Effectiveness of BNT162b2 mRNA and ChAdOx1 adenovirus vector COVID-19 vaccines on risk of hospitalisation among older adults in England: an observational study using surveillance data

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ABSTRACT

Background

National rollout of the BNT162b2 COVID-19 vaccine commenced in the UK on 08 December 2020, with the ChAdOx1 vaccine following on 04 January 2021. We estimate the effectiveness of these two vaccines in reducing the risk of hospitalisation among adults aged 70 and over in England.

Methods

Vaccine effectiveness (VE) was estimated by comparing vaccination rates among individuals hospitalised with COVID-19 at acute hospital trusts in England contributing to SARI Watch (the national surveillance system for COVID-19 hospitalisations), to the matched population coverage. Data spanned the period 08 December 2020-18 April 2021. The primary outcome was hospitalisation to any level of care. The exposure was one or two doses of the BNT162b2 or ChAdOx1 vaccine.

Findings

19,495 admissions were reported by participating acute hospital trusts, of which 13,907 were included in the analysis. In those aged 80+ years, VE against hospitalisation was 80% (95% CI 74-85%) 28 days after one dose of any vaccine, rising to 92% (87-95%) 14 days after the second dose. Equivalent VE following first dose of any vaccine for those aged 70-79 years was 82% (75-87%), but small numbers precluded estimation of second dose effects in this age group. In those aged 80+ years, estimated effectiveness against hospitalisation was 73% (60-81%) by day 28 following first dose of the ChAdOx1 vaccine, and 81% (76-85%) from 28 days after dose 1 of BNT162b2, rising to 93% (89-95%) 7 days after dose 2. In those aged 70-79 years, VE at 28 days post first-dose was 84% for ChAdOx1 (74-89%) and 81% (73-87%) for BNT162b2.

Interpretation

Effectiveness in preventing hospitalisation was high in those aged 70 and over for one dose of either the ChAdOx1 and BNT162b2 vaccines, and especially after two doses of BNT162b2. Vaccination is likely to have a significant impact in reducing demand for high-acuity health services as a result of COVID-19 infection.

Funding

Public Health England.

INTRODUCTION

The UK was the first country to begin nationwide rollout of COVID-19 vaccinations on 08 December 2020, following approval of the BNT162b2 vaccine by the Medicines and Healthcare products Regulatory Authority (MHRA) (1). In England, initial prioritisation for vaccination followed advice from the Joint Committee on Vaccination and Immunisations (JCVI) and was based primarily on age as the predominant risk factor for mortality, with the further inclusion of frontline health and social care workers on the basis of increased occupational risk of exposure to SARS-CoV-2 and potential onward transmission to vulnerable patients (2).

During the first few weeks of the programme, the priority groups for vaccination included residents in a care home for older adults and their carers, those 80 years of age and over and frontline health and social care workers. From the 18 January, rollout was extended to adults aged 70 years or older and those in clinically extremely vulnerable groups. With the addition of the ChAdOx1 vaccine on 4 January 2020 (3) and more recently the mRNA-1273 (4) vaccine to the list of approved products, vaccination delivery has proceeded at pace and as of 25 April 2021, national vaccination coverage (all age groups) was estimated at 46%, with 94% in those aged 70-79 years, and 96% in the eldest cohort (80+ years) now vaccinated (5).

Evidence of the efficacy of approved vaccines against symptomatic infection from clinical trials has been strong. Reported efficacy values range from 70% (95%CI 55-81%) following two doses of the ChAdOx1 vaccine (6), to 95% (90-98%) after two doses of the BNT162b2 vaccine (7), and 94% (89-97%) for the mRNA-1273 vaccine (8). These trial results have been complemented by growing evidence of the real-world effectiveness of the BNT162b2 and ChAdOx1 vaccines especially against symptomatic infection, in a range of different populations and settings, albeit mostly reporting first dose effects (9–12).

However, evaluations of vaccine effectiveness against hospitalisation have, to date, been few in number. Clinical trials have in general had insufficient sample sizes to allow for detailed analysis of hospitalisation risk, typically recording a handful of events (6–8). Establishing effectiveness of approved vaccines against hospitalisation is of critical importance for policy decision-making and service planning and delivery given the significant proportion of severe COVID-19 cases requiring hospitalisation and critical care (a feature of symptomatic COVID-19 infection noted from an early stage in the pandemic (13)), and the ongoing risk that secondary care services are overwhelmed in the event of future waves of infection (14).

Real-world studies, including from the UK, are beginning to address this deficit and all show large reductions in the risk of hospitalisation among vaccinated groups (15–18). A recently published analysis of data from a prospective cohort study in Scotland spanning around 99% of the population found a reduction of 91% (85–94%) in COVID-19 hospital admissions at 28–34 days post-vaccination with the BNT162b2 vaccine, and an equivalent figure of 88% for ChAdOx1 (75–94%) (17). A smaller, test-negative case control study from England but focused on risk of hospitalisation in older, frail adults (aged ≥80) also demonstrated high vaccine effectiveness against admission in this population after first dose of the BNT162b2 vaccine (71.4%, 46.5-90.6%) or ChAdOx1 (80.4%, 36.4-94.5%), although the duration of follow-up in this study was short at a maximum of 9 weeks (16). These studies considered effects arising from a single vaccine dose only. Recently published data from nationwide surveillance in Israel for two doses indicate high effectiveness against both hospitalisation (97.5%, 97.1-97.8%) and hospitalisation with severe or critical illness (96.7%, 96.0-97.3%) after adjusting for age, sex and time period (18).

Here, we report the real-world effectiveness of the BNT162b2 and ChAdOx1 vaccines in preventing hospitalisation as a result of laboratory-confirmed COVID-19 infection in England. We evaluate effectiveness in adults aged 70+ for both single doses and for full (two dose) courses of either vaccination, where data allowed, and accounting for factors including age, sex and risk (as indicated by care home residency status).

METHODS

Design

We used a case-coverage design (also known as the screening method) to estimate the effectiveness of COVID-19 vaccines in preventing hospitalisation (19).

Definitions

A case of COVID-19 was confirmed if there was a laboratory-confirmed positive SARS-CoV-2 reverse transcriptase real-time polymerase chain reaction (RT-PCR) test result from an upper respiratory tract sample taken from an adult hospitalised with clinical features suggestive of an acute respiratory infection. In England, RT-PCR testing for COVID-19 is conducted by hospital and public health laboratories for those with a defined clinical need and for healthcare workers (Pillar 1), or through community testing (Pillar 2) (20). In line with the NHS policy instituted across England in April 2020 of testing all elective and non-elective admissions for COVID-19 irrespective of their presenting complaint, confirmed cases were reported by participating NHS trusts, whether or not COVID-19 was the primary diagnosis in the differential at or during the admission.

Hospitalisations were defined as admissions to hospital at any time, at any level of care, with any primary diagnosis, and to any ward including intensive or high dependency unit care, and timing was defined according to the date of admission. Presentations to accident and emergency departments that did not result in admission were not included. An individual was considered vaccinated if they had received one or two doses of either BNT162b2 or ChAdOx1, but we excluded those who had received different vaccines for first and second dose.

Data sources and handling

The primary outcome for this study was hospitalisation with laboratory confirmed COVID-19. Data on hospitalisations were sourced from the Severe Acute Respiratory Infection (SARI) Watch surveillance system run by Public Health England (PHE), through which participating NHS acute hospital trusts submit daily patient-level data on laboratory-confirmed COVID-19 admissions. This is a hybrid surveillance system of sentinel data (admissions to all level of care for COVID-19) from a small network of NHS trusts and mandatory data (admissions to critical care for COVID-19) required from all NHS trusts. Data from 35 and 71 trusts were submitted to the patient-level sentinel and mandatory systems respectively over the study period. Overall, 72 trusts contributed data over the study period. Despite sentinel data coming from 35 trusts, admissions from this collection accounted for 82.8% of total admissions in this dataset. Case data for adults aged 16 and over were gathered, including variables for sex, age, NHS region, the date, dose and type of vaccination delivered (if any), and a flag to identify those who were care home residents.

For confirmed COVID-19 cases, testing data were linked using NHS number and date of birth to individual vaccine records from the National Immunisation Management Service (NIMS) – the COVID-19 vaccine register for England. Healthcare professionals record

COVID-19 vaccines administered in NIMS through point-of-care applications. Assessment of exposure, i.e. vaccination status was based on receipt of one or more doses of either of the first two approved vaccines between 08 December 2020 (BNT162b2) or 04 January 2021 (ChAdOx1) and 18 April 2021. Data on the mRNA-1273 vaccine were not considered owing to the short time that had elapsed since the introduction of this product into the UK's COVID-19 vaccination programme at the time this study was conducted. NIMS data were extracted on 19 April 2021, to cover the period to 18 April 2021. Data on COVID-19 vaccination coverage for the reference group (i.e. the general population) in England were also drawn from the NIMS.

Vaccine coverage from the NIMS was matched to each case based on date of hospitalisation, age at 31 March 2021, sex, NHS region and population group (e.g. care home residents). These were used as factors known, or likely to, influence the likelihood of vaccination uptake, risk of exposure to SARS-CoV-2 and hospitalisation. Cases were excluded if they were asymptomatic; the date of hospital admission recorded in SARI Watch preceded the recorded date of symptom onset; data on sex or NHS region were missing (as these records could not then be matched); if the positive test occurred more than 5 days before, or more than 2 days after hospital admission; if date of onset was greater than 21 days before the laboratory test that was reported by the trust, or more than 30 days before the hospital admission.

Statistical analysis of vaccine effectiveness

Vaccine effectiveness (VE) was defined as 1 – the odds of hospitalisation following receipt of one or two doses, using the screening method. VE using the screening method is calculated using the following equation (19):

$$VE = \frac{PV - PCV}{PV(1 - PCV)}$$

Where:

PV = proportion of the matched population vaccinated

PCV = proportion of cases who are vaccinated

All analyses were performed using STATA software, version 15.1. To allow for the matching of coverage to each individual, a logistic regression model was used with vaccination status of cases as the outcome variable, and an offset included for the log-odds of the coverage in the matched population. When considering vaccination status, this was stratified by timing of hospitalisation in weeks post-receipt of first or second dose vaccination (0-6, 7-13, 14-20, 21-27 and 28 days+ for dose 1, and 0-6, 7-13 and 14 days+ for dose 2). Overall effects by dose were defined as having received the first dose of vaccine 28 days or more prior to hospital admissions; and as having received the second of vaccine 14 days or more prior to hospital admission. Analyses were stratified by age 70-79 and 80 years and over.

Ethics

Surveillance of COVID-19 testing and vaccination is undertaken under Regulation 3 of The Health Service (Control of Patient Information) Regulations 2002 to collect confidential patient information (http://www.legislation.gov.uk/uksi/2002/1438/regulation/3/made) under Sections 3(i) (a) to (c), 3(i)(d) (i) and (ii) and 3(3). The study was subject to an internal review by the PHE Research Ethics and Governance Group and was found to be fully compliant with all regulatory requirements. As no regulatory issues were identified, and ethical review

is not a requirement for this type of work, it was decided that a full ethical review would not be necessary.

Role of the funding source

This research did not receive any specific grant funding from agencies in the public, commercial or not-for-profit sectors.

RESULTS

There were 19,495 admissions from 19,158 unique patients reported via the SARI Watch individual-level dataset in the period 08 December 2020-18 April 2021. Of the 19,495 admissions, 5,588 were excluded from the analysis for reasons including non-alignment between hospital admission date and date of symptom onset, absence of data on matching variables such as sex, leaving a final sample size of 13,907 admissions overall (71%). (details of selection for the final study sample are set out in **supplementary figure S1**). Descriptive statistics for the final study sample are given in **table 1**. Of those admitted to hospital in this period, 42% were aged 70 and over. Male patients accounted for 56% of hospitalisations overall, and unvaccinated individuals accounted for 43%.

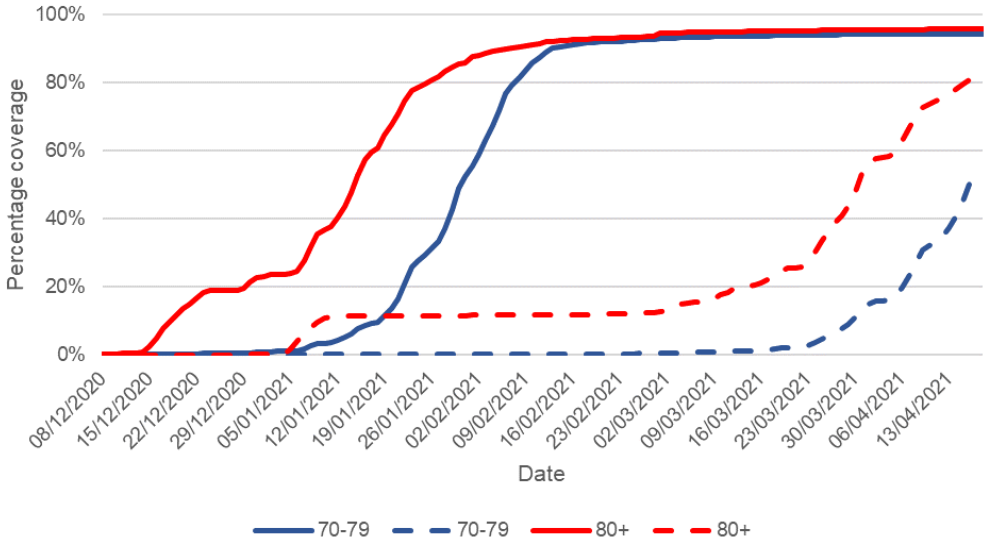
Table 1. Summary of descriptive statistics for hospital admissions included in the analysis († for care home residency, percentages are calculated relative to the total number of admissions among care home residents of any age in the sample).

		All admissions	
		No	**%age**
Sex	**Male**	7,857	56%
	Female	6,050	44%
Age (years)	**<70**	8,048	58%
	70-79	2,827	20%
	80+	3,032	22%
Care home residents†	**All ages**	912	-
	70-79	186	20%
	80+	588	64%
Unvaccinated		5,922	43%
Vaccinated: any product	**Dose 1**	7,985	57%
	Dose 2	2,440	18%
Vaccinated: BNT162b2	**Dose 1**	2,072	15%
	Dose 2	947	7%
Vaccinated: ChAdOx1	**Dose 1**	5,881	42%
	Dose 2	1,493	11%
TOTAL		13,907	

Vaccination coverage by dose and age group for the population as a whole is shown in **figure 1**, covering the period from the beginning of the vaccination programme to 18 April 2021. Coverage levels for first dose vaccination in the 80+ years age group rose rapidly in December 2020 and January 2021, to reach around 96% by the end of the period; similar, albeit later increases were seen in the 70-79 years age group. Dose 2 coverage accelerated in March 2021, with coverage reaching around 80% in those aged 80+ years by the middle of April. The mix of vaccines administered reflected the staggered approval of products and

opening up of vaccination to younger age groups. Around two thirds of those aged 80+ received one or more doses of the BNT162b2 vaccine, whereas in those aged 70-79 years an equivalent proportion received the ChAdOx1 vaccine. Of those aged 80+ years, the population receiving each vaccine differed, with 73% and 30% of those residing in a care home vaccinated with one or more doses of the ChAdOx1 or BNT162b2 vaccine, respectively.

Figure 1. Vaccination coverage by age group and dose from the beginning of the vaccination programme in England on 08 December 2020 to the end of the study period on 18 April 2021, in those aged 70+. Solid lines indicate first dose coverage, by age group; second dose coverage is indicated by dashed lines in the same colours.



Vaccine effectiveness against hospitalisation

Odds ratios for hospitalisation are given in **table 2** and **figure 2** at 28 days+ for dose 1, and 14 days+ for dose 2 for any vaccine, and then disaggregated by vaccine type (more detailed breakdowns by time interval are given in **supplementary table S2** and **supplementary figures S3, S4 and S5**). Figures are, in addition, stratified by age.

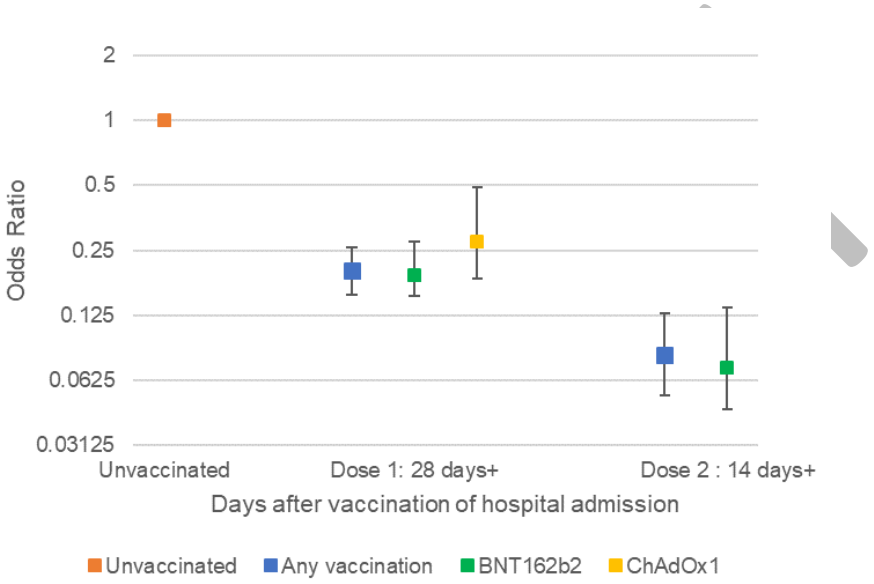
Table 2. Odds ratios for hospitalisation by vaccination status for ChAdOx1 and BNT162b2 vaccines respectively, stratified by age (OR=odds ratio; LCI=lower confidence interval; UCI=upper confidence interval; odds ratios suppressed for some cells due to small numbers).

Vaccine	Dose	70-79 years				80+ years			
		Case	OR	LCI	UCI	Cases	OR	LCI	UCI
Unvaccinated		2404	-	-	-	2010	-	-	-
Any vaccine	Dose 1	87	0.18	0.13	0.25	241	0.20	0.15	0.26
	Dose 2	1	-	-	-	27	0.08	0.05	0.13
ChAdOx1	Dose 1	40	0.16	0.11	0.26	69	0.27	0.19	0.4
BNT162b2	Dose 1	47	0.19	0.13	0.27	172	0.19	0.15	0.24
	Dose 2	1	-	-	-	27	0.07	0.05	0.11

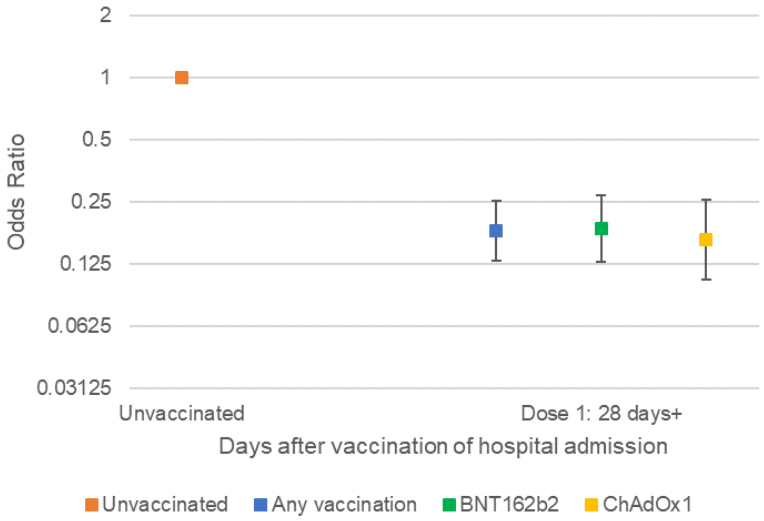
Overall figures indicate a reduction in odds of hospitalisation to 0.20 (95% CI 0.15-0.26) by day 28 following dose 1 of any vaccine in those aged 80+, with a slightly larger reduction in those aged 70-79 years (0.18, 0.13-0.25), although this difference is not statistically significant. Further reductions are seen by day 14 from the second dose, to 0.08 (0.05-0.13) in those aged 80+, although small numbers preclude equivalent calculations for those aged 70-79 years.

Figure 2. Odds of hospital admission in those aged 80+ (panel A) and 70-79 (panel B) after receipt of first and second dose of any vaccine, first and second dose of BNT162b2 and first dose of ChAdOx1, using individual-level SARI Watch data.

A



B



Further analysis disaggregating by vaccine type showed that odds ratio of admission in those aged 80+ fell to 0.27 (95% CI 0.19-0.40) by day 28 following first dose of the ChAdOx1 vaccine, and 0.19 (0.15-0.24) following first dose of the BNT162b2 vaccine.

Declines in risk of a similar order but with marginally lower odds in those aged 70-79 years although these differences were not statistically significant. Data on dose 2 effects were available in sufficient numbers only for the oldest age group who had received the BNT162b2 vaccine, for which odds of hospitalisation in those aged 80+ fell to 0.07 (0.05-0.11) by day 14 post-second dose. In those aged 80+ these figures equate to a vaccine effectiveness against hospitalisation of 73% (95%CI 60-81%) and 81% (76-85%) following first dose of the ChAdOx1 and BNT162b2 vaccines respectively (28 days), and 93% (89-95%) following the second BNT162b2 dose (14 days). Odds of hospital admission divided into time intervals post first and second dose of BNT162b2, and for the first dose of ChAdOx1 are shown in **supplementary figures S4 and S5**.

CONCLUSION

This observational study, incorporating data on both the ChAdOx1 and BNT162b2 vaccines and with a maximum follow-up period of just over four months, found evidence of high effectiveness for either vaccine in preventing severe COVID-19 infection requiring hospitalisation, with effects markedly more pronounced 14 days after the second dose of BNT162b2. Data from both the overall analysis (any vaccine) and by-vaccine analysis indicate that VE reaches a maximal level from around day 28, and then plateaus. In those aged 80+ VE against hospitalisation was 73% (95% CI 60-81%) and 81% (76-85%) 28 days following first dose of the ChAdOx1 and BNT162b2 vaccines respectively, and 93% (89-95%) 14 days following the second BNT162b2 dose. In those aged 70-79 years, VE against hospitalisation was 84% (74-89%) and 81% (73-87%) following first dose of the ChAdOx1 and BNT162b2 vaccines respectively.

Analysis of effects at different time intervals shows transient, lower odds of hospitalisation in the initial period post first dose (**supplementary table S2 and supplementary figures S3, S4 and S5**). This likely represents a deferral effect, similar to that observed in other studies (15–17). It is unlikely that individuals would have been well enough to have been vaccinated and then unwell enough to have been hospitalised within one week, given that guidance states that those who are acutely unwell, or have tested positive for COVID-19, should defer vaccination. Patients are therefore less likely to be hospitalised within a short period of vaccination. This deferral effect will gradually reduce as interval after vaccination increases, which is evidenced by the increasing odds ratios in this early period before a clear vaccine effect is seen, starting from around 21 days when the odds ratio starts to decline, with a plateauing effect from day 28. For those aged 70-79 years, ORs range from 0.13-0.27 from 28 days onwards, although confidence intervals around later estimates are wide. In both age groups cases decrease over time due to decreasing incidence of disease in the context of vaccination and NPIs.

Findings reported here in respect of VE against hospitalisation accord with those in other studies from the UK and elsewhere. In the UK, analysis of vaccine effects on risk of hospital admission in Scotland over the first 10 weeks of the vaccination programme demonstrated slightly higher vaccine effectiveness for both BNT162b2 (91%, 85-94%) and ChAdOx1 (88%, 75-94%), but did not consider second dose effects for which, for BNT162b2, we show a further reduction in risk by day 14 following dose 2 (17). Effects in this analysis are also comparable with findings from a test negative case-control study in frail, elderly patients in England (aged 80+), although this study again reports first dose effects only (16). Two recently published studies from Israel investigating effects from a single dose of BNT162b2 against hospitalisation, the first a test-negative case control study, and the second a screening analysis, show VEs of 74% (95% CI 56-86%) from 14 days after the first dose and

87% (55-100%) after the second dose, and 97% (97-98%) from 7 days after the second dose respectively (18,22). These studies also report high vaccine effectiveness irrespective of age.

A key strength of this study is the use of routine surveillance data allowing for rapid assessment of vaccine effectiveness against hospitalisation at national level. Estimates of total population coverage with COVID-19 vaccinations in England are derived from individual, patient-level data in the NIMS spanning the whole country. This allowed for matching of hospitalised cases to population controls on a range of variables including age, sex, region and care home residency status, increasing confidence in the robustness of data on the comparator group in this study especially by comparison with screening analyses conducted during roll-out of routine vaccination programmes elsewhere (23,24). Secondly, we were able to account for some potentially important confounding factors influencing vaccine effectiveness through matching (e.g. vulnerability proxied using care home residency), but also by stratifying by age.

Our study nevertheless had several limitations. Individual-level data on hospitalisations were only available from 35 NHS sentinel sites out of a total of 141 acute general and specialist hospital trusts nationwide, and we currently have insufficient power to estimate VE for two doses of the ChAdOx1 vaccine. Furthermore, we were unable to capture wider aspects of risk that might have influenced the results of the VE analysis, including the categorisations of clinically extremely vulnerable, or “at risk” individuals identified by the JCVI in their advice on COVID-19 vaccine prioritisation (25). Finally, no account was taken for ethnicity or deprivation in this analysis, and some confounding by care home residency may remain due to the data source used for this, which showed discrepancies compared to a care home flag from SARI-Watch.

This study in the first country to launch a nationwide COVID-19 vaccination programme has shown that single doses of either the BNT162b2 or ChAdOx1 vaccines are highly effective in reducing the risk of hospitalisation in those aged 70+, and that this effect is significantly greater from 14 days following the second dose of BNT162b2 in those aged 80+. These findings suggest that COVID-19 vaccination programmes are likely to substantially reduce morbidity from severe disease, and the associated burden on healthcare systems.

Contributions

JLB, SM, NA, TGV, AV and SAI designed the study. SE, JS and ET obtained, cleaned and linked data on hospital admissions and vaccine coverage respectively. SAI and TGV performed the analysis. SAI wrote the first draft of the manuscript. All authors commented on the draft manuscript.

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Conflicts of interest

None reported.

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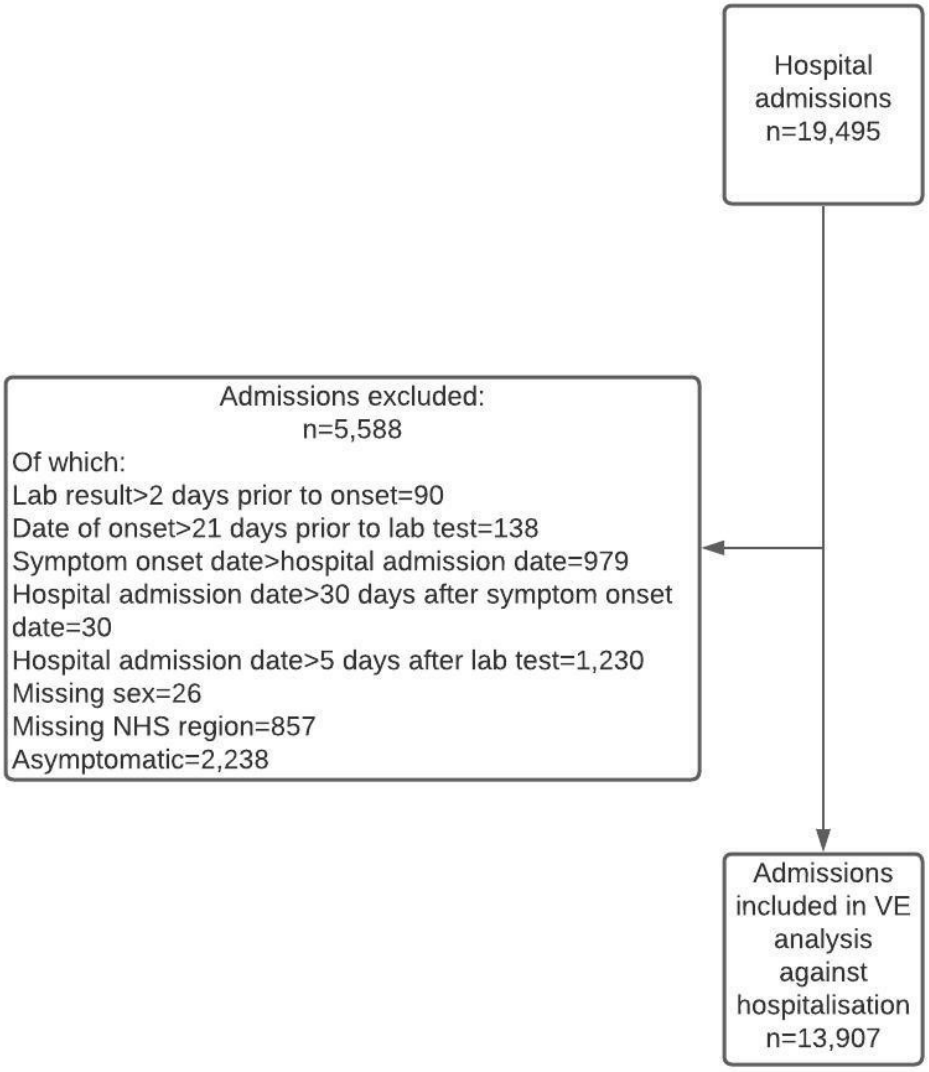
SUPPLEMENTARY MATERIAL

Supplementary figure S1. Flowchart indicating total numbers of admissions, by type, recorded at individual level in SARI Watch during the study period, and the final sample included in the analysis presented in the main paper.

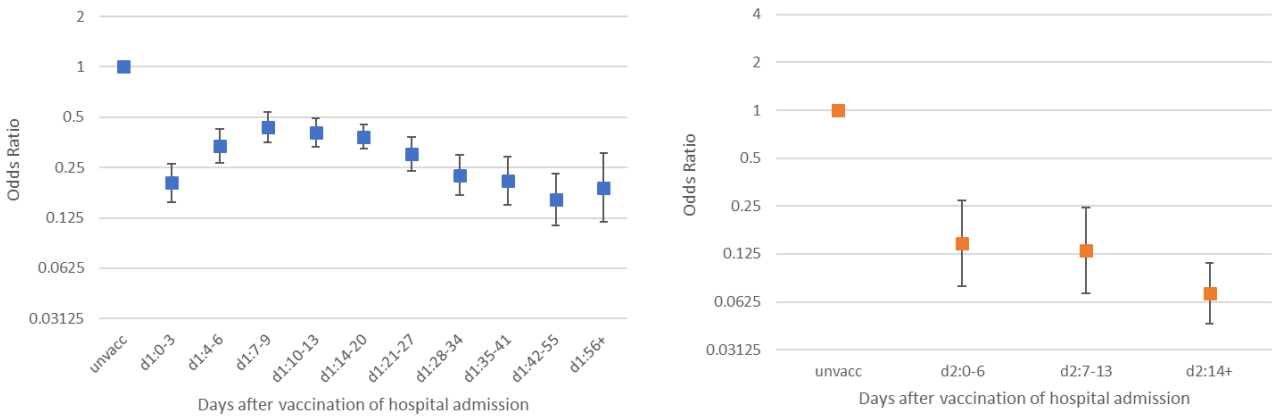


Supplementary table S2. Odds ratios for hospitalisation at defined time intervals following first and second doses of the ChAdOx1 and BNT162b2 vaccines respectively, stratified by age (OR=odds ratio; LCI=lower confidence interval; UCI=upper confidence interval; s=suppressed due to small numbers)

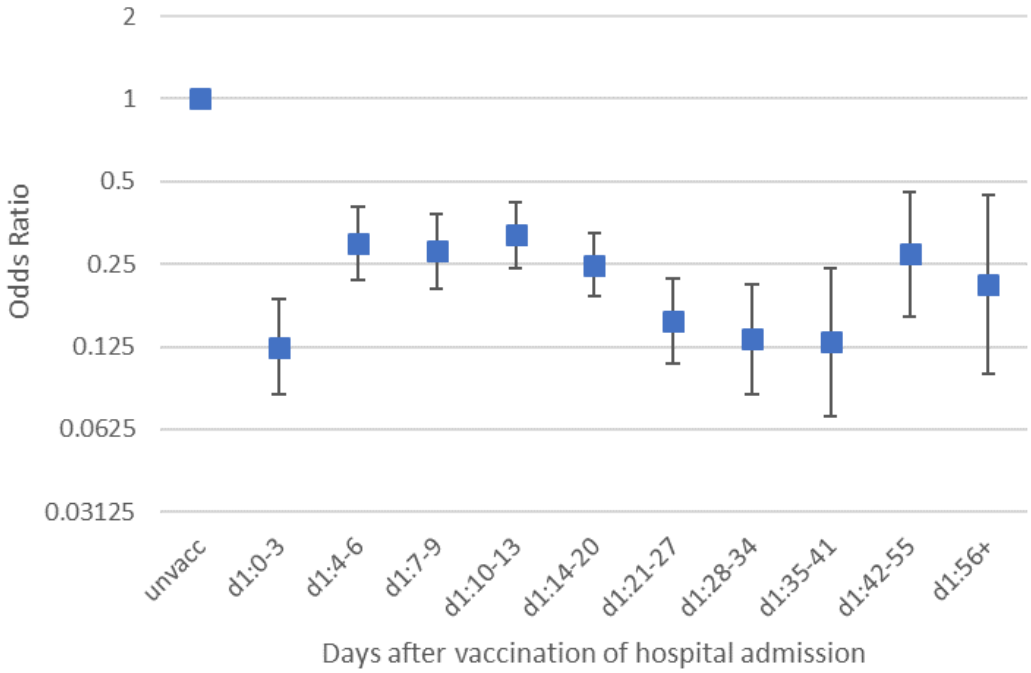
			70-79				80+			
Vaccine	**Dose**	**Interval**	**Case**	**OR**	**LCI**	**UCI**	**Cases**	**OR**	**LCI**	**UCI**
Any vaccine	Dose 1	d1:0-3	25	0.12	0.08	0.19	61	0.20	0.16	0.26
		d1:4-6	48	0.30	0.22	0.40	83	0.34	0.27	0.42
		d1:7-9	46	0.28	0.20	0.38	107	0.43	0.35	0.54
		d1:10-13	69	0.32	0.24	0.42	131	0.41	0.33	0.49
		d1:14-20	87	0.25	0.19	0.32	200	0.38	0.32	0.45
		d1:21-27	46	0.15	0.11	0.22	114	0.30	0.24	0.38
		d1:28-34	25	0.13	0.08	0.21	80	0.22	0.17	0.30
		d1:35-41	14	0.13	0.07	0.24	52	0.21	0.15	0.29
		d1:42-55	32	0.27	0.16	0.46	61	0.16	0.11	0.23
		d1:56+	16	0.21	0.10	0.45	48	0.19	0.12	0.31
	Dose 2	d2:0-6	s	.	.	.	14	0.15	0.08	0.27
		d2:7-13	s	.	.	.	13	0.13	0.07	0.24
		d2:14+	s	.	.	.	27	0.07	0.05	0.11
ChAdOx1	Dose 1	d1:0-6	42	0.19	0.14	0.27	74	0.34	0.27	0.44
		d1:7-13	54	0.24	0.17	0.32	96	0.48	0.38	0.61
		d1:14-20	57	0.27	0.20	0.37	74	0.51	0.38	0.67
		d1:21-27	26	0.17	0.11	0.26	43	0.38	0.26	0.56
		d1:28+	40	0.16	0.11	0.26	69	0.27	0.19	0.40
BNT162b2	Dose 1	d1:0-6	31	0.21	0.15	0.30	70	0.21	0.17	0.27
		d1:7-13	61	0.38	0.28	0.50	142	0.39	0.32	0.47
		d1:14-20	30	0.19	0.13	0.28	126	0.33	0.27	0.41
		d1:21-27	20	0.14	0.08	0.22	71	0.26	0.20	0.34
		d1:28+	47	0.19	0.13	0.27	172	0.19	0.15	0.24
	Dose 2	d2:0-6	s	.	.	.	13	0.15	0.08	0.28
		d2:7-13	s	.	.	.	10	0.12	0.06	0.24
		d2:14+	s	.	.	.	27	0.07	0.05	0.11
		Unvaccinated	2404				2010			

Supplementary figure S3. Trends in odds of hospitalisation by time interval in days following first dose (blue) and second dose (red) of any vaccine in those aged 80+ (panel A) and 70-79 (panel B – for which only first dose estimates are presented due to small numbers), using individual-level SARI Watch data.

A

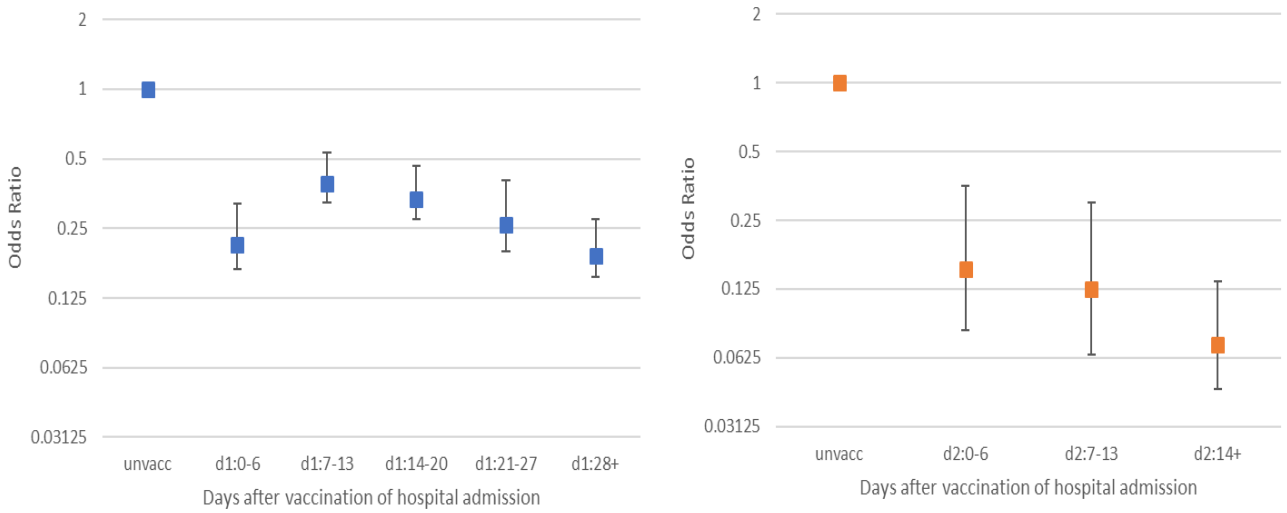


B

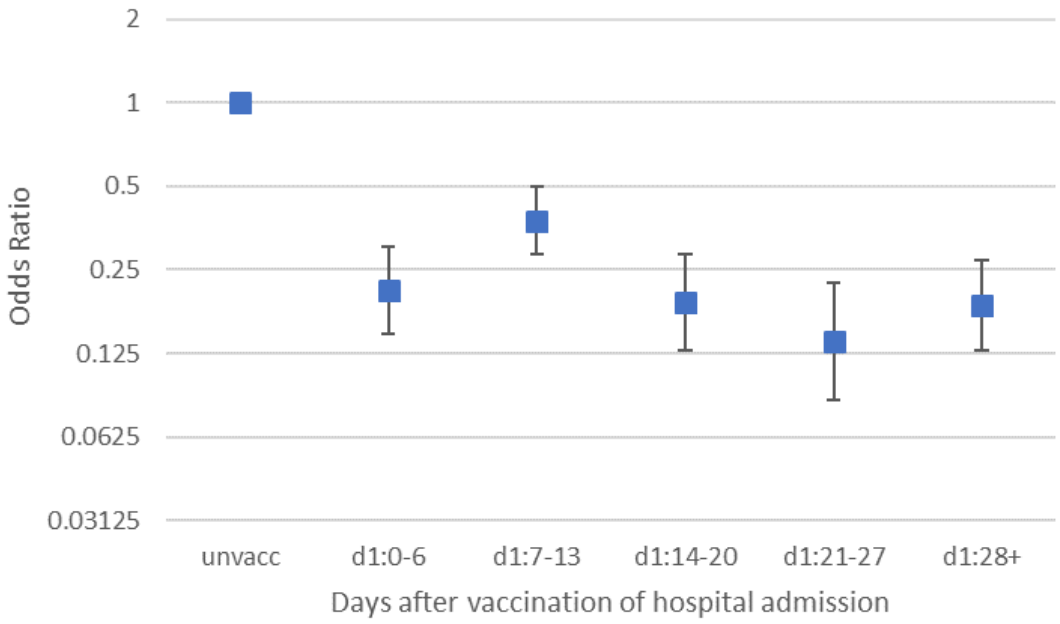


Supplementary figure S4. Odds of hospital admission in those aged 80+ (panel A) and 70-79 (panel B – for which only first dose estimates are presented due to small numbers) by time interval in days from receipt of first and second dose of the BNT162b2 vaccine, using individual-level SARI Watch data.

A



B



Supplementary figure S5. Odds of hospital admission in those aged 80+ (panel A) and 70-79 (panel B) by time interval in days from receipt of first dose of ChAdOx1, using individual-level SARI Watch data.