-4.67) and in cases infected with the Beta variant (HR 2.97, 95% CI 1.65-5.35). The study also estimated that being unvaccinated and infected with Gamma, Delta or Alpha variant increased the likelihood of hospitalization.
61	Agrawal et el(September 29,2021)	Scotland	Prospective cohort	5.4 million Scottish population	Non-VOC, Alpha††	BNT162b2, AZD1222	This prospective cohort study used data from the Early Pandemic Evaluation and Enhanced Surveillance of COVID-19 (EAVE II) national surveillance platform to estimate the frequency of COVID-19 hospitalisation or death in people who received at least one vaccine dose and characterise these individuals in Scotland. The study follow-up period lasted till April 18,2021. Severe COVID-19 outcomes were associated with older age(adjusted RR 4·75, 95% CI 3·85–5·87), comorbidities (adjusted RR 4·24, 3·34–5·39), hospitalisation in the previous 4 weeks (adjusted RR, 3·00, 95%CI 2·47–3·65), high-risk occupations (adjusted RR, I2·14, 95%CI 1·62–2·81), care home residence (adjusted RR 1·63, 95%CI 1·32–2·02), socioeconomic deprivation (adjusted RR 1·57, 95%CI 1·30–1·90), male sex (adjusted RR 1·27, 95%CI 1·13–1·43), and being an ex-smoker (adjusted RR 1·18,

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							95%CI 1·01–1·38). A history of COVID-19 before vaccination was protective (adjusted RR 0·40, 95%CI 0·29–0·54).
60	Arifin et al (September 29, 2021)	Malaysia	Ecologic	25,935 deaths among the population of Malaysia	Non-VOC, Beta, Delta††	BNT162b2, CoronaVac, AZD1222	This ecologic study analyzed national surveillance COVID-19-related death and vaccination data. The data was combined using logistic regression with frequency weighting. Of the 25,935 total COVID-19 related deaths up to September 28, 2021, 69.9% were unvaccinated, 22.5% were partially vaccinated (receipt of any dose through <14 days after final dose), and 7.5% were fully vaccinated (>14 days after final dose). Compared to unvaccinated persons, partially vaccinated groups had a 4.9 times lower risk of death, and fully vaccinated groups had an 8.8 times lower risk of death.
59	Acharya et al (September 29, 2021)	USA	Retrospective cohort	869 test samples from individuals (aged 1+) who sought testing at a community-based testing site in San Francisco or City of Davis/Yolo County testing program in California	Delta^	BNT162b2, mRNA-1273, Ad26.COV2.S	This study compares cycle threshold values (Ct-values) among fully vaccinated versus unvaccinated and symptomatic versus asymptomatic individuals from two testing sites: one in San Francisco (UeS-symptomatic or asymptomatic) and one in Davis, California (HYT- asymptomatic only) during a period of dominant Delta transmission (June 17-August 31, 2021). A total of 869 test samples were included, and Ct-values were compared using two sided t-tests. In contrast to other studies that have found higher Ct-values (corresponding to lower viral load) among vaccinated compared to unvaccinated persons, the study found no statistically significant differences in mean Ct-values among fully vaccinated versus unvaccinated samples for either population: UeS 23.1 vs. 23.4, and HYT 25.5 vs. 25.4. Both the vaccinated and unvaccinated groups had varied Ct-values (<15 to >30). There were also no significant differences in Ct-values between asymptomatic vs. symptomatic cases.
58	Holt et al* (September 27, 2021)	UAE	Prospective cohort	1296 dialysis patients in the UAE	Beta††	Sinopharm	This prospective study looked at responses to the Sinopharm vaccine and SARS-CoV-2 infection in a cohort of dialysis patients at kidney care facilities in Abu Dhabi from March 2020-August 2021. Of 512 PCR-positive patients, 64% were unvaccinated and 37% were vaccinated. Vaccinated cases had significantly shorter duration of infection, or COVID positive days, compared to unvaccinated cases (median 14 versus 17 days, p=0.0001). Among 32 of

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							the cases for which complete antibody information was available, there was no difference between antibody levels in vaccinated and unvaccinated patients. From March 2020 until the start of vaccination in January 2021, the case fatality ratio (CFR) was about 8.9% (17/190), whereas in the post-vaccination period (end of March-August 2021) the CFR fell to 5.2% (13/250). The overall CFRs in unvaccinated and vaccinated patients were 8.7% and 4.3% respectively. Among 32 of the cases for which complete antibody information was available, there was no difference in antibody levels between vaccinated and unvaccinated patients.
57	Haas et al(September 22,2021)*	Israel	Retrospective cohort	All Israeli residents aged ≥16 years	Alpha^	BNT162b2	This retrospective surveillance utilised data from Israeli Ministry of Health from the first 112 days(December 20,2020 to April 10,2021) to estimate the averted burden of four outcomes: documented infections, COVID-19 related hospitalizations, severe disease and deaths. At the end of the follow-up period, 79.8% of Israeli residents aged ≥ 16 years and above were at least partially vaccinated. Age-specific incidence rate was calculated. The study estimated a considerable difference in rates of SARS-CoV-2 infections when stratified by age and time and were generally highest in January and February, 2021. The largest rate differences in hospitalisation and deaths between unvaccinated and vaccinated groups were observed among people aged 65 years or older. The study also reported that overall 158 665 (95% CI 144 640–172 690) SARS-CoV-2 infections, 24 597 (18 942–30 252) hospitalisations, 17 432 (12 770–22 094) severe or critical hospitalisations, and 5532 (3085–7982) deaths were averted among the at least partly vaccinated population who were aged 16 years or older up to April 10, 2021.
56	Alkhafaji et al (October 11, 2021) [Update to Sep 22 preprint]	Saudi Arabia	Retrospective cohort	331 hospitalized patients with COVID-19 disease at a single center	Unknown	BNT162b2 and AZD1222	This study assessed the impact of vaccination on disease outcomes (ICU admission, mechanical ventilation, death, length of hospital stay) among 331 patients hospitalized with COVID-19 at King Fahad University Hospital between April and July 2021. Chi square tests were performed to evaluate associations between variables, including vaccination status and outcomes. Nearly two thirds of participants had

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							received no doses of vaccine, 16.8% had received both doses, and the remaining 19.2% had received one dose. Unvaccinated participants had significantly longer hospital stays than those who had received at least one dose (p=0.02): receipt of any dose reduced the length of hospital stay by 19.7%. Those who had received a vaccine dose >14 days before were significantly less likely to require admission to intensive care (ICU) than those who had received a dose within 14 days (p=0.03). Receipt of any vaccine dose reduced the mortality rate in the cohort by 50%, but the relationship was not statistically significant (p=0.16). No statistically significant differences were observed by vaccine or by doses received in the cohort.
55	Barandalla et al(September 15, 2021)*	Spain	Retrospective cohort	All Spanish residents aged ≥18 years	Alpha and Delta^	BNT162b2, mRNA-1273, Ad26.COV2.S and AZD1222	This study evaluated the impact of vaccination on nation-wide COVID 19 hospitalizations by age-groups, from February 2020 to June 2021 using data from the website of Health Ministry. The reference groups for calculating the incidence rate differed by age-groups and time periods in accordance with the country-specific vaccination policies. The study included 363,960 COVID-19 hospitalizations till June 21st, 2021 and approximately 55% of the population had received at least 1 dose of any vaccine, with a higher proportion receiving BNTB162b2. The adjusted risk of hospitalization increased exponentially on average 71.5% for each decade older above 20 years-old. The study reported a strong inverse relationship between vaccination rollout and COVID-19 hospitalizations, which was noticed in the oldest age groups that became vaccinated earlier.
54	Prato' et al* (September 17, 2021)	Italy	Retrospective cohort	671 HCW in a hospital in Northern Italy	Alpha††	BNT162b2	This study is a retrospective cohort study with an aim to determine if vaccination with the Pfizer BNT162b2 mRNA vaccine can lessen the duration of sick leave among healthcare workers (HCWs) by determining the incidence of asymptomatic infection caused by SARS CoV-2 virus post-vaccination. This study included 671 HCWs with a median age of 39 yeas (range: 22-70 years), who were mostly women (86%). The study concluded that positive cases were reduced from 15.6% to 7.5% after the vaccination period (p <0.0001). This study concluded that even in the case

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							of asymptomatic infection, vaccinated HCWs have a reduced incidence and shorter sick leave following vaccination.
53	Schwarzer et al (September 16, 2021)	Germany	Retrospective cohort	9 staff and 23 residents of a senior citizen home in Bremen, Germany with confirmed SARS-CoV-2 infection	Non-VOC^	BNT162b2	This study evaluated the impact of one dose of BNT162b2 (partial vaccination) on the severity of disease during a COVID-19 outbreak at a senior citizen home. Of 32 PCR-confirmed infections, 22 were among partially vaccinated persons (all residents) while 10 were among unvaccinated persons (9 staff and 1 resident). The majority of cases among partially vaccinated residents were asymptomatic (20/22) while the other 2 experienced mild symptoms (tiredness, temporary lower oxygen saturation, or slightly elevated body temperature). Among the infected unvaccinated staff and resident, 9 of the 10 cases experienced severe symptoms (fever >38.5°C, dry cough, exhaustion, dyspnea, chest pain, ageusia, weakness, hospitalization, death), including 1 death (resident) and 1 hospitalization (staff). The remaining unvaccinated case experienced mild symptoms.
52	Glatman-Freedman et al* (September 16, 2021)	Israel	Retrospective longitudinal cohort	All Israeli residents aged 16+	Alpha^	BNT162b2	This study evaluated the effects of BNT162b2 vaccines on both prevention of COVID-19 related outcomes and on hospitalization, deaths and severe/critical illness amongst vaccinated individuals. The rate reductions for hospitalizations, severe/critical disease and deaths for 16-year-old individuals who became SARS-CoV-2-positive on days 14-20 after the first vaccine dose were 44.2% (95% CI: 27.3-57.3), 46.8% (95% CI: 32.9-57.9) and 36.4% (95% CI: 18.6-50.4%), respectively. The rate reductions for hospitalizations, severe/critical disease and deaths for individuals who became SARS-CoV-2-positive on days 22-28 after the first vaccine dose were 56.1% (95% CI: 35.0-70.4), 66.2% (95% CI: 44.2-79.6) and 47.4% (95% CI: 4.3-71.2), respectively. The study also reported that further analysis by stratifying age group demonstrated that the rate reductions for hospitalizations and severe/critical disease among 80-year-old individuals were lower than other age categories during the first three evaluation periods.
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-

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							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), 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

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							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	Bager et al* (September 3, 2021)	Denmark	Retrospective cohort	88,858 SARS-CoV-2 cases in Denmark	Alpha and Delta^	AZD1222, BNT162b2, mRNA-1273, and	This study assessed the risk of hospitalization for Delta-infected SARS-CoV-2 individuals relative to the risk of hospitalization in Alpha-infected persons. Of 44 patients hospitalized with Delta during the study period (1 January-11 July, 2021), 30 were unvaccinated, 10 had received one dose within less than 14 days of testing positive (effectively unprotected), 2 tested positive >14 days after one dose up to 14 days post-dose 2 (one effective dose), and 2 tested positive >14 days after two doses (two effective doses). Among persons who had received one or two effective doses there was no significant difference in adjusted risk of hospitalization between Delta and Alpha cases (RR 1.29, 95% CI 0.30-5.48 for one dose and 1.25, 0.34-4.59 for two doses). On the other hand, among unvaccinated persons and those who received one dose within 14 days, the risk of hospitalization among Delta cases was significantly higher than for Alpha cases (RR 3.01, 95% CI 2.02-4.50

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							for unvaccinated and 3.98, 2.27-6.99 for one dose =<14 days). The study also presents adjusted RRs for Delta hospitalization relative to Alpha hospitalization overall and by age group.
46	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.
45	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.
44	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.

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43	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.
42	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).
41	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

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							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.
40	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 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).
39	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).

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							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.
38	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, 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)
37	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

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							the first dose to 0.01 in completely vaccinated persons.
36	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 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.
35	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).
34	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

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							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.
33	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 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%.
32	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.
31	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

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							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.
30	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 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).
29	Alencar et al (July 13,2021)	Brazil	Retrospective cohort	313,328 elderly people(75+) from Ceara, northeast 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* (December 23, 2021)	Italy	Retrospective cohort	20,109 HCWs and 4,474,292 residents	Unknown	BNT162b2 (majority) and	This retrospective cohort study included HCWs in Italy from March 6, 2020 to April 4, 2021. The study aimed to assess the patterns of SARS-CoV-2 infections in

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	[Update to July 20 preprint]					mRNA-1273 and AZD1222(limited)	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 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

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							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 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

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							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
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

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							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 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

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							(-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.
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

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
							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).
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

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							vaccination not only protects individual vaccinees but also provides cross-protection to unvaccinated individuals in the community.
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.

#	Reference (date)	Country	Design	Population	Dominant Variants	Vaccine Product	Descriptive Findings
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 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

Please direct any questions about content to:
- Anurima Baidya (abaidya1@jh.edu)
- Karoline Walter (kwalte21@jhmi.edu)