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# Characteristics and outcomes of neonates hospitalised with SARS-CoV-2 infection in the UK by variant: a prospective national cohort study

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## ABSTRACT

**Objective** Neonatal infection with wildtype SARS-CoV-2 is rare and good outcomes predominate. We investigated neonatal outcomes using national population-level data to describe the impact of different SARS-CoV-2 variants.

**Design** Prospective population-based cohort study.

**Setting** Neonatal, paediatric and paediatric intensive care inpatient care settings in the UK.

**Patients** Neonates (first 28 days after birth) with confirmed SARS-CoV-2 infection who received inpatient care, March 2020 to April 2022. Neonates were identified through active national surveillance with linkage to national SARS-CoV-2 testing data, routinely recorded neonatal data, paediatric intensive care data and obstetric and perinatal mortality surveillance data.

**Outcomes** Presenting signs, clinical course, severe disease requiring respiratory support are presented by the dominant SARS-CoV-2 variant in circulation at the time.

**Results** 344 neonates with SARS-CoV-2 infection received inpatient care; breakdown by dominant variant: 146 wildtype, 123 alpha, 57 delta and 18 omicron. Overall, 44.7% (153/342) neonates required respiratory support; short-term outcomes were good with 93.6% (322/344) of neonates discharged home. Eleven neonates died: seven unrelated to SARS-CoV-2 infection, four were attributed to neonatal SARS-CoV-2 infection (case fatality 4/344, 1.2% 95% CI 0.3% to 3.0%) of which three were born preterm due to maternal COVID-19. More neonates were born very preterm (23/54) and required invasive ventilation (27/57) when delta variant was predominant, and all four SARS-CoV-2 related deaths occurred in this period.

**Conclusions** Inpatient care for neonates with SARS-CoV-2 was uncommon. Although rare, severe neonatal illness was more common during the delta variant period, potentially reflecting more severe maternal disease and associated preterm birth.

**Trial registration number** ISRCTN60033461.

## INTRODUCTION

Children are less severely affected by SARS-CoV-2 than adults, and this pattern has been seen across viral variants.<sup>1</sup> In the neonatal period (first 28

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Neonatal infection with wildtype SARS-CoV-2 is rare and good outcomes predominate; the impact of later viral variants on neonates has been unclear.

## WHAT THIS STUDY ADDS

⇒ During the UK COVID-19 pandemic, neonatal infection with SARS-CoV-2 was rare compared with older children and adults across all viral variants; when symptomatic it was associated with respiratory problems, especially during the delta variant period when it was linked to a small number of neonatal deaths.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Rapidly established and ongoing national surveillance was essential to understand the neonatal impact of the evolving SARS-CoV-2 pandemic, highlighting the key role of established systems in future pandemics.  
⇒ The long-term effects of early life exposure to SARS-CoV-2 are unknown, and ongoing data collection, linkage and developmental follow-up remain crucial.

days), neonates can be infected by SARS-CoV-2 or indirectly affected because of maternal infection, for example, through spontaneous or iatrogenic preterm birth. We have previously reported that neonates were more likely than older children to require respiratory support following SARS-CoV-2 infection when the wildtype variant was dominant,<sup>2</sup> but it is not clear if this pattern persisted in later periods. The alpha and delta variants of SARS-CoV-2 resulted in more severe maternal SARS-CoV-2 infection,<sup>3</sup> but there are few studies describing the impact of SARS-CoV-2 viral variants in neonates.<sup>4</sup>

Using population-level active surveillance data linked to maternal, neonatal and paediatric intensive care and perinatal mortality data, we aimed to describe the epidemiology, clinical course and short-term outcomes of neonates with confirmed SARS-CoV-2 infection cared for in hospitals in the



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UK over the first 2 years of the pandemic, stratified by the dominant SARS-CoV-2 variant in circulation at the time of infection.

## METHODS

This was a national prospective cohort study using the British Paediatric Surveillance Unit (BPSU).<sup>5</sup> From 1 April 2020, senior paediatricians (~4000) in all 155 hospital trusts and health boards in the UK with their associated 190 neonatal units (NNUs) received a weekly (until March 2021) then monthly electronic BPSU reporting card asking them to report any baby who had laboratory-confirmed SARS-CoV-2 infection in the first 28 days after birth and received inpatient care on a postnatal ward, NNU, paediatric inpatient ward or paediatric intensive care unit (PICU). Well neonates born in the UK remained with their mother on postnatal wards until mother and baby were fit for discharge; neonates with asymptomatic SARS-CoV-2 on postnatal wards and asymptomatic cases detected through screening were not reported. Monthly reporting cards sought confirmation that all eligible neonates in the previous month had been reported, and that any reports of no infected neonates were accurate (active negative surveillance). To maximise case ascertainment, we linked to national testing data from Public Health England and Health Protection Scotland between 1 March 2020 and 31 March 2021, as well as the Paediatric Intensive Care Audit Network,<sup>6</sup> United Kingdom Obstetric Surveillance System (UKOSS) data<sup>7</sup> and MBRRACE-UK national perinatal mortality surveillance data.<sup>8</sup> Additional details can be found in the online supplemental methods. Intensive care was defined using British Association of Perinatal Medicine categories of care<sup>9</sup> for neonatal admissions, or any admission to a PICU. Severe disease was defined as having received respiratory support. Very preterm birth was defined as birth at <32 gestational weeks.

Neonatal deaths were verified with the MBRRACE-UK national surveillance of perinatal deaths.<sup>10</sup> Neonatal deaths were attributed to SARS-CoV-2 if the treating paediatrician reported that SARS-CoV-2 infection contributed to the baby's death; we also recorded if the referring clinician reported that maternal SARS-CoV-2 infection led to spontaneous or iatrogenic preterm birth.

UK SARS-CoV-2 testing policy among pregnant women and neonates evolved during the study. Initially, only symptomatic women and neonates were tested. Routine screening of all obstetric admissions was recommended by the Royal College of Obstetricians and Gynaecologists on 29 May 2020 and neonatal testing recommended for symptomatic neonates of mothers with a SARS-CoV-2 infection; testing of asymptomatic neonates varied. Confirmation of neonatal SARS-CoV-2 infection required at least two positive samples, including one at least 72 hours after birth.<sup>11</sup> UK policy was that well neonates of SARS-CoV-2-infected mothers should be cared for alongside their mother in the postnatal ward and not routinely tested.

This analysis presents characteristics and outcomes for neonates reported as having confirmed SARS-CoV-2 infection in the first 28 days after birth, between 1 March 2020 and 1 April 2022, and for whom complete data had been received by 30 July 2022. To provide a complete description of the first two pandemic years, this report includes neonates with SARS-CoV-2 infection between 1 March 2020 and 30 April 2020 previously reported.<sup>2</sup>

As individual-level SARS-CoV-2 variant data were not recorded in medical records, the outcomes were compared across four proxy groups according to the period in which the

original wildtype, alpha variant, delta variant or omicron variant was the dominant circulating strain in the UK.

The original wildtype period included neonates diagnosed from 1 March to 30 November 2020, the alpha variant period from 1 December 2020 to 15 May 2021, the delta variant period from 16 May 2021 to 14 December 2021 and the omicron variant period from 15 December 2021 to 1 April 2022. We chose cut-off dates for the delta and omicron periods using data on variant sequencing from Public Health England to identify the week when these variants first contributed >50% of SARS-CoV-2 infections nationally.<sup>12</sup> Since genomic data on the variant were less widely available at the start of the pandemic, Public Health England modelled proxy data and reported that the alpha variant reflected the substantial majority of infections across all areas of England during December 2020; therefore, 1 December 2020 was used as an estimated cut-off date.<sup>13</sup>

## Parent, patient and public involvement

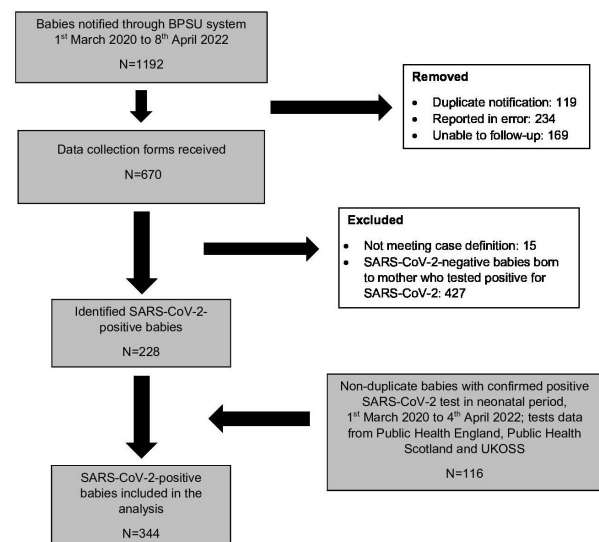
Parents, patients and the public were consulted during the design of the study and presentation of the findings through the MBRRACE-UK third-sector stakeholder group and the NIHR Policy Research Unit in the Maternal and Neonatal Care Public and Patient Involvement group.

## Statistical analysis

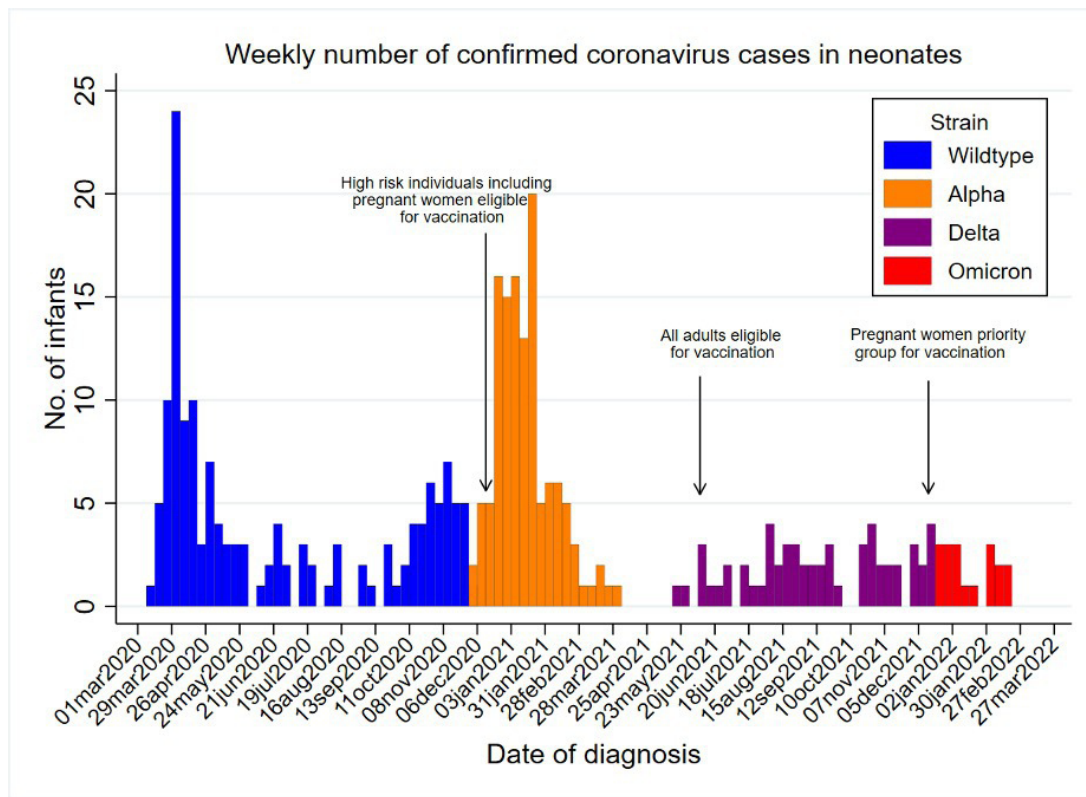
Descriptive statistics are presented as frequencies, proportions and medians with IQRs, as appropriate.

## RESULTS

Monthly BPSU card returns were received between 91.3% (3748/4070, April 2020) and 71.9% (3110/4298, February 2022) of UK paediatricians over the surveillance period. In total, 1192 potentially eligible neonates were reported to the BPSU system over the study period and 116 non-duplicate neonates were identified from other sources (figure 1). Linkage with data held in the NNRD was achieved for 99% (132/134) of neonates reported through the BPSU system who received NNU care. Three hundred and forty-four neonates were diagnosed with SARS-CoV-2 infection in the first 28 days after birth and received inpatient care, predominantly in the wildtype-dominant



**Figure 1** Flow chart of case selection for study period 1 March 2020 to 1 April 2022. BPSU, British Paediatric Surveillance Unit; UKOSS, United Kingdom Obstetric Surveillance System.



**Figure 2** Weekly confirmed neonatal SARS-CoV-2 infections by dominant circulating variant in the UK.

and alpha-dominant periods, with numbers dropping in subsequent variant periods: 146 neonates were reported in the wildtype period, 123 in the alpha period, 57 in the delta and 18 in the omicron periods (figure 2). Three hundred and twenty cases were in England, 16 cases in Scotland, 6 in Wales or Northern Ireland; country data were missing for 2 cases.

Median age at diagnosis was 9 days (IQR 3–17 days); 44.5% (153/344) of the neonates were diagnosed in the first 7 days after birth; of these, 66.7% (102/153) were born to a mother with confirmed SARS-CoV-2 infection within 7 days before or after giving birth. The age distribution at diagnosis was similar across different dominant circulating variant periods (online supplemental figure 1). Respiratory signs were common along with poor feeding or vomiting and fever (online supplemental figure 2); 15% of neonates were asymptomatic.

Neonates in hospital with neonatal SARS-CoV-2 infection were more commonly preterm and male when compared with all live births in England and Wales and this was consistent across all variant epochs, although sex differences were less marked in the alpha period (table 1). The highest proportions of very preterm births were seen in the delta-predominant period. An over-representation of non-white ethnic groups among neonatal SARS-CoV-2 infections in the wildtype period was not seen with later variants (table 1).

Most neonates in hospital with neonatal SARS-CoV-2 infection did not require high-level care; however, 44.7% required some form of respiratory support and 21.8% received intensive care (table 2). Higher numbers and proportions of neonates in hospital with neonatal SARS-CoV-2 in the delta period required intensive care or invasive respiratory support, compared with other variant periods (figure 3). Infection following suspected nosocomial transmission, excluding vertical transmission, affected 7.8% of neonates overall. Outcomes following neonatal

SARS-CoV-2 infection were generally good; however, 11 deaths occurred in neonates who tested positive for SARS-CoV-2, 4 of which were attributed either directly or indirectly to neonatal SARS-CoV-2 infection (case fatality 4/344, 1.2% 95% CI 0.3% to 3.0%). Three of these four neonates had been born preterm due to maternal COVID-19. All four SARS-CoV-2-related neonatal deaths were in the delta period.

As expected in any neonatal population, degree of prematurity was strongly linked with receipt of respiratory support with all extremely preterm neonates infected with SARS-CoV-2 requiring ventilation; this highlights the challenges separating severe manifestations of SARS-CoV-2 infection from conditions related to preterm birth (online supplemental table 1).

## DISCUSSION

Using population-level active surveillance data from March 2020 to April 2022 and spanning wildtype, alpha, delta and omicron variant-predominant periods during which there were approximately 1.4 million births recorded in the UK,<sup>14–16</sup> we confirm that the need for inpatient care for neonates with SARS-CoV-2 infection was rare and outcomes were generally good. Neonatal SARS-CoV-2 infection led to severe disease in a minority of neonates, with death related to neonatal SARS-CoV-2 infection occurring in 1.2% of hospitalised neonates. During the delta variant-predominant period, higher numbers of neonates had severe disease associated with SARS-CoV-2 infection, defined as requiring respiratory support, compared with other variant epochs. We believe this is the first study to present descriptive data from a national cohort on neonatal deaths reported as related to SARS-CoV-2 infection, all of which occurred in the delta-predominant period in the UK.

**Table 1** Background characteristics of neonates in hospital with SARS-CoV-2 infection by dominant circulating variant; distribution of background characteristics in all UK live births in 2021<sup>14</sup>

	Distribution in live births in England and Wales 2021 (%)	All variants N (%)*	Wildtype N (%)*	Alpha N (%)*	Delta N (%)*	Omicron N (%)*
Total cases		344	146	123	57	18
Gestation at birth						
<28 <sup>+0</sup>	0.5	11 (3.3)	5 (3.6)	2 (1.6)	3 (5.6)	1 (5.6)
28 <sup>+0</sup> –31 <sup>+6</sup>	0.8	41 (12.3)	8 (5.7)	12 (9.8)	20 (37.0)	1 (5.6)
32 <sup>+0</sup> –36 <sup>+6</sup>	6.3	79 (23.7)	27 (19.3)	34 (27.9)	12 (22.2)	6 (33.3)
≥37	92.1	203 (60.8)	100 (71.4)	74 (60.7)	19 (35.2)	10 (55.6)
Missing	–	10	6	1	3	0
Sex						
Male	51.2	188 (55.0)	84 (57.9)	63 (51.2)	31 (55.4)	10 (55.6)
Female	48.8	154 (45.0)	61 (42.1)	60 (48.8)	25 (44.6)	8 (44.4)
Missing	–	2	1	0	1	0
Ethnicity						
White	70.5	230 (70.3)	89 (61.8)	80 (71.4)	46 (86.8)	15 (83.3)
Asian/Asian British	12.2	60 (18.3)	34 (23.6)	19 (17.0)	5 (9.4)	2 (11.1)
Black/African/Caribbean/Black British	4.8	19 (5.8)	11 (7.6)	6 (5.4)	1 (1.9)	1 (5.6)
Mixed/Other	9.1	18 (5.5)	10 (7.0)	7 (6.3)	1 (1.9)	0 (0)
Missing	–	17	2	11	4	0

\*Percentage of those with complete data; duration of variant-predominant periods were not equal.

The pattern of more serious neonatal disease in the delta period described here may be explained by the higher number and proportion of neonates born very preterm with neonatal SARS-CoV-2 infection during this period. More severe maternal infection and higher rates of preterm birth have been described in the delta-predominant wave in the UK<sup>3</sup> and internationally<sup>17</sup>; it is unclear whether this pattern of more severe maternal disease was related to changing characteristics of the viral variant or changes in behaviour and low vaccination rates among pregnant women in the UK during this period. Similarly, it is not possible to determine from these data presented whether the delta variant was more pathogenic in neonates, or whether adverse neonatal outcomes were a result of more severe maternal SARS-CoV-2

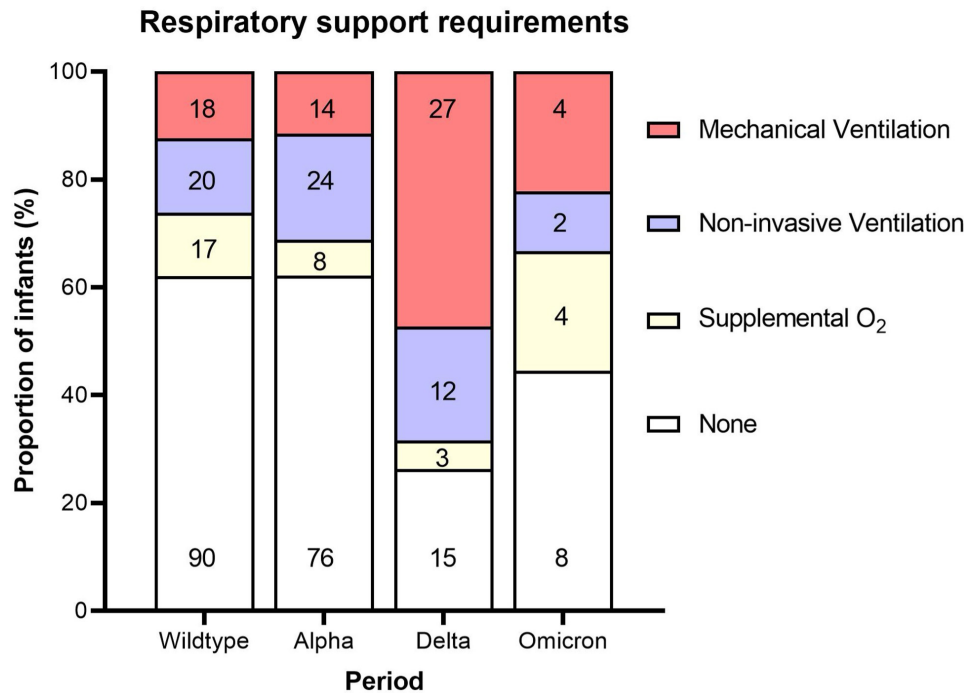
disease leading to more preterm births, a well-described risk factor for neonatal infection.<sup>18</sup>

There have been very few population-based studies of neonates infected with SARS-CoV-2 infection, and data describing neonatal SARS-CoV-2 infection by variant are even more sparse. Population-level data from Germany describing paediatric SARS-CoV-2 infection show higher rates of COVID-19-related hospitalisation and intensive care unit admission for children under 5 years in the delta-predominant period compared with alpha-predominant, wildtype-predominant and omicron-predominant periods,<sup>19</sup> although data from the UK did not report a higher rate of intensive care admissions for children under 5 with delta compared with earlier viral variants.<sup>20</sup> Data covering

**Table 2** Clinical care received and outcomes following neonatal SARS-CoV-2 infection during the dominant circulating variant periods

	All variants N (%)*	Wildtype N (%)*	Alpha N (%)*	Delta N (%)*	Omicron N (%)*
Total cases	344	146	123	57	18
Transmission					
Maternal SARS-CoV-2 infection at birth	133 (38.7)	45 (30.8)	54 (43.9)	25 (43.9)	9 (50.0)
Suspected nosocomial transmission	27 (7.8)	18 (12.3)	3 (2.4)	4 (7.0)	2 (11.1)
Highest level of care					
Intensive care	75 (21.8)	23 (15.8)	18 (14.6)	28 (49.1)	6 (33.3)
Non-intensive care	269 (78.2)	123 (84.2)	105 (85.4)	29 (50.9)	12 (66.7)
Required respiratory support					
Yes	153 (44.7)	55 (37.9)	46 (37.7)	42 (73.7)	10 (55.6)
No	189 (55.3)	90 (62.1)	76 (62.3)	15 (26.3)	8 (44.4)
Missing	2	1	1	0	0
Neonatal outcome					
Discharged home	322 (93.6)	137 (93.8)	119 (96.8)	50 (87.7)	16 (88.9)
Transferred to another site/still admitted	11 (3.2)	7 (4.8)	3 (2.4)	1 (1.8)	0 (0)
Died	11 (3.2)	2 (1.4)	1 (0.8)	6 (10.5)	2 (11.1)
Death related to SARS-CoV-2	4	0	0	4	0

\*Percentage of those with complete data.



**Figure 3** Maximum respiratory support requirements of hospitalised neonates with SARS-CoV-2 infection during the dominant circulating variant period (wildtype n=145, alpha n=122, delta n=57 and omicron n=18).

approximately 10% of the US population found similar rates of intensive care admissions of infants <6 months of age with the delta and omicron variants.<sup>21</sup> A further study examining administrative data representing approximately 20% of US hospital admissions found that COVID-19 among newborns is rare but is associated with newborn critical care outcomes like invasive ventilation, and that risks for invasive compared with non-invasive ventilatory support were higher in delta compared with pre-delta periods,<sup>22</sup> consistent with the UK data we present here. Single-centre case-series have also reported more severe SARS-CoV-2 infection in infants and neonates in delta-predominant compared with other variant-predominant periods,<sup>4</sup> supporting a link between infection with the delta variant and more severe neonatal disease.

Although there have been multiple registries describing neonatal SARS-CoV-2 infection,<sup>23 24</sup> there have been very few representative population-level studies and those that have published have been limited by low case numbers.<sup>25</sup> The population-level data we present here include and build on previously published neonatal surveillance data from the UK from the first weeks of the SARS-CoV-2 pandemic when the wildtype variant predominated.<sup>2</sup> These updated data describe the presentation and clinical course of neonatal SARS-CoV-2 infection in the largest number of neonates reported to date. Consistent with early data,<sup>2</sup> we confirm that while respiratory signs were widespread, symptomatic neonatal SARS-CoV-2 most commonly presented with poor feeding or other gastrointestinal signs. Fever and respiratory signs were also common but did not predominate as in other paediatric groups.<sup>26</sup> Data from Switzerland in one of the few other population-level surveillance studies found fever and respiratory signs most common at presentation in the 73 neonates reported,<sup>25</sup> possibly reflecting the non-specific nature of these neonatal signs. The large number of neonatal cases we report compared with other neonatal studies provide confidence in our key findings that while receipt of respiratory support is relatively common among neonates hospitalised with

neonatal SARS-CoV-2, this is generally seen in the context of preterm birth. Almost half of hospitalised neonates with SARS-CoV-2 infection received some form of respiratory support. We also report reassuring short-term outcomes following neonatal SARS-CoV-2 infection consistent with Swiss national data<sup>25</sup> and international registry data.<sup>27 28</sup>

The high rate of presumed nosocomial transmission reported throughout the study (7.8%) is of concern. This likely reflects the challenges of limiting viral exposure in NNUs with few isolation facilities, in the context of a pandemic with high rates of staff and parent infection.

### Strengths and limitations

A key strength of this national prospective cohort study was the use of an established active surveillance system with high reporting rates by UK paediatricians throughout the study period. The long-standing monthly BPSU reporting cards were augmented by additional weekly reporting and supplemented by national virology testing during the first year. Data were also linked to national obstetric surveillance data, paediatric intensive care national audit data, routinely recorded neonatal data and national perinatal mortality surveillance throughout the study period to ensure comprehensive case ascertainment and nationally representative disease severity and outcome data. Use of such established national reporting systems minimises selection bias. By limiting the study to neonates in hospital with SARS-CoV-2 infection, we focused on the more severe spectrum of disease, which is of most interest to health services and clinicians. The main limitation of this approach is that neonates with less severe SARS-CoV-2 in the community were not included and hence true population incidence and asymptomatic infection rates are not possible to quantify. Linked population-level data from Scotland which included community testing data found that two in three neonates with SARS-CoV-2 infection received hospital care,<sup>29</sup> suggesting that the true incidence of

neonatal infection in the whole UK including community testing was around 500–550 neonates—still rare compared with older children and adults. Other limitations of this study include the challenges of separating out the effects of SARS-CoV-2 infection *per se* from other common causes of neonatal illness, primarily preterm birth which commonly requires respiratory support, and the lack of an agreed severity definition for neonatal infection. We did not have access to viral variant sequencing data for individual neonates and hence we used proxy time periods to ascribe variants. In addition, national guidance for neonatal testing changed over the study period, particularly in the early stages of the pandemic. This may have led to underestimation of the actual numbers of SARS-CoV-2 infection during the wildtype-dominant period. The lower number of BPSU reporting card returns in the omicron-dominant period may reflect reporting fatigue by this point in the pandemic, and may thus also underestimate the number of mildly affected neonates admitted during this period.

## CONCLUSIONS

Inpatient care for neonates infected with SARS-CoV-2 was uncommon throughout the first 2 years of the pandemic and short-term outcomes were generally good. Severe disease was more common, although still rare, during the delta variant period; this may have been influenced by more severe maternal disease resulting in more very preterm neonates. Rapidly established and ongoing national surveillance was essential to understand the neonatal impact of the evolving SARS-CoV-2 pandemic, highlighting the key role of established systems such as the BPSU, UKOSS and MBRRACE-UK perinatal mortality surveillance. The long-term effects of early life exposure to SARS-CoV-2 are unknown, and ongoing data collection, linkage and developmental follow-up remain crucial.

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**Supplemental data: Characteristics and outcomes of neonates hospitalised with SARS-CoV-2 infection in the United Kingdom by variant: a prospective national cohort study**

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**Health Research Authority**

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**Public Health Scotland**

**Members of the MBRRACE-UK third sector stakeholder group**

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### Supplemental methods

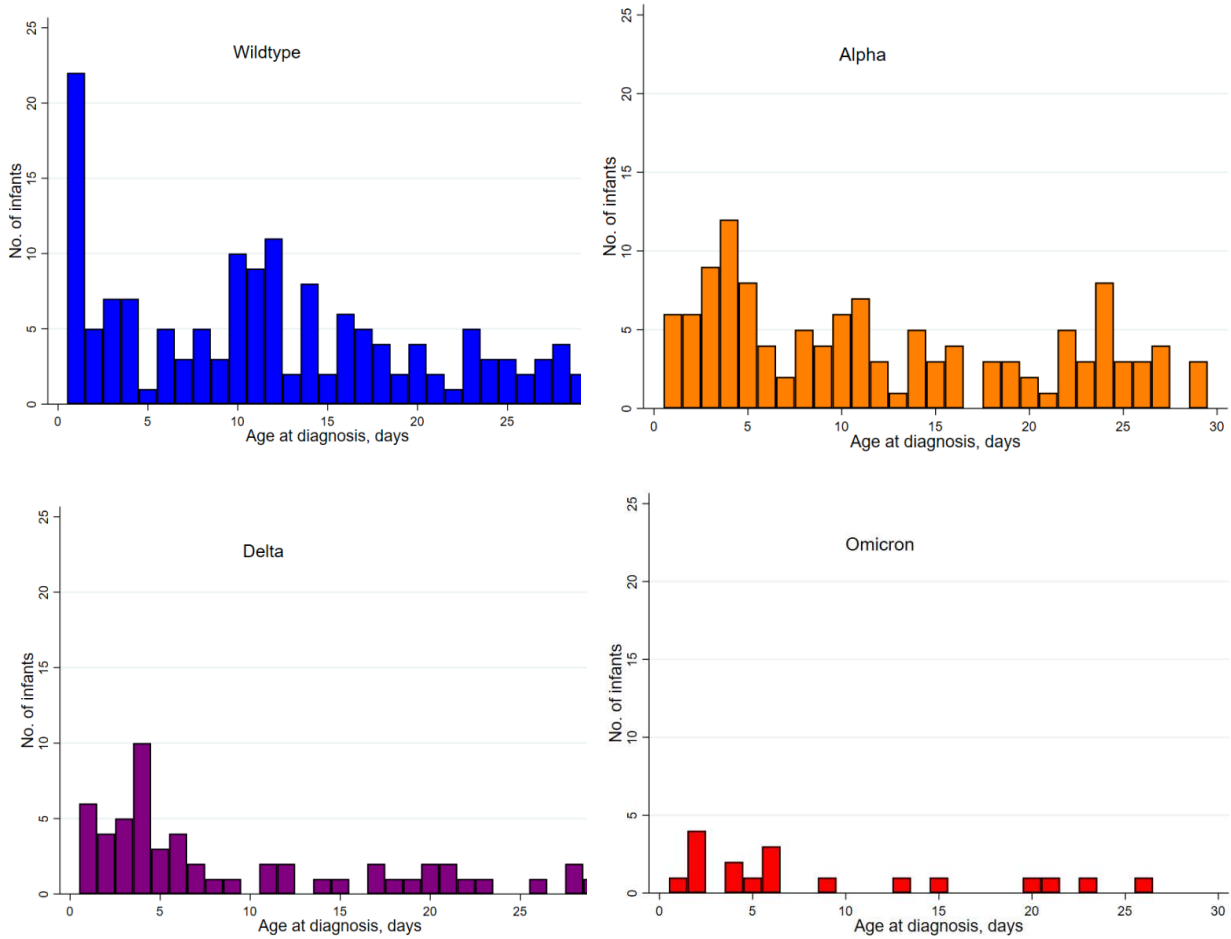
National testing data from public health organisations, PICANet, UKOSS and MBRRACE-UK data were used to identify any baby with a positive SARS-CoV-2 test taken in the first 28 days not reported through the BPSU. Following linkage, newly identified cases from these sources were followed up through local BPSU reporters and research nurses. Where cases identified through national testing data were unable to be matched to hospital records at the site of the test, they were categorised as not admitted for inpatient care and therefore excluded from the study.

Linkage to routinely recorded data held in the National Neonatal Research Database (NNRD) was undertaken to confirm clinical care and outcomes for babies cared for on NNUs. Where there was a discrepancy between data reported via BPSU cards and NNRD data regarding the highest level of care or highest respiratory support a baby received we took the highest level recorded in either data source. We used NNRD data to define outcomes for babies who were reported as still admitted to neonatal units in BPSU reported data.

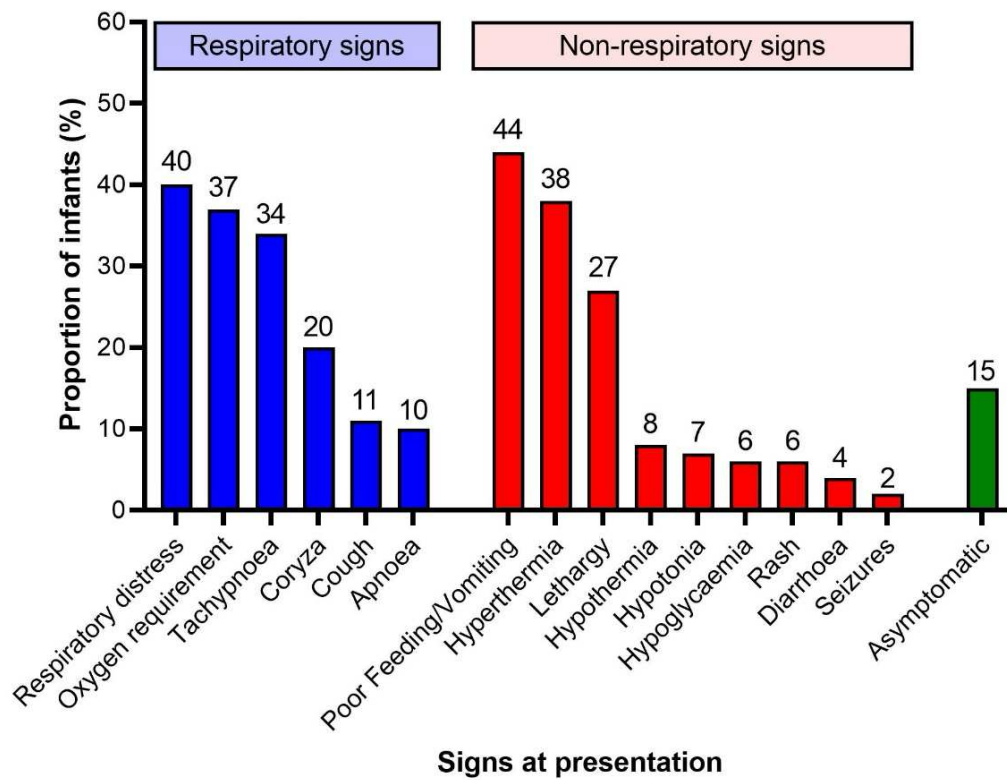
Following receipt of a report, notifying clinicians were asked to complete a data collection form (Supplemental Data) with details of the pregnancy, baby characteristics, neonatal management and outcomes. Reporters who had not returned the form were contacted by email at one, two and four weeks after notification.



## Supplemental data



**Supplemental Figure 1:** Age at diagnosis of neonatal SARS-CoV-2 by dominant circulating strain in the United Kingdom



**Supplemental Figure 2:** Signs at presentation with neonatal SARS-CoV-2 infection. Babies could have more than one sign. For more detail on signs see data collection form.

<b>Gestation at birth in weeks<sup>+days</sup></b>	<b>&lt;28<sup>+0</sup> N (%)*</b>	<b>28+0-31+6 N (%)*</b>	<b>32+0-36+6 N (%)*</b>	<b>≥37 N (%)*</b>
n	11	41	79	203
<b>Highest level of care received</b>				
Intensive care	11 (100.0)	36 (87.8)	18 (22.8)	10 (4.9)
Non-intensive care	0 (0)	5 (12.2)	61 (77.2)	193 (95.1)
<b>Highest respiratory support</b>				
Mechanical ventilation	11 (100.0)	30 (73.2)	15 (19.0)	7 (3.5)
Non-invasive ventilation	0 (0)	11 (26.8)	30 (38.0)	16 (8.0)
Supplemental oxygen	0 (0)	0 (0)	7 (8.9)	24 (11.9)
None	0 (0)	0 (0)	27 (34.2)	154 (76.6)
Missing	0	0	0	2

**Supplemental Table 1:** Respiratory support received by babies with SARS-CoV-2 infection in hospital in the United Kingdom, presented by gestation at birth. \*Percentage of those with complete data

Study ID number:

BPSU ID number:



## Neonatal complications of coronavirus disease (COVID-19)

Data Collection Form - Strictly Confidential

Please report all eligible babies admitted on or after **1st March 2020** and before **1st April 2021**

### Case Definition:

(Please tick relevant box. If unable to do so, your case may not fulfil the case definition.)

Any baby or infant

1. That has a diagnosis of COVID-19 made on a sample taken before 29 days of age and receives inpatient care for COVID-19 (this includes postnatal ward, neonatal unit, paediatric inpatient wards, PICU)

**OR**

2. Where the mother had confirmed COVID-19 at the time of birth or suspected COVID-19 at the time of birth that has subsequently been confirmed, and the baby was admitted for neonatal care (admitted for care on a neonatal unit regardless of the reason for admission and clinical course)

Please **do not** include any cases where the COVID-19 diagnosis in baby or mother **has not** been confirmed by laboratory testing.

A follow-up questionnaire may be sent within the first year after notification.  
Please keep a copy of this form as a record.

Version 2.2 (08/10/20)

England, Wales and Scotland



---

### Section 1: Reporter details

---

- 1.1 Date of completion of questionnaire: / /
- 1.2 Consultant responsible for case: \_\_\_\_\_
- 1.3 a) Hospital name: \_\_\_\_\_
- b) Country:  England  Wales  Scotland
- 1.4 Telephone number: \_\_\_\_\_
- Email: \_\_\_\_\_
- 1.5 Has the patient been transferred to/from another centre? Yes  No
- If Yes:
- 1) Name of referring centre \_\_\_\_\_
- 2) Referring consultant name \_\_\_\_\_
- 1.6 Name of person completing form (if not 1.2) \_\_\_\_\_

---

### Section 2: Infant case details (If multiple babies complete additional form)

---

- 2.1 NHS number: (or equivalent Scottish CHI)
- 2.2 Postcode: (ONLY include **first half of the postcode** e.g. NG7)
- 2.3 Sex: Male  Female
- Date of birth: / /
- Time of Birth: : :  24hr
- 2.4 Gestation at birth: (e.g. 37+1)   +
- 2.5 Birthweight:     g
- Ethnicity\*:  Specify if any 'Other' background: \_\_\_\_\_
- \*Please choose the correct ethnicity code from Appendix A*

### Section 3: Maternal case details

Maternal details are essential to allow linkage with the maternal (UKOSS) surveillance

3.1 NHS number: (or equivalent Scottish CHI or Northern Irish Health & Social Care number)

3.2 Hospital name where this baby was delivered \_\_\_\_\_

3.3 Was this mother tested for COVID-19 in the 7 days before or 7 days after birth?

Yes  No (Go to Qu. 4.1)  Unsure

If Yes, did this confirm the diagnosis? Yes  No

Sample source: \_\_\_\_\_

Date first positive sample taken / /

If there were further positive samples please give date(s) taken and sample source

1: / /  Sample Source \_\_\_\_\_

2: / /  Sample Source \_\_\_\_\_

If Yes, was the baby separated from the mother following birth? Yes  No

How was this done? \_\_\_\_\_

### Section 4: Pregnancy/birth details

4.1 Antenatal steroids given: None  Partial  Full

4.2 MgSO<sub>4</sub> given: Yes  No

4.3 Delivery mode: (Please tick one) Vaginal – spontaneous  Vaginal – forceps/ventouse   
Elective C-section  Emergency C-section  Not known

4.4 Multiple pregnancy: (Is there >1 fetus during pregnancy?)

No  Not known  Yes  If Yes, birth order  of

4.5 Nulliparous: (Is this the first pregnancy?) Yes  No  Not known

4.6 Apgar score: at 5 mins  at 10 mins  Not known

4.7 Lowest cord pH: (either arterial or venous)  .  Not known

Arterial  Venous  Not known

4.8 Did mother have any of the following in the 7 days before birth? (Please tick Yes/No/Not Known)

	Yes	No	Not known
Prolonged rupture of membranes (>24hrs)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meconium stained liquor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fever (>37.8°C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**4.9 Did the baby require any of the following at birth? (Please tick Yes/No/Not Known)**

	Yes	No	Not known
Inflation/ventilation breaths	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Intubation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chest compressions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Resuscitation drugs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Section 5: Infant presentation/clinical features****5.1 Where did the baby receive medical care?**Neonatal unit  PICU  Paediatric ward  Postnatal ward **5.2 Was this baby tested for COVID-19?**Yes  No (Go to Qu. 5.6)  Unsure 

If Yes, did this confirm the diagnosis?

Yes  No 

For each test performed for COVID-19, please state the source, date and result

Sample source (e.g. cord blood, NPA, stool)	Positive	Negative	Time taken	Date taken
1.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="h h : m m"/> <small>24hr</small>	<input type="text" value="D D / M M / Y Y"/>
2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="h h : m m"/> <small>24hr</small>	<input type="text" value="D D / M M / Y Y"/>
3.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="h h : m m"/> <small>24hr</small>	<input type="text" value="D D / M M / Y Y"/>
4.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="h h : m m"/> <small>24hr</small>	<input type="text" value="D D / M M / Y Y"/>
5.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="h h : m m"/> <small>24hr</small>	<input type="text" value="D D / M M / Y Y"/>

**5.3 If COVID-19 positive, did the baby have any signs?**Yes  No 

If Yes, date of onset of signs of COVID-19

**5.4 If COVID-19 positive, did the baby have immediate family or close contacts with sign/symptoms of COVID-19 when diagnosed?**Yes  No  Unsure 

If Yes, who? \_\_\_\_\_

**5.5 If COVID-19 positive, do you think the baby acquired this in hospital (nosocomial)?**Yes  No **5.6 Reason for admission** \_\_\_\_\_

**5.7 Did the baby have any of the following signs? (Please tick Yes/No/Not Known)**

	Yes	No	Not known
Hyperthermia (>37.5°C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hypothermia (<36.5°C)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Apnoea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coryza	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tachypnoea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Respiratory distress/recession	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oxygen requirement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lethargy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hypotonia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Seizures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Poor feeding/vomiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diarrhoea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hypoglycaemia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rash	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Asymptomatic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If Other, please specify: \_\_\_\_\_

**5.8 Other key investigations (use first result from point of suspicion/diagnosis of COVID-19 or following admission related to COVID-19)**

Chest X-Ray performed? Yes  No  Date

Findings: Normal  Pneumonia  Ground glass

If Other, please state: \_\_\_\_\_

Blood tests performed:

	Positive	Date taken
Haemoglobin _____ (g/L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
WBC _____ (10 <sup>9</sup> /L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
Neutrophils _____ (10 <sup>9</sup> /L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
Lymphocytes _____ (10 <sup>9</sup> /L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
Platelets _____ (10 <sup>9</sup> /L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
ALT _____ (U/L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
CRP _____ (mg/L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>
Lactate _____ (mmol/L)	<input type="checkbox"/>	<input type="text" value="DD"/> <input type="text" value="MM"/> <input type="text" value="YY"/>

If Other, please specify: \_\_\_\_\_



## Section 6: Other diagnoses and investigations

6.1 Did the baby have any major congenital abnormalities? Yes  No  Not known

If Yes, please provide details: \_\_\_\_\_

6.2 Was neuroimaging performed? Yes  No (Go to Qu. 6.3)  Not known

If Yes, were any of the following identified? If Yes, please state modality and date first identified:

Finding	Modality	Date first identified
Normal	Cr USS <input type="checkbox"/> MRI <input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Grade I/II IVH	Cr USS <input type="checkbox"/> MRI <input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Grade III/IV IVH	Cr USS <input type="checkbox"/> MRI <input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Cystic periventricular leukomalacia (PVL)	Cr USS <input type="checkbox"/> MRI <input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Hypoxic-ischaemic injury	Cr USS <input type="checkbox"/> MRI <input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Congenital structural anomaly	Cr USS <input type="checkbox"/> MRI <input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY

6.3 Please indicate if any of the following tests were performed:

	Yes	No	Date	Result
EEG or CFAM:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	Normal <input type="checkbox"/> Seizures <input type="checkbox"/> Other: _____
Echocardiogram:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	_____

## Section 7: Treatment/management of infant **Only for infants who are COVID-19 positive**

7.1 Please indicate if any of the following treatments were given for the treatment of COVID-19 (Please tick Yes/No/Not Known)

	Yes	No	Not known	Start date	End date
Oxygen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Non-invasive ventilation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Invasive ventilation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
HFOV	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Nitric oxide	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
Therapeutic hypothermia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY
ECMO	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY	<input type="text"/> DD / <input type="text"/> MM / <input type="text"/> YY

**7.2 Please indicate if any of the following treatments were given at the time of COVID-19 infection: (Please tick Yes/No)**

	Yes	No	Start date	Name of medication(s)
Antibiotics	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="DD/MM/YY"/>	_____
Antivirals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="DD/MM/YY"/>	_____
Postnatal steroids	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="DD/MM/YY"/>	_____
Anti-arrhythmic treatment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="DD/MM/YY"/>	_____
Immunoglobulin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="DD/MM/YY"/>	Not applicable
Other experimental therapy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="text" value="DD/MM/YY"/>	_____

**7.3 Do you think COVID 19 was predominantly responsible or significantly contributed to this neonates illness?**

Yes  No

## Section 8: Outcome of infant

**8.1 What was the final outcome? (Please tick all that apply)**

	Date of event	
Discharged home:	<input type="checkbox"/> <input type="text" value="DD/MM/YY"/>	
Transferred (e.g. another hospital):	<input type="checkbox"/> <input type="text" value="DD/MM/YY"/>	
Still admitted:	<input type="checkbox"/> <input type="text" value="DD/MM/YY"/>	<i>Questionnaire completed</i>
Died:	<input type="checkbox"/> <input type="text" value="DD/MM/YY"/>	
Not known:	<input type="checkbox"/> Not applicable	<i>Questionnaire completed</i>

**8.2 If discharged home, please indicate if any of the following are continued on discharge.**

	Yes	No	Not known
Home oxygen:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Home pressure ventilatory support (CPAP or IPPV):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
For palliation:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Community nursing:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>If discharged home, please indicate if any of the following follow up are organised.</b>			
Follow up in clinic:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**8.3 If transferred, location transferred to:** \_\_\_\_\_

**8.4 If baby died, was a post-mortem (PM) performed?** Yes  No

**If Yes, was evidence of COVID-19 infection found on PM?** Yes  No

Please give brief details: \_\_\_\_\_

### Thank you for taking the time to complete the Questionnaire

Please return the completed form via NHS.net email to:

[orh-tr.mbrance@nhs.net](mailto:orh-tr.mbrance@nhs.net)

Telephone: 01865 289733

### Appendix A: Coding for Ethnic Group (ONS 2011 for UK wide data collection)

	Ethnicity Code	
<b>A White</b>	1	English / Welsh / Scottish / Northern Irish / British
	2	Irish
	3	Gypsy or Irish Traveller
	4	Any other White background, please write <i>in Section B/C</i>
<b>B Mixed/ Multiple Ethnic Groups</b>	5	White and Black Caribbean
	6	White and Black African
	7	White and Asian
	8	Any other Mixed / Multiple ethnic background, please write <i>in Section B/C</i>
<b>C Asian / Asian British</b>	9	Indian
	10	Pakistani
	11	Bangladeshi
	12	Chinese
	13	Any other Asian background, please write <i>in Section B/C</i>
<b>D Black / African / Caribbean / Black British</b>	14	African
	15	Caribbean
	16	Any other Black / African / Caribbean background, please write <i>in Section B/C</i>
<b>E Other ethnic group</b>	17	Arab

