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England

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A data linkage approach to assessing the contribution of hospital-associated SARS-CoV-2 infection to care home outbreaks in England, 30 January to 12 October 2020

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Executive summary

At the request of DHSC and SAGE subgroup, PHE was asked to investigate care homes that received COVID-19 positive patients discharged from hospital, and subsequently experienced an outbreaks (herein referred to as hospital associated seeding of care home outbreaks). The results of this investigation are to be submitted to the Public Accounts Committee (PAC).

The PHE Epidemiology Cell (Epi Cell) developed a process to derive residential property classifications of laboratory confirmed COVID-19 cases in collaboration with the PHE GIS Cell. This facilitated identification of cases residing in care homes. Hospital discharge records were linked to these records to identify care home residents who may have acquired their COVID-19 infection whilst in hospital and subsequent to their discharge, their care homes experienced an outbreak of COVID-19. In summary:

- from 30 January to 12 October 2020, there were a total of 43,398 care home residents identified with a laboratory confirmed positive COVID-19 test result
- of these, 35,740 (82.4%) were involved in an outbreak, equivalent to a total of 5,882 outbreaks
- 1.6% (n=97) of outbreaks were identified as potentially seeded from hospital associated COVID-19 infection, with a total of 804 (1.2%) care home residents with confirmed infection associated with these outbreaks
- the majority of these potentially hospital-seeded care home outbreaks were identified in March to mid-April 2020, with none identified from the end of July until September where a few recent cases have emerged

The findings of this report suggest hospital associated seeding accounted for a small proportion of all care home outbreaks. Policies on systematic testing prior to hospital discharge for patients discharged to care homes, and where a test result was still awaiting, the patient would be discharged and pending the result, isolated in the same way as a COVID-positive patient, were introduced on 15 April 2020. This may have supported the decline seen in these types of outbreaks, contributing to an overall reduction in care home cases.

Introduction

Some of the most vulnerable among our population live in care and nursing homes. Infections in these groups of people are associated with increased morbidity and mortality. These residential settings are also at greater risk of transmission due to large numbers of individuals accommodated, high numbers of staff needed to provide care for these individuals, and necessary contact with one another.

Data released by ONS in May 2020 on deaths involving COVID-19 revealed excess mortality in care homes compared to a similar period in the previous year (2 March to 1 May), by roughly 20,000 (1).

PHE have been requested by DHSC/SAGE subgroup to respond to the following, issued by PAC:

"The Department and NHSE&I should review which care homes received discharged patients and how many subsequently had outbreaks."

The above was commissioned due to concerns on the potential role of hospital-associated SARS-CoV-2 infections in persons who were discharged to care homes and ensuing outbreaks experienced in these homes. Earlier media reports described anecdotal accounts of care home residents being discharged from hospitals to care homes whilst having tested positive for SARS-CoV-2 during their admission, allowing for transmission within the care homes and leading to subsequent outbreaks. A policy was introduced on 15 April 2020 which committed to all patients being tested prior to discharge to a care home. The policy went on to state that where a test result was still awaiting, the patient would be discharged and pending the result, isolated in the same way as a COVID-positive patient (1).

In this investigation, we analysed address and hospital record-matched COVID-19 cases to assess the potential extent of this phenomenon. The PHE Epidemiology Cell applied existing methodologies to identify and calculate the proportion of care home patients who had hospital-associated COVID-19, and their association with subsequent outbreaks within those care homes. NHS admitted patient care (Secondary User Service) and A&E attendance (Emergency Care Data Set) were used to identify prior hospital admission.

Objectives

The objectives were:

- to estimate the number and proportion of care home residents who developed a hospital-associated COVID-19 infection
- to estimate the proportion of potential seeding of care home outbreaks by hospital-acquired cases

Methods

All laboratory confirmed COVID-19 cases in England who were identified as resident in a care home at the time of their earliest positive specimen date were included in this analysis.

Data sources

The data sources were:

- Second Generation Surveillance System (SGSS) dataset of all laboratory confirmed COVID-19 cases reported to PHE from NHS PHE laboratories and private laboratories in England (Pillars 1 and 2)
- Ordnance Survey (OS) AddressBase, OS CQC care home reference, and Master Patient Index used to identify unique property reference number (UPRN) and property classification
- Emergency Care Dataset (ECDS) used to identify A&E attendance with subsequent hospital admission
- Secondary User Service (SUS) Admitted Patient Care to identify hospital admission

Address data source

Full patient address data are available within the SGSS COVID-19 view. Two address data fields are available:

1. Full residential address derived from the demographic batch service (DBS) identified through successful tracing of patient details against NHS summary care records.
2. Residential address reported by the testing laboratory. This alternative address is not a mandatory field and dependent on reporting by the case or provider via the testing laboratory.

For the purposes of identifying property types in COVID-19 positive cases, the alternative address was preferentially used for address matching on the basis of this representing

the most recently documented residential address, facilitating capture of addresses for individuals who may be housed in temporary accommodation or recently relocated.

Address matching using full address

Care home residents were identified through full address matching of residential address details available in SGSS. Full addresses were matched against reference databases held by the PHE GIS team to confirm the validity of the address and to derive the Unique Property Reference Number (UPRN) and Basic Land and Property unit (BLPU) class. This process was developed and undertaken the PHE GIS Cell and EpiCell. The 2 main reference databases used were:

1. OS AddressBase Premium
2. OS CQC list of care homes

The residential address matching steps are described below.

1. Exact address matching against CQC care home directory.
2. Exact address matching against to AddressBase Premium (used for records unsuccessfully matched in step above).
3. 'Fuzzy' address matching against AddressBase Premium (used for records unsuccessfully matched in steps above). This provides tolerance of spelling mistakes in the source data. A further validation step remove any cases that are assigned to a UPRN that has a different result postcode to the source postcode.
4. Manual address matching using the secure ESRI LocatorHub service.

In addition, cases which remain unmatched via the above process were matched by NHS number to the Master Patient Index held by NHS England. This holds residential UPRNs held by the patient's registered GP practice.

Processing of hospital discharge data

Data on all NHS hospital attendances and admissions in England are collated by NHS Digital and accessed by PHE for public health surveillance purposes. This is specifically undertaken via the Secondary Uses Service (SUS) and Emergency Care Dataset (ECDS) data collections for admitted patient care and Accident and Emergency (A&E) attendances, respectively. SUS data are reported monthly; ECDS data are reported daily, due to variation in reporting on a hospital level, data is subject to change, particularly in the most recent 6 weeks, due to reporting delays.

SUS data are presented in consultant episodes, where a patient is under the continuous care of a single consultant. Episodes are grouped into spells, with a continuous inpatient (CIP) spell within a single hospital provider. The standard NHS Digital methodology for

creating CIPs was adapted to restrict hospital spells to a single provider. When CIPs overlapped within a single provider, they were joined into a single CIP. Where the A&E departure date matched an inpatient admission date within the same healthcare provider, this created a single continuous record of patient stay.

Hospital records from SUS and ECDS were linked deterministically to SGSS COVID-19 positive test records using patient NHS number and date of birth or (secondly) local hospital patient identifier and date of birth if the former combination were not available.

Linking care home data to hospital discharge data

The address matched case list was run through the SGSS-ECDS-SUS hospital admissions process to identify and categorise cases according to the hospital-associated (HA) definitions ([Appendix Table 1](#)). Data flow process can be seen in [Appendix Figure 1](#).

Cases not matched to SUS but with an A&E matched record indicating admission to a hospital were classed as unlinked and lost to follow up if time from admission to processing date was 90 days or greater.

Definitions

Definite, probable or possible hospital-associated COVID-19

A patient discharged to a care home who was a hospital inpatient in the 14 days prior to their earliest positive specimen date ([Appendix Fig 2](#)).

Unlinked

A care home resident with no identified hospital spell in the 14 days prior to their earliest positive specimen date.

Care home outbreak

Two or more confirmed COVID-19 cases in the same care home within 14 days of each other.

Death

A death in a person with a laboratory-confirmed positive COVID-19 test and either died within 60 days of the first specimen date or died more than 60 days after the first specimen date, only if COVID-19 is mentioned on the death certificate.

Hospital-associated care home outbreak

A care home outbreak where the index (first) case of the outbreak meets any of the hospital-associated case definitions, succeeded by a subsequent COVID-19 infection at the same care home within 14 days of the index's (first) earliest positive specimen date

and the case discharged from hospital to the care home for at least a day (see Appendices [Table 1](#), [Figure 3](#)).

Potential hospital associated seeding case

Index or other care home cases diagnosed within the first 2 days of the outbreak meeting the HA definitions ([Appendix Figure 3](#)).

Considerations

Accuracy and timeliness of routine NHS data sets (SUS and ECDS hospital admission); there is approximately 6 weeks' lag in data reporting from the end of the hospital spell to reporting to the SUS dataset.

SUS data are subject to changes by the reporting trust, potentially affecting analysis.

Absence of a corresponding SUS hospital admission record can occur due to:

- a SUS admission not being created or poor or incomplete NHS records
- poor or incomplete identifiers preventing cases being linked

In these instances, the case is regarded as lost to follow-up or no SUS record.

Approximately 10% of cases are unmatched through the current address matching process due to poor or no residential address data.

Patient address may be incorrect at the time of earliest positive specimen.

Patients normally resident in another property type prior to hospital admission (for example, private residence and so on) and then discharged to a care home from hospital could not be included in this analysis due to being unable to identify which care home they were discharged to.

Index hospital-associated cases would not be identified if the admitted patient was not tested for COVID-19 either due to asymptomatic status or testing practices.

This analysis is based on data linkage alone using laboratory confirmed cases. This does not include any more detailed virological analysis to further investigate the identified potential seeding events such as sequencing.

This analysis is based on determining potential hospital exposures as sources of infection and does not include other potential sources of infection from the wider community.

This analysis is based on all confirmed cases, and potential for some individuals to be discharged from hospital and not tested as part of an outbreak investigation.

Findings

Our analysis included a total of 514,428 laboratory confirmed COVID-19 positive tests reported to SGSS from 30 January to 12 October 2020. The address matching process identified 43,398 (8.4%) care home resident cases through pillar 1 and 2 testing (28,027 (65%) and 15,371 (35%), respectively) for this time period, of which 35,740 (82.4%) cases were linked to a care home outbreak (Table 1).

Table 1. Laboratory confirmed COVID-19 cases resident in care homes, 30 January to 12 October 2020

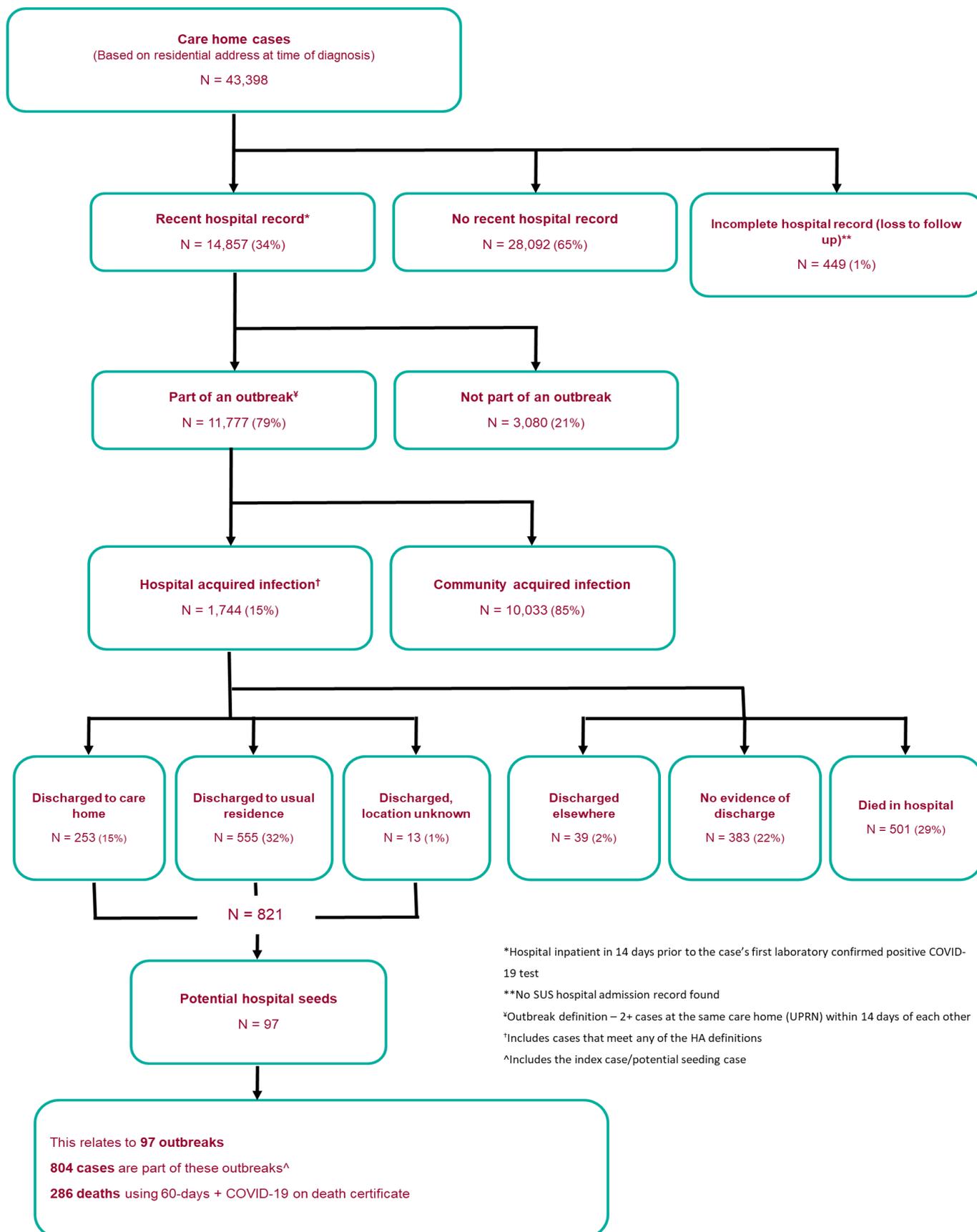
No. cases (%)	No. deaths (%)*	No. cases part of an outbreak (%)	Total no. outbreaks	No. care homes with outbreaks ^
43,398 (8.4%)	13,791 (33.9%)	35,740 (82.4%)	5,882	4,382

*Based on 60 day death definition. Total deaths, n=40,668

^Some care homes experienced multiple outbreaks

The ECDS-SUS data linkage was applied to the addressed matched data and analysed to identify hospital associated infections. Details of counts of cases at the different stages can be seen in [Figure 1](#).

Figure 1. Data flow identifying care home COVID-19 outbreaks potentially seeded from hospital associated cases



There were 425 patients recorded in SUS as discharged into a care home who were identified through address matching as resident in other (non-care home) settings. These cases were excluded from further analysis as there were no details on which care homes they were discharged to or means to verify the discrepancy in residence.

In total 97 (1.6%) cases were identified as potential hospital associated seeding cases. In 85 of these (87.6%), the seeding case was the index case, and in the remaining 12.4% the seeding case tested positive within the first 2 days of the first case diagnosed in the outbreak. The majority of cases identified as potentially seeding care home outbreaks were in the probable care home or possible hospital associated (indeterminate) group, 45.4% (n=44), followed by probable hospital associated 27.8% (n=27). Place of COVID-19 acquisition for these cases remains indeterminate given the shorter duration in hospital.

Table 2. Care home outbreaks potentially seeded by HA COVID-19, 30 January to 12 October 2020

Hospital-associated definition	No. cases identified as hospital associated seeding an outbreak		
	Index case only (%)	Case within first 2 days (%)	Total (%)
Definite hospital-associated	25 (29.4)	1 (8.3)	26 (26.8)
Probable hospital-associated or possible care home-associated	23 (27.1)	4 (33.3)	27 (27.8)
Probable care home-associated or possible hospital-associated (indeterminate)	37 (43.5)	7 (58.3)	44 (45.4)
Total	85 (87.6)	12 (12.4)	97 (100.0)

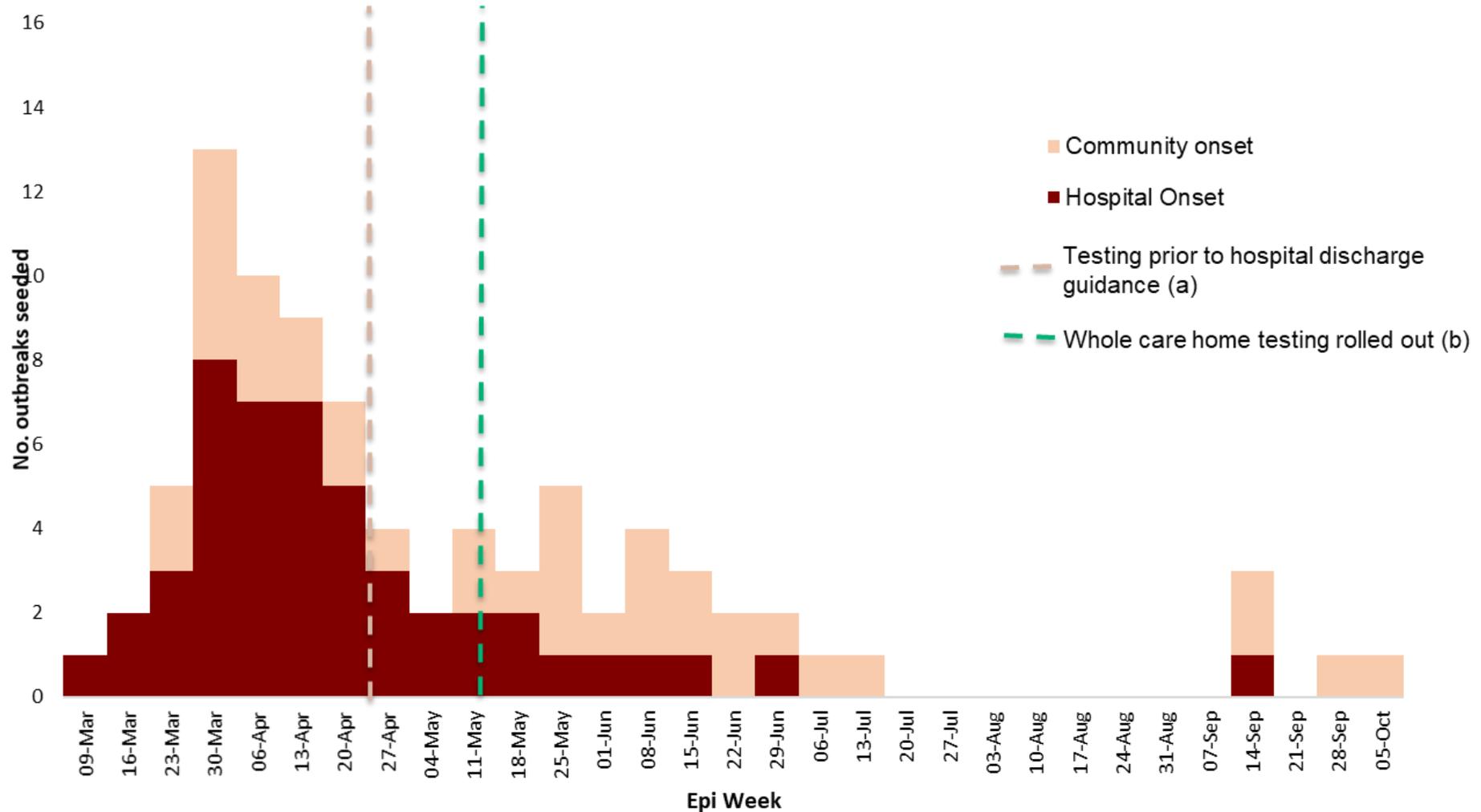
Comparing cases identified as potential hospital associated seeding cases to all care home residents (of cases with a hospital admission in the preceding 14 days leading up to their first positive specimen), and where the positive test was taken during their hospital stay, the mean number of days from positive specimen test to discharge was calculated as 4 and 15 days, respectively. This indicates much shorter duration between testing positive for COVID-19 and discharge back to a care home in cases identified as potentially seeding outbreaks through infections acquired in hospital.

Hospital associated cases potentially seeding care homes outbreaks were seen throughout March to end of July, where no further cases are identified until mid-September, although in small numbers (Figure 2). Most cases were concentrated in March to mid-April, after which cases gradually reduce over time, just prior to the introduction of hospital testing prior to care home discharge, or discharged and isolated

pending test result/positive (a), and whole care home testing (b), policies which came into effect on 15 Apr and 11 May 2020, respectively. However, it must be noted the data from 1 September (last 6 weeks) will suffer from under ascertainment due to delays in SUS data feeds.

Of the 97 cases identified as potentially seeding care home outbreaks, 56 (58%) had a specimen date during their hospital stay (hospital onset), the remaining cases had their positive specimen within 14 days of their discharge (community-onset).

Figure 2. Distribution of hospital associated seeded care home outbreaks by week and onset location, 30 January to 12 October 2020*,**



*Includes outbreaks that meet all HA definitions, definite, probable, indeterminate, and community onset HA.

**The most recent 6 weeks is likely to suffer significant under ascertainment of hospitalisation, due to SUS delays in reporting

a. New requirement to test patients being discharged from hospital to a care home

b. Guidance for stepdown of infection control precautions and discharging COVID-19 patients and asymptomatic SARS-CoV-2 infected patients

The highest proportion of outbreaks due to hospital associated seeding occurred in the East of England, 2.6%, and South West the lowest at 0.7% (Table 3). The rest of England saw a similar distribution of potential hospital associated seeded outbreaks, between, 1.0 to 2.0%. Of all outbreaks, potential hospital associated seeding of care home outbreaks accounted for only 1.6% of all care home outbreaks.

Table 3. Regional distribution of hospital associated seeded care home outbreaks, 30 January to 12 October 2020

PHE Centre	All care home outbreaks	No. outbreaks (%)
East Midlands	524	7 (1.3)
East of England	617	16 (2.6)
London	599	7 (1.2)
North East	397	10 (2.6)
North West	1,018	13 (1.3)
South East	928	15 (1.6)
South West	404	3 (0.7)
West Midlands	707	13 (1.8)
Yorkshire and Humber	688	13 (1.9)
Total	5,882	97 (1.6)

Validation of approach

The approach to this analysis for identified potential hospital associated seeding cases was carried out for one hospital which were investigated by a separate team in relation to care home outbreaks; both the data linkage approach and the separate investigation identified the same hospital associated cases as potential seeding events.

Discussion

From 30 January to 12 October 2020, we identified 43,398 (8.4%) care home residents who tested positive for SARS-CoV-2, with laboratory confirmation, and death was reported in 33.9% (n=13,791). This analysis identified 97 (1.6%) care home outbreaks due to hospital associated seeding, involving 804 care home residents, and 286 (2.1%) deaths.

Two approaches were used to identify hospital associated seeding cases, where the case was the first case in the outbreak (index), or whether the positive specimen was

taken within the first 2 days of the outbreak (to allow for testing or result delays), provided they met one of the HA definitions. In 87.6% of these outbreaks, the index case was identified as seeding the outbreak.

Most cases were also identified as being probable care home or possible hospital associated (indeterminate), 45.4%, where length of hospital stay falls between 2 and 14 days, leading to some uncertainty on where the infection may have been acquired. Comparison of duration from earliest positive specimen date to discharge from hospital, in those cases that met the hospital associated seeding definition, and all care home residents with a healthcare stay in the preceding 14 days leading up to their positive specimen, showed a much shorter mean duration in those identified as hospital associated seeding cases, 4 and 15 days, respectively.

The bulk of hospital associated seeding cases were noted through much of March to mid-April 2020, after which a slow decline in these cases is seen; this approximately coincides with the time testing prior to **care home discharge was introduced on 15 April 2020**, and shortly after **whole care home testing was also introduced, 11 May 2020**. These cases remained low until the end of July, after which no further cases were seen until much recently in September with a few cases emerging. However, recent data should be treated with caution due to the 6 week SUS data delay (possibly longer in some instances), so these more recent observations regarding hospital seeding of outbreaks are likely to be subject to change.

Regionally, cases were evenly distributed across England, and approximately accounted for 1.0 to 2.0% of care home outbreaks in those regions. The highest reported region was the North East at 2.3% and the lowest the South West at 0.7%.

There are certain limitations and considerations that should be taken into account when interpreting these findings. These include the address matching process to identify care homes, which may have missed care home cases with poor or no address data in NHS records. Some cases were lost during the analysis due to no follow-up SUS admission record available, and instances where cases residence at the time of diagnosis was not a care home but recorded as being discharged to a care home following their hospitalisation. The dynamic nature of the SUS and ECDS data also needs to be considered including delays with data submission, leading to poor ascertainment data in the previous 6 weeks, possibly longer in some cases. Furthermore, assessment of the seeding events is based on healthcare usage identified through these records and cannot exclude the influence of other sources during the pandemic.

Conclusion

The impact of suspected hospital associated seeding on care home outbreaks appears to be relatively small, potentially contributing to 1.6% of all care home outbreaks. Time trend analysis shows that most of these outbreaks were concentrated at the early point of the pandemic, March to April 2020, with no more cases seen until recently. However, the small numbers in the more recent time period should be re-assessed in November and December to mitigate under ascertainment of SUS patient records due to timeliness of reporting in this collection.

There are policies in place now, requiring hospitals to ensure a negative COVID-19 test is received prior to discharge to a care home, thus the occurrence of hospital associated outbreaks should be minimised, however the situation should be monitored.

Whilst our analysis identified relatively small numbers of outbreaks potentially seeded from hospital-acquired infections, the potential for their preventability and the ensuing impact on the care homes, their residents, families and staff must be fully acknowledged.

References

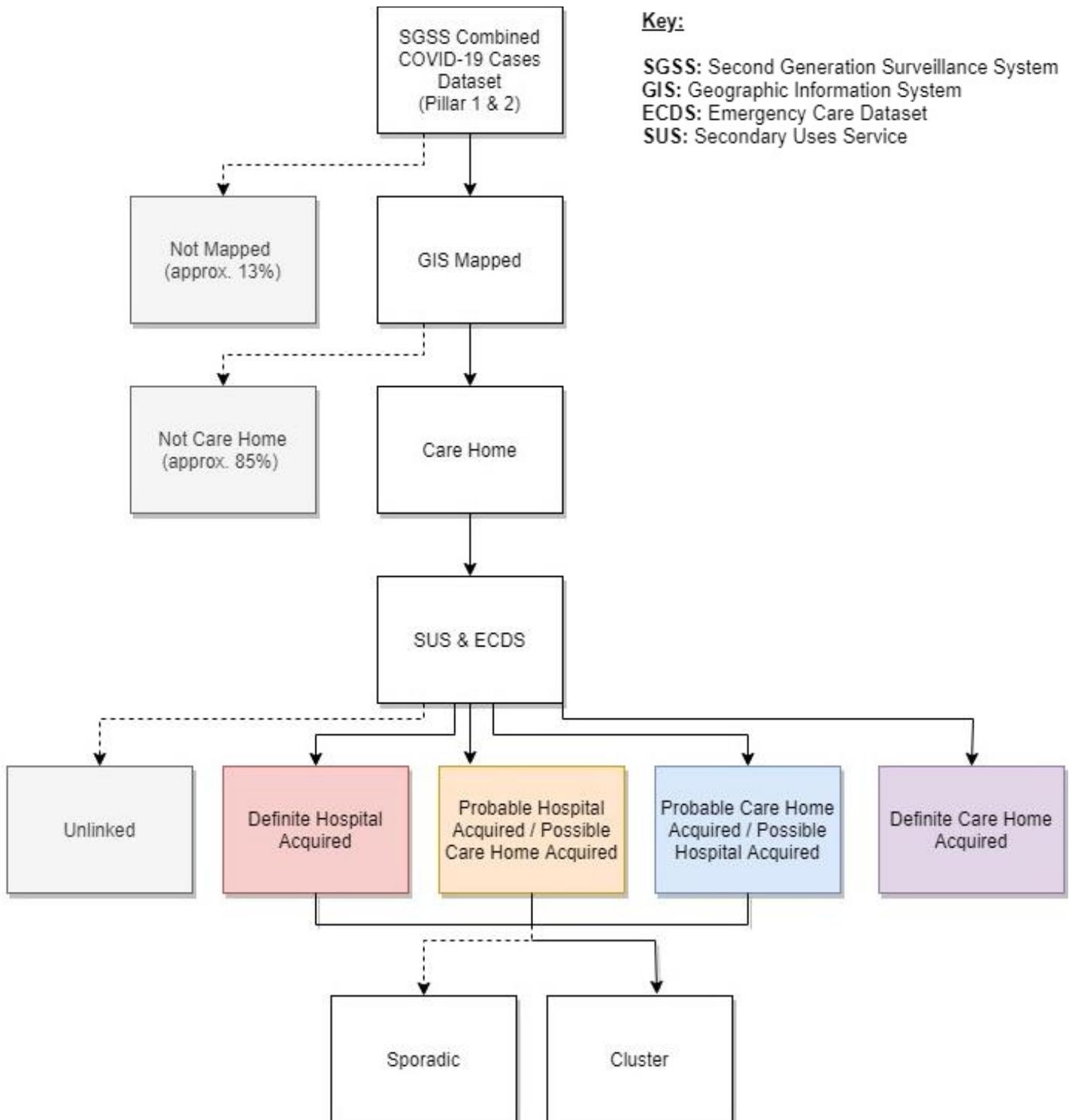
England and Wales see 20,000 excess deaths in care homes (The Lancet)

New requirement to test patients being discharged from hospital to a care home

Guidance for stepdown of infection control precautions and discharging COVID-19 patients and asymptomatic SARS-CoV-2 infected patients

Appendix

Appendix Figure 1. COVID-19 hospitalised data flow diagram



Appendix Table 1. Hospital-associated COVID-19 case definitions

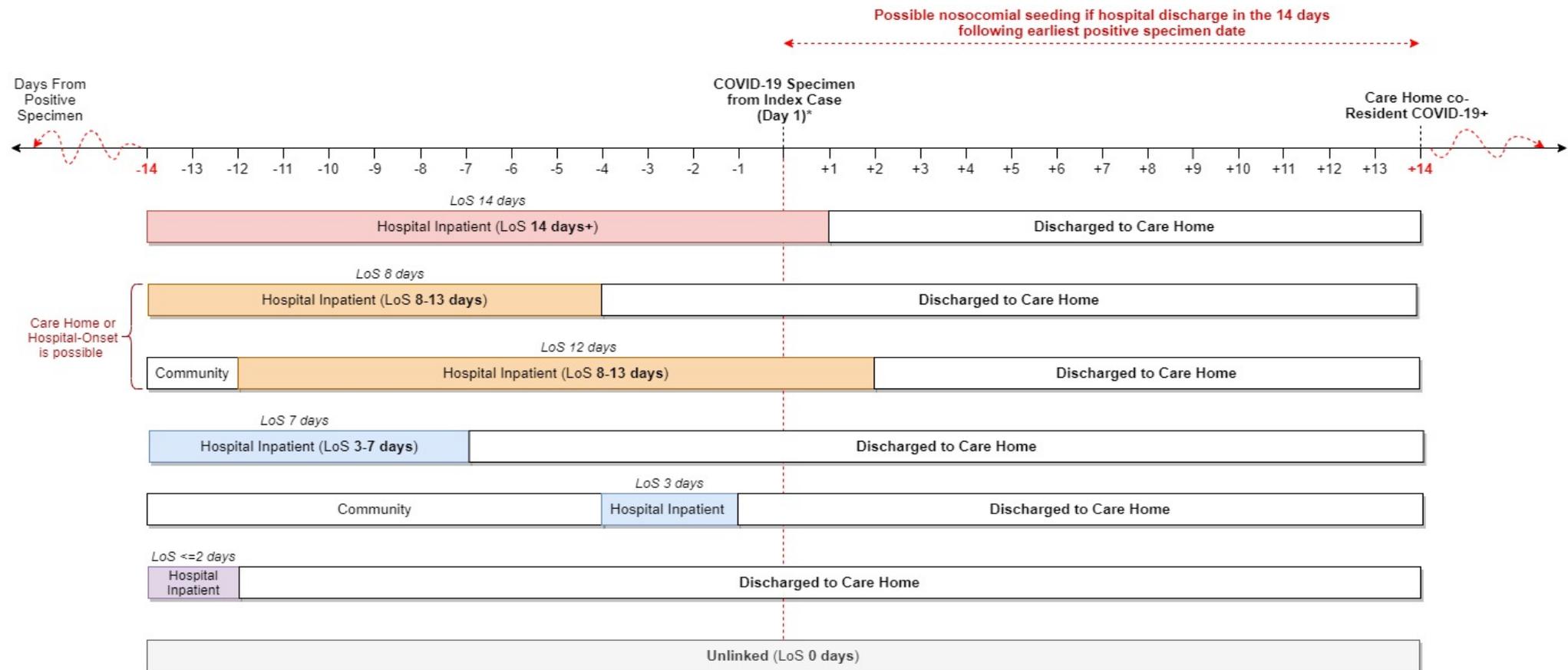
COVID-19 case definitions	Criteria
Case identified as a care home resident at the time of diagnosis AND was a:	
1. Definite hospital-associated	hospital inpatient for the 14 days prior to their earliest positive specimen date
2. Probable hospital-associated or possible care home-associated	hospital inpatient for 8 to 13 days in the fortnight prior to their earliest positive specimen date
3. Probable care home-associated or possible hospital-associated	hospital inpatient for 3 to 7 days in the fortnight prior to their earliest positive specimen date
4. Definite care home-associated	hospital inpatient for ≤ 2 days in the fortnight prior to their earliest positive specimen date
5. Unlinked	no corresponding hospital admission in the fortnight prior to their earliest positive specimen date
6. Hospital-associated care home outbreak	index case meeting definition 1 to 5, succeeded by 1+ subsequent case(s) at same care home within 14 days of positive specimen date and at least a day after hospital-associated case discharged from hospital

Appendix Figure 2. Diagrammatic representation of hospital-associated COVID-19 case definitions

Key:

LoS: Length of hospital stay in the fortnight prior to earliest positive specimen date

- Definite Hospital Acquired
- Probable Hospital Acquired / Possible Care Home Acquired
- Probable Care Home Acquired / Possible Hospital Acquired
- Definite Care Home Acquired
- Unlinked (Not Hospital Inpatient)



*Individuals included in analyses if hospital inpatient within the 14 days prior to their earliest positive specimen date and discharged to a care home within 14 days of their diagnosis.

Appendix Figure 3. Diagrammatic representation of hospital-associated COVID-19 case definitions



X care home cases in outbreak

X case meeting healthcare acquired definition (definite probable, possible)

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