

Practical considerations for the emergency delivery of babies from mothers with confirmed or suspected COVID-19

Maternity and neonatal departments must be prepared for the delivery of babies from COVID-19 positive women. We describe a guideline developed at the North Middlesex University Hospital maternity unit, for multidisciplinary team members attending an emergency caesarean section of mothers with confirmed or suspected COVID-19. Anticipated staff actions and personal protective equipment were considered to optimise staff safety and reduce transmission of SARS-CoV-2. We recommend units generate individualised guidance suitable to their settings.

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Keywords

COVID-19; emergency caesarean section; vaginal delivery; personal protective equipment; infection control; aerosol generating procedure

Key points

Wells P, Taylor A, Battersby C, Singh C. Practical considerations for the emergency delivery of babies from mothers with confirmed or suspected COVID-19. *Infant* 2020; 16(3): 94-98.

1. Healthcare staff must be prepared for the delivery of babies from COVID-19 positive women.
2. Preparations should include planning of logistical steps to prevent transmission of the virus.

The SARS-CoV-2 virus global outbreak has resulted in a significant challenge to healthcare systems globally. Clinical presentation ranges from asymptomatic to severe coronavirus disease 2019 (COVID-19) pneumonia, respiratory failure and death.^{1,2} More severe symptoms are widely described in those populations who have long-term conditions, are older and the immunocompromised.^{1,2} The morbidity in children and neonates is currently believed to be very minimal.³ Pregnancy alters the body's immune system and it is known from experience with other viruses that this can result in more severe symptoms, particularly towards the end of pregnancy.⁴ As of the end of April 2020 the UK had 177,454 confirmed cases and 27,510 deaths.⁵ Over 700,000 births are recorded each year in the UK.⁶ It is likely that at least some of these deliveries will be affected by the SARS-CoV-2 virus.

Evidence relating to the effect of SARS-CoV-2 viral infection on the mother and fetus is currently evolving. In a recent rapid review by Mullins et al, of the 32 pregnant women affected with COVID-19, only two women (6%) required care in the intensive care unit; however, strikingly 47% (n=15) resulted in preterm delivery.⁷ The question of vertical transmission remains unanswered. Evidence is lacking and although in a small cohort the SARS-CoV-2 virus was not detected in amniotic fluid, cord blood, breast milk and neonatal throat swabs,⁸ there are some indications that vertical transmission may occur. In two separate reports from China, a total of three babies born to mothers affected by COVID-19 were found to have a raised SARS-CoV-2 IgM after delivery, despite a negative real-time reverse transcriptase-polymerase chain reaction (RT-PCR) nasal pharyngeal swab for SARS-CoV-2.⁹⁻¹¹

| | PPE requirement for maternity wards | | High risk PPE |
|---------------------------|---|--|---|
| | Non AGP close contact PPE | Non AGP clinical area PPE | |
| Definition | Direct patient contact (within 2m) of a patient with confirmed/possible COVID-19 | Clinical area but no direct patient contact (within 2m) | Used when conducting an AGP or in an acute care area where AGP are being conducted |
| Required equipment | Disposable gloves Disposable plastic apron Fluid resistant (type IIR) surgical mask Eye protection | Fluid resistant (type IIR) surgical mask +/- Eye protection (risk assessment) | Disposable gloves Long sleeved disposable plastic gown Filtering face piece (class 3) Eye protection |

TABLE 1 Recommended PPE, adapted from advice by Public Health England.^{14,15}

- Intubation, extubation and related procedures
- Manual ventilation
- Open suctioning of the respiratory tract (including the upper respiratory tract)
- Less invasive administration of surfactant (LISA)
- Tracheotomy/tracheostomy procedures (insertion/open suctioning/removal)
- Non-invasive ventilation (NIV), eg bi-level positive airway pressure ventilation (BiPAP) and continuous positive airway pressure (CPAP)
- High frequency oscillatory ventilation (HFOV)
- High flow nasal oxygen (HFNO)

FIGURE 1 Aerosol generating procedures, compiled from RCPCH guidance.³

Furthermore there are reports of neonates testing RT-PCR nasal pharyngeal swab positive for SARS-CoV-2 within a week of delivery.¹²

Maternity and neonatal departments must be prepared for the delivery of babies from COVID-19 positive women. Healthcare staff looking after such patients are at risk of contracting SARS-CoV-2. It is therefore vital that preparations include the planning and adoption of management steps to prevent transmission of virus to healthcare workers present at the delivery and, potentially, to the baby.

The transmission of SARS-CoV-2 is thought to occur largely via respiratory droplets generated by coughing or sneezing or through contact with a contaminated surface.¹³ The current guidance by Public Health England (PHE) indicates different personal protective equipment (PPE) should be worn by staff managing patients with suspected or confirmed COVID-19 in different settings (TABLE 1).¹⁴ Endotracheal intubation for general anaesthesia (GA) at an emergency caesarean section (CS) as well as intubation of the newborn and positive pressure ventilation are considered aerosol generating procedures (AGP) and carry a higher risk of transmission of infection (FIGURE 1).^{3,5,14}

Intrapartum care and the safe delivery of babies involves multiple teams and a large number of personnel. Maintaining stringent infection control procedures in such emergencies, to protect staff and patients, is a logistical challenge that requires prior consideration to minimise exposure. In addition to appropriate PPE,

| Department | Individual | Role | PPE required |
|-----------------------|-----------------------------------|---|---|
| Anaesthetics | Anaesthetic doctor 1 | Intubation | High risk PPE |
| | Anaesthetic doctor 2 | Assist if needed | Non-AGP clinical area PPE Might require high risk PPE |
| | Operating department practitioner | Assist | High risk PPE |
| | Runner | Runner outside theatre | Non-AGP clinical area PPE |
| Theatres | Scrub nurse | Prepare theatre Assist operation | High risk PPE + scrubbed |
| | Runner | Prepare donning/ doffing area Pass cord gases and placenta to dirty sluice/ Midwife 1 | High risk PPE |
| Obstetrics | Obstetric doctor 1 | Perform CS | High risk PPE + scrubbed |
| | Obstetric doctor 2 | Assist CS Take cord gases | High risk PPE + scrubbed |
| Midwifery | Midwife 1 | Transfer of patient Run cord gases Check placenta | Non-AGP close contact PPE |
| | Midwife 2 | Prepare theatre checklist Assist Midwife 1 | Non-AGP close contact PPE |
| | Runner | Transfer assist/back up | Non-AGP clinical area PPE |
| Neonatology | Neonatal doctor 1 | Resuscitation and intubation | High risk PPE |
| | Neonatal doctor 2 | Assist if needed | Non-AGP clinical area PPE Might require high risk PPE |
| | Neonatal doctor 3 | Runner Transfer of patient | Non-AGP close contact PPE Might require high risk PPE |
| | Neonatal nurse 1 | Assist resuscitation and intubation | High risk PPE |
| | Neonatal nurse 2 | Transfer assist/back up | Non-AGP close contact PPE |
| Totals | | | |
| Staff required | 16 | PPE required | X3 High risk PPE + scrubbed X5 High risk PPE X8 Non-AGP PPE |
| | | Minimum spare PPE | X3 High risk PPE |

TABLE 2 Staff required for emergency CS alongside anticipated role and required PPE. Contact team members (shaded yellow) are those present within theatre during a CS. Non-contact team members (shaded pink) facilitate actions outside of the theatre. Other team members may be required to join the contact team where necessary (shaded green).

it is also important for 'contact' and 'non-contact' members of staff to be identified. These non-contact team members are important to facilitate actions outside of the delivery room to minimise movement to and from the delivery room, and reduce risk of transmission.

Methods

The North Middlesex University Hospital recognised the need for a pathway for deliveries of COVID-19 positive mothers. We consulted the most up-to-date guidance published by PHE, the Royal

| Timeline | Midwifery team | Obstetric team | Anaesthetic team | Theatre team | Neonatal team |
|--|--|---|--------------------------|---|--|
| Admission to maternity - suspected or confirmed COVID-19 | Inform neonatal team | Clinical review of patient and individualised decision | | | Consider need to counsel |
| Decision to perform emergency CS | | | | | |
| 1) | Locate PPE for all members of staff in CS Leave additional PPE outside theatre Complete theatre checklist Ensure patient catheterised | Consent patient Inform neonatal team, theatre staff and anaesthetic team | | | Discuss with nurse in-charge and on call consultant Identify isolation room available Identify contact and non-contact team members |
| 2) | Move cot to theatre and set up with sterile sheet | | Prepare anaesthetic plan | Prep theatre Set up donning areas Set up doffing area in dirty sluice | Set up resuscitaire and saturation monitor in prep room Bring in temporary grab bag Leave neonatal transport incubator and main grab bag outside prep room |
| 3) | | Scrub and don PPE Wait in corner of theatre | Don PPE | Don PPE +/- scrub Scrubbed: wait in corner of theatre Non-scrubbed: wait in prep room | Contact team: don PPE and wait in prep room Non-contact team: don PPE and assemble outside prep room |
| Confirm ready for patient in theatre | | | | | |
| 4) | Clear corridor and hold doors open Move patient to theatre Transfer mum to theatre bed | | | | |
| 5) | Clear corridor and hold doors open Return bed to patient's room | | Assess patient | | |
| 6) | Ensure all non-contact team members present outside theatre | Prep room team return to theatre Plan where patient will recover + members of staff required | | | |
| WHO surgical checklist | | | | | |
| 7) | | Prep room team return to prep room | | | |
| 8) | | | Anaesthesia | | |
| 9) | | Prep room team (excluding neonatal team) return to theatre | | | |
| Perform CS | | | | | |
| 10) | | Deliver baby | | Move baby in cot to prep room | Resuscitation as required |
| 11) | | Deliver placenta | | | |
| 12) | | Take cord gases | | Pass placenta and cord gases to dirty sluice for midwife 1 waiting outside theatre | |

TABLE 3 Timeline of anticipated team movements and decisions during an emergency CS. *Continues on the next page.*

| Timeline | Midwifery team | Obstetric team | Anaesthetic team | Theatre team | Neonatal team |
|--|--|---|------------------|--------------|---|
| 13) | Take placenta and run cord gases Consider sending placenta Pass cord gas result into prep room | | | | Decide whether baby requires NNU admission If admitting, arrange transfer of baby to 'clean' non-contact outer neonatal team 'Dirty' saturation monitor to be placed in incubator |
| CS completed | | | | | |
| 14) | | Recovery plan as decided earlier Staff not required for recovery to doff in dirty sluice and leave If AGP took place must wait 20 minutes prior to transfer | | | |
| Patient safe for transfer back to room | | | | | |
| 15) | Clear corridor and hold doors open Move patient's bed to theatre | Transfer patient to her bed | | | If admitting: clear corridor, hold doors open Move incubator to NNU Contact team to doff in dirty sluice and leave |
| 16) | Clear corridor and hold doors open Return patient to her room - with baby if staying with mum | Doff PPE in dirty sluice Arrange urgent 'amber clean' (if AGP took place, wait 20 minutes post procedure before cleaning) | | | If admitting: NNU admitting nurse to be donned and ready to receive the baby in isolation room |

College of Obstetricians and Gynaecologists (RCOG), the Royal College of Paediatrics and Child Health (RCPCH) and the British Association of Perinatal Medicine (BAPM).^{3,4,13,14} The guidance was applied to a draft practical pathway for emergency CS. Revisions were made following feedback from simulations with the multidisciplinary team and consultation with our local infection control team. Further modifications were incorporated as guidance from PHE, RCOG, RCPCH and BAPM evolved and subsequent statements were released by the UK Resuscitation Council.¹⁵

Practical guidance

The required personnel from five different teams and appropriate PPE for each member of the team were considered. The obstetric theatre layout was considered (**FIGURE 2A**). Neonatal resuscitation was designated to occur in a sideroom, termed the prep room. This was agreed so that staff exposure to AGP completed on the mother or the baby would be minimised. The PPE 'donning' area was designated as inside theatre or the prep room prior to patient arrival. The PPE 'doffing' area was identified as the dirty sluice, given it was an anteroom containing a sink.

The emergency CS was divided into 16

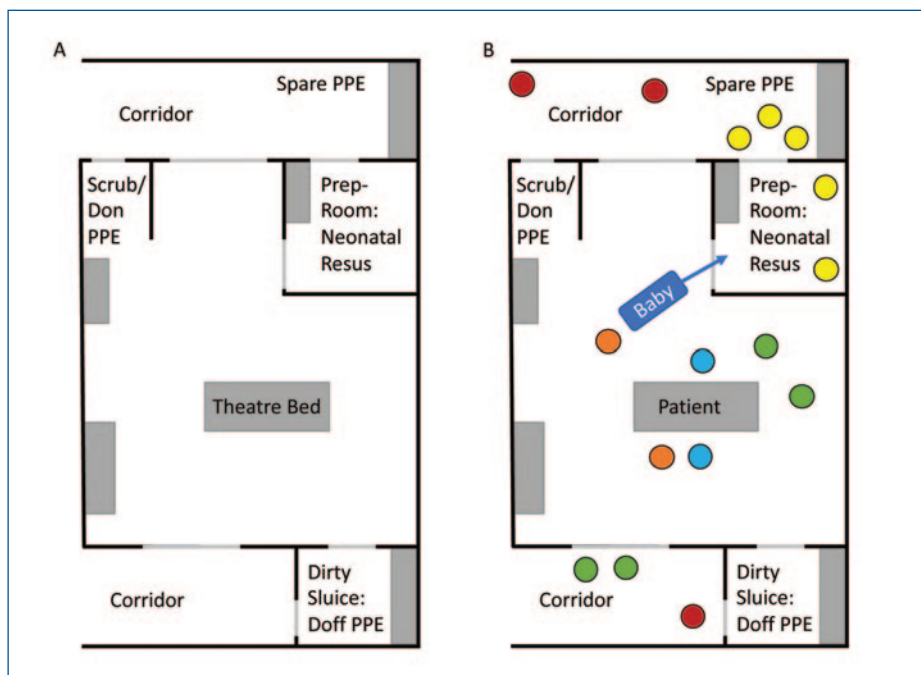


FIGURE 2 Theatre layout. A) Theatre layout and areas designated for donning PPE, doffing PPE, keeping spare PPE and neonatal resuscitation. B) Demonstration of team positions during emergency CS prior to delivery of baby. Key: red=midwifery, yellow=neonatology, green=anaesthetics, blue=obstetrics, orange=theatre staff.

key steps and key roles of team members were identified. High risk PPE and infection control measures are crucial and anticipated staff actions and location were designated to help minimise transmission (**FIGURE 2B, TABLES 2 and 3**). Individual emergency cards were produced for each

staff member involved, documenting their responsibilities, considerations and anticipated PPE (**FIGURE 3**).

Similar guidance was generated for CS under spinal anaesthetic and vaginal delivery requiring neonatal presence (available on request from the authors).

Neonatal resuscitation and commonly used interventions such as suction, and endotracheal intubation are considered AGPs (**FIGURE 1**). Although evidence for vertical transmission is not currently conclusive, the recommendation is that the neonatal team should wear AGP PPE during neonatal resuscitation, or if within 2m of neonatal resuscitation to optimise staff safety and minimise interruption to the resuscitation.^{3,15}

Conclusion

Maternity areas have a high flow of patients and more mothers with COVID-19 should be anticipated in light of the ongoing pandemic. Multiple professionals from various teams are involved in the safe delivery of babies from pregnant mothers. An emergency CS is a high intensity event with multiple clinical and practical considerations for reducing transmission of SARS-CoV-2, for patient and staff. This guidance was generated to provide a clear framework for multidisciplinary team members and has been useful at the North Middlesex University Hospital maternity unit. The authors recommend that all units should develop their own individualised guidance based on theatre and building layout, staffing, skill mix and PPE availability. The areas to be used for donning and doffing of PPE, neonatal resuscitation, and the number of staff required should be planned prior to the event. Simulations of different scenarios is crucial in ensuring local logistics are considered and to familiarise staff with additional PPE considerations.

Contributions and conflict of interest

PW, AT, CS: involved in development and implementation of guideline at North Middlesex University Hospital.
CB: critical review of article.
No conflicts of interest to declare.

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Neonatal doctor 1 (most senior/confident neonatologist present)

Key roles

- Counsel mother
- Lead resuscitation/stabilisation – intubate if required
- Decide whether baby requires admission
- Assist transfer of baby into transport incubator

PPE required

High risk PPE

Don in prep room, doff in dirty sluice

Considerations

- Minimise staff exposure during resuscitation
- Minimise staff exposure post stabilisation, eg if baby required antibiotics but not NNU admission this should be done in theatre by staff already present

Neonatal nurse 1

Key roles

- Identify available isolation room on NNU
- Leave transport incubator and emergency bag outside prep room
- Assist resuscitation/stabilisation
- Assist transfer of baby into transport incubator

PPE required

High risk PPE

Don in prep room, doff in dirty sluice

Considerations

- Minimise staff exposure during resuscitation
- Equipment needed

FIGURE 3 An example of emergency personnel briefing cards.

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