Public Health England

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Single dose of Covid-19 vaccine reduces hospitalisation and death of care home residents

Analysis of care home outbreaks and vaccination data: a natural experiment Cheshire & Merseyside

2020-2021

30 March 2021

Key findings

- **Between 11 December 2020 and 12 March 2021, there were 126 care homes [4042 residents] with COVID-19 outbreaks in the sub-region [8 Local Authorities].**

- **Vaccines used: AstraZeneca 89 (71%) of care homes; and Pfizer 37 (29%) of care homes.**

- **Local data shows that one dose of vaccine improves outcomes for residents of care homes.**

- **Residents of care homes which reported COVID-19 outbreaks with onset date ≥ 10/14 days after vaccine administration to residents (i.e. when vaccine considered protective), are:**
  - ✓ **44% less likely to develop Covid-19 symptoms (statically significant),**
  - ✓ **62% less likely to test positive for Covid-19 (statically significant),**
  - ✓ **66% less likely to be hospitalised with Covid-19 (statically significant), and**
  - ✓ **80% less likely to die from Covid-19 (statically significant).**

- **The number of residents who need to be vaccinated to prevent one care home resident from hospitalisation with Covid-19 is 35, and death is 18.**

- **Vaccine effectiveness [significantly less hospitalisation and death] was also noted in residents of care homes that received a single dose of vaccine less than 10/14 days of outbreak onset in a care home, i.e., before vaccine was considered protective.**

Analysis of care home outbreaks and vaccination data: a natural experiment, Cheshire & Merseyside, 11 Dec 2020 – 12 March 2021

Objective:

- **To describe the epidemiology of COVID-19 outbreaks in vaccinated care homes and residents and estimate the effectiveness of a single dose of the Pfizer/BioNTech BNT162b2 and Astrazeneca ChAdOx1 vaccines by analysing symptomatic and confirmed cases, hospitalisations and deaths of care home residents.**

Method:

- **Natural experiment – assumption of 'as if' randomisation, enabling comparison between intervention (vaccinated) and control (unvaccinated) groups (care homes).**

Setting:

- **Care homes with COVID-19 outbreak**

Intervention:

- **A single dose of Covid-19 Vaccine**

Participants:

- **All care homes in a sub-region [8LAs] of North West (England) that reported COVID-19 outbreaks between 11 December 2020 and 12 March 2021**

Main outcome measures:

- **Symptomatic and confirmed COVID-19 cases, hospitalisations, and deaths with COVID-19.**

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Introduction:

- On the 8th December 2020 the UK became the first country to implement a COVID-19 vaccination programme following the approval of the Pfizer-BioNtech messenger RNA (mRNA) vaccine, BNT162b2 on 2nd December 2020.[1]
- Following MHRA approval of the Oxford-AstraZeneca vaccine on 30th December 2020, the UK programme expanded to include the AstraZeneca vaccine as of 4th January 2021.[2]
- The Joint Committee on Vaccination and Immunisation (JCVI) have advised the first priority group for receipt of COVID-19 vaccination are residents in care homes for older adults and their carers.[3]
- Outbreaks of COVID-19 in care homes represent a significant proportion of total COVID-19 mortality in the United Kingdom (UK), and the majority of COVID-19 deaths in care homes have occurred in homes which had suffered an outbreak.[4]
- Following questions from local Directors of Public Health about the continued occurrence of care home outbreaks since local care home vaccination programme started, we conducted a study of the early effects of a single COVID-19 vaccination.
- The main objective of this study is to determine the efficacy of one dose of COVID-19 vaccine on symptomatic and confirmed cases, hospitalisations and deaths of care home residents.

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Methods (1):

- **Data collection tool was devised to obtain information on each care home in the sub-region [8 Local authorities] which had an outbreak of Covid-19 between 11 December 2020 and 12 March 2021.**

- **Information was collated on: number of residents in the home; date of onset of outbreak; date of vaccination of residents; the number of residents who had symptoms of Covid-19 and positive Covid-19 tests (either lateral flow tests or polymerase chain reaction); vaccinated (and type of vaccine); were hospitalised or had died.**

- **We excluded 5 care homes with incomplete information which we were unable to rectify [death incomplete x2; no outbreak data x2; outbreak outside study period x1]. We classified all eligible care homes [n=126] into three groups: (A) care home reported COVID-19 outbreak with onset date before vaccination of residents commenced (unvaccinated care homes); (B) care homes reported COVID-19 outbreaks with onset date within 10/14 days of vaccine administration to residents (vaccinated but considered unprotected); and (C) care homes reported COVID-19 outbreaks with onset date over 10/14 days after vaccine administration to residents (vaccinated and considered protected).**

- **Protection from one dose of the AstraZeneca, ChAdOx1 nCOV-19 vaccine is very high 14 days after vaccination by the AstraZeneca vaccine,[5] and 10 days after vaccination by the Pfizer vaccine.[6] These cut off points were used to estimate post-vaccination protection for the relevant vaccine (see figure 1).**

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Methods (2):

- **Comparative analysis was undertaken between the numbers and percentages of residents in**
  - **the vaccinated and considered protective vs those in unvaccinated care homes**
  - **the vaccinated and considered unprotective vs those in unvaccinated care homes**

- **Relative risk for the presence of Covid-19 symptoms, positive Covid-19 test result, hospitalisation and deaths were calculated.**

- **Number needed to vaccinate were calculated for hospitalisation and death.**

- **Natural experiment 'as if' randomisation enables comparison between intervention (vaccination) and control (unvaccinated) groups. This method is appropriate where it is impossible to undertake a Randomised Controlled Trial e.g., when it is unethical to withhold intervention.[7,8] The 'as if' randomisation applies to this study because (a) all care home residents were eligible and priority for vaccination, (b) all study care homes had COVID-19 outbreaks, thus exposing each resident of vaccinated and unvaccinated care home to the same risk of disease, (c) all study care homes were exposed in the same time period and geography, (d) deaths in care homes remained high throughout the study period, (e) the vaccination programme was designed and delivered independently of this study as it was offered to all care homes over the same time period, and (f) all care home outbreaks from the sub-region were reported during the same time period.**

Natural experiments

Strengths

- **Can infer cause-effect when ‘as if’ randomization can be supported.**
- **Obviates confounding typical in an observational study due to the natural distribution of confounding factors.**
- **Enables appropriate statistical analyses which are often easy to interpret, e.g. relative risk, providing confidence in results.**
- **More practical than RCTs which can be unethical in some situations.**

Limitations

- **No control over baseline differences in the exposed and less or unexposed groups, although sample size may mitigate some of this limitation.**
- **There is no random assignment in the traditional sense, which may restrict causative assertions when the ‘as if’ randomization cannot be established.**
- **Internal and external validity may be difficult to analyse e.g., when outcome may have multiple contributing factors.**

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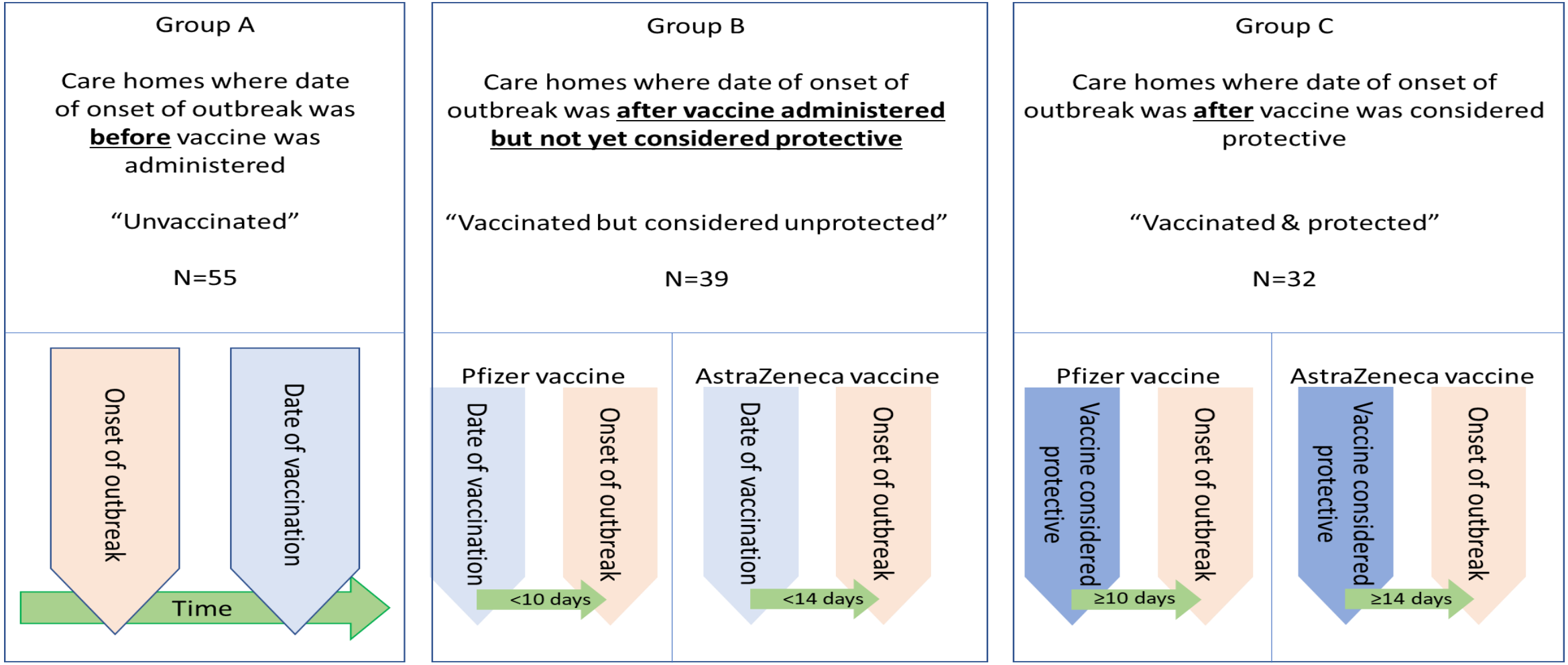
Method (3): **Figure 1 - timeline showing relationships between vaccination date, date vaccine considered protective and outbreak onset date, in C&M Care Homes, 11 December 2020 to 12 March 2021**



Analysis of care home outbreaks and vaccination data: a natural experiment, Cheshire & Merseyside, 11 Dec 2020 – 12 March 2021

Results:

- **In total, between 11 December 2020 and 12 March 2021, there were 126 care homes [4042 residents] with COVID-19 outbreaks in the sub-region [8 Local Authorities]. Of these:**
  - **55 [44%] with 1715 residents reported COVID-19 outbreaks with onset date before vaccination of residents commenced;**
  - **39 [31%] with 1324 residents reported COVID-19 outbreaks with onset date less than 10/14 days of vaccine administration to residents; and**
  - **32 [25%] with 1003 residents reported COVID-19 outbreaks with onset days over 10/14 days after vaccine administration to residents.**

- **Vaccines used:**
  - **AstraZeneca 89 (71%) of care homes**
  - **Pfizer 37 (29%) of care homes**

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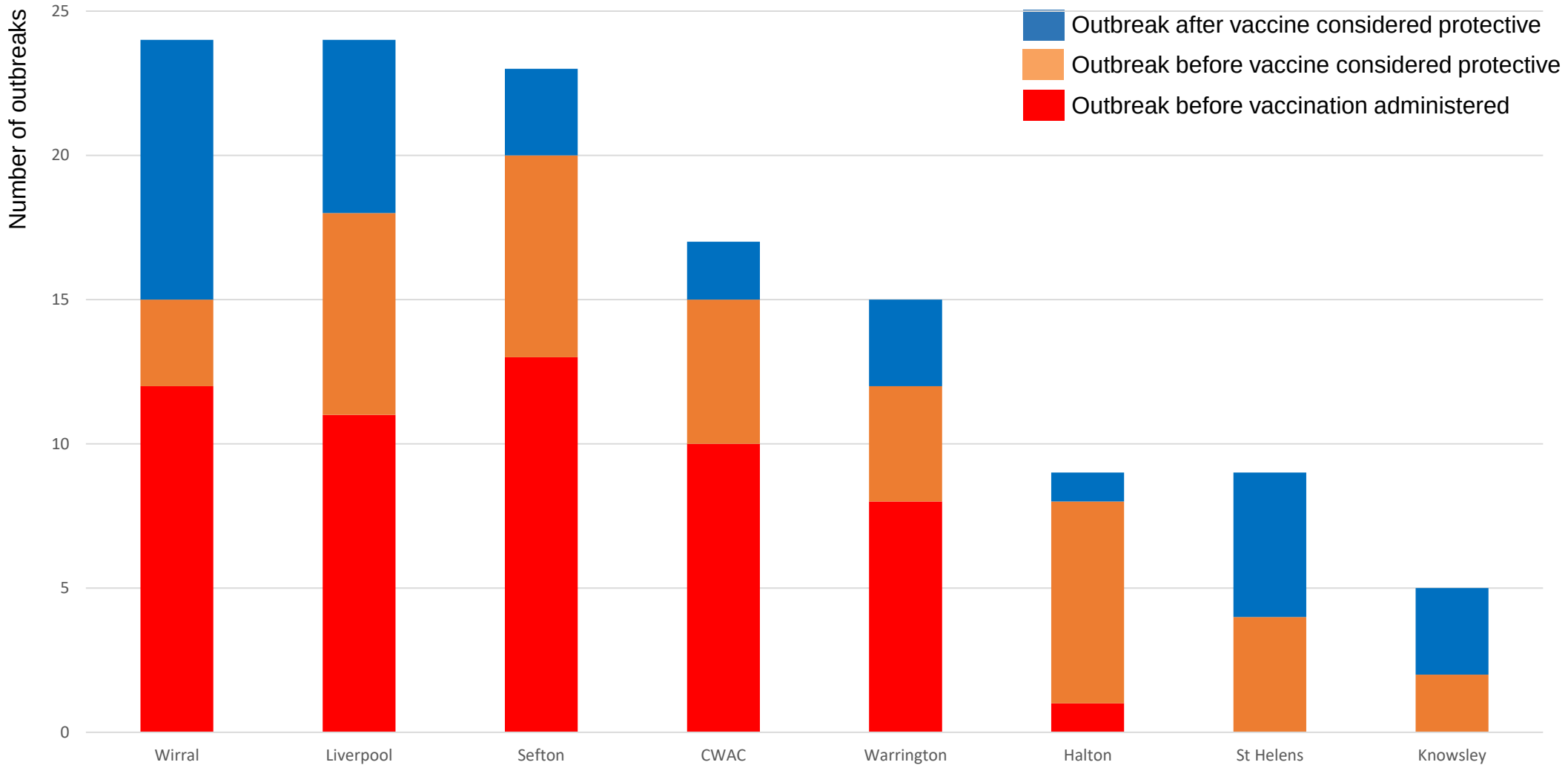
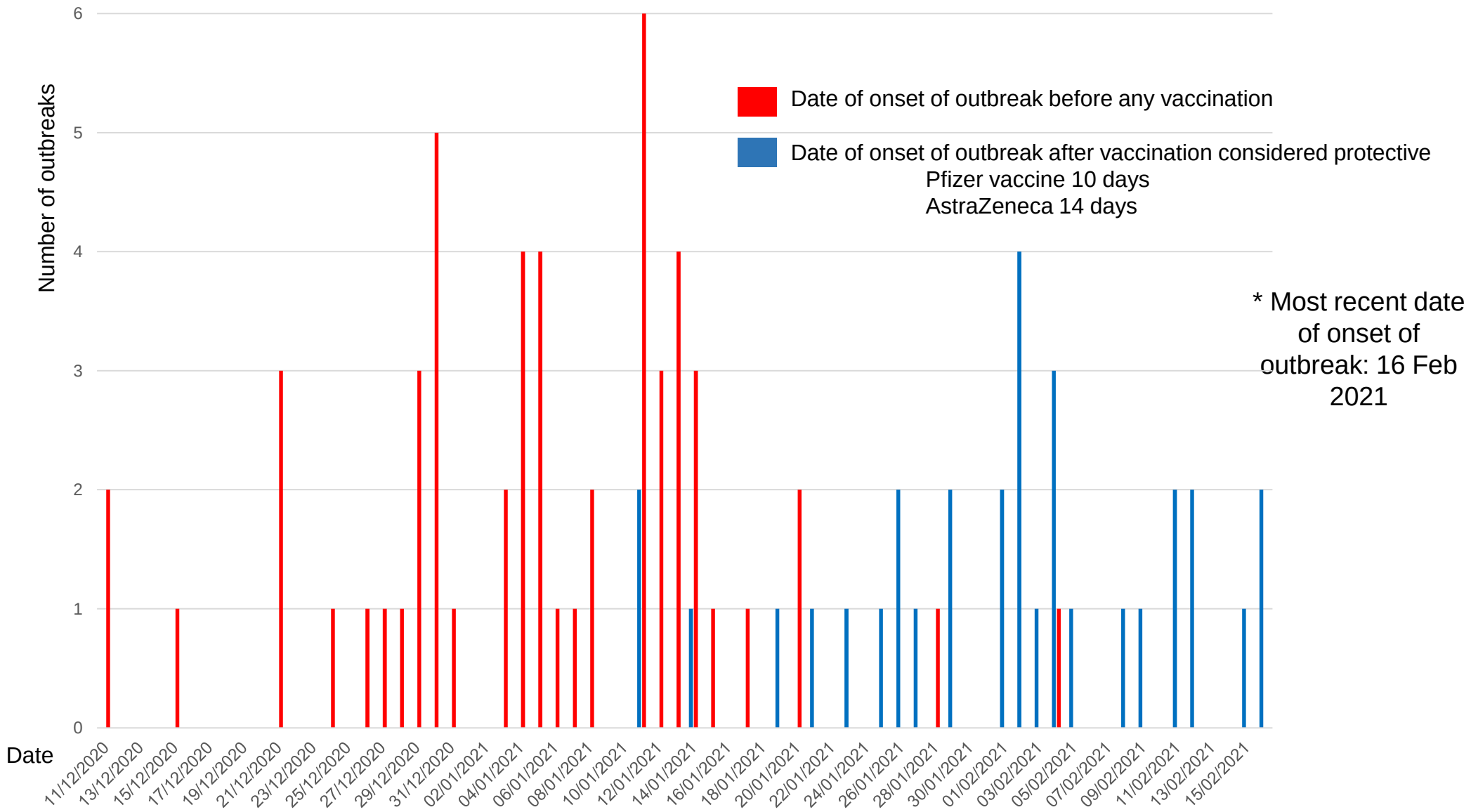
Results: **Table 1 - Date of onset of care home COVIC-19 outbreak against vaccination date and status of residents**

Care Home status	Care Home N	Beds, Occupancy %	Residents N	Notes
A. Reported outbreak with onset date **before** vaccination of residents commenced	55	2285 *75.1%*	1715	AstraZeneca vaccine considered protective from day 14,[5] Pfizer vaccine considered protective from day 10[6]
B. Reported outbreak with onset date **less than** 10 or 14 days of vaccination of residents	39	1592 *83.2%*	1324	
C. Reported outbreak with onset date ≥10 or ≥14* days **after** vaccination of residents	32	1345 *74.5%*	1003	

Number of care homes with complete data on COVID-19 outbreak by LA: 11 Dec 2020 - 12 March 2021



C&M care home COVID-19 outbreaks by vaccination status 11 Dec 20 - 12 Mar 21*



Residents' outcomes in care home with one dose of vaccine considered protective vs care home outbreak before vaccine administered

Care Home status	Total residents	C-19 symptom reported	C-19 test positive	Admission to hospital	Died
A. Reported outbreak with onset date **before** vaccination of residents commenced	1715 *100%*	200 *11.7%*	536 *31.3%*	75 *4.4%*	120 *7.0%*
C. Reported outbreak with onset date ≥10 or ≥14* days **after** vaccination of residents	1003 *100%*	65 *6.5%*	118 *11.8%*	15 *1.5%*	14 *1.4%*
Percentage reduction (Relative Risk Reduction)		**44.4%**	**62.4%**	**65.8%**	**80.1%**

* AstraZeneca vaccine considered protective from day 14,[5] Pfizer vaccine from day 10[6]

Relative Risk (RR): Care home outbreak onset after vaccine considered protective vs before vaccine administered (unvaccinated)

Outcomes	RR	L 95% CI	U 95% CI
Symptoms reported	0.56	0.42	0.73
Tested positive for C-19	0.38	0.31	0.45
Hospitalised	0.34	0.20	0.59
Died	0.20	0.12	0.35

Local C&M data shows that **one** dose of vaccine improves outcomes for residents of care homes.

Residents of care homes which reported COVID-19 outbreaks with onset date ≥ 10/14 days after vaccine administration to residents (i.e. vaccinated and considered protected), are:

- 44% less likely to develop Covid-19 symptoms (significant),
- 62% less likely to test positive for Covid-19 (significant),
- 66% less likely to be hospitalised with Covid-19 (significant), and
- 80% less likely to die from Covid-19 (significant).

Number Needed to Vaccinate (NNV) to prevent residents' from hospitalisation and death

Outcomes	NNV	L 95% CI	U 95% CI
Hospitalised	34.8	23.4	67.2
Died	17.9	13.7	25.5

Local C&M data shows that **one** dose of vaccine protects residents from hospitalisation and death.

The number of residents who need to be vaccinated to prevent one resident from

- hospitalisation with Covid-19 is **35**, and
- death from Covid-19 is **18**.

Residents' outcomes: care home with outbreak before vaccination vs care home outbreak onset less than 10/14 days after vaccination (before vaccine was considered protective)

Care Home status	Total residents	C-19 symptom reported	C-19 test positive	Admission to hospital	Died
A. Reported outbreak with onset date **before** vaccination of residents commenced	1715 *100%*	200 *11.7%*	536 *31.3%*	75 *4.4%*	120 *7.0%*
B. Reported outbreak with onset date **less than** 10 or 14 days of vaccination of residents	1324 *100%*	148 *11.2%*	284 *21.5*	38 *2.9%*	45 *3.4%*
Percentage reduction (Relative Risk Reduction)		**4.3%**	**31.3%**	**34.1%**	**51.4%**

* Pfizer vaccine considered protective from day 10, AstraZeneca vaccine from day 14

Relative Risk: Care home with outbreak before vaccination vs care home outbreak onset less than 10/14 days of vaccination (when vaccine considered unprotective)

Outcomes	RR	L 95% CI	U 95% CI
Symptoms reported	0.58	0.44	0.77
Tested positive for C-19	0.55	0.45	0.67
Hospitalised	0.52	0.29	0.94
Died	0.41	0.23	0.74

The above results clearly indicate that care home outbreaks occurring in less than 10/14 days after vaccine was administered to residents, i.e., before vaccine was considered protective still result in significantly less hospitalisation [48% reduction] and death [59% reduction].

Caveats on C&M care home data

- C&M data grouped by care home:
  - vaccination status is at care home & not individual level (likely to underestimate impact of vaccine as around 10% of residents on average in vaccinated care homes remain unvaccinated at the time of data collection)
- Onset date for care home outbreak not individual patient (likely to underestimate impact of vaccine, as some residents may develop symptoms at a later date)
- Some care home outbreaks started in staff and not residents (likely to underestimate impact of vaccine)
- Some care home vaccinations were spread over time (likely to underestimate impact of vaccine, as we only used the first vaccination date)
- Co-morbidities (e.g. obesity, CVD) not identified (likely to impact both ways)
- Selection bias possible (missing data of some care homes – impact both ways)
- Symptoms not always clear in elderly (impact both ways)
- Hospitalisation reasons, not necessarily Covid-19 (impact both ways)

References

1. Medicines and Healthcare Products Regulatory Agency. Vaccine BNT162b2: conditions of authorisation under Regulation 174 2020 [Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/948935/Conditions_of_authorisation_for_Pfizer_BioNTech_311220.pdf
2. Regulatory approval of COVID-19 Vaccine AstraZeneca. Information for healthcare professionals and the public about the COVID-19 Vaccine AstraZeneca. https://www.gov.uk/government/publications/regulatory-approval-of-covid-19-vaccine-astrazeneca
3. Joint Committee on Vaccination and Immunisation. Joint Committee on Vaccination and Immunisation: advice on priority groups for COVID-19 vaccination, 30 December 2020 2020. https://www.gov.uk/government/publications/priority-groups-for-coronavirus-covid-19-vaccination-advice-from-the-jcvi-30-december-2020/joint-committee-on-vaccination-and-immunisation-advice-on-priority-groups-for-covid-19-vaccination-30-december-2020#contents
4. Burton JK, Bayne G, Evans C et al. Evolution and effects of COVID-19 outbreaks in care homes: a population analysis in 189 care homes in one geographical region of the UK. Lancet Heal Longev 2020; 1: e21–e31.
5. Ramasamy MN, Minassian AM, Ewer KJ, et al. Safety and immunogenicity of ChAdOx1 nCoV-19 vaccine administered in a prime-boost regimen in young and old adults (COV002): a single-blind, randomised, controlled, phase 2/3 trial. Lancet 2020 Nov 18: S0140-6736(20)32466-1. doi: 10.1016/S0140-6736(20)32466-1. https://doi.org/10.1016/S0140-6736(20)32466-1.
6. Polack, FP, Thomas SJ, Kitchin N et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. NEJM 2020. DOI: 10.1056/NEJMoa2034577
7. Kim HM, Stewart AG, Shluter PG. Natural experiments in a hazard context. In: WHO Guidance on Research Methods for Health Emergency and Disaster Risk Management. https://extranet.who.int/kobe_centre/sites/default/files/pdf/WHO%20Guidance_Research%20Methods_Health-EDRM_4.14.pdf
8. Loevinsohn ME. Never let a disaster go to waste: Using natural experiments to understand vulnerability and resilience; 2016 (https://www.ids.ac.uk/events/never-let-a-disaster-go-to-waste-using-natural-experiments-to-understand-vulnerability-and-resilience)