Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

Coronavirus (COVID-19) Infection in Pregnancy

Information for healthcare professionals

Version 15: Published Monday 7 March 2022

RCPCH Royal College of Paediatrics and Child Health *Leading the way in Children's Health*

RCOA Royal College of Anaesthetists

Quick reference summary of acute COVID-19 care

Quick reference summary of acute COVID-19 care in pregnancy or up to 6 weeks postpartum (see section 6 for further detail)

Most common symptoms: cough; fever; dyspnoea; myalgia; sore throat
Risk factors for severe disease: high BMI (> 25 kg/m²), aged > 35 years; pre-existing comorbidity; Black, Asian or minority ethnicity

Initial assessment, taken in the context of risk factors (e.g. Black, Asian or minority ethnicity, BMI > 25 kg/m², age > 35 years, socioeconomic deprivation) and comorbidities

Does the woman fit the following criteria?
SpO_2 ≥ 94% with no desaturation on exertion, RR ≤ 20 breaths/min, HR < 110 bpm, and low clinical concern

Yes

Can be cared for in the community

Advise to stay well hydrated and mobile
Give safety net advice

Complete VTE risk assessment in line with RCOG Green-top Guideline No. 37a risk assessment tool.

Where normally indicated thromboprophylaxis should be offered.

NB:
- COVID-19 = transient risk factor 'current systemic infection'
- Those who are 'immobile, dehydrated' also score an additional transient risk factor point

Assessment
Is the patient:
< 28 weeks of gestation with a score ≥ 4
OR
≥ 28 weeks of gestation with a score of ≥ 3
OR
postpartum with a score of ≥ 2

No

Prophylactic LMWH not required at present

Yes

Prophylaxis should be offered in line with risk assessment tool

No

Admission to hospital required with appropriate isolation

Investigate:
1. Bloods: FBC. U&E, LFT, LDH, coagulation, ferritin, troponin, ABG
2. Specific investigations for anti-spike antibodies against SARS-CoV-2 if required for neutralising monoclonal antibody decisions
3. Consider ECG, ECHO, CT/CTPA, influenza testing

Consider sepsis
1. O_2 to Sats > 94%, monitoring RR and Sats hourly
2. IV access
3. Blood culture
4. IV antibiotics if additional bacterial infection likely
5. Cautious IV fluid (200–500 ml) if lactate > 2 mmol/l and reassess
6. Fluid balance monitoring

Severity of disease

Mild disease
Patients not requiring oxygen and no evidence of COVID-19 pneumonia or other sepsis

Moderate disease
Patients with COVID-19 pneumonia or other sepsis requiring oxygen

Severe disease
Patients with COVID-19 pneumonia or other sepsis requiring mechanical ventilation or CPAP

VTE prophylaxis

Require prophylactic dose LMWH during admission and 10 days post discharge (longer duration should be considered if persistent morbidity / limited mobility suspected)

Appropriate dosing regimen of LMWH should be discussed with the MDT, including a senior obstetrician and obstetric medicine or haematology team

Clinical management

- All women should receive MDT input, including for decisions around early delivery (+/– magnesium sulfate if required).
- Prompt escalation of care is imperative in a deteriorating patient.

- Use supplementary oxygen where required to maintain saturations > 94%.
- Consider proning up to at least 28 weeks if required, with appropriate padding. Consider left lateral position if hypotensive.
- Consider continuing any previously prescribed prophylactic aspirin for pre-eclampsia prophylaxis unless platelets < 50 × 10^9/l.
- Aim neutral fluid balance.
- Women requiring oxygen should receive steroids with proton pump inhibitor cover:
  - Steroids not required for preterm delivery: oral prednisolone 40 mg once daily or IV hydrocortisone 80 mg twice daily. Methylprednisolone also an option.
  - Steroids required for preterm delivery: intramuscular dexamethasone 12 mg twice 24 hours apart, then continue prednisolone.

- Use tocilizumab or sarilumab in women with hypoxia (oxygen < 92% on air or requiring oxygen therapy) and CRP > 75.
- Neutralising monoclonal antibodies should be considered in women who are hospitalised with symptomatic infection who do not have SARS-CoV-2 antibodies (e.g Ronapreve® IV) or who are in the community and who have very high risk factors (e.g. sotrovimab)
- Remdesivir should only be considered for those who are not improving, or who are deteriorating.

- Ivermectin should only be considered within the context of a clinical trial.
- Molnupiravir is not recommended in pregnancy until further studies has established its effectiveness and safety.
- Azithromycin, hydroxychloroquine and lopinavir / ritonavir have been shown to be ineffective and should not be used.

Approach to clinical management
(adapted with permission from M Nana and C Nelson-Piercy, and modified with additions from Bart's NHS Trust with permission from K Wiles)

BMI, body–mass index; SpO2, oxygen saturation; RR, respiratory rate; HR, heart rate; FBC, full blood count; U&E, urea and electrolytes; LFT, liver function test; LDH, lactate dehydrogenase; ABG, arterial blood gases; ECG, electrocardiogram; ECHO, echocardiogram; CTPA, computed tomography (CT) pulmonary angiogram; IV, intravenous; CPAP, continuous positive airway pressure; VTE, venous thromboembolism; LMWH, low-molecular weight heparin; MDT, multidisciplinary team; CRP, C-reactive protein.

Contents

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

Executive summary

Executive summary

Background and epidemiology

- Pregnant women appear no more or less likely to contract SARS-CoV-2 than the general population, and more than two-thirds of identified pregnant women have no symptoms. The most common symptoms of COVID-19 in pregnant women are cough, fever, sore throat, dyspnoea, myalgia and loss of sense of taste.
- There is growing evidence that pregnant women may be at increased risk of severe illness from COVID-19 compared with non-pregnant women, particularly in the third trimester. The overall risk of death remains very low.
- Risk factors associated both with being infected and hospitalised with COVID-19 include being unvaccinated, Black, Asian and minority ethnic backgrounds, having a body–mass index above 25 kg/m^2, having a pre-pregnancy co-morbidity, (e.g. diabetes or hypertension), a maternal age of 35 years or older, living in increased socioeconomic deprivation, and working in healthcare or other public-facing occupations.
- The Delta variant seems to be associated with more severe disease: 1:10 of symptomatic women admitted to hospital with the Alpha variant needed admission to intensive care whereas this is 1:7 for symptomatic women with the Delta variant.
- The Omicron variant may be associated with less severe disease than the Delta variant, but it is more infectious, and it is still likely to be associated with adverse maternal and neonatal outcomes, especially in pregnant women who are unvaccinated.
- There is no reported increase in congenital anomalies incidence because of COVID-19 infection. Vertical transmission is uncommon.
- Maternal COVID-19 infection is associated with an approximately doubled risk of stillbirth and may be associated with an increased incidence of small-for-gestational age babies. The preterm birth rate in women with symptomatic COVID-19 appears to be two to three times higher than the background rate; these are primarily iatrogenic preterm births.
- Higher rates of perinatal mental health disorders have been reported during the pandemic, including anxiety and depression.

Vaccination

- Vaccination in pregnancy against COVID-19 is strongly recommended and pregnant women are a priority group for vaccination.
- There is no evidence to suggest that COVID-19 vaccines affect fertility. Women planning a pregnancy or fertility treatment can receive a COVID-19 vaccine and do not need to delay conception.
- More than 347 150 women in the UK and USA have had a COVID-19 vaccine in pregnancy with no concerning safety signals. There is excellent real-world evidence of vaccine efficacy with 98% of women admitted to hospital and getting severe infection having not had the vaccine.

- Those who have had two doses and a booster (or three doses) of a vaccine are 88% less likely to be admitted to hospital with the Omicron variant than those who have not been vaccinated.
- Two vaccine doses alone are less effective than two doses and a booster against the Omicron variant, and women are advised to receive a booster dose.
- COVID-19 vaccines can be given at any time in pregnancy, including periconception, the first trimester, peri-birth and postpartum; this also includes after an uncomplicated assisted birth or caesarean birth. In pregnancy, the preference is to offer the Pfizer-BioNTech or Moderna vaccines.
- Pregnant women receiving a COVID-19 vaccine show similar patterns of reporting for common minor adverse effects to non-pregnant people. The rare syndrome of vaccine-induced thrombosis and thrombocytopenia (VITT) has been reported after the Oxford-AstraZeneca and the Janssen vaccines. It is an idiosyncratic reaction not associated with any of the usual venous thromboembolism risk factors. There is no evidence that pregnant or postpartum women are at higher risk of VITT than non-pregnant age-matched women.
- Breastfeeding women can receive a COVID-19 vaccine without having to stop breastfeeding.

Antenatal care

- The National Institute for Health and Care Excellence recommended schedule of antenatal care should be offered in full wherever possible.
- Healthcare providers should be aware of the increased risk of domestic abuse in pregnancy, which has escalated during the pandemic.
- There is evidence that the pandemic has resulted in a greater level of anxiety and other mental health problems in pregnant women compared to the overall population. Women should be asked about their mental health at every contact.
- Women who have been seriously or critically unwell from COVID-19 should be offered an ultrasound scan to assess the fetal biometry. It seems reasonable to arrange the first scan within the first 14 days following recovery and to consider further ultrasound monitoring on an individual basis.

Venous thromboembolism

- All pregnant women admitted with confirmed or suspected COVID-19 should be offered prophylactic low molecular weight heparin, unless birth is expected within 12 hours or there is significant risk of haemorrhage. The dose may need to be individualised for women with severe complications of COVID-19.
- All women who have been hospitalised and have had confirmed COVID-19 in pregnancy, or up to 6 weeks postpartum, should be offered thromboprophylaxis for at least 10 days following hospital discharge. A longer duration of thromboprophylaxis should be considered for women with persistent morbidity.

Labour and birth

- In women with symptomatic COVID-19, there may be an increased risk of fetal compromise in active labour and of caesarean birth. Women with symptomatic suspected or confirmed COVID-19 should be advised to labour and give birth in an obstetric unit with continuous electronic fetal monitoring. This is not required for asymptomatic infection.
- Senior obstetric and medical input for a woman with severe or critical COVID-19 should be sought, particularly for decision making about birth.
- The level of personal protective equipment (PPE) required by healthcare professionals caring for a woman with COVID-19 who is undergoing a caesarean birth should be determined by the risk of her requiring intubation for a general anaesthetic.
- Water birth is not contraindicated for women who are asymptomatic of COVID-19, providing adequate PPE can be worn by those providing care. Women with symptomatic COVID-19 should not labour or birth in water.

Clinical deterioration

- Chest imaging is essential for the evaluation of an unwell woman with COVID-19. It should be performed when indicated in pregnant women, and not delayed because of radiation exposure concerns.
- A woman's care should be escalated urgently if signs of decompensation develop. These signs include: increasing oxygen requirements or fraction of inspired oxygen (FiO_2) above 35%, increasing respiratory rate above 25 breaths/minutes or a rapidly rising respiratory rate despite oxygen therapy, a reduction in urine output, acute kidney injury or drowsiness.
- For unwell pregnant women in the third trimester, an individualised assessment should be undertaken by a multidisciplinary team to decide if maternal stabilisation is required before delivery can be undertaken safely. Following this, decisions concerning emergency caesarean birth or induction of labour should be prioritised, either to facilitate maternal resuscitation (including the need for prone positioning) or because of concerns regarding fetal health.
- Aspirin may be beneficial for adults with severe COVID-19. This potential benefit must be weighed up against the increased risk of major bleeding events but, in those who have been taking prophylactic aspirin in pregnancy, it seems reasonable for this to be continued. COVID-19 can be associated with thrombocytopenia, however, and aspirin should be discontinued if the platelet level is less than 50×10^9/l.
- Oxygen should be titrated to ensure saturations of 94–98% using escalation through nasal cannula, face mask, venturi mask, non-rebreather mask, non-invasive positive airway pressure (e.g. continuous positive airway pressure [CPAP]), intubation and intermittent positive-pressure ventilation (IPPV), and extracorporeal membrane oxygenation (ECMO) as appropriate.

- Caution should be applied to fluid balance and intravenous (IV) fluid management. Hourly fluid input/output charts should be recorded in women with moderate to severe symptoms of COVID-19, aiming to maintain a neutral fluid balance in labour. When required, fluid boluses in volumes of 250–500 ml may be employed.
- Corticosteroid therapy should be given for 10 days or up to discharge, whichever is sooner, for women who are unwell with COVID-19 and requiring oxygen or ventilatory support. If steroids are not indicated for fetal lung maturity, treatment should be with oral prednisolone 40 mg once a day, or IV hydrocortisone 80 mg twice daily, for 10 days or until discharge, whichever is sooner. If steroids are indicated for fetal lung maturity, prescribe intramuscular dexamethasone 12 mg twice (24 hours apart), immediately followed by oral prednisolone 40 mg once a day, or IV hydrocortisone 80 mg twice daily, to complete a total of 10 days or until discharge, whichever is sooner. IV methylprednisolone is an alternative especially for intensive care units more familiar with this preparation.
- Tocilizumab (interleukin-6 receptor antagonist) has been shown to improve outcomes, including survival, in hospitalised patients with hypoxia and evidence of systemic inflammation (C-reactive protein at or above 75 mg/l).
- Strongly consider treatment with monoclonal antibodies in pregnant and breastfeeding women who are unwell in hospital settings, particularly if they are unvaccinated and/or have additional risk factors for severe illness. Monoclonal antibodies are also recommended for those in the community who meet specific very high-risk criteria.
- Remdesivir should only be considered in pregnant women with COVID-19 who are not improving or who are deteriorating.
- Hydroxychloroquine, lopinavir/ritonavir and azithromycin should not be used as they are ineffective for treating COVID-19 infection. Molnupiravir is also not recommended in pregnancy until further studies have established its efficacy and safety.

Postnatal care

- National guidelines for routine postnatal care should be followed
- Women should be informed that COVID-19 infection is not a contraindication to breastfeeding.

Coronavirus (COVID-19) Infection in Pregnancy – Summary of updates

Version	Date	Summary of changes
15.0	07/03/2022	Full review of the literature and recommendations since Omicron including epidemiology, disease severity and vaccine effectiveness. **Section 1.5** Recognition that being non-vaccinated is a risk factor for adverse outcome with COVID-19 in pregnancy. **Section 2.2** Acknowledgement that pregnant women are a priority group for vaccination. **Section 6.2** Change in recommendation for those taking prophylactic aspirin to continue unless maternal platelets are low. **Section 6.3** Updates on neutralising monoclonal antibodies in hospital and community. **Sections 1.6, 3.4** and **6.1** Discussion about coagulopathy in COVID-19 as related to pregnancy. **Sections 1.6, 3.4** and **6.1** Recognition of placental pathology in COVID-19 and its potential for adverse perinatal outcome. **Section 7.3** Update around access to neonatal care units for women and birth partners who are COVID-19 positive. **Appendix III:** Update of key studies and references, as well as meta-analyses.

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

1. Purpose and scope

1. Purpose and scope

This document aims to provide guidance to healthcare professionals who care for pregnant women during the COVID-19 pandemic. It is not intended to replace existing clinical guidelines, but to act as a supplement with additional advice on how to implement standard practice during this time.

The advice in this document is provided as a resource for UK healthcare professionals based on a combination of available evidence, good practice and expert consensus opinion. The guidance may also be relevant to other healthcare systems but may need to be adapted for the local environment.

The priorities on which this guideline is based are:

- The provision of safe, personalised and woman-centred care to pregnant and postnatal women with suspected or confirmed COVID-19.
- The provision of safe, personalised and woman-centred care during pregnancy, birth and the early postnatal period, during the COVID-19 pandemic.
- The reduction of transmission of SARS-CoV-2 to pregnant women, their family members and healthcare workers.

This guidance is under regular review and updated as new information and evidence emerges. Owing to the changing prevalence of COVID-19 infections in the UK, changes in care should be proportionate to the background prevalence at a given time. Decision-making around care and discussions about risks and benefits will depend on the background prevalence of the COVID-19 viral infection and the vaccination status of the woman. Updated advice and information will be published in the Coronavirus (COVID-19), pregnancy and women's health section of the Royal College of Obstetricians and Gynaecologists (RCOG) website.

Information for pregnant women and their families is available in question-and-answer format, with accompanying videos, on the RCOG and Royal College of Midwives (RCM) COVID-19 hubs.

Within this document we use the terms 'pregnant woman' and women's health. However, it is important to acknowledge that it is not only people who identify as women for whom it is necessary to access care. Obstetrics and gynaecology services, and delivery of care, must therefore be appropriate, inclusive, and sensitive to the needs of those individuals whose gender identity does not align with the sex they were assigned at birth.

1.1 Identification and assessment of evidence

This guidance has been developed by a multidisciplinary group using the best available evidence retrieved by fortnightly literature reviews undertaken by a member of the RCOG Library team.

Owing to the relatively recent emergence of COVID-19 and the evolving nature of the pandemic, highest level evidence is often lacking. Using a conventional grading system for guideline development, such as SIGN,[1] many of the studies would be classed as level 3 or 4 (non-analytical studies, e.g. case series/reports), with a few studies being classed as level 2– or 2+ (case control or cohort studies with high or low risk of bias respectively), with a few studies being classed as level 2++ (systematic reviews of high quality observational studies) and therefore mostly graded C. Much of the guidance, however, would be graded D (good practice points based on expert opinion). Furthermore, where randomised trials have been undertaken, such as to investigate therapeutic interventions in severe COVID-19, most of the trial participants were not pregnant. Healthcare providers, women and their families are advised to be aware of the low-quality evidence on which the advice is given when using this guidance to assist decision making.

For a more detailed description of the methods used to develop this guidance please see Appendix II.

1.2 Epidemiology

SARS-CoV-2 is the strain of coronavirus which causes COVID-19. It was first identified in Wuhan City, China, towards the end of 2019.[2]

The diagnosis of COVID-19 can be made based on symptoms and known exposure, or simply from a positive test for SARS-CoV-2 in the absence of any symptoms. COVID-19 infection can therefore be symptomatic or asymptomatic.

As with all viruses, mutations can occur leading to the emergence of new strains. To date five of the new strains of the COVID-19 virus are of concern and have been termed the Alpha, Beta, Gamma, Delta and Omicron variants. These variants have specific traits which may include increased transmissibility or more severe disease. The Delta variant seems to be associated with more severe disease; 1:10 symptomatic women admitted to hospital with the Alpha variant needed admission to intensive care whereas this was 1:7 for symptomatic women with the Delta variant.[3]

The Omicron variant was first reported in the UK in November 2021 and, as of 31 December 2021, it is the most prevalent variant in the UK.[4,5] Owing to numerous mutations involving the spike protein, this variant has developed increased transmissibility compared with the Delta variant, rapidly becoming the predominant variant in many other countries.[2,6] Although the COVID-19 vaccines in use are effective against the Omicron variant, a booster dose is recommended to give 'top-up' protection against this new variant.

The World Health Organization (WHO) publishes a weekly international situation report with an additional Situation Dashboard to provide information for individual countries.[2] The UK Health Security Agency (UKHSA) dashboard details the total number of confirmed cases in the UK.[7]

For the most up-to-date advice please refer to health protection agency websites: for England, Wales, Scotland and Northern Ireland.

1.3 Transmission

Most global cases of COVID-19 have evidence of human-to-human transmission. The virus can be readily isolated from respiratory droplets or secretions, faeces and, to a lesser extent, fomites (objects). Transmission is known to occur most often through close contact with an infected person or, uncommonly, from contaminated surfaces. With regard to vertical transmission (transmission from woman to her baby antenatally or intrapartum), evidence now suggests that when vertical transmission does occur, it is uncommon.[8] If it does occur, it appears to not be affected by mode of birth, delayed cord clamping, skin-to-skin contact, method of feeding or whether the woman and baby stay together (rooming in).[9-17]

There is, however, good evidence of transplacental transmission of antibodies against COVID-19 following maternal infection. Several studies[18-21] have demonstrated the presence of immunoglobulin G (IgG) umbilical cord blood samples suggesting that passive immunity might be transferred to the neonate. IgG levels in cord blood have been reported to be higher with longer intervals between maternal infection and birth.[18,21] The duration of IgG antibody persistence, and whether this translates into passive immunity, is unknown.[18,21]

1.4 Effect of COVID-19 on pregnant women

1.4.1 Symptoms of COVID-19 in pregnant women

Key findings

- Pregnant women with no comorbidities do not appear any more or less likely to contract the infection than the general population.
- Pregnant women with comorbidities such as pre-existing diabetes, body–mass index (BMI) > 25 kg/m^2 and gestational diabetes on insulin are at increased risk of contracting SARS-CoV-2 infection.
- The majority of pregnant women who are infected with SARS-CoV-2 are asymptomatic.
- Most symptomatic women experience only mild or moderate cold/flu-like symptoms.
- The main symptoms of COVID-19 in pregnancy are cough, fever, sore throat, dyspnoea, myalgia, loss of sense of taste and diarrhoea.

Pregnant women do not appear to be any more or less likely to contract the infection than the general population.[22] The INTERCOVID multinational study of unvaccinated women,[23] however, has shown that pregnant women with pre-existing diabetes, obesity, and gestational

diabetes on insulin have significant increased chance of contracting SARS-CoV-2 infection compared with pregnant women without these comorbidities. Women with diabetes had nearly double the risk of SARS-CoV-2 infection (RR 1.94, 95% CI 1.55–2.42), those overweight and obese had a 20% increased risk (RR 1.20, 95% CI 1.06–1.37) and women who developed insulin-dependent gestational diabetes mellitus had an increased risk of SARS-CoV-2 infection (RR 1.79, 95% CI 1.06–3.01).[23]

The majority of pregnant women who are infected with SARS-CoV-2 are asymptomatic: the PregCOV-19 Systematic Review[24] reported on universal screening in pregnancy and found that an estimated 73% (95% CI 62–82) of women were asymptomatic, while another study[25] from the USA reported that 86% of women who were admitted in labour and who tested positive for SARS-CoV-2 were asymptomatic. Most symptomatic women experience only mild or moderate cold/flu-like symptoms.[26] The PregCOV-19 Systematic Review[24] included over 64 000 pregnant women worldwide with suspected or confirmed COVID-19. In this review the overall rate of COVID-19 diagnosis in pregnant and recently pregnant women attending or admitted to hospital for any reason was 10%. The most common symptoms of COVID-19 in pregnant women were cough (41%) and fever (40%). Less frequent symptoms were dyspnoea (14%), myalgia (15%), loss of sense of taste (11%) and diarrhoea (6%). Pregnant women with COVID-19 were less likely to have fever or myalgia than non-pregnant women of the same age. The PRIORITY (Pregnancy CoRonavirus Outcomes RegIsTry) study,[27] an ongoing prospective cohort study of pregnant women from the USA, found the most prevalent first symptoms in infected women were cough (20%), sore throat (16%), myalgia (12%) and fever (12%). In this group of 594 symptomatic women, one-quarter had persistent symptoms 8 or more weeks after onset.

At present, it is unclear whether pregnancy will impact on the proportion of women who develop prolonged signs and symptoms after an acute SARS-CoV-2 infection, (so-called 'long COVID' or post COVID-19 condition). The National Institute for Health and Care Excellence (NICE) has produced a rapid guideline outlining the care of individuals who develop long-term effects of COVID-19.[24,28]

The Omicron variant may be associated with less severe disease than the Delta variant, but it is more infectious, and it is still likely to be associated with adverse maternal and neonatal outcomes, especially in pregnant women who are unvaccinated.

1.4.2 Severe illness with COVID-19 in pregnant women

Key findings

- More than two-thirds of pregnant women with COVID-19 are asymptomatic.
- Compared to non-pregnant women with COVID-19, pregnant women with COVID-19:
    - have higher rates of intensive care unit (ICU) admission; this may reflect a lower threshold for admission to ICU, rather than more severe disease.

- have higher rates of ventilation and extracorporeal membrane oxygenation (ECMO).
- who require hospitalisation have overall worse maternal outcomes, including an increased risk of death, although the risk of death remains very low (the UK maternal mortality rate from COVID-19 is 2.4/100 000 maternities).

- Pregnant women may be at increased risk of complications in the third trimester when compared to earlier in pregnancy.

1.4.2.1 Frequency of severe illness in pregnant women

COVID-19 ranges from asymptomatic infection through to mild disease (no evidence of pneumonia or hypoxia), moderate disease (viral pneumonia), severe disease (severe pneumonia, e.g. with SpO_2 below 90% on room air) and critical disease (Acute Respiratory Distress Syndrome [ARDS], sepsis, septic shock, or complications such as pulmonary embolism or acute coronary syndrome).

Most of the data discussed below exploring the impact of COVID-19 infection on maternal and fetal outcomes are from studies when the Alpha variant was most prevalent. In addition, these studies are prior to the development of the COVID-19 vaccinations. There appears to be different levels of maternal and fetal outcomes, as well as variation in transmissibility, with subsequent variants.

The UK Obstetric Surveillance System (UKOSS) published its first report[29] on pregnant women admitted to hospital with confirmed COVID-19 in the UK on 8 June 2020, and an updated report[30] was published on 5 May 2021. The second report covered the period from 1 March–31 August 2020 and, during that time, 1148 hospitalised women had COVID-19 in pregnancy. Most (63%) of the women were symptomatic with COVID-19. This study, however, included many women from the initial wave of the pandemic when testing was only performed on symptomatic individuals. As testing for SARS-CoV-2 has become more routinely offered on admission to labour wards, the proportion of asymptomatic women is likely to have increased. Of the 1148 hospitalised pregnant women, 63 (5%) required critical care. During this time, eight women with symptomatic COVID-19 died in hospital. Two of the deaths were not related to COVID-19, whereas six deaths were, giving a maternal mortality rate of 2.2 hospitalised women per 100 000 maternities (95% CI 0.9–4.3). The second MBRRACE-UK Confidential Enquiries into Maternal Deaths report on SARS-CoV-2 related maternal deaths documented the period between 1 June 2020 and 31 March 2021.[31] MBRRACE methodology reviews the deaths of women occurring during pregnancy and up to 6 weeks after pregnancy, and the deaths of women that occur 6 weeks to 1 year after pregnancy. The estimated SARS-CoV-2 associated maternal mortality rate for this MBRRACE rapid review period is 2.4 per 100 000 (95% CI 1.3–4.0).

Severe illness, such as that requiring ICU admission, is relatively uncommon in women of reproductive age. However, there have been many studies reporting women with severe COVID-19 infection at the time of birth who received ventilation and ECMO,[32] and of maternal death.[33] In the PregCOV-19 Systematic Review Consortium analysis,[24] 0.02% (95% CI 0.00–0.42%) of pregnant women with confirmed COVID-19 were recorded as having died of any cause, and 0.2% (95% CI 0.0–0.7%) of pregnant women with COVID-19 required ECMO. A USA study[34] published in January 2021 compared outcomes for pregnant women with and without COVID-19 from April–November 2020, drawing the information retrospectively from a database that covers about 20% of the American population. Data were available for 406 446 women hospitalised for childbirth, 6380 (1.6%) of whom had COVID-19. In-hospital maternal death was rare, but rates were significantly higher for women with COVID-19 (141/100 000 women, 95% CI 65–268) than for women without COVID-19 (5/100 000 women, 95% CI 3.1–7.7).

A study was published in February 2021 with the results from two large COVID-19 in pregnancy registries.[35] The PAN-COVID registry recorded suspected or confirmed COVID-19 at any stage in pregnancy (in the UK and ten other countries), and the AAP SONPM registry recorded maternal COVID-19 around the time of birth (from 14 days before to 3 days after birth). Maternal mortality was uncommon in both registries: it occurred in 3/651 (0.46%) of women with confirmed COVID-19 in the PAN-COVID registry, and in 5/2398 women with COVID-19 (0.21%) in the AAP SONPM registry. For the UK data (PAN-COVID), as with other countries, the mortality rate may be inflated by under-reporting of women with asymptomatic or mild COVID-19 in pregnancy. The authors of this study[35] have postulated that only 10% of maternal COVID-19 infections were detected as cases, and the true infection fatality rate would therefore be ten times lower (i.e. 0.046%, which is close to the estimate of 0.03% for men and women aged 15–44 years in the UK REACT2 study[36]). These maternal mortality rates are higher than previously recorded maternal mortality rates in these populations – for example, the maternal deaths from the AAP SONPM registry equate to a perinatal maternal mortality rate of 167/100 000 (for women who have COVID-19 around the time of birth), compared with a pre-COVID rate of 17.3/100 000 in the USA. Moreover, COVID-19 was listed as the cause of death for all the maternal deaths in these registries where cause of death was known.

COVID-19 infection appears to be more common in later pregnancy. In the UKOSS study,[30] most women were hospitalised in the third trimester or peripartum (bearing in mind that admission at term to give birth will contribute to this distribution). Symptomatic COVID-19 was principally diagnosed in the third trimester: 83% of symptomatic women were diagnosed at or beyond 28 weeks, with 52% diagnosed at or beyond 37 weeks. The reason for hospital admission was known for a subset of pregnant women in the UKOSS study. For asymptomatic women, the reason for admission was principally to give birth (68%). For symptomatic women, the reasons for admission were roughly a third for symptomatic COVID-19, a third to give birth, and a third for other reasons.

The UK Intensive Care National Audit and Research Centre (ICNARC) has released two reports of patients admitted to intensive care with COVID-19.[37] The first report covered the start of 2020 up until 31 August 2020. During that time, a total of 70 women who were either currently or recently (within 6 weeks) pregnant were admitted to intensive care, representing 8.9% of all the 785 pregnant and non-pregnant women admitted aged 16–49 years. The second ICNARC report included the period from 1 September 2020–31 May 2021. During this period, a further 320 women who were either currently or recently (within 6 weeks) pregnant were admitted to intensive care, corresponding to 13.9% of the 2309 women admitted aged 16–49 years. For context, the conception rate in the UK in 2018 was 75.4/1000 women aged 15–44 years, signifying that the percentage of women pregnant at any one time in the UK is less than 7.5%, which implies there were 6.4% more pregnant women in ICU than expected.[38] It is important to note that the threshold for admitting a pregnant woman to intensive care is likely to be lower than for a non-pregnant woman: a higher rate of intensive care admission for pregnant women does not therefore necessarily mean a higher burden of severe disease.

A publication written as a collaboration between the International Severe Acute Respiratory and Emerging Infection Coronavirus (ISARIC4C), Clinical Characteristic Consortium, UKOSS and the Covid-19 Clinical Information Network (Co-CIN) was presented to the Scientific Advisory Group for Emergencies on 25 March 2021.[39] The three sources of data used for this analysis were ISARIC4C/CO-CIN, UKOSS and MBRRACE-UK Confidential Enquiry into Maternal Deaths. Between 1 March 2020 and 28 February 2021, 5479 pregnant women with confirmed SARS-CoV-2 infection were admitted across the UK. Data suggest that maternal mortality has increased during the pandemic. UK maternal mortality is estimated to be 20% higher than in previous recent years (12/100 000 maternities compared to 10/100 000) although the rise in maternal death is not all attributed directly to COVID-19. Twenty-four women with SARS-CoV-2 infection were reported to MBRRACE-UK;[31] 20 during pregnancy or in the immediate postpartum period (up to 6 weeks postnatal) and four during the extended postpartum period (up to 1 year). Nineteen deaths were because of COVID-related respiratory or thrombotic disease. Of note, in the same time period, the Office for National Statistics reported 319 deaths of women aged 20–39 in England and Wales with COVID-19 mentioned on the death certificate.

1.4.2.2 Data from studies comparing severity of COVID-19 in pregnant and non-pregnant women

There is evidence that pregnant women may be at increased risk of severe illness from COVID-19 compared with non-pregnant women, particularly in the third trimester. The most consistent signal of increased severity of COVID-19 in pregnancy is an increase in ICU admissions for pregnant women. However, as noted above, ICU admission rates must be interpreted with caution as the threshold for ICU admission for a pregnant woman may be lower than for a non-pregnant woman. Moreover, there are currently no robust data from the UK comparing pregnant and non-pregnant women with COVID-19. Part of the UKOSS/ISARIC/CO-CIN investigation[39] compared pregnant women with males and non-pregnant females aged 20–39 years. To summarise, pregnant females were less likely to require oxygen, non-invasive and invasive ventilation, were less likely to be admitted to ICU and were more likely to be discharged alive, rather than die or be admitted to ongoing care compared with

males and non-pregnant females. The studies in this section are from countries with different healthcare systems, populations and different baseline maternal risks, and should therefore be interpreted with caution from a UK perspective.

Intensive care admission is likely to be more common in pregnant women with COVID-19 than in non-pregnant women with COVID-19 of the same age. The PregCOV-19 Systematic Review Consortium analysis[24] concluded that pregnant women are more likely than non-pregnant women to be admitted to intensive care (OR 2.13, 95% CI 1.53–2.95) and require invasive ventilation (OR 2.59, 95% CI 2.28–2.94). The USA Centers for Disease Control and Prevention (CDC) published a study[39] in November 2020 based on surveillance of COVID-19 cases in the USA from January–October 2020. This study addressed some of the limitations of their earlier published work, although missing data might still have led to bias (e.g. pregnancy status was missing for more than half the cases reported to the CDC). The study compared pregnant women with symptomatic COVID-19 (n = 23 434) to non-pregnant women of reproductive age with symptomatic COVID-19 (n = 386 028). The pregnancy rate was 5.7%, close to the expected value, and by focussing on symptomatic women, the study was less likely to be biased by women being admitted principally for obstetric reasons. The study found pregnant women were more likely be admitted to ICU (adjusted risk ratio [aRR] 3.0, 95% CI 2.6–3.4), to receive invasive ventilation (aRR 2.9, 95% CI 2.2–3.8), ECMO (aRR 2.4, 95% CI 1.5–4.0), and to die (1.5/1000 versus 1.2/1000 cases; aRR 1.7, 95% CI 1.2–2.4).

A systematic review[40] from May 2021 included 591 058 women (28 797 pregnant and 562 261 non-pregnant) concluded that pregnant women were at a higher risk of ICU admission compared to non-pregnant women. The risk of ICU admission (RR 2.26, 95% CI 1.68–3.05) and incidence of invasive mechanical ventilation (RR 2.68, 95% CI 2.07–3.47) were significantly higher among the pregnant women.

Since the last update of the PregCOV-19 Systematic Review[24] there have been a number of smaller studies[40-46] These studies have been meta-analysed as part of this version 15 guidance update (Appendix III). Compared to non-pregnant women of reproductive age with COVID-19, pregnant woman are at increased risk of severe disease from COVID-19, with increased risk of ICU admission (OR 2.40, 95% CI 2.25–2.57), mechanical ventilation (OR 1.40, 95% CI 1.33–1.66) and death (OR 1.39, 95% CI 1.27–1.57). The increased risk of ICU admission may in part be explained by a lower threshold for admission in pregnancy in general.

Studies on the risk of severe disease from COVID-19 in pregnancy are summarised in Appendix III, Table 2. The care of pregnant women with severe COVID-19 is covered in section 6 of this guidance.

1.5 Risk factors for hospital admission with COVID-19 infection in pregnancy

Key findings

- Risk factors that appear to be associated both with COVID-19 infection and admission to hospital with COVID-19 include:
    - Being unvaccinated.
    - Black, Asian or other minority ethnic background.
    - Having a BMI of 25 kg/m^2 or more.
    - Pre-pregnancy co-morbidity, such as pre-existing diabetes or chronic hypertension.
    - Maternal age 35 years or older.[24,29]
    - Living in areas or households of increased socioeconomic deprivation (data not specific to pregnancy).[47]
- In addition to these, the risk of becoming infected with SARS-CoV-2 is higher in individuals who are more exposed, for example, those working in healthcare or other public-facing occupations.

In the PregCOV-19 Systematic Review,[24] the maternal risk factors associated with severe COVID-19 were: age 35 years and older, OR 1.83 (95% CI 1.27–2.63); BMI 30 kg/m^2 and above, OR 2.37 (95% CI 1.83–3.07); chronic hypertension, OR 2.0 (95% CI 1.14–3.48); and pre-existing diabetes, OR 2.12 (95% CI 1.62–2.78).

The UKOSS/ISARIC/CO-CIN study[39] in the UK described the characteristics of 5479 pregnant women with confirmed SARS-CoV-2. The estimated incidence of pregnant women admitted to hospital with SARS-CoV-2 aged 35 and older was 8.93/1000 maternities (95% CI 8.49–9.39), pregnant women with a BMI at 30 kg/m^2 and above 10.18/1000 maternities (95% CI 9.70–10.68), and pregnant women of Black, Asian or other minority ethnic background 18.06/1000 maternities (95% CI 17.12-19.04), 18.83/1000 maternities (95% CI 17.36–20.42) and 8.17/1000 maternities (95% CI 7.35–9.07) respectively.

The association between Black, Asian and minority ethnic background and severe COVID-19 in pregnancy echoes findings from before the pandemic which showed women of Black, Asian and minority ethnic background have higher morbidity and mortality in pregnancy than white women. For example, the MBRRACE-UK report of the Confidential Enquiry into Maternal Death and Morbidity 2016– 2018[48] showed there remains a more than four-fold difference in mortality rates among Black women, three-fold among mixed ethnicity women and an almost two-fold difference among Asian women compared with white women.

The association between Black, Asian and minority ethnic background and severe COVID-19 or death from COVID-19 is not confined to pregnant women. In the UK, 13% of the total population identify as being from a Black, Asian and minority ethnic background, but 30% of all individuals admitted to UK critical care for COVID-19 were from these backgrounds, and furthermore were more likely to die from COVID-19.[37,49] In the case of COVID-19, it has been postulated this association may be related to health inequalities or socioeconomic factors, or vitamin D deficiency.[29,50,51,52] UK advice recommends vitamin D supplementation to all pregnant women and individuals of Black, Asian and minority ethnic background, regardless of the COVID-19 pandemic.[53,54]

1.6 Effect of COVID-19 on pregnancy

Key findings

- Symptomatic maternal COVID-19 is associated with an increased likelihood of iatrogenic preterm birth.
- COVID-19 infection in pregnancy may be associated with an increased incidence of small-for-gestational-age (SGA) babies.
- It seems likely that neonatal morbidity for babies born to women with COVID-19 infection is linked to preterm birth rather than the COVID-19 infections itself.
- While stillbirth remains a rare outcome, maternal COVID-19 infection is associated with an increased risk of stillbirth.

Preterm birth is the single biggest cause of neonatal morbidity and mortality in the UK, with about 7% of babies in the UK born preterm.[55,56] The preterm birth rate in women with symptomatic COVID-19 appears to be two to three times higher than this background rate. The PregCOV-19 Systematic Review[24] estimated the risk of preterm birth at approximately 17%. Most of these preterm births (94%) were iatrogenic. In the initial UKOSS study,[29] the median gestational age at birth was 38 weeks of gestation (IQR 36–39 weeks of gestation). Of the women who gave birth, 27% had preterm births: 47% of these were iatrogenic for maternal compromise and 15% were iatrogenic for fetal compromise. An updated UKOSS study[30] confirmed that preterm birth was more likely for women with COVID-19: 19% of women with symptomatic COVID-19 and 9% of women with asymptomatic COVID-19 gave birth before 37 weeks of gestation. Compared with a historical cohort of pregnant women without SARS-CoV-2, pregnant women with symptomatic COVID-19 were more likely to give birth before 32 weeks of gestation (adjusted OR [aOR] 3.98, 95% CI 1.48–10.70) and before 37 weeks of gestation (aOR 1.87, 95% CI 1.23–2.85). Further studies[57-60] have confirmed this increased risk of preterm birth with symptomatic maternal COVID-19 infection. The care of women at risk of iatrogenic preterm birth is addressed in section 5.2. Pregnant women with asymptomatic COVID-19 do not, however, seem to be at significantly increased risk of preterm birth.

The results of two large COVID-19 in pregnancy registries[35] found the number of SGA neonates was comparable to historical and contemporaneous UK and USA data. Fetal growth restriction (FGR) in pregnancies complicated by COVID-19 is, however, a plausible possibility as two-thirds of pregnancies with SARS were affected by FGR.[26,61,62] Furthermore, a published systematic review of 42 studies[59] reported an increased risk of low birthweight (OR 1.89, 95% CI 1.14-3.12) associated with maternal COVID-19 infection, and a large multinational study[63] also reported a higher low birthweight rate (RR 1.58, 95% CI 1.29–1.94) among women with COVID-19 infection. This evidence adds to the possibility that maternal COVID-19 infection causes FGR.

For babies born to women with COVID-19 the overall outcomes are very positive, with over 95% of newborns included in the PregCOV-19 Systematic Review[24] reported as being born in good condition. A large study[10] from the USA also reported reassuring neonatal outcomes during the pandemic. Of 1481 births overall, 116 (8%) women (giving birth to 120 neonates) tested positive for SARS-CoV-2. All 120 neonates were tested at 24 hours of life and none were positive for SARS-CoV-2. Of 79 neonates who had a repeat SARS-CoV-2 test at age 5–7 days (66% follow-up rate), all tested negative; 72 neonates were also tested at 14 days old and again, none were positive. None of the neonates had signs of COVID-19. A national cohort study in Sweden[64] reported small increases in measures of neonatal morbidity for neonates born to women with COVID-19 infection, including admission to neonatal unit and respiratory distress syndrome, but without differences in neonatal length of stay or mortality. In the updated UKOSS study,[30] 19% of babies born in the UK to women with symptomatic SARS-CoV-2 infection were admitted to the neonatal unit. These admissions may, in part, represent the policy of the maternity unit rather than concerns about wellbeing of the neonate.

A national study in England[58] of maternal COVID-19 infection also reported no difference in measures of neonatal morbidity including admission to neonatal unit or readmission, when restricting the analysis to babies born at term. This is indicative that reports of neonatal morbidity for babies born to women with COVID-19 infection is likely to be associated with prematurity.

Despite over 100 million confirmed COVID-19 infections worldwide, there has been no reported increase in the incidence of congenital anomalies.

The PregCOV-19 Systematic Review[24] reported that compared with pregnant and recently pregnant women without the disease, pregnant women with COVID-19 were at higher risk of stillbirth (OR 2.84, 95% CI 1.25–6.45). It is important to note that the overall number of stillbirths was small. The updated UKOSS report[30] found no significant difference in the risk of stillbirth or neonatal death for any symptom status of SARS-CoV-2 infection compared to the historical cohort of pregnant women over a 6-month period. Although the number of stillbirths or neonatal deaths that occurred in the groups of pregnant women with symptomatic (n = 5) or asymptomatic (n = 4) SARS-CoV-2 were higher than the historical cohort (n = 2), this difference did not reach statistical significance.

Subsequent studies and systematic reviews have reported an increased risk of stillbirth associated with maternal COVID-19 infection.[58,59,63,65] A study in England,[58] reported a statistically significant two-fold increase in stillbirth for women with a laboratory confirmed SARS-COV-2 infection at the time of birth (OR 2.21 95% CI 1.58–3.11). This study was unable to differentiate between severity of COVID-19 disease in the cohort and was not able to quantify risk of stillbirth based on historical COVID-19 infection at any other time during pregnancy. In addition, a multinational study[63] covering 18 countries also reported a two-fold increase in a composite measure of severe perinatal morbidity and mortality, which included intrauterine fetal death, and an increase in the risks of these as the severity of COVID-19 infection increased. A systematic review of 42 studies[59] reported a two-fold increase in stillbirth (OR 2.11) associated with maternal COVID-19 infection. Finally, a USA study,[65] published in November 2021, reviewed 249 634 births from March 2020–September 2021. Overall, stillbirths were rare (8154; 0.65%) but there was a statistically significant increase in adjusted risk for stillbirth in women with COVID-19 compared to those without COVID-19 (aRR 1.90, 95% CI 1.69–2.15). This study compared stillbirth rates during the pre-Delta and Delta periods showing an increased rate during both periods (pre-Delta aRR 1.47, 95% CI 1.27–1.71; and Delta aRR 4.04, 95% CI 3.28–4.97). In conclusion, COVID-19 infection at birth was associated with increased risk for stillbirth, which is further increased with the Delta variant.

There is evidence that COVID-19 infection causes a range of non-specific placental histological changes including fetal and maternal vascular changes, malperfusion, chorioamnionitis, acute inflammatory pathology, chronic inflammatory pathology, increased perivillous fibrin and intervillous thrombosis. Studies[66-68] have described specific histological features in placentas associated with cases of stillbirth and late second trimester miscarriage in relation to infection with both the Alpha and Delta variants. Severe placental lesions in the context of proven COVID-19 placental infection, such as trophoblastic necrosis and massive haemorrhage, causing rapidly deteriorating placental function has been linked to a number of stillbirths in women with COVID-19 infection. In one study,[67] 10 out of 50 placentas from COVID-19 positive unvaccinated women showed evidence of placental COVID-19 infection. Five of these were associated with stillbirth with severe placental changes, while the remaining five had more focal changes in association with possible FGR. Another study[68] showed the same histological findings for COVID-19-associated (Alpha variant) placentitis, which resulted in six stillbirths all attributable to placental insufficiency, three of which were associated with clotting abnormalities, and three of which had presented in the days before stillbirth with reduced fetal movements. Both studies[67,68] reported that the placentitis changes resulting in stillbirth did not correlate with the severity in COVID-19 symptoms experienced by the woman, as most only had mild symptoms. FGR was not a feature in these cases as these histological changes resulted in rapid placental dysfunction and stillbirth. It is therefore possible that a relatively sudden, severe placental dysfunction may occur with COVID-19, which appears to be unrelated to severity, but instead to placental COVID-19 infection. This can be associated with a coagulopathy similar to disseminated intravascular coagulation (DIC), characterised by low platelets and low fibrinogen, and is strongly linked to an adverse perinatal outcome.

There are fewer data available for the impact of COVID-19 infection on first- and second-trimester pregnancy loss. A nationwide study in the USA[69] reported no increase in the risk of fetal loss prior to 20 weeks of gestation because of COVID-19 infection. Smaller studies[70,71] have also confirmed similar findings, with no statistically significant increase in fetal loss prior to 20 weeks of gestation associated with COVID-19 infection.

Maternal COVID-19 is associated with an increased rate of caesarean birth. From the initial UKOSS study,[29] 59% of women had caesarean births; approximately half of these were because of maternal or fetal compromise. The remainder were for obstetric reasons (e.g. progress in labour, previous caesarean birth) or maternal request (6%). Of the women having a caesarean birth, 20% required general anaesthesia (GA). Approximately two-thirds of the women who had GA were intubated for maternal respiratory compromise, and the remaining third was to facilitate urgent birth. The updated UKOSS data[30] confirmed this trend, with a 49% caesarean birth rate for women with symptomatic COVID-19 versus 29% for a historical control group from 2018.

Appendix III provides a summary of the key studies and meta-analyses on maternal and pregnancy outcomes.

1.7 Effect of service modifications during the COVID-19 pandemic on maternal and perinatal experience and outcomes

Key findings

During the first wave of the COVID-19 pandemic in 2020, changes were made to the provision of maternity services with the aim of reducing nosocomial transmission. This included reduced antenatal and postnatal appointments, on adoption of remote consultation methods, restricted access to midwifery-led birth settings or home birth, and changed methods of screening for SGA and gestational diabetes.[72,73] These service changes impacted on the experience of women and their families, potentially increasing barriers to care and exacerbating adverse physical and mental health outcomes. The full consequences of these changes have yet to be determined.

During the first wave of the COVID-19 pandemic in 2020, changes were made to the provision of maternity services with the aim of reducing nosocomial transmission, the unintended consequences of which have yet to be determined.

In the UK, two survey studies have demonstrated that during April 2020, the majority of units reduced antenatal and postnatal appointments, adopted remote consultation methods, restricted access to midwifery-led birth settings or home birth, and changed methods of screening for FGR and gestational diabetes.[72,73] These service changes impacted on the experience of women and their families. An online questionnaire survey[74] of 1451 pregnant or recently pregnant women in the UK found that the majority felt there were barriers to accessing maternity care while anxieties were expressed about changes to antenatal, intrapartum and postnatal services.[27]

Meta-analyses and systematic reviews[75,76] have found higher rates of perinatal mental health disorders during the pandemic, including anxiety and depression. Some of these impacts may be attributed to modifications to maternity services. The MBRRACE-UK rapid report[77] highlighted two instances where women died by suicide, where referrals to perinatal mental health teams were affected by restrictions related to COVID-19.

Appendix III provides a summary of the key studies and meta-analyses on maternal and pregnancy outcomes.

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

2. COVID-19 vaccination in pregnancy

2. COVID-19 vaccination in pregnancy

This section aims to summarise, in a format useful for maternity care, the evidence presented in existing COVID-19 vaccination guidance from the UKHSA Green Book[78] as well as leaflets and information from Public Health England (PHE) and the NHS.

2.1 Background on COVID-19 vaccines available in the UK

Key findings

COVID-19 vaccine background (in non-pregnant population):

- The phase 3 trials of the four currently-approved vaccines assessed protection against COVID-19 after two doses in three, and after a single dose in one. Prior to Omicron:
    - The Pfizer-BioNTech vaccine had an efficacy of 95% (95% CI 90.0–97.9%) against symptomatic COVID-19.[79]
    - The Oxford-AstraZeneca vaccine had an efficacy of 66.7% (95%CI 57.4–74.0%) against symptomatic COVID-19.[80]
    - The Moderna vaccine had an efficacy of 94.1% (95% CI 89.3–96.8%).[81]
    - The Janssen vaccine had an efficacy of 66.1% (95% CI 55.0–74.8%).[82]
- Real-world monitoring has confirmed that one dose of the Pfizer-BioNTech or Oxford-AstraZeneca vaccines confers about 60% protection against symptomatic COVID-19 (Alpha and Delta variants), however, less protection may be conferred against the Omicron variant.[83]
- Real-world monitoring has confirmed that one dose of the Pfizer-BioNTech or Moderna vaccines confers about 75% protection against symptomatic COVID-19 which drops to 25% after 25 weeks. Two doses of the Oxford-AstraZeneca vaccine confers around 45–50% protection against Omicron, which falls to almost no effect after 20 weeks.[84]
- A booster dose of Pfizer-BioNTech or Moderna confers around 60–75% protection against Omicron, which drops to 25–40% after 15 weeks.[85]
- Vaccination with two doses of the Pfizer-BioNTech or Oxford-AstraZeneca vaccines are effective against symptomatic disease secondary to infection by the Delta variant.[86,87]
- Those who have had two doses and a booster (or three doses) of vaccine (combined data on Pfizer-BioNTech, Oxford-AstraZeneca and Moderna) are 88% less likely to be admitted to hospital with the Omicron variant than those who have not been vaccinated.[88]

- Women should be advised that influenza vaccination is still safe at all gestations of pregnancy and is recommended to protect both the woman and baby from the adverse effects of becoming seriously ill with influenza during pregnancy.
- Women can receive COVID-19 and influenza vaccines at the same time.

2.1.1 Available vaccines in the UK and their mechanisms of action

As of February 2022, five COVID-19 vaccines are approved for use in the UK: the Pfizer-BioNTech vaccine, the Oxford-AstraZeneca vaccine, the Moderna vaccine, the Janssen vaccine and the Novavax vaccine.

The Pfizer-BioNTech and Moderna vaccines are messenger RNA (mRNA) vaccines in which mRNA encoding SARS-CoV-2 spike protein is injected via a lipid nanoparticle coat. The mRNA does not go into the nucleus of the host cell, so it remains separate from the host DNA. The host cell produces the spike protein, as for the Oxford-AstraZeneca and Janssen vaccines below, which elicits a protective immune response. The mRNA from the vaccine is broken down by the host cell within a few days.[78]

The Oxford-AstraZeneca and Janssen vaccines are viral-vector vaccines in which DNA encoding the SARS-CoV-2 spike protein is injected within a modified adenovirus vector. The adenovirus vector has been modified so that it cannot replicate, and the spike protein is not expressed on the adenovirus itself. Rather, the adenovirus vector serves only to deliver the spike protein DNA into the host cell. The host cell then produces the spike protein, and this elicits a protective immune response.

Current COVID-19 vaccines offer a lesser degree of protection against the Omicron variant with the level of protection waning more quickly in the months post vaccination.[89] Nevertheless, vaccination does protect individuals against symptomatic coronavirus and hospitalisation.

UKHSA data have demonstrated the importance of a booster vaccine for protection against the Omicron variant.[88] For example, a Pfizer-BioNTech or Moderna booster following two initial doses of the Oxford-AstraZeneca or Pfizer BioNTech vaccines boosted protection against symptomatic Omicron infection from 0–10% protection pre-booster to 50–80% within 1 week. Protection levels of about 40–70% persisted 10 weeks after booster vaccination depending on the exact vaccination regimen administered. There is also evidence that a booster vaccination reduces hospital admission rates with a 68% reduction in hospitalisation from Omicron infection, and an 88% reduction in hospitalisation risk 2 weeks after a booster dose.[88]

2.1.2 Vaccine safety

The adverse effect profiles of the four available vaccines were similar in their phase 3 trials. Most participants in the trials had a minor local reaction (pain, redness or swelling at the injection site). Mild systemic adverse effects like fatigue, headache or myalgia were also common; these were typically short-lived (less than a few days). About 10–20% of participants had a fever after vaccination. In general, adverse events are more common after the first dose than the second dose for the Oxford-AstraZeneca vaccine and more common after the second dose than the first dose for the Pfizer-BioNTech and Moderna vaccines.

These vaccines have continued to be monitored for safety after their authorisation, and an association has emerged between the Oxford-AstraZeneca vaccine and rare cases of serious thrombosis in the context of thrombocytopenia (see section 2.3.1.2). There have also been rare reports of myocarditis and pericarditis following vaccination with Pfizer-BioNTech and Moderna vaccines (see section 2.3.1.3).[90]

2.2 Eligibility for the vaccine in pregnancy

Key findings

- Vaccination against COVID-19 is strongly recommended and should be offered to all pregnant women. Pregnant women are recognised as a priority group for vaccination.
- Pregnant women should be offered the Pfizer-BioNTech or Moderna vaccines unless they have already had one dose of the Oxford-AstraZeneca vaccine, in which case they can complete the course with the same vaccine or with an mRNA vaccine (provided there are no contraindications to either).
- Pregnant women vaccinated against COVID-19 have a lower risk of hospital admission than unvaccinated pregnant women.
- 96% of pregnant women admitted to hospital with symptomatic COVID-19 were unvaccinated.[91]
- 98% of pregnant women admitted to intensive care were unvaccinated.[91]
- There is excellent real-world evidence of vaccine efficacy, with vaccinated pregnant women having almost 50:1 lower odds of severe infection.[3]

The eligibility criteria are based on recommendations from the Joint Committee on Vaccination and Immunisation (JCVI).[92] The choice of vaccine is based on the recommendations from the UKHSA Green Book[78] and reflects the fact that most of the safety data regarding vaccination in pregnancy comes from the USA where pregnant women were usually offered the Pfizer-BioNTech or Moderna vaccines.

2.3 Potential fetal and maternal effects

Published data indicates that more than 347 150 women in the UK and USA have had a COVID-19 vaccine in pregnancy with no concerning safety signals.[85,93-96]

Pregnant women were not included in the large randomised controlled trials testing the safety and adverse effect profiles of the COVID-19 vaccines. However, as of January 2022, over 201 035 pregnant women in the USA, from diverse ethnic backgrounds, have received either a Pfizer-BioNTech, Moderna or Johnson & Johnson vaccine, with no evidence of harm being identified.[93] In general, there are no known risks from receiving inactivated or recombinant vaccines in pregnancy, or while breastfeeding,[97] and therefore, there is no reason to suppose that the adverse effects from these COVID-19 vaccines should differ for pregnant women compared to non-pregnant women.

2.3.1 Maternal effects

2.3.1.1 Common minor adverse effects

Minor and short-lived adverse effects such as soreness at the injection site, headache and fatigue are common in the general population after a COVID-19 vaccine. A report[98] on the first 35 000 pregnant women to receive a COVID-19 vaccine in the USA showed similar patterns of reporting for common minor adverse effects. Systemic features such as fever appeared more commonly in non-pregnant women, but pregnant women did report nausea and vomiting more frequently after the second dose of the Pfizer-BioNTech and Moderna vaccines.[98] Smaller observational studies[99,100] have also reached similar conclusions showing no significant difference between pregnant and non-pregnant women in their symptoms post vaccination, and a reduced incidence of systemic features such as fever in pregnant women.

2.3.1.2 Vaccine-induced thrombosis and thrombocytopenia

The rare syndrome of vaccine-induced thrombosis and thrombocytopenia (VITT) has been reported after the Oxford-AstraZeneca vaccine;[101,102] it has also been reported after the Janssen vaccine.[103] VITT is an unpredictable, idiosyncratic vaccine reaction (not dissimilar to heparin-induced thrombocytopenia and thrombosis associated with heparin therapy) and it is not associated with typical venous thromboembolism (VTE) risk factors. It has been described as presenting 5–28 days after the first dose, particularly in adults younger than 50 years old. Although pregnancy increases the risk of coagulopathy there is no evidence that pregnant or postpartum women are at higher risk of VITT than non-pregnant age-matched women.[78,104] NICE has produced a rapid guideline [NG200][105] on the clinical management of patients who develop VITT after COVID-19 vaccination.[106]

The risk of VITT is extremely low with a first dose of the Oxford-AstraZeneca vaccine (approximately 1:50 000),[107,108] and even lower with a second dose for those who were well after the first dose. The UK government has advised that individuals younger than 40 years old should be offered an alternative vaccine to the Oxford-AstraZeneca vaccine based on the

risk/benefit ratio for this age group. There is no known risk of VITT with the Pfizer-BioNTech and Moderna vaccines.

2.3.1.3 Vaccine-induced myocarditis or myopericarditis

A population-based study in Denmark[109] reported the rare occurrence of myocarditis or myopericarditis (inflammation of the muscle layer of the heart and the sac enclosing it) in individuals following vaccination with the Pfizer-BioNTech and Moderna vaccines. Individuals were followed up for an average of 1 year post vaccination. During this period, 69/584 031 (0.01%) individuals were found to develop myocarditis or myopericarditis in the 28 days following vaccination.

Individuals who received the Pfizer-BioNTech vaccine had a non-significant increase in myocarditis or myopericarditis compared to unvaccinated individuals (adjusted hazard ratio 1.34, 95% CI 0.9–2.0). However, individuals who received the Moderna vaccine had a significant increase in myocarditis or myopericarditis compared with unvaccinated individuals (adjusted hazard ratio 3.29, 95% CI 2.3–6.68).

A USA study[110] reported a higher risk of developing myocarditis or myopericarditis in unvaccinated individuals after COVID-19 infection, estimated to be 450/1 000 000 (0.045%), than in vaccinated individuals. The overall risk of developing myocarditis or myopericarditis is extremely low and is likely to be much lower than the risk of developing these conditions following COVID-19 infection itself.

2.3.2 Fetal effects

It is recognised that currently there are no long-term data on COVID vaccinations in pregnancy, but long-term follow-up data from the use of similar vaccines (e.g. whooping cough and influenza) are very reassuring. Pregnancy outcomes following mRNA vaccination (Pfizer-BioNTech and Moderna) appear similar to comparator groups prior to the onset of COVID-19, with preterm birth, SGA and major congenital anomalies detected similar to background incidence.[98] None of the women whose babies were born with congenital anomalies had received the COVID-19 vaccine in the first trimester or the periconception period.[98]

Findings from the USA[98] have not identified any safety problems with regards to maternal and neonatal risks. Spontaneous miscarriage occurred at a similar rate in women who received a COVID-19 vaccine as those who were unvaccinated (104/827, 12.6%), with 92.3% of these miscarriages occurring in the first trimester. More recent studies[111-115] have confirmed the safety of COVID-19 vaccines in early pregnancy with no increased risk of miscarriage.

2.3.2.1 Antibody transfer

Key findings

- SARS-CoV-2 antibodies in neonatal cord blood and in breast milk have been found following COVID-19 infection in pregnancy, and therefore it should be that passive immunity is conferred.
- Vaccine-elicited antibodies have been found in neonatal cord blood and breast milk following the administration of a COVID-19 vaccine, and therefore it should be that passive immunity is conferred.

Studies[19,116] have demonstrated the presence of SARS-CoV-2 antibodies in neonatal cord blood and in breast milk produced in response to COVID-19 infection in pregnancy. These findings suggest the development of passive immunity in the neonate. In one of these studies,[19] 87% of neonates (n = 83) had IgG detected in cord blood following COVID-19 infection in pregnancy. Furthermore, another cohort study[116] of 2312 lactating women in the Netherlands reported that 23.1% of women had IgA antibodies in their breast milk, which remain present for 10 months following infection in pregnancy.

Similar findings have been reported following the administration of the COVID-19 vaccine. Two cohort studies of over 100 women established the presence of vaccine-elicited antibodies in infant cord blood and breast milk. Both studies were conducted in the USA and utilised Pfizer-BioNTech or Moderna vaccines. There is some suggestion that timing of vaccination in pregnancy or during lactation may influence the level of passive immunity conferred to the neonate, with two studies[98,116] reporting that production of IgG antibodies and their subsequent transfer are improved following a second dose of either vaccine. Similar to natural infection, IgA titres appear to remain stable for several weeks following vaccination, with mRNA vaccines suggesting continual transference of antibodies during lactation.[117]

2.4 Recommended vaccine timing in relation to stage of pregnancy or breastfeeding

2.4.1 Timing of vaccination in pregnancy

Key findings

- COVID-19 vaccines can be given at any time in pregnancy.
- Breastfeeding women can receive a COVID-19 vaccine; there is no need to interrupt breastfeeding to receive a dose of the vaccine.
- There is no evidence to suggest that COVID-19 vaccines affect female fertility. Women planning to conceive can also receive a COVID-19 vaccine and do not need to delay conception.

There is no robust evidence to guide the timing of vaccination in pregnancy: the advice above is based on expert opinion rather than experimental data.

The COVID-19 vaccines are considered to be safe and effective. Pregnant women are more likely to become seriously unwell when compared to non-pregnant women, and have a higher risk of their baby being born prematurely if they develop COVID-19 in their third trimester (after 28 weeks of gestation). As far as possible, women should be offered both doses and a booster before giving birth if time allows, or before entering the third trimester, bearing in mind that it takes time for immunity to develop and protection is higher after the second dose and a booster of the vaccine.[78]

There is no evidence to suggest COVID-19 vaccinations affect fertility. Vaccination is strongly recommended regardless of conception intentions or pregnancy status.

2.4.2 Timing in the postpartum period

Women in the immediate postpartum period should be offered vaccination in line with the general (non-pregnant) population.[78]

There has been a suggestion by the Royal College of Surgeons that it might be wise to avoid vaccination for 7 days after significant surgery. This advice is theoretical and based on caution around the possibility of any concomitant illness after surgery. It seems entirely reasonable, however, to offer vaccination after an uncomplicated assisted vaginal or caesarean birth, and this may be a useful opportunity to ensure vaccination coverage. As with all vaccinations, it would be appropriate to defer if a woman is unwell.

2.4.3 Timing with breastfeeding

The JCVI advice[92] published on 30 December 2020 stated there is no known risk in giving available COVID-19 vaccines to breastfeeding women. Breastfeeding women should be offered vaccination at the time when they become eligible (as for the general non-pregnant population). Although safety data are lacking for the available vaccines relating to breastfeeding, there have been no adverse events reported in infants to breastfeeding women who received a vaccine. Women do not need interrupt breastfeeding in order to be receive a dose of a COVID-19 vaccine.

2.4.4 Timing for women who are planning a pregnancy/undergoing fertility treatment

The JCVI advises that women do not need a pregnancy test before vaccination, and that women planning a pregnancy do not need to delay pregnancy after vaccination.[92] The British Fertility Society and Association of Reproductive and Clinical Scientists[118] advise people of reproductive age to have a COVID-19 vaccine, including those individuals who are trying to get pregnant or planning a pregnancy in the future. Furthermore, they advise that women can have the COVID-19 vaccine during fertility treatment, and that there is no need to delay fertility treatment after receiving a COVID-19 vaccine.

There is no evidence that the current vaccination programme of adults in the UK has affected rate of conception and childbirth. Animal studies[119,120] of the Pfizer-BioNTech and Moderna vaccines showed that administering these vaccines in rats had no effect on fertility. Preliminary animal studies[121,122] also showed no effect on fertility from the Oxford-AstraZeneca vaccine or mRNA COVID vaccines. Several studies[111-115] in humans have shown no increase in the rate of miscarriage following vaccination. The speculation that immunity to the spike protein could lead to fertility problems is not supported by evidence. Most people who contract COVID-19 will develop antibody to the spike protein and there is no evidence of fertility problems in people who have already had COVID-19.

2.5 How should women be counselled?

Key findings

- Pregnant women should be supported to come to an informed decision about vaccination.
- There is high-quality real-world evidence of vaccine efficacy, with vaccinated pregnant women having almost 50:1 lower odds of severe COVID-19 infection.[3]
- An informed decision-making process should cover the options for timing of vaccination, the benefits and risks of vaccination and of declining vaccination.
- The RCOG Information sheet and decision aid can be used to aid counselling.

It is a pregnant woman's choice to have a vaccination against COVID-19. If a pregnant woman is undecided whether to get the COVID-19 vaccine, the role of the healthcare provider is to enable the pregnant woman to make her decision through an informed decision-making process. It is not necessary to show evidence of this discussion prior to the pregnant women receiving their vaccination (as is the same for the general population presenting for COVID-19 vaccination).

A pregnant woman should have the opportunity to access reliable information about COVID-19 vaccine in pregnancy, for example from the NHS, UKHSA or the RCOG. An informed decision-making process involves supporting a pregnant woman to understand the options available (including the risks and benefits of those options) and to make a decision based on the evidence and her personal preference.[123,124]

Counselling may cover the following points.

1. **The options available to the pregnant woman:**

    - To receive vaccination against COVID-19 now.
    - To decline the vaccine, with the option of having it in future (either later in her pregnancy, or after the birth of her baby).
    - To decline to have the vaccine altogether; this is a woman's individual choice.

2. The benefits of vaccination:

- Reduction in severe disease and hospital admission for a pregnant woman.
- Potential reduction in the risk of preterm birth associated with COVID-19.
- Potential reduction in transmission of COVID-19 to vulnerable household members.
- Potential reduction in the risk of stillbirth associated with COVID-19.
- Potential protection of the newborn from COVID-19 by passive antibody transfer.
- Potential reduction in the risk of developing long COVID.

3. The risks of vaccination (see section 2.3 for further detail):

- Minor local reaction (pain, redness or swelling at the injection site).
- Mild systemic adverse effects like fatigue, headache or myalgia, typically short-lived (less than a few days).
- Very rare thrombotic adverse events following use of the Oxford-AstraZeneca or Janssen vaccines, or very rare cardiac inflammation adverse events following Pfizer-BioNTech and Moderna vaccines.
- There has been no evidence to suggest fetal harm following vaccination against COVID-19, and fetal harm is considered to be extremely unlikely based on evidence from other non-live vaccines. Risk of fetal harm cannot be precisely estimated until large-scale studies of vaccination in pregnancy have been completed.

4. The risks from COVID-19 to the woman and her fetus if the pregnant woman declines vaccination (see section 1 for further detail):

Maternal risks:

- Most women with COVID-19 in pregnancy will have no symptoms. Some women will develop critical illness from COVID-19.
- The risk of severe illness from COVID-19 is higher for pregnant women than for non-pregnant women, particularly in the third trimester.
- There is consistent evidence that pregnant women are more likely to be admitted to an ICU than non-pregnant women with COVID-19.

Fetal risks:

- Symptomatic maternal COVID-19 is associated with a two to three times greater risk of preterm birth.
- Although the overall risk of stillbirth is small, the risk is approximately doubled with SARS-CoV-2 infection.[24,58]

These risks should be personalised to each individual pregnant woman:

- Risk of exposure because of occupation: for example (and not limited to) healthcare and social workers, public-facing roles and education settings.
- Risk of severe illness: medical conditions (hypertension, diabetes), Black, Asian or minority ethnicity, BMI above 25 kg/m^2, aged 35 years and older, and being unvaccinated.

2.6 Research on COVID-19 vaccines in pregnant women

There is ongoing research on COVID-19 vaccines in pregnant women, addressing aspects of immunity, safety, different vaccines, and optimal schedules for protecting women. These include a randomised controlled trial funded by Pfizer[125] being conducted worldwide, including several UK National Institute for Health Research sites, in which pregnant women are being randomly assigned to receive either the Pfizer-BioNTech vaccine or a placebo. Those who receive the placebo during the trial will then be offered the vaccine once they give birth to ensure all participants have the opportunity of being vaccinated. The HORIZON1 study is also being planned by Janssen,[126] in which all participants will receive the Janssen vaccine (no one will receive a placebo). Finally, there is the PregCOV-19LSR pragmatic trial[127] in which pregnant women are receiving different vaccines on different schedules, depending on their gestational age at enrolment. The aim is to identify the most effective schedule in order to protect pregnant women, as well as other aspects such as whether vaccines improve immunity conferred by breast milk.

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

3. Antenatal care during the COIVD-19 pandemic

3. Antenatal care during the COVID-19 pandemic

3.1 What are the considerations for organisation of antenatal care?

Advice

- Women should be advised to continue their routine antenatal care, although it may be modified in line with their COVID-19 status.
- Service modifications are required to enable social distancing measures and where possible good ventilation, to reduce the risk of transmission between women, staff and other clinic/hospital visitors, and to provide care to women who have suspected or confirmed COVID-19 for whom a hospital attendance is essential.
- The NICE recommended schedule of antenatal care should be offered in full wherever possible. Ideally, and where safe, these appointments should be offered in-person, particularly to those from Black, Asian and other minority ethnic communities, those with communication difficulties or those living with medical, social or mental health conditions that put them at higher risk of complications, or adverse outcomes, during pregnancy.
- Maternity staff should be aware that for some women with hearing or communication difficulties, mask wearing may prevent lip reading.
- Basic assessments such as blood pressure and urine testing, and assessment of fundal height in women not receiving serial fetal growth ultrasound scans, are still required. Trusts and health boards should plan local strategies to ensure women are able to receive this monitoring.
    - If it is considered more appropriate for appointments to be conducted remotely, for example during periods of tighter restrictions, units should employ teleconferencing or videoconferencing consultations. The limitations of remote consultation methods should be recognised, including being aware that some women will not have sufficient internet access on their mobile devices or other computer hardware.
    - It should be acknowledged that remote appointments, particularly by telephone, may cause new challenges in relationship-building between women and healthcare professionals, especially among socially vulnerable groups, women for whom English is not their first language or women who are hearing impaired.
    - Healthcare professionals should be aware that the women may have unvoiced concerns regarding their care if they have less contact in person.

- Healthcare professionals should be aware that women may not have the privacy within their home to disclose private, personal and sensitive information. Efforts should be made at in-person appointments, such as ultrasound scans, to discuss sensitive issues such as domestic violence, sexual and psychological abuse, psychiatric illness and recreational drug use.

- In-person appointments (e.g. for blood tests, maternal examination or ultrasound scans) should be coordinated to limit repeated clinic attendance.
- Appropriate screening for diabetes in pregnancy should still be provided, following NICE guidance as far as possible, with awareness that modifications to screening protocols are associated with a reduction in the detection of cases of gestational diabetes.
- Particular consideration should be given to pregnant women who have comorbidities which make them clinically vulnerable to the effects of COVID-19. For example, shared waiting areas should be avoided and they should be cared for in single rooms.
- Units should appoint a named midwife or consultant to coordinate care for women unable to attend appointments owing to a positive test. Missed appointments should be reviewed and either rescheduled if an in-person review is necessary or converted to a virtual appointment.
- For women receiving antenatal care across different sites, units must ensure that there are clear pathways for communication via handheld notes, electronic records and correspondence to general practitioners.
- Open access to day assessment and maternity triage services should be maintained. Women should be actively encouraged to attend if they have concerns about their or their baby's wellbeing.
- Continuity of care should be maintained wherever possible, particularly for women from vulnerable groups.
- Healthcare providers should be aware of suggested changes to services within subspecialty service guidance available via the RCOG website.

Summary of evidence and rationale for guidance

Antenatal and postnatal care should be regarded as essential and women encouraged to attend, while observing social distancing and infection prevention measures, as recommended by the UK Government. Studies[128,129] in the UK and internationally have shown that women who do not attend antenatal services are at increased risk of maternal death, stillbirth and other adverse perinatal outcomes. NICE guidance[130] on antenatal care, including the schedule of antenatal appointments recommended for women with uncomplicated pregnancies, is well established in the UK.

The UK Government has published a **list of conditions** that make an individual extremely vulnerable to the severe effects of COVID-19, along with guidance on how best to protect these individuals.

A study[131] in Massachusetts, USA, conducted early in the pandemic showed there was no relationship between the number of in-person antenatal visits and the risk of developing COVID-19 for pregnant women, suggesting that nosocomial transmission could be minimised. No similar evidence exists for the UK.

A UK study[132] documented experiences of virtual antenatal clinic appointments during the COVID-19 pandemic to determine satisfaction and question the safety and quality of care received. The study reported that 86% patients were highly satisfied (127/148) with virtual clinics. However, 56% still preferred face-to-face appointments and these preferences were not associated with significant differences in patient demographics.

Another survey study from the USA[133] had similar results and noted that 86.9% were satisfied by the care they received. It also noted that offering remote consultations reduced the number of women who 'did not attend' their appointments.

NHS England[134] and NHS Scotland/Scottish Perinatal Network[135] have issued guidance on the adoption of remote consultations in secondary care in order to minimise hospital visits.[136] Data directly comparing telephone/video appointments with in-person appointments are not available; until these are, healthcare providers should follow locally agreed guidelines for antenatal care provision.

During the pandemic, modifications to the NICE recommendation to screen for gestational diabetes were suggested to reduce the risk of pregnant women being infected with SARSCoV-2 during hospital visits.[137] While the number of cases of COVID-19 avoided using this strategy is unknown, evidence has quantified the reduction in diagnoses of gestational diabetes.[138-140] The rationale for the modified testing strategy is described in the Appendix of the RCOG document **Guidance for maternal medicine services in the coronavirus (COVID-19) pandemic**.

The use of personal protective equipment (PPE) and face masks in particular can lead to difficulties in communication, especially for women with hearing loss.[141] Masks block lip movements and facial expressions and muffle the high frequency portions of sound. Various strategies to improve communication with women of the deaf community have been suggested and can be found on the **Royal National Institute for Deaf People** website.

The care of pregnant women with complex healthcare needs is challenging during a pandemic. To support healthcare providers caring for these women, the following guidance documents to assist maternity units with changes to antenatal and postnatal care were developed and can be found on the RCOG and RCM websites.

- Guidance for antenatal and postnatal services in the evolving coronavirus (COVID-19) pandemic.
- Guidance for antenatal screening and ultrasound in pregnancy during the coronavirus (COVID-19) pandemic.
- Guidance for maternal medicine in the coronavirus (COVID-19) pandemic (Version 2.5).
- RCM professional clinical briefings:
    - RCM Professional briefing on providing safe and effective virtual consultations.
    - RCM Professional briefing on domestic abuse during the pandemic.
    - RCM Professional briefing on public health care during the pandemic, including smoking cessation support.
    - RCM Professional briefing on antenatal care for women with and without COVID-19.

3.2 What are the considerations for antenatal appointments and advice for pregnant women?

Advice

- Evidence suggests that individuals from a Black, Asian or minority ethnic background, including pregnant women from these groups, are at higher risk of developing severe complications of COVID-19. Therefore, it is advised that:
    - Healthcare providers should discuss these risks with women of Black, Asian or minority ethnic background in a sensitive manner.
    - Women of Black, Asian or minority ethnic background should be encouraged to seek advice without delay if they are concerned about their health.
    - Healthcare providers should be aware of this increased risk, and have a lower threshold to review, admit and consider multidisciplinary escalation of symptoms in women of Black, Asian or minority ethnic background.
    - When reorganising services, maternity units should be particularly cognisant of evidence that individuals from a Black, Asian or minority ethnic background are at particular risk of developing severe and life-threatening COVID-19 disease.
- Healthcare professionals should proactively advise all pregnant women to contact emergency antenatal services if they have any concern about their or their baby's wellbeing.

- Carbon monoxide (CO) testing of all pregnant women should be undertaken, where it is safe to do so.
- Women should continue to take folic acid and vitamin D supplements in line with national recommendations.
- Women should be advised that influenza vaccination is still safe at all gestations of pregnancy and is recommended to protect both the woman and baby from the adverse effects of becoming seriously ill with influenza during pregnancy.
- Pregnant women will continue to need at least as much support, advice, care and guidance in relation to pregnancy, childbirth and early parenthood as before the pandemic, especially socially vulnerable women (with risk factors including poverty, homelessness, substance misuse, being an asylum seeker, experiencing domestic abuse and mental health problems).
    - Midwifery, obstetric and support staff should remain aware of the support needs for all women, acknowledging any restrictions on visitors and accompanying persons may affect the amount of support women require.
- Healthcare providers should be aware of the increased risk of domestic abuse in pregnancy, which has escalated during the pandemic. Women should be encouraged to share any concerns at every opportunity and be provided with advice and support on how to access the appropriate services if required.
- Healthcare providers should prioritise in-person appointments with women when there are safeguarding concerns, in order to provide extra support.
- There is evidence the pandemic has resulted in a greater level of anxiety and other mental health problems in pregnant women than in the overall population. Women should be asked about their mental health at every contact. Women who require further support should be signposted to resources and local services, which may be provided by virtual means. These include:
    - Sources of self-help for anxiety and stress.
    - Self-referral to local IAPT (Improving Access to Psychological Therapies) services in England. In Scotland, advice is available from Parentclub and NHS Inform. Further information is available from the RCM and Royal College of Psychiatrists websites.
- Women who express concern about their mental health or 'red flag' symptoms, such as suicidal thoughts or sudden mood changes, or where their families express these concerns on their behalf, should be supported to access urgent care either through appropriate signposting or, when required in severe cases, by immediate referral.

- Services should establish triage processes to ensure that women with mental health concerns can be appropriately assessed.

Summary of evidence and rationale for guidance

The appropriate use of PPE is to protect healthcare workers, women and their families by functioning as a physical barrier to the transmission of infectious particles present in bodily fluids. Units should follow the regularly updated public health guidance issued jointly by the UKHSA, NHS England, Public Health Wales and Public Health Agency (Northern Ireland), and the National Infection Prevention and Control Manual issued by NHS National Services Scotland. National guidance should be reviewed alongside local guidance and in collaboration with infection control teams. There is also clear guidance on PPE from the RCM.

The UK Government has issued guidelines on the use of face coverings within enclosed spaces in England; these are applicable to women attending outpatient maternity appointments (including scans) and to hospital visitors.[72] Scotland, Northern Ireland and Wales have issued similar guidance.

Before the pandemic, there was already extensive evidence of the inequality of experience and outcomes for women from Black, Asian and minority ethnic backgrounds giving birth in the UK.[48,142,143] The increased risks of COVID-19 among individuals of Black, Asian or minority ethnic background are likely to result from a number of factors such as socioeconomic disadvantage, and the fact that they are more likely to work in key worker roles, including health and social care. Women of Black, Asian or minority ethnic background who are living with socioeconomic deprivation and/or in crowded conditions, those who were born outside the UK and whose first language is not English, and those with a high BMI and/or underlying medical conditions appear to be at particularly high risk.

The RCOG Race Equality Taskforce has launched a joint campaign with FiveXMore that aims to help communication with women of Black, Asian or minority ethnic background, with five easy to remember steps.

There is currently an absence of accurate information about the additional risk of smoking and severe COVID-19 infection.[144] A scientific brief from the WHO[145] on smoking and COVID-19 concludes that smoking is associated with increased severity of disease and death in hospitalised COVID-19 patients. The UK National Centre for Smoking Cessation and Training have advised maternity units to resume carbon monoxide testing on all pregnant women, where it is safe to do so. A risk assessment must be undertaken prior to CO testing including a well-ventilated room and being able to maintain a 2 m distance between the woman and healthcare professionals. Recommendations on smoking screening and cessation support are based on previous evidence on the effectiveness of these interventions.

Pregnancy is a risk factor for hospital admission with influenza.[146] Influenza vaccination is safe and effective for pregnant women, who are included in the annual NHS flu campaign.[147] It is possible to be co-infected with influenza and SARS-CoV-2.[148] The impact of co-infection is not known. In addition, influenza symptoms are difficult to distinguish from COVID-19 symptoms.

Isolation, bereavement, financial difficulties, insecurity and inability to access support systems are all widely recognised risk factors for mental ill health and are expected to affect individuals more than usual during the pandemic.[149] Access to mental health services has also been constrained and delays in care has become evident through the recordings of maternal deaths by suicide during the pandemic.[77]

This pandemic has resulted in an increased level of anxiety and other mental health problems in the general population.[150,151] This has had a larger impact on women than on men.[152] There is increasing evidence that this is likely to be even greater for pregnant women, as pregnancy represents a period of additional uncertainty.[149,153,154] Specifically, these anxieties are likely to revolve around: a) COVID-19 itself, b) the impact of social isolation resulting in reduced support from wider family and friends, c) the potential of reduced household finances and d) major changes in antenatal and other NHS care, including some appointments being changed from in-person to telephone contact.[155-157] Meta-analyses and systematic reviews[75,76] have found higher rates of perinatal mental health disorders during the pandemic, including anxiety and depression.

The Royal College of Psychiatrists, in collaboration with NHS England and NHS Improvement, have developed recommendations on mental wellbeing during the COVID-19 pandemic.

The coronavirus pandemic has increased the incidence of domestic abuse.[155,158] Additional advice regarding support for victims of domestic abuse during the pandemic is available from the UK government. In addition, Women's Aid, Save Lives and Refuge have updated guidance for people experiencing domestic abuse during the COVID-19 outbreak.

3.3 How should women with suspected or confirmed COVID-19 needing hospital attendance or advice be cared for?

Advice

For women who telephone maternity services:

- If women report symptoms attributed to COVID-19 on the phone to maternity services, consider differential diagnoses for fever, cough or shortness of breath. This includes, but is not limited to urinary tract infection, chorioamnionitis and pulmonary embolism.
- If women have symptoms suggestive of COVID-19, they should be advised to follow the advice regarding confirmatory testing.

- Maternity units should develop triage tools to assess the severity of illness for women who telephone with suspected or confirmed COVID-19. This should include an assessment of symptoms, clinical and social risk factors and escalation pathways. This should include 'safety netting advice' about the risks of deterioration and when to seek urgent medical attention. Women may also be referred for community oxygen saturation monitoring.
- It is recognised that COVID-19 infection gives a transient risk factor for the development of VTE as it is a 'current systemic infection' in pregnancy in line with the RCOG Green-top Guideline No. 37a VTE risk assessment tool (see section 4).[159]

For women with possible or confirmed COVID-19 for whom hospital attendance is required or who self-present:

- These women should be advised to attend via private transport where possible.
- If an ambulance is required, the call handler should be alerted if the woman, or a member of her household, is symptomatic of COVID-19.
- Women should be advised to alert a member of maternity staff by mobile telephone on arrival at the hospital entrance prior to entering any of the buildings.
- Women should be met at the maternity unit or hospital entrance by staff wearing appropriate PPE to provide the woman with a fluid-resistant surgical mask.
- Staff providing care should wear appropriate PPE as per UK health protection guidance.
- Women should be cared for within isolation rooms from which all non-essential items have be removed prior to the woman's arrival (this includes other rooms in which the woman spends time during her hospital attendance [e.g. scan rooms when bedside scans are not appropriate]).
- Women should immediately be escorted to an isolation room or cohort bay/ward, suitable for the majority of care during their hospital visit or stay.
    - Isolation rooms or ward bays should ideally have a defined area for staff to put on and remove PPE, and suitable bathroom facilities.
- Women should be advised to wear a face mask until they are isolated in a suitable room or cohort bay.
- Only essential staff should enter the isolation room or bay.
- Visitors to isolation rooms or cohort bays/ward should be kept to a minimum and follow local hospital visitor policies.

- All clinical areas must be cleaned following use, according to specific COVID-19 UK wide public health guidance.

Summary of evidence and rationale for guidance

Maternity units should develop triage tools to assess the severity of illness for women who telephone with suspected or confirmed COVID-19. An example developed by clinicians in Guy's and St Thomas' NHS Foundation Trust is provided in Appendix IV. Triage tools should include an assessment of symptoms, clinical and social risk factors and escalation pathways. This should include 'safety netting advice' about the risks of deterioration and when to seek urgent medical attention.

Availability of resources, provision of services, building/unit configuration and local prevalence of COVID-19 will vary across geographical regions and will determine how women requiring hospital admission with confirmed or suspected COVID-19 are cared for. Advice on care in isolation rooms and COVID-19 cohort bays is available from the UKHSA, having been issued on behalf of the four nations of the UK.[160] This advice may change frequently and it is vital that healthcare providers stay abreast of the latest developments.

As above, units should follow the regularly updated advice on PPE, in conjunction with guidance from the RCM and their local guidance and infection control teams.[160,161] Guidance on cleaning clinical areas used to provide care to women with suspected or confirmed COVID-19 is available from the UKHSA.[160]

3.4 What are the considerations for antenatal care for women who have recovered from COVID-19?

Advice

- For women who have recovered from COVID-19 with mild, moderate or no symptoms, without requiring admission to hospital, antenatal care should remain unchanged.
- A transient additional risk factor should be recorded on the woman's VTE checklist as per the RCOG Green-top Guideline No. 37a risk assessment tool.[159] Appropriate VTE prophylaxis should be arranged with the woman's local maternity service if additional treatment is required.
- Services should ensure that women who have missed antenatal appointments because of self-isolation are seen as early as is practical after the period of self-isolation ends.
- For women who have recovered from a period of serious or critical illness with COVID-19 requiring admission to hospital for supportive therapy, ongoing antenatal care should be planned together with a consultant obstetrician prior to hospital discharge.

- Women who have been seriously or critically unwell from COVID-19 should be offered an ultrasound scan to assess the fetal biometry. It seems reasonable to arrange the first scan within the first 14 days following recovery and to consider further ultrasound monitoring on an individual basis.
- Women recovering from severe infection with COVID-19 should have enhanced monitoring for hypertensive disorders of pregnancy.

Summary of evidence and rationale for guidance

To date, there is an absence of evidence to guide the care for women recovering from mild or moderate symptoms of COVID-19. Women who have recovered should be encouraged to attend antenatal appointments in line with advice statements outlined above.

Studies have suggested an association between COVID-19 infection and stillbirth.[58,59,63] As discussed in section 1.6, adverse perinatal outcomes have been associated with severe placental disease that may occur over a short timescale. There is also evidence that moderate or severe COVID-19 infection may be associated with FGR in the more medium term.

The role of ultrasound in identifying at-risk babies in the short term is unknown as FGR is unlikely to be a feature over this timescale; it is also unknown whether abnormal umbilical artery Dopplers precedes stillbirth. Liquor volume has been normal in reported stillbirth cases. Based on the evidence available it is unlikely that ultrasound would detect or predict acute adverse outcomes, though it may have some role when used in conjunction with other monitoring. Although still uncommon, clinicians should be aware of severe placentitis associated with COVID-19 when reviewing women and the importance of ensuring women attend if they are experiencing reduced fetal movements especially when accompanied by a recent diagnosis of COVID-19. More evidence is required to advise on a care plan for these suspected cases where underlying COVID-19 placentitis remains a possibility.

Given the possible association with FGR in the more medium term (see section 1.6), women who have been seriously or critically unwell from COVID-19 should be offered an ultrasound scan to assess the fetal biometry. It seems reasonable to arrange the first scan within the first 14 days following recovery and to consider further ultrasound monitoring on an individual basis. Guidance on fetal growth surveillance following COVID-19 is available in the NHS England and NHS Improvement Saving Babies' Lives Care Bundle Appendix G.

Studies[60,162-164] have reported an increased risk of developing hypertension in pregnancy following COVID-19 infection. There are reassuring data[60,165] to suggest that women recovering from asymptomatic or mild COVID-19 infection are not at higher risk of developing hypertension, pre-eclampsia or preterm birth, which supports routine antenatal follow-up for this group. In severe or critical COVID-19 infection there is statistically significant evidence to demonstrate an increased risk of hypertensive disease in pregnancy (including pre-eclampsia) when compared to asymptomatic COVID-19 women (aRR 1.61, CI 1.18–2.20).

Therefore, this confirms that women recovering from severe infection with SARS-CoV-2 should have enhanced monitoring for hypertensive disorders of pregnancy.

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

4. Venous thromboembolism prevention

4. Venous thromboembolism prevention

Advice

- Women who are self-isolating at home should stay hydrated and mobile.
- Women should have a VTE risk assessment performed during their pregnancy in line with RCOG Green-top Guideline No. 37a. Infection with SARS-CoV-2 should be considered a transient risk factor and trigger reassessment.
- Where normally indicated, thromboprophylaxis should still be offered and administered as prescribed during the COVID-19 pandemic.
- If healthcare professionals are concerned about the risk of VTE during a period of self-isolation, a clinical VTE risk assessment (in person or by virtual means) should be performed, and thromboprophylaxis considered and prescribed on an individual basis.
- Local procedures should be followed to ensure women are supplied with low molecular weight heparin (LMWH), particularly where they cannot attend hospital during periods of self-isolation.
- Thromboprophylaxis initiated for pregnant women who are self-isolating should be continued until they have recovered from the acute illness (between 7 and 14 days). Advice should be sought from a clinician with expertise in VTE for women with ongoing morbidity and limited mobility.
- Pregnant women admitted with confirmed or suspected COVID-19 who are:
    - on low-flow oxygen and at low risk of bleeding should be offered a therapeutic dose of LMWH for thromboprophylaxis, unless birth is expected within 24 hours.
    - on high-flow oxygen, CPAP, non-invasive ventilation or invasive ventilation should be offered a prophylactic dose of LMWH.
- All pregnant women who have been hospitalised and have had confirmed COVID-19 should be offered thromboprophylaxis for 10 days following hospital discharge. A longer duration of thromboprophylaxis should be considered for women with persistent morbidity.
- If women are admitted with confirmed or suspected COVID-19 within 6 weeks postpartum, they should be offered thromboprophylaxis for the duration of their admission and for at least 10 days after discharge. Consideration should be given to extending this until 6 weeks postpartum for women with significant ongoing morbidity.

Summary of evidence and rationale for guidance

Pregnancy is a hypercoagulable state.[166] The existing RCOG Green-top Guidelines No. 37a[159] and 37b[167] on VTE prevention and management should continue to support decision making during the COVID-19 pandemic. VTE risk assessment in the context of the COVID-19 pandemic should consider both the hypercoagulable state associated with the infection, as well as the increased risk that may come from immobility with self-isolation.

Evidence[168,169] indicates that individuals admitted to hospital with moderate and severe COVID-19 are also hypercoagulable. Infection with SARS-CoV-2 may also be associated with an overall increased risk of maternal VTE. This risk is likely to be multifactorial, including the reduced mobility resulting from self-isolation at home or hospital admission and other associated obstetric or maternal morbidities. Consequently, the cumulative risk is difficult to quantify. In the MBRRACE rapid report[170] one women died from a confirmed thromboembolic event and a second woman experienced a sudden deterioration that may be attributed to a thromboembolic event. A study[60] has estimated the rate of thromboembolic events in relation to COVID-19 disease severity: 6% in a severe–critical group, 0.2% in a mild–moderate group and none in an asymptomatic group ($P < 0.001$ for trend across severity).

The above are recommendations are based on expert consensus opinion. VTE prevention for an unwell woman with COVID-19 is considered in section 6.2.

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

5. Labour and birth during the COVID-19 pandemic

5. Labour and birth during the COVID-19 pandemic

Women admitted to hospital, including maternity units, should be offered testing for SARS-CoV-2 on admission. This includes women admitted for intrapartum care.

5.1 What are the considerations for labour and birth in asymptomatic women who test or have tested positive for SARS-CoV-2?

Advice

- Low risk women who test positive for SARS-CoV-2 within 10 days prior to birth who are asymptomatic and wish to give birth at home or in a midwifery-led unit, should have an informed discussion around place of birth with their clinician.
- For asymptomatic women who test positive for SARS-CoV-2 on admission, continuous electronic fetal monitoring (CEFM) during labour using cardiotocography (CTG) is not recommended solely because of a positive test.
- Fetal monitoring options should be discussed with the woman, acknowledging the current uncertainties in women who are asymptomatic with a positive test for SARS-CoV-2.
- Women who test positive for SARS-CoV-2 should be offered delayed cord clamping and skin-to-skin contact with their baby in line with usual practice.

Summary of evidence and rationale for guidance

NHS England and NHS Scotland have recommended that women (and their support partners in NHS England) should be offered testing for SARS-CoV-2 when they attend maternity units to give birth.

While fetal compromise in women who are symptomatic of COVID-19 has been reported by some case series,[171,172] it is reassuring that measures of fetal compromise at birth for asymptomatic women who test positive for SARS-CoV-2 are not reported to differ from women who test negative.

The need for CEFM for asymptomatic women who test positive for SARS-CoV-2 but who are otherwise low risk for labour (e.g. CEFM would not otherwise be indicated by NICE Clinical Guideline [CG190] on *Intrapartum care for healthy women and babies*[173]) is an area of clinical uncertainty because of the lack of robust evidence. It is, therefore, important that asymptomatic women of low obstetric risk should continue to have the risks and benefits of CEFM discussed with them on a individual basis.

The practice of delayed cord clamping and skin-to-skin contact between the woman and her baby has been shown not to increase the transmission of SARS-CoV-2 to the neonate.[12,15] The well-documented benefits of these practices should be discussed with the woman to make an

informed choice and implemented in line with pre-pandemic practice. In the absence of other evidence, NICE CG190 should be followed.[173]

5.2 How should a woman with suspected or confirmed COVID-19 be cared for in labour if they are symptomatic?

Advice

- Women with mild COVID-19 symptoms can be encouraged to remain at home (self-isolating) in early (latent phase) labour consistent with routine care.
- If there are no concerns regarding the health of either the woman or baby, women who attend the maternity unit and would usually be advised to return home until labour is more established can still be advised of this, unless private transport is not available.
    - Women should be provided with the usual advice regarding signs and symptoms of labour, but also be informed about symptoms that might suggest deterioration related to COVID-19 and be advised to call back or reattend if concerned.
- Advice on PPE is available in section 5.8.
- Women with symptomatic suspected or confirmed COVID-19 should be advised to labour and give birth in an obstetric-led unit.
- On admission, a full maternal and fetal assessment should be undertaken, including:
    - Assessment of the severity of COVID-19 symptoms by the most senior available clinician.
    - Maternal observations including temperature, respiratory rate and oxygen saturation.
    - Confirmation of the onset of labour, as per standard care.
    - CEFM using continuous CTG in labour.
- The following members of the MDT should be informed of the woman's admission: consultant obstetrician, consultant anaesthetist, midwife-in-charge, consultant neonatologist, neonatal nurse-in-charge and the infection control team. Other members of the team may include an obstetric physician or respiratory physician.
- Standard hourly maternal observations and assessment should be performed (as per the recommendations in NICE CG190, *Intrapartum care for healthy women and babies*), with the addition of hourly oxygen saturation monitoring. Oxygen therapy should be titrated to aim for saturation above 94%.

- CEFM should be offered to women with symptomatic suspected or confirmed COVID-19 during labour and birth.
- Maternal infection with SARS-CoV-2 is in itself not a contraindication to performing a fetal blood sample or using fetal scalp electrodes.
- The number of staff members entering the room should be minimised, and units should develop a local policy specifying essential personnel for emergency scenarios.
- Women with symptomatic suspected or confirmed COVID-19 should be offered delayed cord clamping and skin-to-skin contact with their baby if the condition of the woman and baby allows.

Summary of evidence and rationale for guidance

COVID-19 infection and control guidance issued by the UKHSA, on behalf of the four nations of the UK, gives advice about avoiding disease transmission.[160]

In women with symptomatic COVID-19, there may be an increased risk of fetal compromise in active labour.[171,172,174,175] In addition, it is reported[176] that women with symptomatic COVID-19 have an increased risk of caesarean birth, which further supports the guidance to give birth in an obstetric unit where timely access to emergency care is available.

While further data are required in women with symptomatic confirmed or suspected COVID-19, it appears prudent to use CEFM, as would usually be recommended for maternal systemic infection.

The practice of delayed cord clamping and skin-to-skin contact between the woman and her baby has been shown not to increase the transmission of SARS-CoV-2 to the neonate.[12,15] The well-documented benefits of these practices should be discussed with the woman to make an informed choice and implemented in line with pre-pandemic practice. In the absence of other evidence, NICE CG190 should be followed.[173]

5.3 What are the considerations for labour and birth for women who have recovered from COVID-19?

Advice

- For women who have recovered from antenatal COVID-19 without requiring admission to hospital, and who have completed self-isolation in line with public health guidance, there should be no change to planned care during labour and birth.
- For women who have recovered following a hospital admission for serious or critical COVID-19 illness needing supportive therapy, healthcare professionals should discuss and plan place of birth with the woman. While making a personalised assessment,

consideration should be given to both the growth of the fetus and the woman's choices.

- Healthcare professionals should ensure that any ultrasound scan undertaken following a period of severe illness has been reviewed. If the interval between resolution of illness and presentation for birth has been insufficient to allow for a growth scan, the implications of this should be considered in the assessment and care plan.
- When participating in informed discussions with women about fetal monitoring, healthcare professionals should acknowledge evidence of fetal distress is based on small numbers of babies born to women symptomatic of COVID-19, and theoretical risks extrapolated from pregnancies affected by FGR in women with other coronaviruses.

Summary of evidence and rationale for guidance

There is an absence of evidence for this situation. The above is based on expert consensus.

5.4 What are the considerations for birth partners during the COVID-19 pandemic?

Advice

- Women should be supported and encouraged to have a birth partner present with them during active labour and birth if they wish to do so. This also applies to women with suspected or confirmed COVID-19 infection.
- Birth partners who are symptomatic, or in a period of self-isolation for confirmed SARS-CoV-2 infection, should remain in self-isolation at home and not attend the hospital.
- NHS England recommends efforts should be made to utilise the available testing capacity to test both the woman and her birth partner to mitigate infection risk where resources allow.
- Local level risk assessments should be made for each maternity service space (for example shared wards) to identify if there are elevated risks of SARS-CoV-2 transmission from the presence of a birth partner.
- On attendance at the maternity unit, all birth partners should be asked whether they have experienced any symptoms suggestive of COVID-19 in the preceding 10 days.
    - If they have had symptoms within the last 10 days, the birth partner should leave the maternity unit immediately and self-isolate at home, unless they have had a negative test result for SARS-CoV-2 since the onset of symptoms.

- If they have had a fever within the last 48 hours, birth partners should leave the maternity unit immediately and self-isolate at home, regardless of their test result, and follow the latest public health advice about further testing or isolation.

- Birth partners, not otherwise advised to be self-isolating, should be allowed to stay with the woman through labour and birth, unless the birth occurs under general anaesthetic. Further guidance about access to maternity services for a birth partner and other supportive adults has been published by the NHS and should be followed as far as possible.

- Birth partners should wear a face covering unless exempt, remain by the woman's bedside, be advised not to walk around the ward/hospital and should wash their hands frequently.

- Restrictions on visitors should follow local hospital policy.

- Trusts and health boards who are restricting access to the hospital for birth partners should prioritise access for the birth partners of women who require continuous support, such as women with disabilities, communication challenges or complex medical, mental health or social factors.

Summary of evidence and rationale for guidance

Having a trusted birth partner present throughout labour is known to make a significant difference to the safety and wellbeing of women in childbirth.[177-179] The pandemic has affected the levels of perinatal stress experienced by pregnant women, as well as feelings of fear and loneliness in relation to their birth experience.[180,181] A supportive birth partner is a recognised protective factor for the emotional wellbeing and birth experiences of women. UKHSA guidance, local hospital infection control and visitor policies should be adhered to.[160,182] The NHS has produced guidance to support the access of birth partners and other supportive adults to maternity services in England and Scotland.[183]

5.5 What informed discussions should take place with women regarding timing and mode of birth during the COVID-19 pandemic?

Advice

- Clinicians should discuss mode of birth during the COVID-19 pandemic with the woman, and consideration should be given to her preferences and any obstetric or fetal indications for intervention.

- A personalised assessment should take place to determine whether it is beneficial overall to delay a planned caesarean birth or induction of labour (IOL), and any associated appointments, for women who are self-isolating because of suspected COVID-19 in themselves or in a household contact.

- Consider the urgency of the birth and the risk of infectious transmission to other women, healthcare workers and, postnatally, to her baby.
- If a planned caesarean birth or IOL cannot be delayed, follow the advice for services providing care to women admitted with suspected or confirmed COVID-19.
- Women with worsening symptoms, or who are becoming exhausted, should be offered personalised information so they can make an informed decision about expediting birth.
- Senior obstetric and medical input should be sought when urgent birth of the baby is required to aid supportive care of a woman with severe or critical COVID-19 and vaginal birth is not imminent. Consider whether the benefits of an urgent caesarean birth outweigh any risks to the woman.
- The advice in section 5.8 on PPE for caesarean birth should be followed.
- Women and their families should be informed that donning PPE for emergency caesarean births is time-consuming but essential, and this may impact on the time it takes to assist in the birth of the baby. Consider this during decision making and, where possible, discuss during birth planning.

Summary of evidence and rationale for guidance

There is no evidence to favour one mode of birth over another in women with COVID-19. In a UKOSS study,[29] 12 (5%) babies tested positive for SARS-CoV-2 infection; six within the first 12 hours (two were born by unassisted vaginal birth and four by caesarean birth) and six after 12 hours (two born vaginally and four by caesarean birth). The rate of neonatal COVID-19 infection is no greater when babies are born vaginally, breastfed or stay with their mother after birth.[9,47,56,184]

Donning PPE is expected to lengthen the decision to birth interval because of the additional action required before commencing surgery, however, there is no evidence of this within the UK setting. A single centre cohort study[185] demonstrated a possible longer time to birth in urgent caesarean births for women with suspected or confirmed COVID-19 (25.5 minutes [95% CI 17.5–31.75] versus 18.0 minutes [95% CI 10.0–26.25]; $P = 0.113$]). This did not reach statistical significance, which may be explained by the study sample size which was not chosen to power for the outcome. Simulation training has been proposed as a way of improving the response to obstetric emergencies during the COVID-19 pandemic, including donning and doffing of PPE.[186]

5.6 What are the considerations for water birth?

Advice

- Water birth is not contraindicated for women who are asymptomatic of COVID-19 and presumed or confirmed SARS-CoV-2 swab negative, providing adequate PPE can be worn by those providing care.
- Women with symptomatic COVID-19 who have a cough, fever or feel unwell, should not labour and birth in water.
- Asymptomatic women who have tested positive for SARS-CoV-2 should be advised there is inadequate evidence about the risk of transmission of the virus in water.
- Healthcare providers should be aware that the integrity of PPE, such as a face mask, could be compromised if it becomes wet.

Summary of evidence and rationale for guidance

Labour and birth in water may confer benefits to women at low risk of complications during birth. Women report[74] that restrictions to access water birth are a concern during the pandemic, and therefore in the absence of contraindication to water birth, this option should be available. Care providers should discuss with women the lack of evidence on this topic in the context of the COVID-19 pandemic in order to facilitate informed decision making.

The RCM[187] notes that in relation to women who are asymptomatic of COVID-19, but test positive for SARS-CoV-2, there is inadequate evidence about the risk of transmission of the virus in water. There is evidence that SARS-CoV-2 RNA may be present in faeces, but no evidence to support that this has resulted in faecal–oral spread.[188,189] There is, therefore, insufficient evidence for or against the use of water in labour or birth for asymptomatic women and staff caring for them. The RCM does note that healthcare providers should be aware that the integrity of PPE, such as a face mask, could be compromised when it becomes wet.

It is recommended that women with pyrexia should not labour or birth in water.[173] Women with a cough or breathing difficulties, or those who feel unwell, should be closely monitored for their oxygen saturations and other vital signs and may require oxygen support. This care is better provided out of water to enable more effective monitoring and rapid access to emergency care.

5.7 What are the specific considerations for labour analgesia or anaesthesia?

Advice

- Entonox® (50% nitrous oxide and 50% oxygen) can be safely offered with a standard single-patient microbiological filter.
- The option of epidural analgesia should be discussed with women with suspected or confirmed COVID-19 when they are in early labour so they can make informed decisions regarding use or type of labour analgesia. Women should be informed that the use of epidural analgesia may avoid the need for GA in some cases, and the associated additional risks in this scenario.
- In those with current or recent COVID-19 a full blood count (FBC) should be checked prior to neuraxial anaesthesia to exclude thrombocytopenia.

Summary of evidence and rationale for guidance

Advice published on the considerations for labour analgesia or anaesthesia is based on expert opinion following consultation with the Obstetric Anaesthetists Association (OAA).

There is no evidence that the use of Entonox® is an aerosol-generating procedure (AGP).

There is no evidence that epidural or spinal analgesia or anaesthesia is contraindicated in the presence of coronaviruses.[190]

Intubation, required for GA, is an AGP. This significantly increases the risk of transmission of SARS-CoV-2 to attending staff.[160]

Retrospective analysis of UK case studies[191] reported significantly lower rates of GA for caesarean births (from 7.7% to 3.7%), as well as lower rates of conversion from neuraxial to GA during the initial wave of the SARS-CoV-2 infection in 2020. Recommendations for anaesthetic decision making made by the OAA are thought to have been influential in the decline in the GA rate. This supports the guidance that clinicians should facilitate fully informed discussions regarding choice of analgesia early in labour for women with suspected or confirmed COVID-19.

5.8 What personal protective equipment is recommended when caring for women during labour and birth?

Advice

- Healthcare professionals should follow national recommendations on the use of PPE in clinical settings.

- Owing to the differing levels of PPE required for caesarean birth, a multidisciplinary discussion should be held about the likelihood of a woman requiring a GA.
- Where GA is planned from the outset, all staff in theatre should wear PPE, including an FFP3 mask and visor. PPE should be donned prior to commencing the GA.
- Local policies should be developed to determine the type of PPE required where a higher chance of neuraxial anaesthesia being ineffective is anticipated to allow for completion of the procedure.

Summary of evidence and rationale for guidance

The appropriate use of PPE is to protect healthcare workers, women and their families by functioning as a physical barrier to the transmission of infectious particles present in bodily fluids. General advice from PHE, issued on behalf of the four nations of the UK, on type and specification of PPE is available.[192] The RCM and the OAA have provided specific advice on the type and specification of PPE for maternity care and obstetric anaesthesia.

The level of PPE required by healthcare professionals caring for a woman with COVID-19 who is undergoing a caesarean birth should be determined on the basis of the risk of her requiring a GA, which would require intubation and is, therefore, an AGP.[193]

The provision of neuraxial anaesthesia (spinal, epidural or combined spinal epidural [CSE]) is not an AGP.

The chance of requiring conversion to a GA during a caesarean birth commenced under neuraxial anaesthesia is small, but this chance increases with the urgency of caesarean birth. In situations where there are risk factors that make conversion to a GA more likely, the decision on what type of PPE to wear should be based on the individual circumstances. If the risk of requiring conversion to a GA is considered significant (e.g. in a category 1 caesarean birth), the theatre team should wear PPE appropriate to a GA in readiness.

A retrospective analysis[191] of anaesthetic practices for caesarean births in maternity units in the north-west of England during the initial wave of the COVID-19 pandemic found a reduction in GA rates (from 7.7% before the pandemic to 3.7% during). Furthermore there was a reduction in conversion rates from neuraxial to GA (from 1.7% to 0.8%). The key factors identified for these reductions included anaesthetic decision-making, recommendations from anaesthetic guidelines and the increased presence of on-site anaesthetic consultants. This is encouraging but should be interpreted with some caution as the authors did not report other maternal or neonatal outcomes.

5.9 How should obstetric theatres be managed during the COVID-19 pandemic?

Advice

- Elective obstetric procedures, such as caesarean birth or cervical cerclage, for women with suspected or confirmed COVID-19, should ideally be scheduled at the end of the operating list.
- Emergency procedures for women with suspected or confirmed COVID-19 should be conducted in a second obstetric theatre where available, allowing time for a full postoperative theatre clean as per national health protection guidance.
- The number of staff in the operating theatre should be kept to a minimum and all colleagues should wear appropriate PPE.
- Anaesthetic care for women with suspected or confirmed COVID-19 should be provided with reference to guidance from the Royal College of Anaesthetists (RCoA)/OAA/Faculty of Intensive Care Medicine/Intensive Care Society/Association of Anaesthetists.
- Operating theatre checklists should be used to aid closed loop communication as the wearing of PPE compromises communication.

The advice above is based on UK government advice on infection prevention and control,[160] and guidance from the RCoA, OAA, Faculty of Intensive Care Medicine, the Intensive Care Society and the Association of Anaesthetists.[193]

The use of PPE causes communication difficulties in operating theatre settings,[194] including obstetric theatres.[193] It is proposed that operating theatre checklists should be employed to improve communication in operating theatres.

5.10 What are the considerations for bereavement care during the COVID-19 pandemic?

Advice

- Maternity services should ensure that bereavement care remains of a high standard during the COVID-19 pandemic, with continued provision of appropriate intrapartum and postnatal care, including all appropriate investigations and postnatal appointments.
- Women should be supported and encouraged to have a support person accompany them to all care episodes related to a pregnancy loss if they wish.

Summary of evidence and rationale for guidance

Sands and the RCM have provided further guidance on bereavement care during the pandemic in their briefing Bereavement Care in Maternity Services During COVID-19 pandemic. Sands has also produced information for bereaved families about care during the pandemic.

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

6. Managing clinical deterioration of COVID-19

6. Managing clinical deterioration of COVID-19

6.1 How should a pregnant woman requiring hospital admission with symptoms suggestive of COVID-19 be investigated?

Advice

- Pregnant and postpartum women presenting with COVID-19 should be investigated and treated the same as non-pregnant women unless there is a clear reason not to do so.
- The decision for admission or for self-directed care at home depends on the overall clinical picture. Care at home should include clear 'safety netting advice' and in some instances this may involve home monitoring of oxygen saturation levels.
- Women presenting with a fever, should be cared for in line with RCOG Green-top Guideline No. 64a *Bacterial Sepsis in Pregnancy*. Testing for SARS-CoV-2 and other respiratory viruses should be offered in parallel to blood cultures.
- While pyrexia may suggest COVID-19, clinicians should not assume that all pyrexia is because of COVID-19. The possibility of bacterial or other viral infection should be considered and a full sepsis screen performed in line with the UK Sepsis Trust Sepsis Screening and Action Tool and IV antibiotics administered where appropriate.
- Bacterial (rather than viral) infection should be considered if the white blood cell count is raised (lymphocytes are usually low with COVID-19) and antibiotics should be commenced.
- Radiographic investigations should be performed as for the non-pregnant adult; this includes chest X-ray and computerised tomography (CT) of the chest. Urgent chest imaging is essential for the evaluation of an unwell woman with COVID-19 and should be performed promptly when indicated.
- A diagnosis of pulmonary embolism or heart failure should be considered for women presenting with chest pain, worsening hypoxia or a respiratory rate above 20 breaths/minute (particularly if there is a sudden increase in oxygen requirements), or in women whose breathlessness persists or worsens after expected recovery from COVID-19. Additional tests to investigate for possible differential diagnoses, including electrocardiogram, echocardiogram, CT pulmonary angiogram, ventilation perfusion lung scan, should be considered.
- Ferritin and C-reactive protein are usually raised in COVID-19. D-Dimer is also usually raised and is therefore not useful to assess VTE.
- Disseminated intravascular coagulation can also occur, with low platelets and low fibrinogen levels, and sometimes prolonged prothrombin time and/or activated partial thromboplastin time. This may not always be related to disease severity but, in some instances, may relate to placental COVID-19 infection.

- Women reporting reduced fetal movements in the context of current or recent COVID-19 infection should be advised to attend for assessment. Only if fetal assessment is non-reassuring, further investigations should ideally include a FBC and coagulation screen (including fibrinogen level). A new finding of thrombocytopenia or low fibrinogen level in this context should prompt careful ongoing assessment for fetal compromise.

Summary of evidence and rationale for guidance

The clinical symptoms of COVID-19 overlap with those of a variety of other clinical conditions. Healthcare providers should consider all differential diagnoses for women who present with a fever in pregnancy and follow the advice and guidance of the RCOG Green-top Guideline No. 64a.[195]

Several studies[196] have shown decreased lymphocyte counts in the general population affected by COVID-19. One systematic review[197] noted decreased lymphocyte counts in pregnant women.

'Safety netting' describes what symptom deterioration to look out for and the specific actions to take if this occurs. Pulse oximetry may be offered as part of this process, or used in some situations, for home monitoring of oxygen saturation. An example of safety netting might include the points below, and further advice is available from the NHS.[183,198,199]

- Call your GP/local out-of-hours service/labour ward (the advice should be clear and specific to each local service) as soon as possible if you start feeling more unwell or more breathless, or are having difficulty breathing when getting up to go to the toilet or similar, or you sense that something is wrong (e.g. general weakness, extreme tiredness, loss of appetite, small volumes of concentrated urine, unable to care for yourself), or if you use a pulse oximeter and your blood oxygen level is 94% or 93%.
- Attend your nearest A&E within an hour, or call 999 immediately, if you are unable to complete short sentences when at rest because of breathlessness, or your breathing suddenly worsens within an hour, or you have blue lips or a blue face, or you feel cold sweaty and pale, or collapse or faint, or become agitated, confused or very drowsy, or you use a pulse oximeter and your blood oxygen level measures 92% or less.
- If using a pulse oximeter, caution should be observed for women with darker skin tones as pulse oximeters may overestimate the oxygen saturation.[200]

6.2 How should a pregnant, or recently pregnant, woman with suspected or confirmed COVID-19 who is clinically deteriorating be cared for?

Advice

Organisation and principles of care:

- Obstetricians should be familiar with and follow local guidelines for the initial investigation and care of women presenting with possible COVID-19.
- Women with suspected COVID-19 should be treated as if positive until test results are available.
- The priority for medical care should be to stabilise the woman's condition with standard therapies.
- An urgent MDT meeting should be arranged for any unwell woman with suspected or confirmed COVID-19. This includes women who are requiring oxygen to maintain saturations between 94% and 98%, women with a respiratory rate above 20 breaths/minute and women with a heart rate greater than 110 beats/minute. This should ideally involve senior decision makers and may include: a consultant obstetrician, consultant anaesthetist, midwife-in-charge, consultant neonatologist, neonatal nurse-in-charge, intensivist responsible for obstetric care, an obstetric physician, a respiratory physician, the infection control and critical care outreach teams. The discussion should be shared with the woman, and her family if she chooses. The following should be considered:
    - Key priorities for medical care of the woman and her baby, and her birth preferences.
    - The most appropriate location of care (e.g. ICU, 'COVID bays', specific COVID-19 wards, isolation room in infectious disease ward or other suitable isolation room) and lead specialty.
    - Concerns among the team regarding special considerations in pregnancy, including the health of the baby.
- A consultant in obstetrics and gynaecology should review all pregnant and recently pregnant women with suspected or confirmed COVID-19 who are in hospital at least daily, particularly if they are admitted to a bed outside of the maternity unit.
- If appropriate, a designated team member should be responsible for regularly updating the woman's family about her health, and that of the baby.

Observations and investigations:

- Clinicians should monitor both the absolute values and trends of the hourly observations, including heart rate, respiratory rate and oxygen saturation.

- Clinicians should be aware that young, fit women can compensate for deterioration in respiratory function and are able to maintain normal oxygen saturations until sudden decompensation.
- Units should have an escalation plan for the care of pregnant and postnatal women with COVID-19.
- A woman's care should be escalated urgently if any of the following signs of decompensation develop:
    - increasing oxygen requirements or FiO_2 above 35%,
    - increasing respiratory rate despite oxygen therapy of, or above, 25 breaths/minutes or a rapidly rising respiratory rate,
    - reduction in urine output when this is being monitored,
    - acute kidney injury (serum creatinine levels above 77 µmol/l in women with no pre-existing renal disease),
    - drowsiness, even if the oxygen saturations are normal.
- The possibility of myocardial injury should be considered, as the symptoms are similar to those of respiratory complications of COVID-19.
- Clinicians should be advised to seek support from haematology if evidence of COVID-19-related coagulopathy develops.
- The appropriateness and frequency of fetal heart rate monitoring should be considered on an individual basis, accounting for the gestational age and the maternal condition.

Planning for the birth of the baby:

- For pregnant women in the third trimester who are unwell, an individualised assessment should be undertaken by the MDT to decide whether emergency caesarean birth or IOL should be performed, either to facilitate maternal resuscitation (including the need for prone positioning) or because of concerns regarding fetal health.
- If maternal stabilisation is required before birth can be undertaken safely, this is the priority, as it is in other maternity emergencies.
- If urgent intervention for birth is indicated for fetal reasons, then birth should be expedited as for usual obstetric indications, provided the maternal condition is stable.

- When iatrogenic preterm birth is required, the administration of antenatal corticosteroids to promote fetal lung maturation and magnesium sulfate for fetal neuroprotection should be considered by the MDT.

A useful summary on supportive care for adults diagnosed with COVID-19 has been published by the WHO.[201] Specific guidance on the care of patients with COVID-19 who are admitted to critical care has been published by NICE and SIGN.[202,203]

Hospitals should have escalation guidelines for the care of pregnant and postnatal women with COVID-19. An example of a maternity escalation plan from Guy's and St Thomas' NHS Foundation Trust is given in Appendix V. Appendix VI may also provide a useful template to formulate a maternity care checklist for hospitals caring for pregnant/postpartum women who become unwell with COVID-19.

As discussed in section 4, infection with SARS-CoV-2 requiring admission to hospital is associated with an increased risk of VTE. All pregnant and recently pregnant women should be assessed for risk of VTE and prescribed thromboprophylaxis with LMWH unless there is a contraindication. The dose of LMWH should be considered on an individual basis and discussed with the MDT. There is currently not enough evidence in pregnant women to recommend therapeutic anticoagulation routinely in the absence of suspected or proven VTE. Women who take LMWH thromboprophylaxis during pregnancy should discontinue this if their platelet count falls below 50×10^9/l and their care should be discussed with a haematologist.

While most patients with severe COVID-19 infection will have normal or even high platelet counts, COVID-19 can be associated with thrombocytopenia.[204] It was previously suggested that when aspirin has been prescribed as prophylaxis for pre-eclampsia or SGA, it should be discontinued for the duration of the infection as this may increase the bleeding risk in women with thrombocytopenia.[205] Results from the RECOVERY trial,[206] however, have concluded that, in general, prescribing 150 mg aspirin daily to hospitalised patients with COVID-19 can increase the likelihood of being discharged home alive within 28 days (RR 1.06, CI 1.02–1.1). The trial also noted the rate of thromboembolic events was lower in the group allocated to aspirin, but there was an increase in the risk of a major bleeding event. The decision to stop aspirin prophylaxis during an acute illness with COVID-19 should therefore be balanced by the risk of bleeding versus the evidence for improved outcomes, but it seems reasonable for this to be continued in most cases. LMWH thromboprophylaxis during pregnancy should be discontinued when the woman's platelet count falls below 50×10^9/l and their further care should be discussed with a haematologist.

Myocardial injury as demonstrated by abnormal cardiac biomarkers and bradycardia may be common among pregnant women with severe or critical COVID-19.[207] Early involvement of an MDT to investigate for potential myocardial injury is essential if this is suspected.[208] Further details of investigation and management is available in the NICE rapid guideline on managing COVID-19.[208]

Increased rates of iatrogenic preterm birth are associated with severe COVID-19 infection in pregnancy (sections 1.4.3 and 1.6). Antenatal corticosteroids are well established as being beneficial in preterm labour, or if iatrogenic preterm birth is anticipated.[56] Magnesium sulfate therapy is recommended for neuroprotection of the neonate, and should be offered to women up to 29^{+6} weeks of gestation and considered up to 33^{+6} weeks of gestation.[56] The administration of steroids and magnesium sulfate to women who are severely unwell with COVID-19 should be considered by an MDT.

For non-specialist anaesthetists and physicians involved in the care of pregnant women with COVID-19 and other medical conditions, useful information is available from the RCoA guideline *Care of the critically ill woman in childbirth; enhanced maternal care* and the Royal College of Physicians' *Acute care toolkit 15: Managing acute medical problems in pregnancy*.

Prone positioning of patients with moderate to severe acute respiratory distress syndrome (ARDS) can improve respiratory function and has been recommended for the care of patients with COVID-19.[201] There is little evidence on the use of prone positioning in pregnancy, and guidance from the Intensive Care Society in the UK[209] advises that it is relatively contraindicated in the second and third trimesters of pregnancy. However, a review article[210] on prone positioning for pregnant women who are unwell with COVID-19 provides advice, guidance and an algorithm on how this can be undertaken successfully in the second and early third trimesters.

6.3 What therapies should be offered to pregnant, or recently pregnant, women with COVID-19?

Advice

- If there is clinical uncertainty about whether to offer a therapy to a pregnant woman, advice should be sought through maternal medicine networks.
- Oxygen should be titrated to target saturations to 94–98%. Using escalation through nasal cannula, face mask, venturi mask, non-rebreather mask, non-invasive positive airway pressure (e.g. CPAP), intubation and IPPV, and ECMO as appropriate. Referrals to the NHS ECMO service should be made for pregnant or postpartum women using the same criteria as for other adult patients, i.e. if worsening severe respiratory failure despite appropriate conventional ventilatory support, or for women in whom lung-protective ventilation cannot be achieved because of the severity of hypoxaemia or hypercapnia, or significant air-leak (e.g. barotrauma or bronchopleural fistula).
- Proning should be strongly considered. Although evidence is limited there are reports that this is feasible (with appropriate padding).

- Caution should be applied to IV fluid management:
    - Hourly fluid input/output charts should be used to monitor fluid balance in women with moderate to severe symptoms of COVID-19.
    - The aim should be to maintain a neutral fluid balance.
    - When required, boluses in volumes of 250–500 ml should be employed and an assessment for fluid overload made before proceeding with further fluid resuscitation.
- Antibiotics should be commenced at presentation if there is clinical suspicion of bacterial infection or sepsis, with an early review and rationalisation of antibiotics if COVID-19 is confirmed. Even when COVID-19 is confirmed, clinicians should remain open to the possibility of another coexisting condition. There should be no delay in the administration of therapy that would usually be given in maternity care (e.g. IV antibiotics in woman with fever and prolonged rupture of membranes).
- All pregnant women should be assessed for risk of VTE and, where indicated, prescribed thromboprophylaxis with LMWH unless there is a contraindication (see section 4). The dose of LMWH should be considered on an individual basis and discussed with the MDT. Therapeutic doses of LMWH should be employed when VTE is suspected until objective testing can be undertaken.
- Thrombocytopenia may be associated with severe COVID-19. For women with thrombocytopenia (platelets less than 50×10^9/l), aspirin and LMWH thromboprophylaxis should be discontinued and haematology advice sought. The use of mechanical aids (such as intermittent pneumatic compression) should be used if LMWH therapy is contraindicated or paused secondary to thrombocytopenia.
- Maternal corticosteroid therapy should be given for 10 days or up to discharge, whichever is sooner, for women who are unwell with COVID-19 and requiring oxygen supplementation or ventilatory support. Suggested steroid regimens:
    - If steroids are not indicated for fetal lung maturity, oral prednisolone 40 mg daily (or oral methylprednisolone 32 mg daily), or IV hydrocortisone 80 mg twice daily, for 10 days or until discharge, whichever is sooner. IV methylprednisolone is an alternative especially for ICUs more familiar with this preparation (e.g. 1 mg/kg twice daily for 5–7 days, weaned to 1 mg/kg once daily for 5–7 days).
    - If steroids are indicated for fetal lung maturity, intramuscular dexamethasone 12 mg twice (24 hours apart), immediately followed by oral prednisolone 40 mg once a day, or IV hydrocortisone 80 mg twice daily, to complete a total of 10 days or until discharge, whichever is sooner.

- Short courses of steroids, such as the course described in the RECOVERY trial (dexamethasone 6 mg once a day for up to 10 days), are considered safe in breastfeeding.[211]

- The interleukin-6 receptor antagonist (anti-IL6) tocilizumab has been shown to improve outcomes, including survival, in hospitalised patients with hypoxia (oxygen saturation below 92% on air or requiring oxygen therapy) and evidence of systemic inflammation (C-reactive protein at or above 75 mg/l). Although data for the use of tocilizumab in pregnancy in this situation are limited, there is currently no evidence that tocilizumab is teratogenic or fetotoxic. For women meeting the criteria above (hypoxic with systemic inflammation), the use of tocilizumab should be strongly considered. It is recommended that any decision to treat with anti-IL6 agents should be taken by an MDT, including obstetric and infection specialists, and given if the benefits outweigh the risks.

- Strongly consider treatment with neutralising monoclonal antibodies (nMABs) in pregnant and breastfeeding women if they are symptomatic, hospitalised with COVID-19 infection, and have no SARS-CoV-2 antibodies. The decision about which preparation to offer may depend on the variant; the most up-to-date information can be found at the Medicines and Healthcare products Regulatory Agency (MHRA) Central Alerting System.

- Sotrovimab (Xevudy), a nMAB, is recommended for pregnant women in the community who have recent-onset PCR-confirmed SARS-CoV-2 infection and are at very high risk (e.g. those with active malignancy, primary immune deficiencies, HIV with low CD4 count, solid organ transplants, etc.). It is likely the counselling for, and the administration of, sotrovimab will need direct involvement of secondary care. Updated information can be found at the MHRA Central Alerting System.

- Remdesivir may be considered in pregnant women with COVID-19 as described below if a woman is not improving or if there is deterioration. Clinicians should be aware that the fetal risk profile of remdesivir is largely unknown.

- Molnupiravir is not recommended in pregnancy until further studies have established its effectiveness and safety.

- Other therapies (e.g. antivirals such as Paxlovid [PF-07321332/ritonavir]) are being investigated for the management of COVID-19, and pregnant women should be offered the opportunity to enrol, if they are eligible, in clinical trials (such as the RECOVERY trial).

- Hydroxychloroquine, lopinavir/ritonavir and azithromycin have been shown to be ineffective in treating COVID-19 infection and should not be used for this purpose.

Summary of evidence and rationale for guidance

Adequate early oxygen therapy is essential.[31] There is evidence that ECMO is either not being considered or being inappropriately discounted[31] and there is now a UK NHS consensus statement for COVID-19 patients on the criteria for considering, and referring to, an ECMO centre.[212]

There is no evidence to guide prophylactic LMWH dosing in obstetric patients with COVID-19, i.e. whether to prescribe the usual prophylactic dose, a higher prophylactic dose or a therapeutic dose. There is some evidence to guide dosing in other groups of patients,[213,214] which may not translate to an obstetric population, and this is also summarised in the NICE *COVID-19 rapid guideline: managing COVID-19*.[208]

The interim results of the RECOVERY trial demonstrated a significant reduction in 28-day mortality for individuals with COVID-19 requiring oxygen who were given corticosteroid therapy (age-adjusted rate ratio 0.83, 95% CI 0.75–0.93; $P < 0.001$).[215] The RECOVERY trial protocol for pregnancy recommends oral prednisolone 40 mg once daily and, in women unable to take oral medicine, IV hydrocortisone 80 mg twice daily instead of dexamethasone treatment.[77,216,217] Unlike dexamethasone, prednisolone and hydrocortisone are extensively metabolised in the placenta with minimal transfer to the fetus.

While the neonatal benefits of antenatal corticosteroids (betamethasone and dexamethasone) are well-established when administered to women at risk of imminent preterm birth (NICE NG25),[56] exposure to repetitive doses of steroids is associated with adverse neonatal outcomes.[218] It is, therefore, recommended that if corticosteroids are not indicated for fetal lung maturity, oral prednisolone 40 mg once a day, or IV hydrocortisone 80 mg twice daily, should be administered for 10 days or up to discharge, whichever is sooner. If steroids are indicated for fetal lung maturity, intramuscular dexamethasone 12 mg twice (24 hours apart), immediately followed by oral prednisolone 40 mg once a day, or IV hydrocortisone 80 mg twice daily, to complete a total of 10 days or until discharge, whichever is sooner. Methylprednisolone is commonly used in the intensive care setting and may be used for those more familiar with its administration. A reasonable dose would be oral methylprednisolone 32 mg daily, or it may be given IV (e.g. 1 mg/kg twice daily for 5–7 days, weaned to 1 mg/kg once a day for 5–7 days).

The WHO[219] has recommended the use of anti-IL-6 agents, tocilizumab and sarilumab, for patients with severe or critical COVID-19 infection. Corticosteroids should be used alongside anti-IL-6 agents in patients meeting the severity criteria. A DIC-like coagulopathy may rarely occur after only relatively mild disease in pregnancy. In contrast to COVID-19 in non-pregnant individuals there may be low platelets and fibrinogen, and aggressive treatment (including with cryoprecipitate) and earlier delivery may be warranted. Anti-IL-6 agents reduce mortality (OR 0.86, 95% CI 0.79–0.95)[220] and the need for mechanical ventilation (OR 0.72, 95% CI 0.57–0.90).[221] Tocilizumab is given as single IV infusion of 8 mg/kg of actual body weight, up to a maximum of 800 mg. Sarilumab is most commonly given at 400 mg as single IV infusion consistent with the REMAP-CAP trial.[215,221-225] Drug registries[226,227] on the use of tocilizumab

in pregnancy have limited numbers and show no evidence of harm. Tocilizumab is excreted in very low levels in breast milk.[228] Any decision to treat pregnant or postnatal women with anti-IL6 agents should be taken by an MDT and, when feasible, in discussion with the woman.

Comparable efficacy between tocilizumab and sarilumab has been demonstrated in several international clinical trials.[225,229,230] When tocilizumab is unavailable or cannot be used, it is reasonable to consider using sarilumab in severe cases of COVID-19.[231] There has been no research examining the safety of sarilumab in pregnancy or during breastfeeding. Decisions to use sarilumab should be made with multidisciplinary input, and ideally within the context of a clinical trial.

There is a question around the timing of BCG vaccination for the babies of women who have received tocilizumab. In general, women who have been taking biologics throughout pregnancy are advised to defer BCG vaccination until the baby is aged 6 months because of a theoretical possibility of neonatal or infant immunosuppression. However, there is limited evidence for that recommendation and there are data to suggest that babies born to these women are able to mount a good immune response. Tocilizumab is only used as a short dose, is extremely unlikely to affect the baby, and delay in BCG immunisation may cause more harm than good. It therefore seems reasonable, after an informed discussion, to offer BCG immunisation at the usual time in pregnancy. Note that Ronapreve® (casirivimab plus imdevimab) is not an immunosuppressant and maternal administration does not require any changes to the infant vaccine schedule.

nMABs are synthetic antibodies that bind to the spike protein of SARS-CoV-2, preventing subsequent entry of the virus into the host cell and its replication. This effectively 'neutralises' the virus particle.[232] Data on the safety of monoclonal antibodies in pregnancy have been evaluated in earlier cohort and registry studies, indicating that exposure in pregnancy is not associated with an increased risk for adverse pregnancy outcomes when compared to unexposed pregnancies with the same underlying medical diseases.[233] This is supported by a consensus report on immunosuppressives and biologics during pregnancy and lactation, with no evidence of elevated adverse pregnancy outcomes or malformation risks,[234] and in a small observational series' of tocilizumab in pregnant women with COVID-19.[235]

There are two nMABs with conditional marketing authorisation for use in the UK in the treatment of COVID-19. These are Ronapreve® and sotrovimab.

Results from the RECOVERY trial[236] indicated that Ronapreve® reduced the relative risk of mortality by 20% (24% in the treatment group versus 30% in those who received standard care alone) in hospitalised patients with COVID-19 who had not mounted an antibody response of their own to the virus (were seronegative/anti-S antibody negative) at the time of treatment. The RECOVERY trial included women who were pregnant or breastfeeding, with no serious adverse events reported. Although there are no specific data for sotrovimab in pregnant women, it is recommended that both Ronapreve® and sotrovimab may be used during pregnancy.[232] Evidence indicates that Ronapreve® has significantly decreased efficacy against the Omicron variant.[237] Sotrovimab use in breastfeeding is not well researched and

should therefore be used with caution. However, because it is a large protein molecule, the amount in breast milk is likely to be very low. It is also likely to be partially destroyed in the infant's gastrointestinal tract and absorption by the infant is probably minimal.[238]

Sotrovimab is recommended for pregnant women in the community who have recent-onset PCR-confirmed SARS-CoV-2 infection and are at very high risk (e.g. those with active malignancy, primary immune deficiencies, HIV with low CD4 count, solid organ transplants, etc.).[239] Data suggest that administration in these groups resulted in a relative risk reduction in hospitalisation or death by 85%. There is no clear view, however, as to how nMABs should be given to pregnant women in the community. Given the relative rarity of this situation, it seems most appropriate administration should be through secondary care and involve the most experienced team members available (e.g. a maternity COVID-19 Champion, a clinician with maternal medicine experience, or an obstetrician working jointly with a physician experienced in COVID-19 treatment).

Eligibility criteria have been published by the MHRA for advice on the use of nMABs in hospital/community settings and can be found in detail by accessing their Central Alerting System, which is regularly updated. Dose scheduling and exemptions can also be accessed using this link.

Remdesivir (Veklury®), an IV antiviral medication, has conditional marketing authorisation in the UK. Eligibility criteria for its use can be accessed via the MHRA Central Alerting System. The evidence demonstrates that administering to non-hospitalised patients with risk factors for disease progression within 7 days of COVID-19 symptom onset, resulted in a relative risk reduction of 87% in hospitalisation or death at day 28.[240] To date, there have been limited data on remdesivir use in pregnant women. Remdesivir should ideally be avoided in pregnancy and while breastfeeding unless clinicians believe the benefits of treatment outweigh the risks to the individual.[232] Since the safety of remdesivir in pregnancy is largely unknown it should be:

- considered on an individual basis for those who are stable but not improving
- considered more strongly in those who are deteriorating.

In breastfeeding women with COVID-19, the use of remdesivir should be restricted to women where benefit has been reported (hospitalised patients requiring oxygen therapy, especially early in disease course, and not in patients who are mechanically ventilated).[241] Any decision to treat with remdesivir should be taken by an MDT and, when feasible, in discussion with the woman.

Molnupiravir is an oral antiviral medicine which has demonstrated a relative risk reduction of 30% in the composite primary outcome of hospitalisation or death at day 29 during the phase 3 MOVe-OUT trial in at-risk, non-hospitalised adult patients with mild–moderate COVID-19.[242] A relative risk reduction of 30% was seen in the composite primary outcome of hospitalisation or death at day 29 (6.8% in the molnupiravir group versus 9.7% in the placebo group, $P = 0.0218$). Eligibility criteria required that all patients had laboratory-confirmed mild–moderate COVID-19, with symptom onset within 5 days of study randomisation, and

to have a significant risk factor (e.g. obesity, diabetes or heart disease). Molnupiravir is not recommended in pregnancy, however, until further studies have established its efficacy and safety. Pregnant women who have received molnupiravir at any stage in their pregnancy should be discussed with UKTIS for further advice (www.uktis.org, 0344 892 0909 Mon-Fri 9am–5pm) and follow-up as per MHRA advice.

A review of the literature on ivermectin does not show benefit for ivermectin in either hospital or community settings, and it should only be considered as part of a clinical trial.[208]

Pregnant women are eligible for enrolment in the RECOVERY trial.[215,216]

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

7. Postnatal care

7. Postnatal care

Routine postnatal care for women in accordance with NICE guideline [NG194] *Postnatal care* and the RCOG guidance for optimising maternity services in coronavirus (COVID-19) pandemic - antenatal and postnatal care should be followed. As the local prevalence of COVID-19 varies, strategies will be needed to ensure that previous evidence-based services which were suspended or modified are reinstated.

7.1 How should neonatal care for the baby be provided during the COVID-19 pandemic?

Advice

- Women and their babies should remain together in the immediate postpartum period if they do not otherwise require urgent maternal care or additional neonatal support.
- Women with suspected or confirmed COVID-19 should remain with their baby and be supported to practise skin-to-skin/kangaroo care if the newborn does not require additional medical care at this time.
- Adopt a precautionary approach for a woman who has suspected or confirmed COVID-19 and whose baby needs to be cared for in the neonatal unit to minimise any risk of women-to-infant or women-to-staff transmission; at the same time, involve parents in decisions, mitigating potential problems for the baby's health and wellbeing and for breastfeeding, bonding and attachment.
- Women should be supported to make an informed decision about how they feed their baby. Women who choose to breastfeed should be supported to do so, even if they have probable or confirmed COVID-19.
- Babies born to SARS-CoV-2-positive women should be cared for as per guidance from the British Association of Perinatal Medicine (BAPM).
- Specific guidance on neonatal resuscitation during the COVID-19 pandemic is available from the Resuscitation Council.

Summary of evidence and rationale for recommendation

There are limited data to guide the neonatal care of babies of women who tested positive for SARS-CoV-2 in the third trimester.[243] A prospective cohort study[244] in the UK investigating SARS-CoV-2 infection in the first 28 days of life found neonatal infection is uncommon (66 babies with confirmed SARS-CoV-2 infection [incidence 5.6/10 000 livebirths, 95% CI 4.3–7.1], of whom 28 [42%] had severe neonatal SARS-CoV-2 infection [incidence 2.4/10 000 livebirths, 95% CI 1.6–3.4]), and infection with neonatal admission following birth to a woman with

perinatal SARS-CoV-2 infection was unlikely; consequently, this study supported guidance to avoid separation of women and their babies.

The RCPCH/BAPM and the RCM have provided separate guidance on this topic,[245,246] with accompanying FAQs produced by BAPM, as well as various COVID-19 resources on newborn life support from the Resuscitation Council.

7.2 What should women and families be advised regarding infant feeding during the COVID-19 pandemic?

Advice

- Breastfeeding should continue to be recommended to all women.
- Individualised support, advice and guidance on breastfeeding should be offered to all women who wish to breastfeed. Remote support for breastfeeding should be signposted to all women.
- Women and their families should be informed that infection with COVID-19 is not a contraindication to breastfeeding.
- Women and their families should be supported to make a fully informed choice on how to feed their baby. The potential risks and benefits of feeding the baby near individuals with suspected or confirmed COVID-19 should be discussed.
- When a woman is not well enough to care for her own infant or where direct breastfeeding is not possible, the woman should be supported to express her breast milk by hand or using a breast pump, and/or offer access to donor breast milk. It is entirely appropriate for a woman to choose formula milk to feed her baby.
- The following RCPCH/BAPM precautions should be taken to limit viral spread to the baby:
    - Wash hands before touching the baby, breast pump or bottles.
    - Avoid coughing or sneezing on the baby while feeding.
    - Consider wearing a face covering or fluid-resistant face mask while feeding or caring for the baby.
- Babies should not wear masks or other face coverings as they risk suffocation.
- When women are expressing breast milk in hospital, a dedicated breast pump should be used. Follow recommendations for pump cleaning after each use.

- Adhere strictly to sterilisation guidance for babies who are bottle-fed with formula or expressed milk.
- Consider asking someone who is not infected with COVID-19 to bottle feed the baby expressed breastmilk or formula.

Summary of evidence and rationale for guidance

Throughout the pandemic, international organisations including WHO and UNICEF have continued to support breastfeeding.[247,248] Breastfeeding has many advantages for the woman and her infant and does not need to be discontinued during COVID-19 infection nor before or following vaccination of the woman.

One systematic review[249] has established the presence of antibodies against SARS-CoV-2 in breastmilk, both when the woman contracts the disease and after the vaccine against the virus has been administered. Although there is a transmission of antibodies against SARS-CoV-2 through breastmilk this appears to be passive transmission rather than because of neonatal infection: SARS-CoV-2 RNA has been found in breastmilk, but not viable viruses. This review also supported recommendations to continue breastfeeding during mild–moderate maternal COVID-19 illness, as breastmilk may provide specific immune benefits to infants. The main risk of breastfeeding is postulated to be the close contact between the baby and the woman, who is likely to share infective respiratory droplets.

Specific recommendations on minimising the risk of COVID-19 transmission when feeding babies has been developed by the BAPM and RCM.[245,246] The NHS has general guidance on sterilising bottles in order to protect babies against infections.

Face coverings are not appropriate for babies. The UK government advice for using face coverings is directed towards adults and children aged 11 and over.[250]

7.3 What are the considerations for postnatal care for women and babies following admission with COVID-19?

General advice

- Postnatal care should be provided as per NICE guideline [NG194] *Postnatal care*.
- Following childbirth, effective contraception should be discussed with and offered to all women prior to discharge from maternity services.

Advice

- It is important to remember that the advice regarding self-isolation and how to act when you have been identified as a close contact of COVID-19 is updated regularly and is not aligned throughout the UK. Regular review of the latest government advice (England, Scotland, Wales and Northern Ireland) is recommended.

- When a woman with COVID-19 infection has given birth, all members of her household should refer to the relevant government self-isolation guidelines (England, Scotland, Wales and Nothern Ireland).
- Women and their families should be given clear advice about careful hand hygiene and infection control measures when caring for and feeding the baby.
- Families should be guided on how to identify signs of illness in their newborn or worsening of the woman's symptoms and should be provided with appropriate contact details if they have concerns or questions about their baby's wellbeing. NHS leaflets, providing this information, are also available.
- Women should be advised that, if they or their babies require readmission for postnatal obstetric or neonatal care during a period of self-isolation for suspected or confirmed COVID-19, they should contact their local unit ahead of arrival.
- Women who have recently given birth and test positive for COVID-19 should receive all recommended advice, guidance and support in relation to their postnatal physical and mental health, and wellbeing and care of their newborn baby. This includes necessary in-person assessments using appropriate PPE.
- In-person home or clinic appointments should be offered to allow an overall assessment of the physical and psychological health and wellbeing of the woman and her baby.
- In some areas, and where appropriate, some postnatal care may need to be via telephone or video link, but considerations should be made upon individual circumstances. This should be discussed with women and families.
- All pregnant women who have been hospitalised and have had confirmed COVID-19 should be offered thromboprophylaxis for 10 days following hospital discharge. A longer duration of thromboprophylaxis should be considered for women with persistent morbidity. See section 4 for further information.
- For advice about neonatal BCG vaccination, following maternal immunotherapy for the treatment of COVID-19 infection in pregnancy, see section 6.3.

Summary of evidence and rationale for guidance

The BAPM has published guidelines on the neonatal care of babies born to women with COVID-19.[245]

It has generally not been appropriate for SARS-CoV-2 positive or self-isolating parents to attend the neonatal unit – in such circumstances every effort should be made to facilitate remote contact by use of video technology. For babies critically ill or receiving palliative or end-of-life care, all possibilities should be explored to have parental presence and participation

in care for SARS-CoV-2-positive parents. For end-of-life neonatal care, consideration should be given to allow other close family members to visit.

There may be local arrangements ongoing for staff and parent testing to minimise unnecessary separation and reduce risk to other parents and members of staff. This may include routine surveillance testing, as well as testing of symptomatic parents and suspected contacts. An asymptomatic mother who is awaiting the result of routine SARS-CoV-2 admission screening should usually be allowed to attend her baby in the neonatal unit and to provide skin-to-skin care.

If it is not possible for a mother to attend the neonatal unit because of suspected/confirmed COVID-19 infection, it may be possible for the woman's partner or other family members to visit if they fulfil the criteria for avoidance of self-isolation, but additional testing such as a negative lateral flow/PCR may also be recommended.[182]

In determining the period of self-isolation for a mother with a baby in a neonatal unit, the risk of the mother transmitting infection must be weighed against the well-documented adverse effects for both mother and baby of their separation. UK government advice regarding self-isolation and COVID-19 testing in community and hospital settings is subject to change. In addition, advice may not be aligned throughout the UK. For the latest recommendations, staff and patients should refer to national (**England**, **Scotland**, **Wales** and **Northern Ireland**) and local trust guidelines.

Guidance on the provision of postnatal contraception during the COVID-19 pandemic has been produced jointly by the Faculty of Sexual and Reproductive Health, the RCOG and the RCM. It has been recognised that access to sexual health and primary care contraceptive services has been significantly reduced during the pandemic. Maternity services are ideally placed to provide effective postpartum contraception before discharge. Recommendations on postnatal care should be maintained as per the NICE guideline [NG194] *Postnatal care*.[251]

Acknowledgments

RCOG COVID-19 guidance cell is comprised of:

Dr Edward Morris (President, RCOG), **Professor Tim Draycott** (Vice President for Clinical Quality, RCOG), **Dr Pat O'Brien** (Vice President for Membership, RCOG), **Dr Brian Magowan** (COVID Guidance Development Lead), **Dr Mary Ross-Davie** (Director for Scotland, RCM), **Dr Corinne Love (**Senior Medical Officer, Obstetrics, the Scottish Government), **Dr Maria Crouch** (Honorary Clinical Fellow, RCOG), **Dr Elizabeth Layden** (Honorary Clinical Fellow, RCOG), **Dr Hannah Ribbans** (Honorary Clinical Fellow, RCOG), **Dr Michael Rimmer** (Honorary Clinical Fellow, RCOG), **Dr Amar Karia** (Clinical Obstetric Fellow, RCOG), **Louise Thomas** (Head of Quality Improvement, RCOG), **Emma Gilgunn-Jones** (Director of Media and PR, RCOG), **Jenny Priest** (Director of Policy and Public Affairs, RCOG), **Hannah Gurney** (Media and PR Manager, RCOG), **Daniel Wolstenholme** (Director of Clinical Quality, RCOG), **Farrah Pradhan** (Interim Business Manager, RCOG), **Michelle Sadler** (Guidance Editorial Manager, RCOG), **Sarah Miles** (Guidance Editorial Manager, RCOG) and **Sophie Cooper** (Business Coordinator, RCOG).

We also wish to acknowledge the contributions of colleagues from the RCOG Digital, External Affairs, Library and Clinical Quality teams.

We wish to acknowledge the contributions of the following current and previous members of the RCOG/RCM vaccination subgroup:

Dr Pat O'Brien, Dr Mary Ross Davie, Professor Lucy Chappell, Dr Edward Morris, Dr Ayisha Ashmore, Professor Adam Balen, Dr Helen Campbell, Sophie Cooper, Dr Catherine Coyle, Dr Christine Ekechi, Emma Gilgunn-Jones, Hannah Gurney, Professor Paul Heath, Dr Ken Hodson, Miss Fatima Husain, Sarah James, Karen Jewell, Dr Jennifer Jardine, Professor Chrissie Jones, Dr Amar Karia, Professor Marian Knight, Dr Alison Little, Clare Livingstone, Dr Corinne Love, Dr Sarah Mee, Dr Janet Nooney, Dr Heather Payne, Jenny Priest, Charlie Podschies, Dr Luke Richardson, Dr Mike Shea, Mr Nigel Simpson, Dr Judith Standing, Dr Victoria Tzortziou-Brown.

The following external experts contributed to the guidance:

Dr Matthew Jolly and Dr Misha Moore at NHS England, **Professor Beverley Hunt, Professor Catherine Nelson-Piercy, Professor Rezan Abdulkadir, Dr Peter MacCallum, Dr Louise Bowles** and **Dr Shohreh Beski, Dr Margaret Blott, Dr Arlene Wise, Professor Lucy Chappell, Dr Anita Banerjee, Dr Guy Glover and staff** at Guy's and St Thomas' NHS Foundation Trust, **Professor Marian Knight** at the University of Oxford, **Dr Alison Wright** and **Rebecca Wilson-Crellin** at NHS England and Improvement, **Katie De Freitas-Merchant** at the Maternal and Neonatal Safety Improvement Programme, **Professor Russell Viner** and **Dr David Evans** on behalf of the Royal College of Paediatrics and Child Health, **Dr Fiona Donald** on behalf of the Royal College of Anaesthetists and **Dr Nuala Lucas** from the Obstetric Anaesthetists Association, **Dr Giles Berrisford** on behalf of the Royal College of Psychiatrists, **Professor Asma Khalil, Dr Lucy Mackillop, Dr Charlotte Frise, Dr Toni Hazell, Dr Ed Mullins, Dr Mayank Madhra, Emma Crookes** and **Shaista Gohir** on behalf of the RCOG Women's Network, **Dr Benjamin Black, Zeenath Uddin, Mr Kim Hinshaw** from the British Maternal & Fetal Medicine Society, **Professor Donald Peebles** from University College Hospitals NHS Foundation Trust, **Professor Justin Clarke** from the British Society for Gynaecological Endoscopy, **Jaki Lambert** at the Scottish Government, **Louise Page** from the British Intrapartum Care Society, **Dr Jennifer Jardine, Dr Chrissie Jones** at the University of Southampton, **Dr Peter MacCallum** at Barts and the London School of Medicine and Dentistry, Queen Mary University of London, **Dr Helen Mactier** on behalf of the British Association of Perinatal Medicine, **Dr Sarah Stock** and **Professor James Boardman,** Edinburgh, **Dr Victoria Male a**t Imperial College London, **Dr Katie Cranfield**, Newcastle, **Dr Stephen Webb**, Intensive Care Society President, **Dr Deborah Horner,** Bradford NHS Trust, **Dr Tony Kelly,** National Clinical Advisor for Maternal and Neonatal Safety Improvement Programme at NHS England and Improvement, and **members of the RCOG Guidelines Committee.**

These individuals were, but are not currently, members of the guidance cell and have contributed to earlier versions of this document:

Dr Jennifer Jardine (Clinical Fellow, RCOG), **Dr Sophie Relph** (Clinical Fellow, RCOG), **Dr Andrew Thomson** (COVID Guidance Development Lead, RCOG), **Dr Jahnavi Daru** (Honorary Clinical Fellow, RCOG), **Dr Christine Ekechi** (Honorary Clinical Fellow, RCOG), **Dr Gemma Goodyear** (Clinical Fellow, RCOG), **Dr Anushka Tirlapur** (Honorary Clinical Fellow, RCOG), **Dr Sayaka Okano** (Honorary Clinical Fellow, RCOG), **Dr Michael Shea** (Honorary Clinical Fellow, RCOG), **Lara Waite** (Clinical Midwifery Fellow, RCOG), **Dr Ayisha Ashmore** (Clinical Fellow, RCOG), **Anita Powell** (Senior Director for Clinical Quality, RCOG), **Gemma Thurston** (Business Manager, RCOG), **Stephen Hall** (Political Advisor to the President, RCOG) **and Gozde Zorlu** (Media and PR Manager, RCOG).

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

Appendices

Appendix I: Summary of previous updates

Version	Date	Summary of changes
2	13/03/2020	**1.2:** At the time of writing, Public Health Wales are aligning with Public Health England on case definitions, assessment, infection prevention and control and testing. We will update this guidance if this changes
2	13/03/2020	**2.2:** Updated to reflect PHE and health protection advice as per 13.03.20, in particular to use online symptom checkers and to treat all individuals with symptoms as possibly having COVID-19.
2	13/03/2020	**3.2:** Sentence on who to test updated to reflect advice to test women with symptoms suggestive of COVID-19 who require admission
2	13/03/2020	**3.6.4 and 3.6.5:** Updated to suggest considering delay of elective caesarean birth or induction for women with symptoms suggestive of COVID-19 as well as those with confirmed COVID-19.
2	13/03/2020	**3.8:** Infant feeding modified from recommendation to wear a face mask to try and avoid coughing or sneezing on the baby, and consider wearing face mask where available.
2	13/03/2020	**4:** New section added for antenatal care for pregnant women following self-isolation for symptoms suggestive of COVID-19.
2	13/03/2020	**5 (new).** New section - Advice for pregnant healthcare professionals.
2	13/03/2020	**Appendix 1**: Flow chart amended to reflect modified PHE guidance.
2	13/03/2020	**References: 19:** NHS Staff Council Statement on Covid-19 2020 [Available from: https://www.nhsemployers.org/-/media/Employers/Documents/Pay-and-reward/NHS-Staff-Council---Guidance-for-Covid-19-Feb-20.pdf?la=en&hash=70C909DA995280B9FAE4BF6AF291F4340890445C] accessed 12 March 2020.
3	17/03/2020	**2:** Advice for Health Professionals to share with Pregnant Women updated to reflect current guidelines.
3	17/03/2020	**3:** New section added on Advice for all midwifery and obstetric services.
3	17/03/2020	**4.1:** General advice to services providing care to pregnant women updated to reflect advice from chief medical officer on 16/3/20
3	17/03/2020	**4.1:** Advice on cleaning ultrasound equipment added, and reference added.
3	17/03/2020	**4.5:** Linked to new national guidance on the actions required when a COVID-19 case was not diagnosed on admission
3	17/03/2020	**4.6.2:** Recommendations added: There is evidence of household clustering and household co-infection. Asymptomatic birth partners should be treated as possibly infected and asked to wear a mask and wash their hands frequently. If symptomatic, birth partners should remain in isolation and not attend the unit. The use of birthing pools in hospital should be avoided in suspected or confirmed cases, given evidence of transmission in faeces and the inability to use adequate protection equipment for healthcare staff during water birth.
3	17/03/2020	**4.6.2:** Advice about Entonox changed to There is no evidence that the use of Entonox is an aerosol-prone procedure Entonox should be used with a single-patient microbiological filter. This is standard issue throughout maternity units in the UK
3	17/03/2020	**4.6.4:** Anaesthetic management for women with symptoms or confirmed COVID-19, which was previously in this guidance, has been removed and external links provided

3	17/03/2020	**4.7.1:** Statement inserted 'Chest imaging, especially CT chest, is essential for the evaluation of the unwell patient with COVID-19 and should be performed when indicated and not delayed due to fetal concerns.'
3	17/03/2020	**Updated** to reflect current public health guidance on self-isolation and social distancing.
3	17/03/2020	**4.7.1:** Advice on neonatal management and testing has been removed. Please refer to RCPCH guidance.
3	17/03/2020	**6:** Advice for healthcare professionals updated in line with Chief Medical Officer statement on Monday 16 March.
4	21/03/2020	**6:** Section on 'Occupational health advice for employers and pregnant women during the COVID-19 pandemic' added, replacing the previous section 6 on 'Information for Healthcare Professionals'. Section includes specific recommendations for healthcare professionals.
4	21/03/2020	**1.3-1.4:** Additional information added on the susceptibility of pregnant women to COVID-19 infection.
4	21/03/2020	**2:** Additional information on social distancing for pregnant women added, particularly specifying stringent adherence to recommendations for women >28 weeks gestation
4	21/03/2020	**4.7:** New section added on specific recommendations for PPE during labour and birth.
4	21/03/2020	**1:** Addition of information and links for the UKOSS reporting system.
4	21/03/2020	**All:** General proofread and editorial changes
4	21/03/2020	**6:** Page 36 title changed to 'Occupational health advice for employers and pregnant women during the COVID-19 pandemic
4.1	26/03/2020	**Chapter 6:** 'Occupational health advice for employees and pregnant women during the COVID-19 pandemic' has been removed from this general guidance on pregnancy and COVID-19 infection, and published as a separate document given the distinct audience for the occupational health advice.
4.1	26/03/2020	**4.7.3:** On Personal Protective Equipment updated in line with NHS England guidance
5	28/03/2020	**1.3:** Section updated to include new evidence on possible vertical transmission
5	28/03/2020	**2.2:** Sentence added on the major new measures announced by government for pregnant women with co-existing significant congenital or acquired heart disease.
5	28/03/2020	**2.3:** Section updated to emphasise the need to attend maternity care.
5	28/03/2020	**3:** General advice for antenatal care extended to include considerations for vulnerable women. Section also added on general advice regarding intrapartum services.
5	28/03/2020	**3.1:** Specific advice added regarding the cessation of carbon monoxide monitoring in pregnancy, following advice from the National Centre for Smoking Cessation and Training.
5	28/03/2020	**4:** Scotland specific links to Health Protection Scotland removed after confirmation from the Scottish government that National links from gov.uk should be used.
5	28/03/2020	**4.3.6:** Scotland specific links to Health Protection Scotland removed after confirmation from the Scottish government that National links from gov.uk should be used

5	28/03/2020	**4.7.3 and 4.76:** Advice on PPE considerations for caesarean birth and general advice for obstetric theatres moved to new section 'Specific peri-operative advice for pregnant women with suspected/confirmed COVID-19 requiring surgical intervention'.
5	28/03/2020	**4.8.1:** Reference made to new guidance published by NICE on the management of patients with COVID-19 in critical care.
5	28/03/2020	**4.8.1:** Additional recommendations made for the management of women admitted during pregnancy with suspected/confirmed COVID-19.
5	28/03/2020	**4.9.2:** Section edited to make infant feeding recommendations to any caregiver, not just to the mother
5	28/03/2020	**4.10:** New section on 'Specific peri-operative advice for pregnant women with suspected/confirmed COVID-19 requiring surgical intervention' .
5	28/03/2020	**5.1:** Correction of an error in the title to clarify that this section refers to the care of women recovering from suspected (not confirmed) COVID-19 for which hospitalisation was not required.
6	03/04/2020	**Throughout:** References to the new RCOG guidance on (1) antenatal and postnatal services (2) antenatal screening (3) fetal medicine services (4) maternal medicine services and (5) self-monitoring of blood pressure, have been added throughout the document.
6	03/04/2020	**1.2:** New resources signposted on current UK and international disease incidence
6	03/04/2020	**1.4:** Sentence reporting that there are 'no reported maternal deaths from COVID-19' removed because there was recently a possible maternal death reported in tabloid media. There is not any robust evidence to amend this statement or report confidently in the guideline.
6	03/04/2020	**3.2**: Addition of new advice on screening birth partners for recent possible symptoms of COVID-19 when they attend the maternity unit. In addition, suggestion of information to give the birth partner about what is expected of them whilst they are in the hospital, to assist staff in reducing the risk of infection transmission and to assist with communication when birth partners accompany women into operating theatres
6	03/04/2020	**3.4:** Moved to section 3.2.
6	03/04/2020	**3.5**: New section on maternal mental wellbeing during the pandemic.
6	03/04/2020	**4.1** The previous section 4.2 was repetitive of section 3.1 and so has been removed. Sections 4.2 onwards have been re-numbered.
6	03/04/2020	**4.3:** Inclusion of the PHE case definition for COVID-19 testing, rather than referring readers to this through the link
6	03/04/2020	**4.9:** Updates to advice on PPE for caesarean birth, to ensure that these are consistent with new PHE advice.
7	09/04/2020	**1.4:** Update to data from ICNARC and inclusion of a report of 43 pregnant women with COVID-19 from New York
7	09/04/2020	**1.4:** New comment on risk of venous thromboembolism from COVID-19.
7	09/04/2020	**2.3:** Advice for pregnant women added – if they are advised to attend a face-to face antenatal appointment, this is because the appointment is important and the benefit of attending is perceived to be greater than the possible risk of infection with COVID-19 caused by leaving home. Added also emphasised advice to contact maternity services if concerns during pregnancy.
7	09/04/2020	**3.1:** New section of reducing the risk to women of new infection caused by attending maternity settings. All other subsections in section 3 have been re-numbered
7	09/04/2020	**3.2:** New comment on visitor restrictions in maternity settings.

7	09/04/2020	**3.2:** List of risk factors which contribute to mental ill health in pregnant women, and acknowledgement of the risk of increasing domestic violence with policy for social distancing, moved to section 3.6 on maternal mental wellbeing
7	09/04/2020	**3.3:** Advice about induction of labour changed to reference update to Saving Babies' Lives Care Bundle.
7	09/04/2020	**4.2:** Section 4.2 renamed 'Women with unconfirmed COVID-19 but symptoms suggestive of possible infection' to allow for inclusion of new recommendations on women who call the maternity unit with possible COVID-19 infection (not just attend in person).
7	09/04/2020	**4.2:** Additional recommendations made to consider usual differential diagnoses in women who call the maternity unit to report a new fever/ cough/respiratory symptoms.
7	09/04/2020	**4.3.1:** New subsection added on the care of pregnant women who are self-isolating at home with suspected COVID-19.
7	09/04/2020	**4.4:** Changed to subsection 4.3.3 (subsequent subsections re-numbered).
7	09/04/2020	**4.6.1:** New recommendations re. prophylactic low molecular weight heparin to reduce risk of venous thromboembolism with COVID-19 infection in pregnancy, and to consider pulmonary embolism if women with COVID-19 suddenly deteriorate
7	09/04/2020	**4.7.2:** Statement on calling neonatal team early to inform them of imminent birth of a baby to a woman with COVID-19 moved to section 4.5, because it applies to all cases of COVID-19, not just in women with severe disease.
8	17/04/2020	**1:** New paragraph on the quality of the available evidence and resultant classification of the advice.
8	17/04/2020	**1.4:** New evidence included on the risk of COVID-19 in the woman, including a case series of pregnant women attending two maternity units in New York, who were screened for COVID-19 on arrival, the inclusion of the first report of maternal death directly attributed to COVID-19 in scientific literature and an update to the ICNARC data.
8	17/04/2020	**4.2, 4.5.2 & 4.6.2:** Restructured, including some new subtitles to organise and break up the text
8	17/04/2020	**4.3.1:** Renamed 'risk of venous thromboembolism'.
8	17/04/2020	**4.6:** Section restructured for clarity.
8	17/04/2020	**4.7** and **4.8:** Re-ordered the two sections within the text so that considerations for birth are written before considerations for neonatal and postnatal care.
8	17/04/2020	**5.3:** Section re-structured. Also includes clarification that the recommendation for 10 days postnatal LMWH is regardless of mode of birth.
8	17/04/2020	**Appendix 2:** Table of previous updates moved to appendix 3
8	17/04/2020	**Appendix 3:** New information on considerations when caring for women with suspected/confirmed COVID-19 during labour and birth
9	13/05/2020	**1:** Aims updated to include: The provision of safe, woman-centred care to women who are pregnant, give birth or are in the early postnatal period during the COVID-19 pandemic.
9	13/05/2020	**1:** Findings of UKOSS data included in the summaries on viral transmission, effects on the woman and effects on the fetus/neonate. Where this supersedes existing references because of higher quality research or larger numbers, it has been used to replace it.
9	13/05/2020	**1.3:** Updated information on possibility of vertical transmission to state that there are serious limitations to the available evidence.

9	13/05/2020	**1.4:** Updated with emerging evidence on increased risk from COVID-19 to individuals with black, Asian and minority ethnic (BAME) background.
9	13/05/2020	**2:** Information to share with pregnant women and their families has been removed from the guidance. All this information is also available in the RCOG information for pregnant women and their families in the COVID-19 hub. All subsequent sections have been renumbered.
9	13/05/2020	**3.1 (Now 2.1):** Added paragraph about reducing transmission between staff
9	13/05/2020	**3.2 (Now 2.2):** Statement and recommendations added: Emerging evidence suggests that individuals of black and minority ethnic (BAME) background may be at higher risk of developing severe complications of COVID-19. This may equally apply to pregnant women. We therefore advise: Women of BAME background should be opportunistically advised that they may be at higher risk of complications of COVID-19, and advised to seek help early if they are concerned about their health. Clinicians should be aware of this increased risk, and have a lower threshold to review, admit and consider multidisciplinary escalation in women of BAME background.
9	13/05/2020	**2.2:** Removed statement that further guidance on remote consultations will be published soon, and provided reference to RCM/RCOG guidance on antenatal and postnatal care
9	13/05/2020	**2.3:** Changed the statement that units should consider reducing provision of induction of labour for indications that are not 'strictly necessary', to units should consider reducing induction of labour where this is not 'medically indicated'.
9	13/05/2020	**3.3 (Now 2.3):** Reference to NHS England 'Clinical guide for the temporary reorganisation of intrapartum maternity care during the coronavirus pandemic' added.
9	13/05/2020	**3.3 (Now 2.3):** Statement added: 'Care should be taken to maintain safe services which continue to offer women support and choice as far as possible at this time. In particular, women should continue to be encouraged to contact their maternity unit with concerns about their or their baby's wellbeing. Justification should be provided for any service rationalisation required.'
9	13/05/2020	**3.3 (Now 2.3):** Statement added: 'When reorganising services, maternity units should be particularly cognisant of emerging evidence that black, Asian and minority ethnic group (BAME) individuals are at particular risk of developing severe and life-threatening COVID-19. There is already extensive evidence on the inequality of experience and outcomes for BAME women during pregnancy and birth in the UK. Particular consideration should be given to the experience of women of BAME background and of lower socioeconomic status, when evaluating the potential or actual impact of any service change.'
9	13/05/2020	**4.6 (Now 3.6):** Recommendation to be aware that myocardial injury is common among individuals with COVID-19, and reference added to NICE Guidance on diagnosis of myocardial injury in patients with suspected or confirmed COVID-19.
9	13/05/2020	**4.8.1 (Now 3.8.1):** Reference added to Resuscitation Council guidance on neonatal life support during the COVID-19 pandemic.
9	13/05/2020	**4.5.2 (Now 3.5.2):** Care in labour: Risk of venous thromboembolism. Clarification added that all women with suspected or confirmed COVID-19 should be discharged with 10 days' supply of prophylactic LMWH

9	13/05/2020	**4.4 (Now 3.4):** Women who develop new symptoms of COVID-19 during admission: Statement added that prophylaxis for venous thromboembolism should be considered and prescribed unless contraindicated.
9	13/05/2020	**4.6 (Now 3.6):** Title change from 'Additional considerations in women with moderate/ severe symptoms' to 'Women with suspected or confirmed COVID-19 and moderate/severe symptoms', to reflect that this includes information relevant to pregnant women admitted with COVID-19 outside of obstetric services.
9	13/05/2020	**4.6 (Now 3.6):** Recommendation added: 'Prophylaxis for venous thromboembolism should be prescribed during admission unless contraindicated. At the time of discharge from hospital following a period of care for confirmed COVID-19 infection, all women should be prescribed at least 10 days of prophylactic LMWH.' This is consistent with recommendations already made elsewhere in previous versions of this document.
9	13/05/2020	**4.6 (Now 3.6):** Changed statement 'Consider bacterial infection if the white blood cell count is raised (lymphocytes usually normal or low with COVID-19) and commence antibiotics' to 'Bacterial infection is an important differential diagnosis to COVID-19 infection. We advise blood cultures and a low threshold for antibiotics at presentation, with early review and rationalisation of antibiotics if COVID-19 is confirmed.'

Version 10

The following Version 10 summary of changes includes an additional column to reflect significant restructure changes between version 9 and 10 of this guidance.

Date	Summary of changes from version 9 to version 10		
	Subject	**Section content from v9**	**Location in v10**
04/06/2020	Introduction		Now incorporates the following sections from v9: • Purpose and scope • Identification and assessment of evidence • Epidemiology • Transmission • Effect of COVID-19 on pregnant women • Risk factors for hospital admission with COVID-19 • Effect of COVID-19 on the fetus
04/06/2020	Antenatal care during the COVID-19 pandemic	**2.2.** General advice regarding the continued provision of antenatal and postnatal services	**2.1** What are the considerations for organisation of antenatal care during the COVID-19 pandemic?
04/06/2020	Antenatal care during the COVID-19 pandemic	**2.3** General advice regarding possible service modifications during COVID-19	**2.2** What are the considerations for antenatal appointments?
04/06/2020	Antenatal care during the COVID-19 pandemic	**2.6** Smoking cessation and carbon monoxide monitoring in pregnancy	**2.3** What are the considerations for antenatal appointments?
04/06/2020	Antenatal care during the COVID-19 pandemic	**2.5** Maternal mental wellbeing	**2.2** What are the considerations for antenatal appointments?
04/06/2020	Antenatal care during the COVID-19 pandemic	**3.1** General advice for services providing care to pregnant women with suspected or confirmed COVID-19, where hospital attendance is necessary	**2.3** How should women with suspected or confirmed COVID-19 needing hospital attendance or advice be cared for?

04/06/2020	**Antenatal care during the COVID-19 pandemic**	**3.2** Women with unconfirmed COVID-19 but symptoms suggestive of possible infection	**2.3** How should women with suspected or confirmed COVID-19 needing hospital attendance or advice be cared for?
04/06/2020	**Antenatal care during the COVID-19 pandemic**	**3.3.3** Attendance for unscheduled/urgent antenatal care in women with suspected or confirmed COVID-19	**2.3** How should women with suspected or confirmed COVID-19 needing hospital attendance or advice be cared for?
04/06/2020	**Antenatal care during the COVID-19 pandemic**	**4.1** Antenatal care for pregnant women following self-isolation for symptoms suggestive of COVID-19	**2.4** What are the considerations for antenatal care for women who have recovered from COVID-19?
04/06/2020	**Antenatal care during the COVID-19 pandemic**	**4.2** Antenatal care for pregnant women following hospitalisation for confirmed COVID-19 illness	**2.4** What are the considerations for antenatal care for women who have recovered from COVID-19?
04/06/2020	**Venous thromboembolism prevention**	**3.3.1** Risk of venous thromboembolism	**3.1** How should prevention of venous thromboembolism during the COVID-19 pandemic be addressed?
04/06/2020	**Venous thromboembolism prevention**	**3.4** Women who develop new symptoms of COVID-19 during admission (antenatal, intrapartum or postnatal) Sentence on thromboprophylaxis	**3.1** How should prevention of venous thromboembolism during the COVID-19 pandemic be addressed?
04/06/2020	**Labour and birth**	**2.4** General advice regarding intrapartum services	**4.4** What about birth partners during the COVID-19 pandemic?
04/06/2020	**Labour and birth**	Not in version 9	**New section in version 10: 4.1** What are the considerations for labour and birth in asymptomatic women who test or have tested positive for SARS-CoV-2?
04/06/2020	**Labour and birth**	**3.5** Women attending for intrapartum care with suspected or confirmed COVID-19	**4.2** How should a woman with suspected/confirmed COVID-19 be looked after in labour if they are symptomatic? **4.5** What informed discussions should take place with women regarding timing and mode of birth during the COVID-19 pandemic? **4.6** What are the specific considerations for labour analgesia or anaesthesia?

04/06/2020	**Labour and birth**	**3.7** Specific perioperative advice for healthcare professionals caring for pregnant women with suspected/confirmed COVID-19 who require surgical intervention	**4.8** How should obstetric theatres be managed during the COVID-19 pandemic? **4.7** What personal protective equipment is recommended when caring for women during labour and birth?
04/06/2020	**Postnatal**	**3.8** Neonatal care	**6.1** How should neonatal care for the baby be provided during the COVID-19 pandemic? **6.2** What should parents/carers be advised regarding infant feeding during the COVID-19 pandemic?
04/06/2020	**Postnatal**	**4.3** Postnatal care for pregnant women immediately following hospitalisation for confirmed COVID-19 illness	**6.3** What are the considerations for postnatal care for women and babies following admission with COVID-19?

Version	Date	Summary of changes
10.1	19/06/2020	**1.1:** Removal of 'MERS, Middle East Respiratory Syndrome' from the literature search strategy since it has not resulted in any new references since the first search.
10.1	19/06/2020	**1.4:** UKOSS reference changed to the published article in The BMJ.
10.1	19/06/2020	**2.2:** Advice on face masks changed to reflect national guidance from NHS England.
10.1	19/06/2020	**4.4:** Advice on number of visitors and/or birth partners for hospital inpatients changed to reflect national guidance from NHS England
10.1	19/06/2020	**5.2:** Advice for women who are clinically deteriorating modified to include government recommendations based on the interim results of the RECOVERY trial.
10.1	19/06/2020	**6.2:** Specified that babies should not be advised to wear face masks because of the risk of suffocation.
11	24/07/2020	**1.1:** Updated methodology about search strategies and the review process.
11	24/07/2020	**1.3:** Updated evidence that there is a low rate of vertical transmission and possible transplacental transmission.
11	24/07/2020	**1.4:** Updated evidence that pregnant women are not necessarily more susceptible to SARS-CoV-2 than the general population
11	24/07/2020	**1.5:** Updated evidence identifying the risk factors of Black, Asian and minority ethnicity (BAME), obesity and comorbidities in pregnant women admitted with COVID-19.
11	24/07/2020	**1.6:** Updated evidence on possible fetal growth restriction associated with COVID-19.

❙❙	24/07/2020	**2.1:** Updated advice: Units should employ teleconferencing and videoconferencing where possible and consider which appointments can be most appropriately conducted remotely, especially in areas of local lockdown to minimise hospital attendance. Particular consideration should be given to pregnant women who are 'shielding' or have been 'shielding'. Shared waiting areas should be avoided. Units should appoint a named midwife or consultant to coordinate care for women forced to miss appointments due to self-isolation or a positive test. Missed appointments should be reviewed and either rescheduled if a face-to-face review is necessary or converted to a remote appointment. Evidence added on the possible increased incidence of stillbirths in women without symptoms suggestive of COVID-19 in the pandemic compared to pre-pandemic periods.
❙❙	24/07/2020	**2.2:** Updated advice: Evidence suggests that individuals of BAME background are at higher risk of developing severe complications of COVID-19. This also applies for pregnant women. We therefore advise that: Women of BAME background should be advised that they may be at higher risk of complications of COVID-19; and encouraged to seek advice without delay if they are concerned about their health. Clinicians should maintain face-to-face appointments with women when there are safeguarding concerns in order to provide extra support. It is recommended that women should continue to take folic acid and vitamin D supplements as per national recommendations. If women or their families express concerns about their mental health or 'red flag' symptoms such as suicidal thoughts or sudden mood changes they should be supported to access urgent care by healthcare providers signposting or referring appropriately.
❙❙	24/07/2020	**2.3:** Amended advice: Visitors to isolation rooms or ward cohort bays should be kept to a minimum and follow local hospital visitor policies.
❙❙	24/07/2020	**4.1:** Amended advice: For asymptomatic women who test positive for SARS-CoV-2 on admission, continuous electronic fetal monitoring (CEFM) during labour using cardiotocography (CTG) is not recommended solely for this reason, and should only be used if it is required for another reason (e.g. previous caesarean birth). Fetal monitoring options should be discussed with the woman, acknowledging the current uncertainties in the care of women who are asymptomatic with a positive test for SARS-CoV-2.
❙❙	24/07/2020	**4.2:** Additional advice: There are no contraindications to performing a fetal blood sample or using fetal scalp electrodes. Advice on waterbirths has been revised and moved to (new) section 4.6.

❙❙	24/07/2020	**4.3:** Amended advice: Informed discussions with women about fetal monitoring should acknowledge that evidence of fetal distress is based on small numbers of babies born to women symptomatic of COVID-19 and theoretical risks extrapolated from pregnancies affected by fetal growth restriction in women with other coronaviruses.
❙❙	24/07/2020	**4.4:** Amended advice: If birth partners are symptomatic or in a period of self-isolation for confirmed SARS-CoV-2 infection, they should remain in self-isolation at home and not attend the unit. Advice removed: on birth partners being asked to remain by the woman's bedside and not to walk around the ward/hospital.
❙❙	24/07/2020	**4.5:** Amended advice: Women and their families should be aware that donning PPE for emergency caesarean births is time-consuming but essential, and that this may impact on the time it takes to assist in the birth of the baby and potentially result in an adverse outcome. This should be taken into account during decision-making and ideally discussed during birth planning. Removed advice on the use of birthing pools in hospital for women with suspected or confirmed cases of COVID-19. Updated evidence about vertical transmission and data about donning PPE.
❙❙	24/07/2020	**4.6:** New section on 'What are the considerations regarding waterbirth?'
❙❙	24/07/2020	**4.8:** Amended advice: Healthcare professionals are advised to follow national recommendations on the use of personal protective equipment in clinical settings.
❙❙	24/07/2020	**4.10:** New section 'What are the considerations for bereavement care during the COVID-19 pandemic?'
❙❙	24/07/2020	**5.1:** Amended advice: Women should be offered testing for COVID-19 if they meet the inpatient or community PHE criteria.
❙❙	24/07/2020	**5.2:** Updated advice: A designated team member should be responsible for regularly updating the woman's family about her progress, utilising interpreting services where necessary. Thrombocytopenia is associated with severe COVID-19. For women with thrombocytopenia (platelets $<50 \times 10^9$/L) stop aspirin prophylaxis and thromboprophylaxis and seek haematology advice. Consider using mechanical aids (such as intermittent calf compressors) if thromboprophylaxis is paused secondary to thrombocytopenia Consider the use of antiviral medications, such as remdesivir, that have been shown to be potentially beneficial in COVID-19. If there is clinical uncertainty in whether to offer a therapy to a pregnant woman, seek advice through maternal medicine networks.

11	24/07/2020	**6.1:** Added advice: Women with suspected or confirmed COVID-19 should be supported and enabled to remain together with their babies when the woman is well enough, and to practice skin-to-skin/kangaroo care, if the newborn baby does not require additional medical care at this time. For a woman who has suspected or confirmed COVID-19 and whose baby needs to be cared for on the neonatal unit, a precautionary approach should be adopted to minimise any risk of women-to-infant transmission; at the same time, steps should be taken to involve parents in decisions, mitigating potential problems for the baby's health and well-being and for breastfeeding and attachment. Women who have suspected, probable or confirmed COVID-19 should be enabled and supported to breastfeed, if this is what they choose.
11	24/07/2020	**6.2:** Title amended to: What should women and families be advised regarding infant feeding during the COVID-19 pandemic? Added advice Breastfeeding is recommended for all women and newborn infants. Support, advice and guidance on breastfeeding should be provided to all women who choose to breastfeed When a woman is not well enough to care for her own infant or where direct breastfeeding is not possible, she should be supported to express her breastmilk by hand expression or by pump, and/or be offered access to donor breast milk.
11	24/07/2020	**6.3:** Added advice: New mothers with COVID-19 still require all recommended advice, guidance and support in relation to their postnatal physical and mental health and wellbeing and care of their newborn. Postnatal care should be provided as per national guidance. Face-to face home or clinic appointments are required to provide physical checks and the offer of screening, including any wound examinations from caesarean births/assisted births, the newborn blood spot test and checking the weight of the baby. In some areas, and where appropriate, some postnatal care will need to be via virtual appointments using telephone or video link due to local infection rates and staff absence but considerations need to be made upon individual circumstances. This needs to be communicated to women and families.
12	14/10/2020	**Throughout:** Comprehensive editorial review resulting in rewording and minor changes which do not affect meaning. Any changes to meaning and recommendations are detailed elsewhere in this table of changes
12	14/10/2020	**1.2-1.7 Summary of evidence:** Comprehensively updated and rewritten to incorporate changes to evidence base, in particular the MBRRACE Rapid Report and recent systematic reviews

12	14/10/2020	2.1 Antenatal care Recommendations added: The NICE recommended schedule of antenatal care should be offered in full wherever possible. These appointments should be offered in-person as far as possible, with particular attention to those from BAME communities or those living with medical, social or psychological conditions that make them higher risk. Appropriate screening for diabetes in pregnancy should be provided, following NICE guidance as far as possible, with awareness that changes in screening provision may be associated with a reduction in the detection of milder cases of gestational diabetes. Open access for pregnant women to day assessment and triage services should be maintained. Women should be actively encouraged to attend if they have concerns about their or their baby's wellbeing. Continuity of carer should be maintained wherever possible, particularly where this is offered to women from vulnerable groups who may also be at greater risk from COVID-19.
12	14/10/2020	2.2 Title changed for 'what are the considerations for antenatal appointments?' to 'what are the considerations for antenatal appointments and advice for pregnant women?'
12	14/10/2020	2.2 Recommendations added Women should be advised that vaccination against influenza is safe at all gestations of pregnancy and is recommended to protect both the woman and baby from the adverse effects of becoming seriously ill with flu during pregnancy. During the COVID-19 pandemic, it is particularly important that pregnant women take up the influenza vaccine to reduce their risk of contracting flu. Appointments where physical examination is not required and where there are no additional risk factors are most appropriate to be conducted by virtual means. Services should establish triage processes to ensure that women with mental health concerns can be appropriately assessed. Recommendations removed Virtual consultations should be encouraged where appropriate to minimise contact in person, however traditional in-person appointments may be more effective, especially when interpreters are required. Supporting statement updated with evidence from MBRRACE UK Rapid Report and survey studies regarding modifications to care during the pandemic.
12	14/10/2020	3.1 Thromboembolism. Supporting statement updated with reference to MBRRACE rapid report.
12	14/10/2020	4.1 Labour and birth. Recommendations updated to reflect national policy change to 10 days isolation following a positive test for COVID-19.

12	14/10/2020	**4.4** Birth partners. Recommendations revised to : On attendance at the maternity unit, all birth partners should be asked whether they have experienced any symptoms suggestive of COVID-19 in the preceding 14 days, e.g. fever, acute persistent cough, changes in or loss of sense of smell (anosmia) or taste. If they have had symptoms within the last 10 days, they should be asked to leave the maternity unit immediately and self-isolate at home, unless they have had a negative test result for coronavirus since symptom onset If they have had a fever within the last 48 hours, they should be asked to leave the maternity unit immediately and self-isolate at home, regardless of their test result. Guidance about testing of women and their birth partners is discussed in the RCOG document . Asymptomatic birth partners, not otherwise advised to be self-isolating, should be permitted to stay with the woman throughout labour and birth, unless the birth occurs under general anaesthetic. Further guidance about access to maternity services for birth partners and other supportive adults has been published by the NHS, and should be followed as far as possible.
12	14/10/2020	**4.6** Water birth. Supporting statement updated to reflect evidence review by the UK Infection Prevention and Control Cell.
12	14/10/2020	**6.3** Postnatal care. Recommendation revised to clarify that postnatal women who have tested positive for COVID-19, while required to isolate along with their households for 14 days, should still receive necessary in-person postnatal care.
13	18/02/2021	**Throughout:** Comprehensive editorial review resulting in rewording and minor changes.
13	18/02/2021	**Throughout:** New evidence added to most sections to support or update existing conclusions or advice.
13	18/02/2021	**1.4** New section added: Vaccination against COVID-19.
13	18/02/2021	**1.5:** Comprehensively updated including new evidence, key findings, new sections on the frequency of severe illness in pregnant women, data from the UK comparing pregnant and non-pregnant women, data from international studies comparing pregnant and non-pregnant women and insertion of tables in appendix summarising studies.
13	18/02/2021	**Sections 2** and **6** updated: to signpost to guidance documents to assist maternity units with changes to antenatal and postnatal care.
13	18/02/2021	**New appendices** added and updated to reflect changes to document.
14.0	30/07/2021	**Throughout** Comprehensive editorial review resulting in rewording and minor changes, some of which made to align with new RCOG style guidance.
14.0	30/07/2021	**Throughout** New evidence added to most sections to support or update existing conclusions or advice.
14.0	30/07/2021	**New Executive summary** added, replacing Appendix II in v13.
14.0	30/07/2021	**New Quick reference summary** of acute COVID-19 management in pregnancy added.
14.0	30/07/2021	**Sections 1.2, 1.4.2** and **1.5** update of epidemiology and risk factors including evidence about severity of disease in pregnancy with the Delta variant.
14.0	30/07/2021	**New Section 2** COVID-19 Vaccination in pregnancy added, replacing section 1.4 in v13 (Vaccination against COVID-19). Inclusion of vaccination guidance, addition of Janssen vaccine and an increased emphasis on the importance of vaccination given increased evidence of safety and efficacy.

14.0	30/07/2021	**Section 6** overall update, including addition of monoclonal antibodies, emphasis on ECMO and proning, and advice about remdesivir, safety netting and saturation monitoring.
14.0	30/07/2021	**Appendix III, Table 1** updated with new studies. Table 2 (summary of key studies relevant for the effect of COVID-19 on maternal outcomes) added, along with meta-analyses of studies.
14.1	25/10/2021	Minor updates were made as follows: **Quick reference summary:** information about ivermectin added. **Table of contents:** Hyperlinks to sections added. **Section 2.1:** Reference updated in key findings. **Section 6.3:** new evidence added on the use of sarilumab and ivermectin.
14.2	30/07/2021	Minor updates where made as follows: **Quick reference summary:** replaced by flowchart. **Section 2:** Minor updates of vaccination safety data. **Section 6**: Clarification of Ronapreve dose to 2.4 g, restoration of dexamethasone dose to 12 mg intramuscular twice (24 hours apart), advice not to use Molupiravir outside a trial setting and on neonatal BCG after maternal administration of tocilizumab. **Section 7:** Update of postnatal neonatal guidance in line with British Association of Perinatal Medicine (BAPM). Addition of **Appendix VI.**
14.3	11/01/2022	Minor updates were made as follows: **Section 2:** Minor updates on Omicron vaccine efficacy. **Section 6:** Recognition that monoclonal antibody advice is changing rapidly, with external links for clarification. Clarification of recommended steroid preparations, with addition of methylprednisolone if preferred. **Section 7:** Aligning with BAPM isolation advice.

Appendix II: Development method of this guidance

The development methods have evolved over the lifetime of this guidance. This version of the guidance was developed by a multidisciplinary group of authors listed in Acknowledgments. Specific sections of the guidance were contributed by subject experts also listed in Acknowledgments.

Fortnightly literature reviews are generated using the following search terms, MESH headings and associated synonyms: pregnancy, coronavirus, SARS, severe acute respiratory syndrome, infant, newborn and breastfeeding. The search results are published fortnightly on the RCOG website. Populations of interest include pregnant women, those recently given birth, partners, neonates. Studies of other populations are included where necessary, in order to understand population risk, asymptomatic carriage of coronavirus and antibody results where we believe these findings can be extrapolated to pregnant women. The retrieved evidence is reviewed by clinically trained members of the guidance team for inclusion. The criteria for including evidence have evolved as the evidence base has matured. For each section of the guidance, the best available evidence is included. The guidance also includes reference to 'grey' literature such as registry studies, reports from national organisations and non-peer reviewed content. Where there is a need to change practice and where published alternatives are not available, 'preprints' are discussed within the core guidance team and considered for inclusion.

For this guidance, good practice points are based on expert consensus of the multidisciplinary guidance group comprising healthcare providers across a variety of disciplines reviewing the available evidence and from their own expertise and experience within clinical practice. Appreciating the paucity of high-quality evidence in this area, this guidance is reviewed regularly to ensure the advice remains up-to-date and relevant.

While this document has not been subject to an open peer review or formal stakeholder consultation process, specific individuals and groups were asked to review its content prior to publication. These are listed in Acknowledgments and include a wide range of external stakeholders including lay representatives, other Royal Colleges and professional associations and representatives from the governments across England and the devolved nations. Feedback on this guidance sent to the dedicated COVID-19 inbox is also considered.

No external funding was received in order to develop this guidance.

Appendix III: Summary of key studies and meta-analyses on maternal and pregnancy outcomes

Key studies summary on the effect of COVID-19 on pregnancy and maternal outcomes

Tables 1 and 2 give details of the key studies on which sections 1.4.2 and 1.6 are based. The largest study is the PregCOV-19 Systematic Review.[24] Thirteen publications already included in that systematic review are not listed individually; only the PregCOV-19 Systematic Review and studies that were published since that review are shown in these tables. Forest plots from an unpublished meta-analysis of the publications listed in Tables 1 and 2 are included below. Updated February 2022. Case series with less than 20 cases have been excluded.

Table 1: Summary of key studies relevant for the effect of COVID-19 on pregnancy outcomes

The table below only includes studies with a comparison group (pregnant individuals without COVID-19).

Study	Country	Population		Effect of COVID-19 on pregnancy		
Allotey et al. 2020[24] PregCOV-19 Systematic Review (updated 29/11/20)	30 countries	*COVID-19* Approx. 1000 pregnant women with COVID-19	*Control* Approx. 5000 pregnant women without COVID-19	*COVID-19* 12.4% preterm (147/1184) 0.9% stillbirth (9/1039)	*Control* 7.8% preterm (572/7365) 0.5% stillbirth (26/4755)	*aOR* 1.47 (1.14–1.91) 2.84 (1.25–6.45)

Vousden et al. 2021[30] UKOSS update	UK	*COVID-19* 1148 pregnant women with COVID-19 hospitalised for any reason (722 symptomatic)	*Control* Historical control of 694 pregnant women from 2018	*Overall* 15.6% preterm (156/1003) 1.1% stillbirth (11/1019) Symptomatic COVID 19% preterm birth (76% iatrogenic) (120/623) 49% caesarean section	*Control* 9% preterm birth (63/702) 0.3% stillbirth (2/705) 29% caesarean section	
				Asymptomatic COVID 9% preterm birth (36/380) 40% caesarean section		
Jering et al. 2021[34]	USA	*COVID-19* 6380 pregnant women with COVID	*Control* 400 066 pregnant women without COVID	*COVID-19* 7.2% preterm birth (322) 28.9% caesarean birth 8.8% pre-eclampsia 0.5% stillbirth (34)	*Control* 5.8% preterm (16137) 27.5% caesarean 6.8% pre-eclampsia 0.3% stillbirth (1289)	*aOR (95%CI)* 1.17 (1.06–1.29) 1.07 (1.02–1.13) 1.21 (1.11–1.33)

Crovetto et al. 2021[252]	Barcelona, Spain	*COVID-19* 317 pregnant women with COVID-19 (detected by antibody or PCR)	*Control* 1908 pregnant women without COVID-19	*COVID-19* 13.6% pregnancy complication 11.4% preterm (20/176) 0.6% perinatal death (1/178)	*Control* 14% pregnancy complication 7.2% preterm (81/1128) 0.5% perinatal death (6/1160)	*Risk difference* –0.4% (–4.1 to 4.1) 4.2% (–0.03 to 9.9) 0.1% (–0.7 to 2.7)
				Symptomatic COVID 16.9% preterm birth (12/71) 19.2% intrapartum fetal distress	*Control* 7.2% preterm birth (81/1128) 9.1% intrapartum fetal distress	
Molenaar 2021[253]	NY, USA	*COVID-19 (not acute)* 105 women who were seropositive for SARS-COV-2 but PCR negative at birth	*Control* 591 women who were seronegative for SARS-CoV-2 and PCR negative at birth	*COVID-19* 7.6% preterm (8) 8.6% SGA (9)	*Control* 6.3% preterm (37) 7.3% SGA (43)	*aOR* 1.08 (0.46–2.54) 1.19 (0.53–2.65)
Metz et al. 2021[60]	USA	1219 pregnant women with COVID-19, split by severity: 47% asymptomatic 27% mild 14% moderate 8% severe 4% critical		*Severe/critical COVID* 41.8% preterm birth	*Asymptomatic COVID* 11.9% preterm birth	*aRR (95% CI)* 3.53 (2.42–5.14)

Savirón-Cornudella et al. 2021[254]	Spain	*COVID-19* 65 pregnant with COVID (by Ab or PCR), all asymptomatic or mild infection	*Control* 1146 pregnant women without COVID-19	*COVID-19* 0% stillbirth (0)	*Control* 0.2% stillbirth (2)	*P-value* 0.944
Abedzadeh-Kalahroudi 2021[255]	Iran	*COVID-19* 56 women with COVID-19	*Control* 94 pregnant women with COVID-19	*COVID-19* 16.1% fetal distress 34.5% preterm (19) 3.6% perinatal death (2)	*Control* 4.3% fetal distress 12.8% preterm (12) 0% perinatal death (0)	*RR* 3.84 (1.24–11.90) 2.70 (1.42–5.14) 8.48 (0.41–173.53)
Trahan 2021[256]	Canada	*COVID-19* 45 pregnant women with COVID-19	*Control* 225 pregnant women without COVID-19	*COVID-19* 16% preterm (7)	*Control* 9% preterm (21)	*P* = 0.28
Zgutka 2021[257]	NY, USA	*COVID-19* 62 pregnant women with COVID-19	*Control* 124 pregnant women without COVID-19	*COVID-19* 18.3% preterm (11)	*Control* 8.1% preterm (10)	*P* = 0.04
Katz 2021[258]	USA	*COVID-19* 490 pregnant women with COVID-19 (176 [35.9%] symptomatic)	*Control* 964 pregnant women without COVID-19	*COVID-19* 14.8% preterm (73) symptomatic	*Control* 10.2% preterm (98)	*aOR (95% CI)* 1.47 (1.03–2.09) 2.08 (1.29–3.36)

Martinez-Perez 2021[259]	Spain	*COVID-19* 246 pregnant women with COVID-19	*Control* 763 pregnant women without COVID-19	*COVID-19* 13.8% preterm (34) 1.2% stillbirth (3)	*Control* 6.7% preterm (51) 0.1% stillbirth (1)	*aOR or P* 2.12 (1.32–3.36) 0.047
Hcini 2021[260]	French Guiana	*COVID-19* 137 pregnant women with COVID-19	*Control* 370 pregnant women without COVID-19	*COVID-19* 5.1% stillbirth (7) 0.8% preterm < 34 weeks (1)	*Control* 1.1% stillbirth (4) 3.4% preterm < 34 weeks (12)	*RR* 4.7 (1.4–15.9) RR not given
Villar 202[163]	18 countries	*COVID-19* 706 pregnant women with COVID-19	*Control* 1424 pregnant women without COVID-19	*COVID-19* 22.5% preterm (159) 17% severe perinatal morbidity and mortality index (120)	*Control* 13.6% preterm (194) 7.9% severe perinatal morbidity and mortality index (113)	*RR* 1.59 (1.30–1.94) 2.14 (1.66–2.75)
Adhikari 2020[261]	USA	*COVID-19* 252 pregnant women with COVID-19	*Control* 3122 pregnant women without COVID-19	*COVID-19* 11% preterm (27) 0% stillbirth (0)	*Control* 11% preterm (328) 0.6% stillbirth (18)	*RR* 1.02 (0.70–1.48) 0.33 (0.02–5.48)
Soto-Torres 2021[262]		*COVID-19* 106 pregnant women with COVID-19	*Control* 103 pregnant women without COVID-19	*COVID-19* 20.8% preterm (35/40 weeks of gestation) (22/106)	*Control* 8.8% preterm (35/40 weeks of gestation) (9/103)	*OR* 2.37 (1.14–4.91)
Gurol-Urganci 2021[58]	UK	*COVID-19* 3527 pregnant women with COVID-19	*Control* 338 553 pregnant women without COVID-19	*COVID-19* 12.1% preterm 0.85% stillbirth	*Control* 5.8% preterm 0.34% stillbirth	*aOR* 2.17 (1.96–2.42) 2.21 (1.58–3.11)

Aabakke et al. 2021[263]	Denmark	*COVID-19* 418 pregnant women with COVID-19	*Control* 82 262 pregnant women without COVID-19	*COVID-19* 4.7% preterm (13) 2 stillbirth	*Control* 5.4% preterm (2539) 0.3% stillbirth (134)	*OR* 0.85 (0.49–1.49)
Tadas et al. 2021[264]	India	*COVID-19* 181 pregnant women positive at delivery	*Control* 181 pregnant women without COVID-19 at delivery	*COVID-19* 7 stillbirth	*Control* 7 stillbirth	*P value* 1
Akbar et al. 2021[265]	Indonesia	*COVID-19* 62 pregnant women with COVID-19 at delivery	*Control* 79 pregnant women without COVID-19 at delivery	*COVID-19* 12.06% preterm birth (7)	*Control* 6.49% preterm (5)	*P value* 0.25
Papageorghiou et al. 2021[266]	18 countries	*COVID-19* 725 pregnant women with COVID-19 during pregnancy	*Control* 1459 pregnant women without COVID-19 at enrolment	*COVID-19* 21.0% preterm birth (152)	*Control* 13.1% preterm birth (191)	
Teixeira et al. 2021[267]	Brazil	*COVID-19* 26 pregnant women with COVID-19	*Control* 73 pregnant women without COVID-19	*COVID-19* 26.9% preterm (7)	*Control* 13.7% preterm (10)	*P value* 0.139
Saadia et al. 2021[268]	Pakistan	*COVID-19* 48 pregnant women with COVID-19	*Control* 46 pregnant women without COVID-19	*COVID-19* 2.1% preterm labour (1)	*Control* 0% preterm labour (0)	

Ruggiero et al. 2021[269]	Italy	*COVID-19* 28 pregnant women with COVID-19 at delivery	*Control* 287 pregnant women without COVID-19 at delivery	*COVID-19* 7.1% preterm (2)	*Control* 7.7% preterm (22)	*P value* 1.00
Timircan et al. 2021[270]	Romania	*COVID-19* 101 pregnant women admitted with COVID-19	*Control* 938 pregnant women without COVID-19 on admission	*COVID-19* 15% preterm (15)	*Control* 8% preterm (75)	*P value* 0.095
Karasek et al. 2021[271]	California, USA	*COVID-19* 8957 pregnant women with COVID-19 at delivery	*Control* 231 200 pregnant women without COVID-19 at delivery	*COVID-19* 11.8% preterm (1060)	*Control* 8.7% preterm (19 999)	*OR* 1.4 (1.3–1.4)
Hill et al. 2021[165]	New Jersey USA	*COVID-19* 218 pregnant women with asymptomatic COVID-19 at delivery	*Control* 413 pregnant women with no COVID-19 at delivery	*COVID-19* 23% preterm (50)	*Control* 11.4% preterm (48)	
Chinn et al. 2021[272]	USA (499 centres)	*COVID-19* 18 715 pregnant women with COVID-19 at delivery	*Control* 850 364 pregnant women without COVID-19 at delivery	*COVID-19* 16.4% preterm (3072)	*Control* 11.5% preterm (97 967)	

Cuñarro-López et al. 2021[273]	Spain	*COVID-19* 1347 pregnant women with COVID-19	*Control* 1347 pregnant women without COVID-19	*COVID-19* 11.1% preterm birth (149)	*Control* 6.0% preterm (81)	*P value* 0.001
Son et al. 2021[274]	USA	*COVID-19* 7432 pregnant women with COVID-19	*Control* 613 264 pregnant women pre COVID-19 pandemic	*COVID-19* 0.4% stillbirth (26) 8.5% preterm (631)	*Control* 0.4% stillbirth (366) 6.9% preterm (7669)	
Overtoom et al. 2021[275]	Netherlands	*COVID-19* 289 pregnant women with COVID-19 Subgroup: 70 pregnant women with symptomatic COVID-19	*Control* 183 413 pregnant women pre-pandemic	*COVID-19* 9.7% preterm (28) 18.6% preterm (13)	*Control* 6.7% preterm (12 352)	*OR* (0.68–1.49) 2.02 (1.11–3.69)
Blitz et al. 2021[276]	New York, USA	*COVID-19* 2473 pregnant women with COVID-19 in pregnancy	*Control* 29 077 pregnant women without COVID-19	*COVID-19* 8.5% preterm (211)	*Control* 7.1% preterm (2067)	

Lankford et al. 2021[277]	Maryland USA	*COVID-19* 261 pregnant women with COVID-19 at birth (all caesarean births)	*Control* 12 046 pregnant women without COVID-19 at birth (all caesarean births)	*COVID-19* 8.8% preterm (23) 3.1% stillbirth (8)	*Control* 4.5% preterm (546) 0.8% stillbirth (96)	*P value* 0.001 < 0.001
Harel et al. 2021[278]	Israel	*COVID-19* 172 pregnant women with COVID-19 at delivery	*Control* 2299 pregnant women without COVID-19 at delivery	*COVID-19* 2.9% preterm (5)	*Control* 4.3% preterm (98)	*P value* 0.39
DeSisto et al. 202[165]	USA (736 hospitals)	*COVID-19* 18 094 pregnant women with COVID-19 at delivery (pre-Delta) 3559 pregnant women with COVID-19 at delivery (Delta period)	*Control* 1 058 651 pregnant women without COVID-19 at delivery (pre-Delta) 169 330 pregnant women without COVID-19 at delivery (Delta period)	*COVID-19* 1.0% stillbirth (177) 2.7% stillbirth (96)	*Control* 0.6% (6806 stillbirth) 0.6% stillbirth (1075)	*Adjusted RR* 1.47 (1.27–1.71) 4.04 (3.28-4.97)
DeSisto et al. 2021 (overall)[65]	USA (736 hospitals)	*COVID-19* 21 653 pregnant women with COVID-19 at delivery	*Control* 1 227 981 pregnant women without COVID-19 at delivery	*COVID-19* 1.3% stillbirth (273)	*Control* 0.6% stillbirth (7881)	

Budhram et al. 2021[279]	South Africa	*COVID-19* 148 pregnant women admitted for COVID-19	*Control* 382 pregnant women admitted for other medical indication (no COVID-19)	*COVID-19* 33.1% preterm (49) 3.4% stillbirth (5)	*Control* 31.7% preterm (121) 5.2% stillbirth (20)	
Gupta et al. 2021[280]	India	*COVID-19* 70 pregnant women with COVID-19 at delivery	*Control* 116 pregnant women without COVID-19 at delivery	*COVID-19* 17% preterm (12)	*Control* 12% preterm (14)	*P value* 0.096
Epelboin et al. 2021[281]	France	*COVID-19* 874 pregnant women with COVID-19 at birth	*Control* 234 771 pregnant women with no COVID-19 at birth	*COVID-19* 16.7% preterm (146)	*Control* 7.1% preterm (17 215)	*OR* 2.64 (2.21–3.16)
Khoiwal et al. 2021[282]	India	*COVID-19* 60 pregnant women with COVID-19 at admission	*Control* 60 pregnant women without COVID-19 at admission	*COVID-19* 31.7% preterm (19)	*Control* 30% preterm (18)	
Vera von Bargen et al. 2021[283]	Chile	*COVID-19* 68 pregnant women with COVID-19 at delivery	*Control* 633 pregnant women	*COVID-19* 23.52% preterm (16)	*Control* 8.68% preterm (55)	*P value* 0.0002

Vizheh et al. 2021[284]	Iran	*COVID-19* 254 pregnant women with COVID-19	*Control* 345 pregnant women without COVID-19	*COVID-19* 21.65% preterm (55)	*Control* 13.0% preterm (45)	*P value* 0.043
Regan et al. 2021[285]	USA	*COVID-19* 2655 pregnant women with COVID-19 in pregnancy	*Control* 75 628 pregnant women without COVID-19	*COVID-19* 7.8% preterm birth (199) 0.5% stillbirth (14)	*Control* 6.6% preterm (4431) 0.6% stillbirth (387)	*Hazard ratio* 2.37 (1.89–2.98) 1.55 (0.52–4.61)
Zgutka et al. 2021[257]	USA	*COVID-19* 60 pregnant women with COVID-19 at birth	*Control* 124 pregnant women without COVID-19 at birth	*COVID-19* 18.3% preterm (11)	*Control* 8.1% preterm (10)	
Ali et al. 2021[286]	Pakistan	*COVID-19* 90 pregnant women with COVID-19	*Control* 90 pregnant women without COVID-19	*COVID-19* 22.2% preterm (20)	*Control* 11.1% preterm (10)	
Akyıldız et al. 2021[287]	Turkey	*COVID-19* 101 pregnant women with COVID-19 at birth	*Control* 101 pregnant women without COVID-19 at birth	*COVID-19* 28.7% preterm (29)	*Control* 10.9% (11)	*P value* 0.01
Lucovnik et al. 2021[288]	Slovenia	*COVID-19* 193 pregnant women with COVID-19 in pregnancy	*Control* 1124 pregnant women without COVID-19 at birth	*COVID-19* 5.7% preterm (11) 0.5% stillbirth (1)	*Control* 3.1% preterm (35) 0.4% stillbirth (4)	*OR* 0.85 (0.46–1.60) 1.41 (0.16–12.56)

Table 2: Summary of key studies relevant for the effect of COVID-19 on maternal outcomes

The table below only includes studies with a comparison group (non-pregnant individuals with COVID-19).

Study	Country	Population		Effect of COVID-19 on pregnant women		
Allotey et al. 2020[24] PregCOV-19 Systematic Review (updated 29/11/2020)	30 countries	*Pregnant* 34 047 pregnant women with COVID-19	*Not pregnant* 567 075 non-pregnant women with COVID-19	*Pregnant* 1.8% ICU (616) 0.6% ventilation (270)	*Not pregnant* 1.7% ICU (9568) 0.6% ventilation (3280)	*aOR* 2.13 (1.54–2.95) 2.59 (2.28–2.94)
Zambrano et al. 2020[289] CDC Report	USA	*Pregnant* 23 434 pregnant women with symptomatic COVID-19	*Not pregnant* 386 028 non-pregnant women aged 15-44 with symptomatic COVID-19	*Pregnant* 1.05% ICU 0.29% invasive ventilation 0.07% ECMO 0.15% death	*Not pregnant* 0.39% ICU 0.11% invasive ventilation 0.03% ECMO 0.12% death	*aRR (95% CI)* 3.0 (2.6–3.4) 2.9 (2.2–3.8) 2.4 (1.5–4.0) 1.7 (1.2–2.40)
Martinez-Portilla et al. 2020[42]	Mexico	*Pregnant* 5183 pregnant women with symptomatic COVID-19 admitted to hospital	*Not pregnant* 5183 matched non-pregnant women aged 15–49 with symptomatic COVID-19	*Pregnant* 1.5% death 13% ICU 8.1% intubated	*Not pregnant* 0.8% death 7.4% ICU 8.6% intubated	*OR (95% CI)* 1.84 (1.30–2.61) 2.25 (1.86–2.71) 0.93 (0.70–1.25)
DeBolt et al. 2020[43]	UK	*Pregnant* 38 pregnant women with severe or critical COVID-19	*Not pregnant* 94 non-pregnant women aged 23–50 with severe or critical COVID-19	*Pregnant* 39.5% ICU 26.3% invasive ventilation	*Not pregnant* 17% ICU 10.6% invasive ventilation	*aOR (95% CI)* 5.2 (1.5–17.5) 3.3 (0.5–21.1)

Badr et al. 2020[44]	France	*Pregnant* 83 pregnant women (≥ 20 weeks) with COVID-19	*Not pregnant* 107 non-pregnant women of reproductive age with COVID-19	*Pregnant* 11.08% ICU 10.16% invasive ventilation	*Not pregnant* 2.38% ICU 1.67% invasive ventilation	
Oakes et al. 2021[45]	USA	*Pregnant* 22 pregnant women with symptomatic COVID-19	*Not pregnant* 240 non-pregnant women aged 13–45 with symptomatic COVID-19	*Pregnant* 31.8% severe COVID (NCPERET criteria) 13.6% severe COVID (WHOOSCI criteria)	*Not pregnant* 7.1% severe COVID (NCPERET criteria) 2.5% severe COVID (WHOOSCI criteria)	*aRR (95% CI)* 3.59 (1.49–7.01) 5.65 (1.36–17.31)
Lokken et al. 2021[46]	USA	*Pregnant* 240 women with COVID-19	*Not pregnant* 34 902 adults (male and female) aged 20–39	*Pregnant* 10% hospitalisation for COVID-19 1.25% death	*Not pregnant* 2.8% hospitalisation for COVID-19 0.091% death	*RR (95% CI)* 3.5 (2.3–5.3) 13.6 (2.7–43.6)
Artymuk et al. 2021[290]	Siberia, Russia	*Pregnant* 8485 women with COVID-19	*Not pregnant* General population (496 170)	*Pregnant* 5933 per 100 000 incidence 3.57% ICU 0.48% mechanical ventilation	*Not pregnant* 1960 per 100 000 incidence 2.24% ICU 1.05% mechanical ventilation	
Behrens 2021[291]	USA	*Pregnant* 43 women with COVID	*Not pregnant* 1265 women with COVID aged 16–51	*Pregnant* 0% deaths (0)	*Not pregnant* 3% deaths (39)	

Vizheh 2021[292]	Iran	*Pregnant* 110 pregnant women with COVID	*Not pregnant* 234 non-pregnant women with COVID	*Pregnant* 9.1% ICU (10) 5.5% death (6)	*Not pregnant* 8.1% ICU (18) 5.1% death (12)	*P value* 0.76 0.80
Qeadan 2021[293]		*Pregnant* 1609 pregnant women with COVID-19	*Not pregnant* 20 884 non-pregnant women with COVID aged 18–44	*Pregnant* 1.6% ventilation (26) 0.2% death (4)	*Not pregnant* 1.9% ventilation (396) 0.5% death (100)	*P value* 0.48 0.26
Crossette-Thambiah et al. 2021[294]	UK	*Pregnant* 36 pregnant women admitted with COVID-19	*Not pregnant* 36 propensity matched women admitted with COVID-19	*Pregnant* 8% mechanical ventilation (3) 0% deaths (0)	*Not pregnant* 31% mechanical ventilation (11) 0% deaths (0)	*P value* 0.03
Cojocaru et al. 2021[295]	USA (multiple centres)	*Pregnant* 189 pregnant women with COVID-19	*Not pregnant* 948 women aged 18–45 with COVID-19	*Pregnant* 8.5% ICU (16) 5.3% mechanical ventilation (10) 0.5% death (1)	*Not pregnant* 3.1% ICU (29) 1.8% mechanical ventilation (17) 0.2% death (2)	*P values* < 0.001 0.008 0.4
Scheler et al. 2021[296]	Brazil	*Pregnant* 4853 pregnant or postpartum women with ARDS secondary to severe COVID-19	*Not pregnant* 42 915 women aged 15–49 with ARDS secondary to severe COVID-19	*Pregnant* 7.8% deaths (377)	*Not pregnant* 13.9% deaths (5946)	*OR (95% CI)* 0.52 (0.47–0.58)

Knobel et al. 2021[297]	Brazil	*Pregnant* 2265 pregnant women with acute respiratory symptoms of COVID-19	*Not pregnant* 21 910 non-obstetric women of reproductive aged 10–45 with acute respiratory symptoms of COVID-19	*Pregnant* 6.7% deaths (152) 18.7% ICU admission (424) 7.4% mechanical ventilation (168)	*Not pregnant* 13.0% death (2,848) 24.4% ICU admission (5346) 10.7% mechanical ventilation (2344)	*P value* > 0.0001 > 0.0001 > 0.0001
Serra et al. 2021[298]	Brazil	*Pregnant* 3372 pregnant women hospitalised with acute respiratory symptoms of COVID-19	*Not pregnant* 37 268 non-obstetric women of reproductive age hospitalised with acute respiratory symptoms of COVID-19	*Pregnant* 21.1% ICU (574/2721) 8.0% invasive ventilation (209/2598) 6.2% deaths (181/2904)	*Not pregnant* 27.3% ICU (8014/29 368) 12.5% invasive ventilation (3536/28 199) 14.1% deaths (4534/32 081)	*OR (95% CI)* 0.71 (0.65–0.78) 0.42 (0.36–0.48) 0.40 (0.34–0.47)
Hazari et al. 2021[299]	United Arab Emirates	*Pregnant* 79 pregnant women	*Not pregnant* 85 non-pregnant women with COVID-19	*Pregnant* 12.6% ICU (10) 8% ventilation (6) 1% death (1)	*Not pregnant* 1.2% ICU (1) 1% ventilation (1) 0% death (0)	*P value* 0.003 0.03
Januszewski et al. 2021[300]		*Pregnant* 52 pregnant women admitted with COVID-19	*Not pregnant* 53 non-pregnant women of reproductive age admitted with COVID-19	*Pregnant* 0% ventilation (0) 3.9% ICU admission (2)	*Not pregnant* 1.9% ventilation (1) 1.9% ICU admission (1)	*P value* 0.32 0.547

Strid et al. 2021[301]	USA	*Pregnant*	*Not pregnant*	*Pregnant*	*Not pregnant*	*RR (95% CI)*
Pre-Delta		89 435 pregnant women with COVID-19	1 491 870 non-pregnant women aged 15–44 with COVID-19	0.51% ICU (455)	0.21% ICU (3115)	2.44 (2.18–2.72)
				0.12% invasive ventilation or ECMO (111)	0.07% invasive ventilation or ECMO (1013)	1.83 (1.45–2.30)
				0.11% death (94)	0.09% death (1400)	1.12 (0.89–1.41)
Delta		14 910 pregnant women with COVID-19	260 273 non-pregnant women aged 15–44 with COVID-19	0.77% ICU(115)	0.24% ICU (622)	3.23 (2.61–3.99)
				0.18% invasive ventilation or ECMO (27)	0.09% invasive ventilation or ECMO (232)	2.03 (1.32–3.12)
				0.34% death (50)	0.18% death (478)	1.83 (1.34–2.48)
Leung et al. 2021[302]	Brazil	*Pregnant*	*Not pregnant*	*Pregnant*	*Not pregnant*	*P value*
		7235 pregnant women admitted for COVID-19	90 477 non-pregnant women aged 15–45 admitted for COVID-19	29.2% ICU (2113)	26.6% ICU (24 038)	< 0.001
				48.4% ventilated (3500)	60.1% ventilated (54 379)	< 0.001
BahaaEldin et al. 2021[41]	Egypt	*Pregnant*	*Not pregnant*	*Pregnant*	*Not pregnant*	< 0.001
		408 pregnant women with COVID-19	22 697 non pregnant women aged 18–49 with COVID-19	2.9% ICU (12)	1.2% ICU (281)	
				2.7% ventilated (11)	0.7% ventilated (157)	
				2.5% death (10)	1.5% death (348)	

Gonçalves et al. 2021[303]		*Pregnant* 9370 pregnant women with acute respiratory symptoms of COVID-19	*Not pregnant* 399 970 non-pregnant women aged 10–45 with acute respiratory symptoms of COVID-19	*Pregnant* 26.5% ICU (2226/8407) 11.1% death (1031/9270)	*Not pregnant* 36.7% ICU (127 070/345 822) 38.4% death (153 457/399 970)	

ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; NCPERET, Novel Coronavirus Pneumonia Emergency Response Epidemiology Team; WHOOSCI, World Health Organization Ordinal Scale for Clinical Improvement; ARDS, acute respiratory distress syndrome.

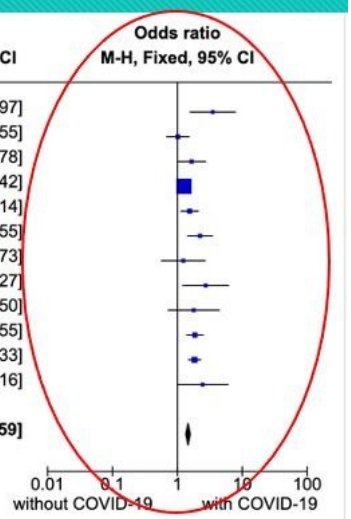
Meta-analysis of the effect of COVID-19 on pregnancy outcomes

Meta-analysis of the effects of COVID-19 on pregnancy outcomes (preterm birth, stillbirth) was performed using data from the studies in Table 1 (above) published since the last update of the PregCOV-19 systematic review, using the online Cochrane Revman software (Shea and Karia et al, unpublished). The results of this meta-analysis are compared with the results of the latest online update of the PregCOV-19 systematic review from 29 November 2020.[24]

Preterm birth – studies since PregCOV-19

Study or Subgroup	Pregnant with COVID-19 Events	Total	Pregnant without COVID-19 Events	Total	Weight	Odds ratio M-H, Fixed, 95% CI
Abedzadeh-Kalahroudi 2021	19	56	12	94	0.7%	3.51 [1.54 , 7.97]
Adhikari 2020	27	252	328	3122	5.3%	1.02 [0.67 , 1.55]
Crovetto 2021	20	176	81	1128	2.4%	1.66 [0.99 , 2.78]
Jering 2021	322	6380	16137	400066	58.7%	1.26 [1.13 , 1.42]
Katz 2021	73	490	98	964	6.9%	1.55 [1.12 , 2.14]
Martinez-Perez 2021	34	246	51	763	2.6%	2.24 [1.41 , 3.55]
Molenaar 2021	8	105	37	591	1.3%	1.23 [0.56 , 2.73]
Soto-Torres 2021	22	106	9	103	0.9%	2.74 [1.19 , 6.27]
Trahan 2021	7	45	21	225	0.7%	1.79 [0.71 , 4.50]
UKOSS 2021	156	1003	63	702	7.6%	1.87 [1.37 , 2.55]
Villar 2021	159	706	194	1424	12.2%	1.84 [1.46 , 2.33]
Zgutka 2021	11	62	10	124	0.7%	2.46 [0.98 , 6.16]
Total (95% CI)		**9627**		**409306**	**100.0%**	**1.46 [1.35 , 1.59]**
Total events:	858		17041			

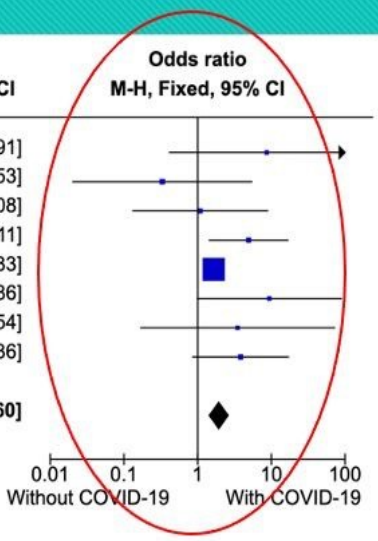
Heterogeneity: Chi² = 27.17, df = 11 (P = 0.004); I² = 60%
Test for overall effect: Z = 8.93 (P < 0.00001)
Test for subgroup differences: Not applicable

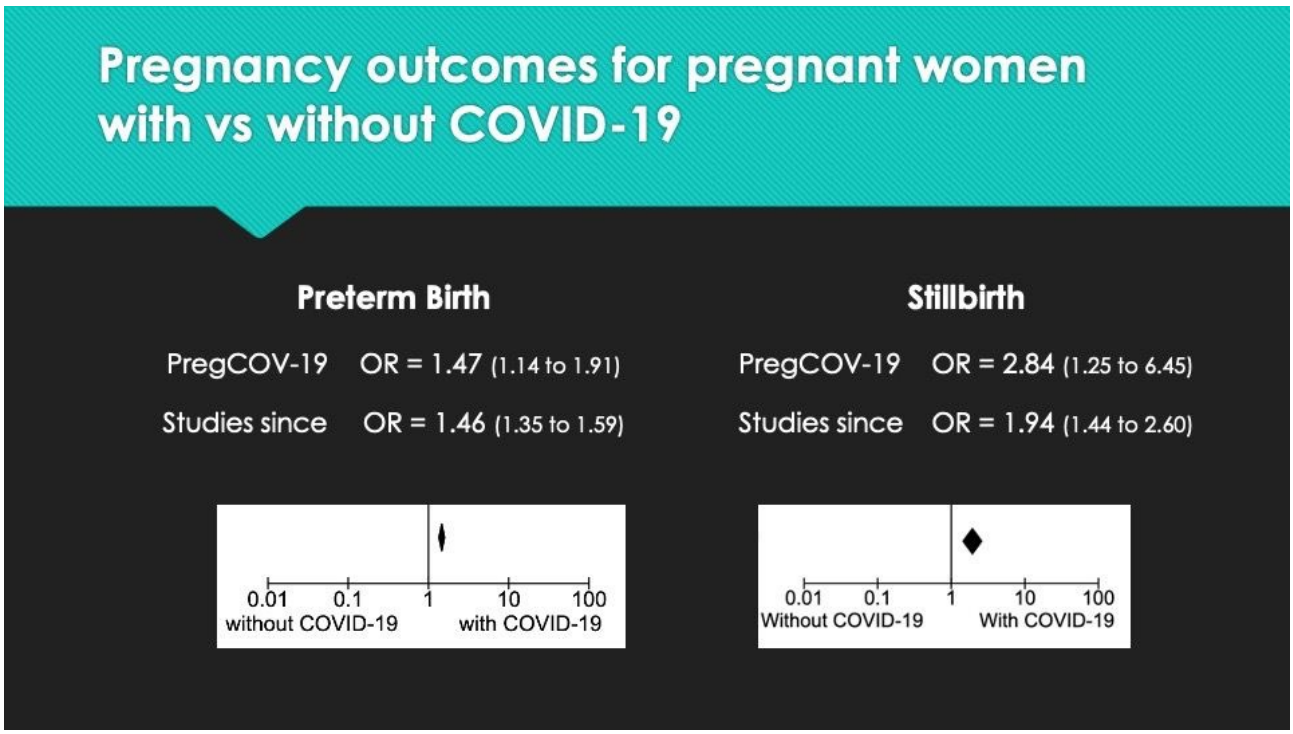


Stillbirth – studies since PregCOV-19

Study or Subgroup	With COVID-19 Events	Total	Without COVID-19 Events	Total	Weight	Odds ratio M-H, Fixed, 95% CI
Abedzadeh-Kalahroudi 2021	2	56	0	94	0.7%	8.67 [0.41 , 183.91]
Adhikari 2020	0	252	18	3122	5.5%	0.33 [0.02 , 5.53]
Crovetto 2021	1	178	6	1160	3.2%	1.09 [0.13 , 9.08]
Hcini 2021	7	137	4	370	4.1%	4.93 [1.42 , 17.11]
Jering 2021	34	6380	1289	400066	80.3%	1.66 [1.18 , 2.33]
Martinez-Perez 2021	3	246	1	763	1.0%	9.41 [0.97 , 90.86]
Savirón-Cornudella 2021	0	65	2	1146	0.5%	3.49 [0.17 , 73.54]
UKOSS 2021	11	1019	2	705	4.7%	3.84 [0.85 , 17.36]
Total (95% CI)		**8333**		**407426**	**100.0%**	**1.94 [1.44 , 2.60]**
Total events:	58		1322			

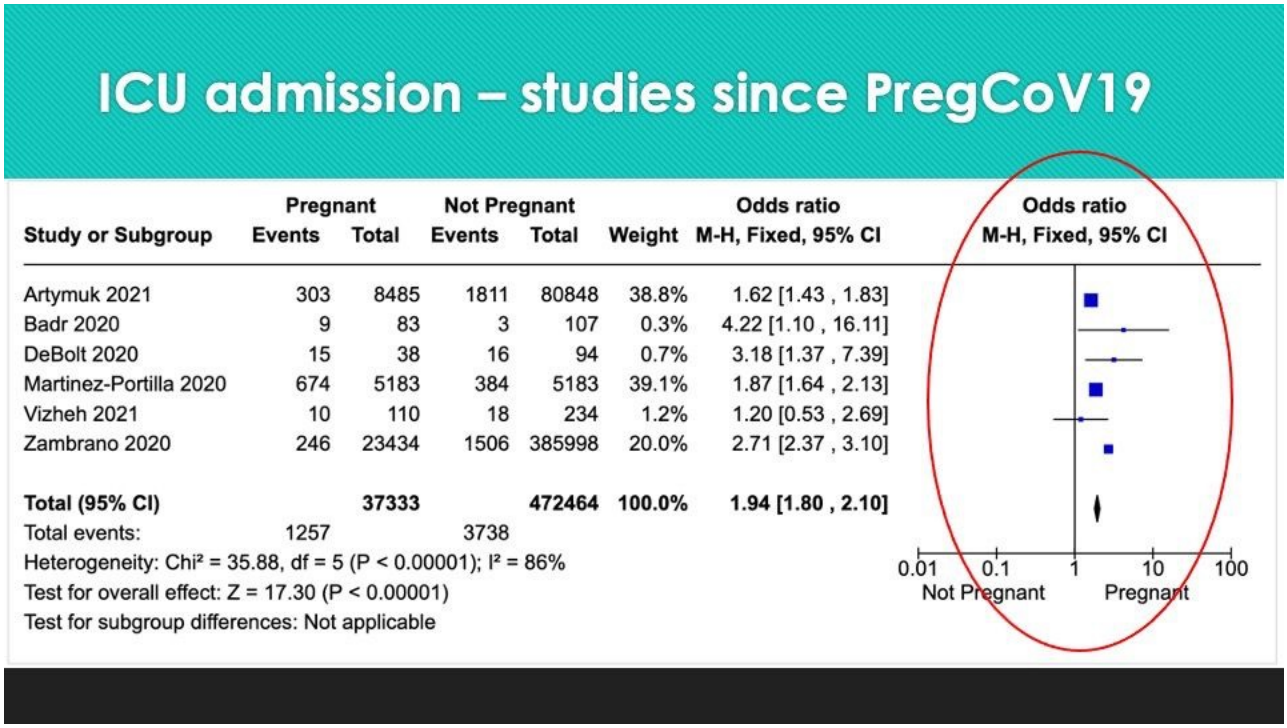
Heterogeneity: Chi² = 8.48, df = 7 (P = 0.29); I² = 17%
Test for overall effect: Z = 4.41 (P < 0.0001)
Test for subgroup differences: Not applicable





Meta-analysis of the maternal effects of COVID-19

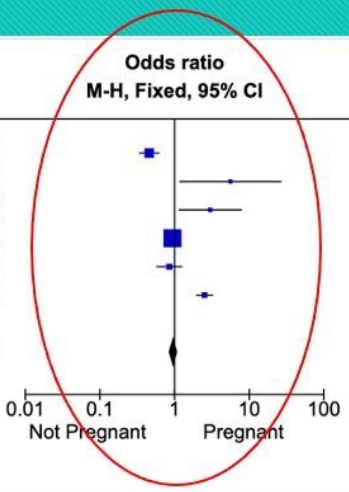
Meta-analysis of the maternal effects of COVID-19 (ICU admission, mechanical ventilation, and death) was performed using data from the studies in Table 2 (above) published since the last update of the PregCOV-19 systematic review, using the online Cochrane Revman software (Shea and Karia et al, unpublished). The results of this meta-analysis are compared with the results of the latest online update of the PregCOV-19 systematic review from 29 November 2020.[24]



Mechanical ventilation – studies since PregCov19

Study or Subgroup	Pregnant Events	Pregnant Total	Not Pregnant Events	Not Pregnant Total	Weight	Odds ratio M-H, Fixed, 95% CI
Artymuk 2021	41	8485	845	80476	23.6%	0.46 [0.33 , 0.63]
Badr 2020	8	83	2	107	0.2%	5.60 [1.16 , 27.12]
DeBolt 2020	10	38	10	94	0.6%	3.00 [1.13 , 7.96]
Martinez-Portilla 2020	420	5183	446	5183	60.2%	0.94 [0.81 , 1.08]
Qeaden 2021	26	1609	396	20884	8.2%	0.85 [0.57 , 1.27]
Zambrano 2020	65	23434	425	386028	7.1%	2.52 [1.94 , 3.28]
Total (95% CI)		**38832**		**492772**	**100.0%**	**0.95 [0.86 , 1.06]**
Total events:	570		2124			

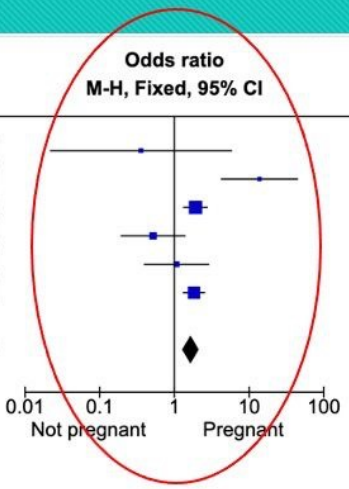
Heterogeneity: Chi² = 84.78, df = 5 (P < 0.00001); I² = 94%
Test for overall effect: Z = 0.87 (P = 0.39)
Test for subgroup differences: Not applicable



Death – studies since PregCOV-19

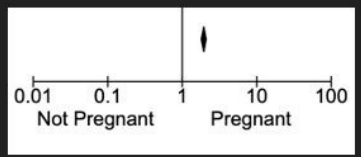
Study or Subgroup	Pregnant Events	Pregnant Total	Not Pregnant Events	Not Pregnant Total	Weight	Odds ratio M-H, Fixed, 95% CI
Behrens 2021	0	43	39	1265	2.6%	0.36 [0.02 , 5.90]
Lokken 2021	3	240	32	34902	0.4%	13.79 [4.19 , 45.35]
Martinez-Portilla 2020	78	5183	41	5183	39.7%	1.92 [1.31 , 2.80]
Qeaden 2021	4	1609	100	20884	14.0%	0.52 [0.19 , 1.41]
Vizheh 2021	6	110	12	234	7.1%	1.07 [0.39 , 2.92]
Zambrano 2020	35	23434	463	567075	36.1%	1.83 [1.30 , 2.58]
Total (95% CI)		**30619**		**629543**	**100.0%**	**1.64 [1.30 , 2.07]**
Total events:	126		687			

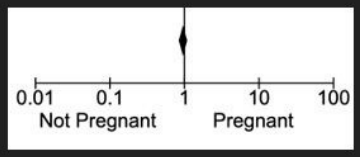
Heterogeneity: Chi² = 20.27, df = 5 (P = 0.001); I² = 75%
Test for overall effect: Z = 4.18 (P < 0.0001)
Test for subgroup differences: Not applicable

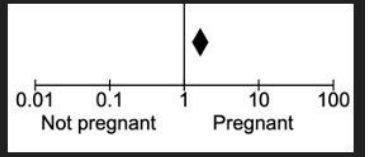


Maternal Risks: pregnant vs non-pregnant women with COVID-19

	ICU admission	Mechanical ventilation	Death
PregCOV-19:	OR = 2.13 (1.54 to 2.95)	OR = 2.59 (2.28 to 2.94)	OR = 0.96 (0.79 to 1.18)
Studies since:	OR = 1.94 (1.86 to 2.10)	OR = 0.95 (0.86 to 1.06)	OR = 1.64 (1.30 to 2.01)







Appendix IV: Example of a telephone triage tool for symptomatic women with suspected or confirmed COVID-19

(adapted from Guy's and St Thomas' NHS Foundation Trust)

Assess severity of illness:

- Shortness of breath/difficulty breathing
- Difficulty completing short sentences without needing to stop/gasp for air
- Coughing blood
- Pain or pressure in chest (other than with coughing)
- Unable to keep liquids down
- Less responsive than normal or becoming confused while talking

Symptoms present → RECOMMEND ATTENDANCE FOR MATERNITY ASSESSMENT

None of these symptoms

Assess clinical and social risks:

- Age >35 years old, BMI >25 kg/m^2
- Women of the Black, Asian or other minority ethnic community
- Consider VTE risk assessment and score
- Medical co-morbidities: diabetes, hypertension, asthma/respiratory disease, HIV, heart disease, immunosuppression, chronic kidney disease
- Obstetric factors: at risk of fetal growth restriction, suspected preterm labour, reduced fetal movements
- Social factors: language barriers, safeguarding concerns, mental health issues, poor social support, domestic violence

Risk factors present → DISCUSS WITH CONSULTANT ABOUT POSSIBLE NEED FOR ADMISSION

No risk factors

Advise to self-isolate and arrange a COVID-19 test (if not yet done) in line with national guidance:

- Inform named consultant and midwifery team
- Safety net to call back if symptoms worsen

Appendix V: Example of a maternity escalation plan for women with suspected or confirmed COVID-19

(adapted from Guy's and St Thomas' NHS Foundation Trust)

Category	Clinical criteria for oxygenation	Suggested actions	Other considerations for viable fetus
Green	SpO_2 94%–98% Room air and RR ≤ 20	Ensure no obstetric or medical concerns Discharge for self-isolation in line with national guidance	
Yellow	Target SpO_2 94%–98% on ≥ FiO_2 28% and/or RR ≥ 21	Increase oxygen flow rate to maintain SaO_2 94%–98% Assessment by obstetric registrar In-patient care **Inform** maternity escalation team: • Obstetric consultant • Obstetric anaesthetist • On-call medical team Give oral prednisolone 40 mg for treatment of COVID-19	Assess fetal wellbeing Consider fetal monitoring Discuss timing of birth Depending on the gestational age: • Consider steroids for fetal lungs • Consider magnesium sulfate for neuroprotection if considering birth of the baby
Amber	Target SpO_2 94%–98% on ≥ FiO_2 35% and/or RR ≥ 25	Increase oxygen flow rate to maintain SaO_2 94%–98% Consider 15 l/min O_2 via non-rebreathe mask Refer to ITU team **Urgent review** by the maternity escalation team Consider awake proning position when feasible/high flow oxygen in critical care setting only	Discuss the risks and benefits of emergency caesarean birth Depending on the gestational age: • Consider steroids for fetal lungs • Consider magnesium sulfate for neuroprotection if considering birth
Red	SpO_2 < 94% on 15 l/min O_2 via non-rebreathe mask	Urgent review by ITU team **Urgent attendance** by the maternity escalation team Consider awake proning position when feasible/high flow oxygen in critical care setting only	Discuss the risks and benefits of emergency caesarean birth Depending on the gestational age: • Consider steroids for fetal lungs • Consider magnesium sulfate for neuroprotection if considering birth
Peri-arrest		Call 2222 – adult cardiac arrest team, obstetric crash team and neonatal crash team	

Appendix VI: Maternal structured checklist – for pregnant and/or postpartum women with confirmed or suspected COVID-19

(adapted with permission from North Bristol NHS Trust)

NHS North Bristol NHS Trust

Maternal structured checklist – for pregnant and/or postpartum women with confirmed or suspected COVID-19

This is designed to be used during the **multi-professional review** of a pregnant or postpartum woman with confirmed or suspected symptoms of COVID-19

It does not replace, nor should repeat the observations and information recorded on the Maternal Critical Care chart or eObs.

Relevant notes can be made as each item is considered either directly into the woman's notes or by annotating the work sheet which should be dated, signed and filed in the woman's maternity notes at the end of the review.

Patient ID (addressogrpah)

Date..... Time.....

VACCINATION STATUS:

Clinical summary:

Bloods to be taken on Day 1:

- SARS Spike antibody
- FBC/Renal 3/ LFTs
- Procalcitonin
- D-dimer
- LDH
- CK Troponin
- BNP
- Ferritin
- AST

	Items to be considered	Notes:
A	**Airway:** o Respiratory deterioration requiring high flow nasal O_2, CPAP, or invasive ventilation, requires transfer to ITU. o Early ITU involvement – contact: xxxx. o Anaesthetic team to accompany for transfer. **N.B. In peri-arrest situation staff in room to doom full AGP PPE in case of deterioration and CPR requirement**	

B	**Breathing**: ○ Respiratory rate & trend (*concerning if > 30*) ○ SpO_2 (*titrate O_2 to maintain 94–96%*) – prescribe on drug chart ○ Are there increasing O_2 requirements? ○ FiO_2 (*concerning if > 40%, or over 4 litres per min*). ○ Cough, sputum. ○ Chest examination findings. ○ CXR e.g., atypical viral pneumonitis, ARDS ○ If abnormal CXR for follow-up repeat CXR in 6 weeks. ○ Consider PE if chest pain and worsening hypoxia or if deteriorates after expected recovery from COVID-19. ○ If requires **oxygen, give oral prednisolone 40 mg once a day or IV hydrocortisone 80 mg twice a day** (for 10 days or discharge home), or dexamethasone as in 'N' below. ○ **Which medics should see COVID-19 patients in obstetrics?** • Stable: Medical on call (Contact details: xxxx) • Acutely unwell women: ICU Consultant (Contact details: xxxx)	
C	**Circulation & cardiovascular**: ○ Heart rate, BP, capillary refill time, vasopressors ○ Presence of palpitations and chest tightness ○ Consider ECG & echocardiogram ○ Measure Troponin and BNP – if raised is a marker of severe disease **N.B. In cardiac arrest chest compressions & airway management will generate aerosols, therefore full AGP PPE required before commencing CPR**	
D	**Disability**: ○ Level of consciousness: AVPU (*concerning if drowsy*) ○ Pain ○ Epidural or spinal block	
E	**Electrolytes**: ○ **Renal function** - Acute kidney Injury (has been reported in 25% of COVID-19 cases) ○ **Liver function may be deranged** ○ High neutrophil-lymphocyte ratio (> 3.0), low albumin, elevated troponin, elevated D-dimers, and elevated ferritin – are markers of severe illness	
F	**Fluid balance**: ○ Input (*consider targeted fluid therapy and neutral fluid balance as under and over resuscitation may be problematic*) ○ Urine output (*concerning if reduction in output*) ○ Blood loss, drains	

G	**GI & glucose control**: ○ Gastro-protection measures (commence omeprazole 40 mg BD until eating for 48 hours) ○ Bowel function (up to 40% of cases suffer bowel symptoms – N.B. stools can be potential source of infection) ○ Glucose level	
H	**Hematology & VTE prophylaxis**: Laboratory findings: ○ FBC (lymphopenia is common and a high (> 3.0) neutrophil-lymphocyte ratio concerning) ○ Thrombocytopenia may occur (stop LMWH if platelets under 50) ○ Lactate ○ Clotting profile (prothrombotic state is common). **VTE prophylaxis** for all suspected or confirmed cases of COVID-19 ○ Non-pharmacological treatments (TEDS and Flowtrons) ○ LMWH unless delivery planned/likely in next 12 hours ○ No oxygen requirement = normal prophylaxis. ○ O_2 dependent = high dose LMWH prophylaxis (e.g. 40 mg BD) – but balance with bleeding/delivery risk ○ A minimum of 10 days LMWH normal dose prophylaxis on discharge ○ Treatment dose if suspected or confirmed VTE (if antenatal give 1 mg/kg BD)	
I	**Infection**: ○ Raised temperature (*not always due to COVID-19, so check for other causes*). ○ Sepsis Six screening. ○ CRP – if > 75 and O_2 requirement consider **tociluzimab.** ○ Inflammatory markers, cultures. ○ Give antibiotics for normal indications (e.g., GBS, prematurity, PROM). ○ Consider antibiotics if bacterial superinfection suspected. Review all outstanding investigations.	
L	**Lines**: Cannula, arterial line, urinary catheter, wound drains.	
M	**Maternal comorbidities:** e.g. diabetes, hypertension, asthma, epilepsy – continue treatment and monitor.	

N	**Neonatal considerations:** **Antenatal** ○ If steroids are indicated for fetal lung maturity, **intramuscular (IM) dexamethasone 12 mg twice (24 hours apart)**. If steroids are also required for COVID (oral prednisolone 40 mg once a day, or IV hydrocortisone 80 mg twice daily omit these for the 48 hours that fetal steroids are given. ○ **administer $MgSO_4$**, if appropriate for neonatal neuroprotection. ○ **Intrapartum** – Neonatologist present in full PPE for AGP for neonatal resuscitation. **Postnatal** – baby remaining with mother? Update on condition if on NICU. Discussion around parental visiting on NICU based on timing and availability of baby swab results. If woman has had **tociluzimab** no live vaccines for baby for 6 months after the dose – document on the Front of the Pink Notes, Page 41 Yellow Book and on ICE discharge to GP	
O	**Obstetric**: **Antenatal** ○ BD CTGs whilst unwell. ○ MDT decision regarding mode and timing of birth consider: maternal condition, fetal condition and gestation, and potential for maternal improvement after elective birth. ○ Stabilise mother prior to birth. ○ Serial growth scans with first scan within the first 14 days following COVID recovery – further monitoring to be determined on an individual basis. **Intrapartum** ○ Electronic fetal monitoring advised – with acute COVID or COVID during pregnancy (write on Pink notes). ○ Full AGP PPE when birth imminent in case neonatal resuscitation is required. **Postpartum** ○ At least 10 days LMWH prophylaxis on discharge.	

P	**Pharmacology**: Review medications ○ If requires oxygen give **oral prednisolone 40 mg** once a day or **intravenous hydrocortisone 80 mg** twice a day (for 10 days or discharge home). ○ If patient is already on oral prednisolone and need dexamethasone for fetal lungs, stop oral prednisolone while giving IM dexamethasone. Restart oral prednisolone after two doses of IM dexamethasone given. ○ **Tociluzimab** if CRP > 75 and O_2 requirement – discuss with infectious disease/acute medicine/ respiratory consultant to consider tocilizumab. ○ **Ronapreve** (REGEN-COV monoclonal antibodies) in those with no SARS-Cov-2 antibodies (see flowchart) • COVID-19 POSITIVE WITH SYMPTOMS • Send blood for Spike antibody • Spike antibody positive – not for Ronapreve ○ Spike antibody NEGATIVE – MDT discussion re-treatment with Ronapreve 2.4 g • COVID-19 positive on screening and no symptoms • Send blood for Spike antibody but can be treated with Ronapreve 1.2g regardless of antibody status if at high risk of progression to severe covid" or "covid presents material risk of destabilising an existing condition or compromising recovery from hospital procedure as determined by MDT".	

S	**Summary and plan:**
	Multi-professional review completed by: **Anaesthetist**…… **Midwife**…… **Obstetrician**…….. **Signature**…… **Print**…… **Date**……..

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

References

References

1. Scottish Intercollegiate Guidelines Network. Implementation support. https://www.sign.ac.uk/what-we-do/implementation-support/.

2. World Health Organization. Coronavirus disease (COVID-19) Weekly Epidemiological Update and Weekly Operational Update. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.

3. Vousden N, Ramakrishnan R, Bunch K, et al. Impact of SARS-CoV-2 variant on the severity of maternal infection and perinatal outcomes: Data from the UK Obstetric Surveillance System national cohort. *medRxiv.* 2021:2021.07.22.21261000. doi:10.1101/2021.07.22.21261000.

4. UK Health Security Agency. COVID-19 variants: genomically confirmed case numbers. https://www.gov.uk/government/publications/covid-19-variants-genomically-confirmed-case-numbers.

5. UK Health Security Agency. COVID-19: Omicron daily overview. https://www.gov.uk/government/publications/covid-19-omicron-daily-overview.

6. Miller NL CT, Raman R, Sasisekharan R. Insights on the mutational landscape of the SARS-CoV-2 Omicron variant. *bioRxiv.* 2021;Preprint. doi:https://dx.doi.org/10.1101/2021.12.06.471499.

7. UK Health Security Agency. Coronavirus (COVID-19) in the UK. https://coronavirus.data.gov.uk/.

8. Musa SS BU, Zhao S, Abdullahi ZU, Lawan MA, He D. Vertical Transmission of SARS-CoV-2: A Systematic Review of Systematic Reviews. *Viruses.* 2021;13(9):1877. doi:10.3390/v13091877.

9. Walker KF, O'Donoghue K, Grace N, et al. Maternal transmission of SARS-COV-2 to the neonate, and possible routes for such transmission: a systematic review and critical analysis. *BJOG.* Oct 2020;127(11):1324-1336. doi:10.1111/1471-0528.16362.

10. Salvatore CM, Han JY, Acker KP, et al. Neonatal management and outcomes during the COVID-19 pandemic: an observation cohort study. *Lancet Child Adolesc Health.* 10 2020;4(10):721-727. doi:10.1016/S2352-4642(20)30235-2.

11. Dumitriu D, Emeruwa UN, Hanft E, et al. Outcomes of Neonates Born to Mothers With Severe Acute Respiratory Syndrome Coronavirus 2 Infection at a Large Medical Center in New York City. *JAMA Pediatr.* 02 01 2021;175(2):157-167. doi:10.1001/jamapediatrics.2020.4298.

12. Mejía Jiménez I, Salvador López R, García Rosas E, et al. Umbilical cord clamping and skin-to-skin contact in deliveries from women positive for SARS-CoV-2: a prospective observational study. *BJOG.* 04 2021;128(5):908-915. doi:10.1111/1471-0528.16597.

13. Ronchi A, Pietrasanta C, Zavattoni M, et al. Evaluation of Rooming-in Practice for Neonates Born to Mothers With Severe Acute Respiratory Syndrome Coronavirus 2 Infection in Italy. *JAMA Pediatr.* 03 01 2021;175(3):260-266. doi:10.1001/jamapediatrics.2020.5086.

14. World Health Organization. Definition and categorization of the timing of mother-to-child transmission of SARS-CoV-2. COVID-19: Scientific briefs. WHO; 2021. https://www.who.int/publications/i/item/WHO-2019-nCoV-mother-to-child-transmission-2021.1.

15. Sánchez-Luna M, Fernández Colomer B, de Alba Romero C, et al. Neonates Born to Mothers With COVID-19: Data From the Spanish Society of Neonatology Registry. *Pediatrics.* 02 2021;147(2)doi:10.1542/peds.2020-015065.

16. Boateng JO, Wachman EM, Turcinovic J, et al. SARS-CoV-2 in infant urine and fecal samples after in utero COVID-19 exposure. *Pediatr Res.* Oct 30 2021;doi:10.1038/s41390-021-01822-x.

17. Capozza M, Salvatore S, Baldassarre ME, et al. Perinatal Transmission and Outcome of Neonates Born to SARS-CoV-2-Positive Mothers: The Experience of 2 Highly Endemic Italian Regions. *Neonatology.* 2021;118(6):665-671. doi:10.1159/000518060.

18. Song D, Prahl M, Gaw SL, et al. Passive and active immunity in infants born to mothers with SARS-CoV-2 infection during pregnancy: Prospective cohort study. *medRxiv.* May 03 2021;doi:10.1101/2021.05.01.21255871.

19. Flannery DD, Gouma S, Dhudasia MB, et al. Assessment of Maternal and Neonatal Cord Blood SARS-CoV-2 Antibodies and Placental Transfer Ratios. *JAMA Pediatr.* 06 01 2021;175(6):594-600. doi:10.1001/jamapediatrics.2021.0038.

20. Kubiak JM, Murphy EA, Yee J, et al. Severe acute respiratory syndrome coronavirus 2 serology levels in pregnant women and their neonates. *Am J Obstet Gynecol.* 07 2021;225(1):73.e1-73.e7. doi:10.1016/j.ajog.2021.01.016.

21. Rathberger K, Häusler S, Wellmann S, et al. SARS-CoV-2 in pregnancy and possible transfer of immunity: assessment of peripartal maternal and neonatal antibody levels and a longitudinal follow-up. *J Perinat Med.* Jul 27 2021;49(6):702-708. doi:10.1515/jpm-2021-0166.

22. Docherty AB, Harrison EM, Green CA, et al. Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study. *BMJ.* May 22 2020;369:m1985. doi:10.1136/bmj.m1985.

23. Eskenazi B, Rauch S, Iurlaro E, et al. Diabetes mellitus, maternal adiposity, and insulin-dependent gestational diabetes are associated with COVID-19 in pregnancy: the INTERCOVID study. *Am J Obstet Gynecol.* Dec 20 2021;doi:10.1016/j.ajog.2021.12.032.

24. Allotey J, Stallings E, Bonet M, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ.* 09 01 2020;370:m3320. doi:10.1136/bmj.m3320.

25. Reale SC, Lumbreras-Marquez MI, King CH, et al. Patient characteristics associated with SARS-CoV-2 infection in parturients admitted for labour and delivery in Massachusetts during the spring 2020 surge: A prospective cohort study. *Paediatr Perinat Epidemiol.* 01 2021;35(1):24-33. doi:10.1111/ppe.12743.

26. UK Health Security Agency. COVID-19: investigation and initial clinical management of possible cases. Accessed 05 March, 2020. https://www.gov.uk/government/publications/wuhan-novel-coronavirus-initial-investigation-of-possible-cases/investigation-and-initial-clinical-management-of-possible-cases-of-wuhan-novel-coronavirus-wn-cov-infection.

27. Afshar Y, Gaw SL, Flaherman VJ, et al. Clinical Presentation of Coronavirus Disease 2019 (COVID-19) in Pregnant and Recently Pregnant People. *Obstet Gynecol.* 12 2020;136(6):1117-1125. doi:10.1097/aog.0000000000004178.

28. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing the long-term effects of COVID-19. NICE guideline [NG188]. NICE; 2020. https://www.nice.org.uk/guidance/ng188.

29. Knight M, Bunch K, Vousden N, et al. Characteristics and outcomes of pregnant women admitted to hospital with confirmed SARS-CoV-2 infection in UK: national population based cohort study. *BMJ.* 06 08 2020;369:m2107. doi:10.1136/bmj.m2107.

30. Vousden N, Bunch K, Morris E, et al. The incidence, characteristics and outcomes of pregnant women hospitalized with symptomatic and asymptomatic SARS-CoV-2 infection in the UK from March to September 2020: A national cohort study using the UK Obstetric Surveillance System (UKOSS). *PLoS One.* 2021;16(5):e0251123. doi:10.1371/journal.pone.0251123.

31. Knight M, Bunch K, Cairns A, et al. on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care. Rapid report 2021: Learning from SARS-CoV-2-related and associated maternal deaths in the UK June 2020-March 2021. MBRACE-UK: July 2021. https://www.npeu.ox.ac.uk/mbrrace-uk#mbrrace-uk-rapid-report-2021-learning-from-sars-cov-2-related-and-associated-maternal-deaths-in-the-uk-june-2020-march-2021.

32. Zaigham M, Andersson O. Maternal and perinatal outcomes with COVID-19: A systematic review of 108 pregnancies. *Acta Obstet Gynecol Scand.* 07 2020;99(7):823-829. doi:10.1111/aogs.13867.

33. Nakamura-Pereira M, Betina Andreucci C, de Oliveira Menezes M, Knobel R, Takemoto MLS. Worldwide maternal deaths due to COVID-19: A brief review. *Int J Gynaecol Obstet.* 10 2020;151(1):148-150. doi:10.1002/ijgo.13328.

34. Jering KS, Claggett BL, Cunningham JW, et al. Clinical Characteristics and Outcomes of Hospitalized Women Giving Birth With and Without COVID-19. *JAMA Intern Med.* May 01 2021;181(5):714-717. doi:10.1001/jamainternmed.2020.9241.

35. Mullins E, Hudak ML, Banerjee J, et al. Pregnancy and neonatal outcomes of COVID-19: coreporting of common outcomes from PAN-COVID and AAP-SONPM registries. *Ultrasound Obstet Gynecol.* 04 2021;57(4):573-581. doi:10.1002/uog.23619.

36. Ward H, Atchison C, Whitaker M, et al. Antibody prevalence for SARS-CoV-2 following the peak of the pandemic in England: REACT2 study in 100,000 adults. *medRxiv.* 2020:2020.08.12.20173690. doi:10.1101/2020.08.12.20173690.

37. Intensive Care National Audit and Research Centre (ICNARC). ICNARC report on COVID-19 in critical care: England, Wales and Northern Ireland. 2021. https://www.icnarc.org/our-audit/audits/cmp/reports.

38. Office for National Statistics. Conceptions in England and Wales: 2018. ONS; March 2020. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/conceptionandfertilityrates/bulletins/conceptionstatistics/2018.

39. ISARIC4C Consortium, UK Obstetric Surveillance System (UKOSS), COVID-19 Clinical Information Network (CO-CIN). UKOSS/ISARIC/CO-CIN: Females in Hospital with SARS-CoV-2 infection, the association with pregnancy and pregnancy outcomes, 25 March 2021. Scientific Advisory Group for Emergencies: April 2021. https://www.gov.uk/government/publications/ukossisaricco-cin-females-in-hospital-with-sars-cov-2-infection-the-association-with-pregnancy-and-pregnancy-outcomes-25-march-2021.

40. Khan DSA, Pirzada AN, Ali A, Salam RA, Das JK, Lassi ZS. The Differences in Clinical Presentation, Management, and Prognosis of Laboratory-Confirmed COVID-19 between Pregnant and Non-Pregnant Women: A Systematic Review and Meta-Analysis. *Int J Environ Res Public Health.* 05 24 2021;18(11)doi:10.3390/ijerph18115613.

41. BahaaEldin H, El Sood HA, Samy S, et al. COVID-19 outcomes among pregnant and nonpregnant women at reproductive age in Egypt. *J Public Health (Oxf).* 12 08 2021;43(Suppl 3):iii12-iii18. doi:10.1093/pubmed/fdab376.

42. Martinez-Portilla RJ, Sotiriadis A, Chatzakis C, et al. Pregnant women with SARS-CoV-2 infection are at higher risk of death and pneumonia: propensity score matched analysis of a nationwide prospective cohort (COV19Mx). *Ultrasound Obstet Gynecol.* 02 2021;57(2):224-231. doi:10.1002/uog.23575.

43. DeBolt CA, Bianco A, Limaye MA, et al. Pregnant women with severe or critical coronavirus disease 2019 have increased composite morbidity compared with nonpregnant matched controls. *Am J Obstet Gynecol.* 05 2021;224(5):510.e1-510.e12. doi:10.1016/j.ajog.2020.11.022.

44. Badr DA, Mattern J, Carlin A, et al. Are clinical outcomes worse for pregnant women at ≥20 weeks' gestation infected with coronavirus disease 2019? A multicenter case-control study with propensity score matching. *Am J Obstet Gynecol.* 11 2020;223(5):764-768. doi:10.1016/j.ajog.2020.07.045.

45. Oakes MC, Kernberg AS, Carter EB, et al. Pregnancy as a risk factor for severe coronavirus disease 2019 using standardized clinical criteria. *Am J Obstet Gynecol MFM.* 05 2021;3(3):100319. doi:10.1016/j.ajogmf.2021.100319.

46. Lokken EM, Huebner EM, Taylor GG, et al. Disease severity, pregnancy outcomes, and maternal deaths among pregnant patients with severe acute respiratory syndrome coronavirus 2 infection in Washington State. *Am J Obstet Gynecol.* 07 2021;225(1):77.e1-77.e14. doi:10.1016/j.ajog.2020.12.1221.

47. Williamson EJ, Walker AJ, Bhaskaran K, et al. Factors associated with COVID-19-related death using OpenSAFELY. *Nature.* 08 2020;584(7821):430-436. doi:10.1038/s41586-020-2521-4.

48. Knight M, Bunch K, Tufnell D, et al., on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care 2020. Lessons to inform maternity care from the UK and Ireland Confidential Enquiries in Maternal Death and Morbidity 2016-18. MBRRACE-UK: December 2020. https://www.npeu.ox.ac.uk/mbrrace-uk/reports.

49. Office for National Statistics. Updating ethnic contrasts in deaths involving the coronavirus (COVID-19), England and Wales: deaths occurring 2 March to 28 July 2020. ONS; 2020. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/updatingethniccontrastsindeathsinvolvingthecoronaviruscovid19englandandwales/deathsoccurring2marchto28july2020.

50. Khunti K, Singh AK, Pareek M, Hanif W. Is ethnicity linked to incidence or outcomes of covid-19? *BMJ.* 04 20 2020;369:m1548. doi:10.1136/bmj.m1548.

51. Magnus MC, Oakley L, Gjessing HK, et al. Pregnancy and risk of COVID-19: a Norwegian registry-linkage study. *BJOG.* 01 2022;129(1):101-109. doi:10.1111/1471-0528.16969.

52. Liu N, Sun J, Wang X, Zhang T, Zhao M, Li H. Low vitamin D status is associated with coronavirus disease 2019 outcomes: a systematic review and meta-analysis. *Int J Infect Dis.* Mar 2021;104:58-64. doi:10.1016/j.ijid.2020.12.077.

53. NHS. Vitamin D. https://www.nhs.uk/conditions/vitamins-and-minerals/vitamin-d/.

54. NHS. Vitamins, supplements and nutrition in pregnancy. https://www.nhs.uk/pregnancy/keeping-well/vitamins-supplements-and-nutrition/.

55. D'Onofrio BM, Class QA, Rickert ME, Larsson H, Långström N, Lichtenstein P. Preterm birth and mortality and morbidity: a population-based quasi-experimental study. *JAMA Psychiatry.* Nov 2013;70(11):1231-40. doi:10.1001/jamapsychiatry.2013.2107.

56. National Institute for Health and Care Excellence. Preterm labour and birth. NICE guideline [NG25]. NICE; 2015, Updated 2019. https://www.nice.org.uk/guidance/ng25/.

57. Cruz-Lemini M, Ferriols Perez E, de la Cruz Conty ML, et al. Obstetric Outcomes of SARS-CoV-2 Infection in Asymptomatic Pregnant Women. *Viruses.* Jan 15 2021;13(1) doi:10.3390/v13010112.

58. Gurol-Urganci I, Jardine JE, Carroll F, et al. Maternal and perinatal outcomes of pregnant women with SARS-CoV-2 infection at the time of birth in England: national cohort study. *Am J Obstet Gynecol.* May 20 2021;doi:10.1016/j.ajog.2021.05.016.

59. Wei SQ, Bilodeau-Bertrand M, Liu S, Auger N. The impact of COVID-19 on pregnancy outcomes: a systematic review and meta-analysis. *CMAJ.* 04 19 2021;193(16):E540-E548. doi:10.1503/cmaj.202604.

60. Metz TD, Clifton RG, Hughes BL, et al. Disease Severity and Perinatal Outcomes of Pregnant Patients With Coronavirus Disease 2019 (COVID-19). *Obstet Gynecol.* 04 01 2021;137(4):571-580. doi:10.1097/AOG.0000000000004339.

61. Swartz D, Graham A. Potential Maternal and Infant Outcomes from Coronavirus 2019-nCoV (SARS-CoV-2) Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections. *Viruses.* 2020:1-16.

62. Alserehi H, Wali G, Alshukairi A, Alraddadi B. Impact of Middle East Respiratory Syndrome coronavirus (MERS-CoV) on pregnancy and perinatal outcome. *BMC Infect Dis.* Mar 02 2016;16:105. doi:10.1186/s12879-016-1437-y.

63. Villar J, Ariff S, Gunier RB, et al. Maternal and Neonatal Morbidity and Mortality Among Pregnant Women With and Without COVID-19 Infection: The INTERCOVID Multinational Cohort Study. *JAMA Pediatr.* 08 01 2021;175(8):817-826. doi:10.1001/jamapediatrics.2021.1050.

64. Norman M, Navér L, Söderling J, et al. Association of Maternal SARS-CoV-2 Infection in Pregnancy With Neonatal Outcomes. *JAMA.* 05 25 2021;325(20):2076-2086. doi:10.1001/jama.2021.5775.

65. DeSisto CL, Wallace B, Simeone RM, et al. Risk for Stillbirth Among Women With and Without COVID-19 at Delivery Hospitalization - United States, March 2020-September 2021. *MMWR Morb Mortal Wkly Rep.* Nov 26 2021;70(47):1640-1645. doi:10.15585/mmwr.mm7047e1.

66. Garrido-Pontnou M, Navarro A, Camacho J, et al. Diffuse trophoblast damage is the hallmark of SARS-CoV-2-associated fetal demise. *Mod Pathol.* 09 2021;34(9):1704-1709. doi:10.1038/s41379-021-00827-5.

67. Dubucs C, Groussolles M, Ousselin J, et al. Severe placental lesions due to maternal SARS-CoV-2 infection associated to intrauterine fetal death. *Hum Pathol.* Jan 04 2022;doi:10.1016/j.humpath.2021.12.012.

68. Fitzgerald B, O'Donoghue K, McEntagart N, et al. Fetal deaths in Ireland due to SARS-CoV-2 placentitis caused by SARS-CoV-2 Alpha. *Arch Pathol Lab Med.* Jan 12 2022;doi:10.5858/arpa.2021-0586-SA.

69. Jacoby VL, Murtha A, Afshar Y, et al. Risk of pregnancy loss before 20 weeks' gestation in study participants with COVID-19. *Am J Obstet Gynecol.* Jun 24 2021;doi:10.1016/j.ajog.2021.06.080.

70. González Rodríguez L, Oreja Cuesta AB, Pardo Pumar MI, et al. SARS-CoV-2 infection in early first-trimester miscarriages: a prospective observational study. *Reprod Biomed Online*. Sep 20 2021;doi:10.1016/j.rbmo.2021.09.010.

71. Cosma S, Carosso AR, Cusato J, et al. Coronavirus disease 2019 and first-trimester spontaneous abortion: a case-control study of 225 pregnant patients. *Am J Obstet Gynecol.* 04 2021;224(4):391.e1-391.e7. doi:10.1016/j.ajog.2020.10.005.

72. Rimmer MP, Al Wattar BH, Members U. Provision of obstetrics and gynaecology services during the COVID-19 pandemic: a survey of junior doctors in the UK National Health Service. *BJOG.* 08 2020;127(9):1123-1128. doi:10.1111/1471-0528.16313.

73. Jardine J, Relph S, Magee LA, et al. Maternity services in the UK during the coronavirus disease 2019 pandemic: a national survey of modifications to standard care. *BJOG.* 04 2021;128(5):880-889. doi:10.1111/1471-0528.16547.

74. Karavadra B, Stockl A, Prosser-Snelling E, Simpson P, Morris E. Women's perceptions of COVID-19 and their healthcare experiences: a qualitative thematic analysis of a national survey of pregnant women in the United Kingdom. *BMC Pregnancy Childbirth.* Oct 07 2020;20(1):600. doi:10.1186/s12884-020-03283-2.

75. Yan H, Ding Y, Guo W. Mental Health of Pregnant and Postpartum Women During the Coronavirus Disease 2019 Pandemic: A Systematic Review and Meta-Analysis. *Front Psychol.* 2020;11:617001. doi:10.3389/fpsyg.2020.617001.

76. Fan S, Guan J, Cao L, et al. Psychological effects caused by COVID-19 pandemic on pregnant women: A systematic review with meta-analysis. *Asian J Psychiatr.* Feb 2021;56:102533. doi:10.1016/j.ajp.2020.102533.

77. Knight M, Bunch K, Cairns A, on behalf of MBRRACE-UK: Saving Lives, Improving Mothers' Care. Rapid report: Learning from SARS-CoV-2-related and associated maternal deaths in the UK March-May 2020. Rapid report: Learning from SARS-CoV-2-related and associated maternal deaths in the UK March-May 2020. MBRRACE-UK: 2020. https://www.npeu.ox.ac.uk/mbrrace-uk/reports.

78. UK Health Security Agency. COVID-19: the green book, chapter 14a. Coronavirus (COVID-19) vaccination information for public health professionals. November 2020. https://www.gov.uk/government/publications/covid-19-the-green-book-chapter-14a.

79. Polack FP, Thomas SJ, Kitchin N, et al. Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine. *N Engl J Med.* 12 31 2020;383(27):2603-2615. doi:10.1056/NEJMoa2034577.

80. Voysey M, Clemens SAC, Madhi SA, et al. Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. *Lancet.* 01 09 2021;397(10269):99-111. doi:10.1016/S0140-6736(20)32661-1.

81. Baden LR, El Sahly HM, Essink B, et al. Efficacy and Safety of the mRNA-1273 SARS-CoV-2 Vaccine. *N Engl J Med.* 02 04 2021;384(5):403-416. doi:10.1056/NEJMoa2035389.

82. Sadoff J, Gray G, Vandebosch A, et al. Safety and Efficacy of Single-Dose Ad26.COV2.S Vaccine against Covid-19. *N Engl J Med.* 06 10 2021;384(23):2187-2201. doi:10.1056/NEJMoa2101544.

83. Bernal JL, Panagiotopoulos N, Byers C, et al. Transmission dynamics of COVID-19 in household and community settings in the United Kingdom. *medRxiv*. 2020:2020.08.19.20177188. doi:10.1101/2020.08.19.20177188.

84. UK Health Security Agency. COVID-19 vaccine weekly surveillance reports (weeks 39 to 4, 2021 to 2022). https://www.gov.uk/government/publications/covid-19-vaccine-weekly-surveillance-reports.

85. UK Health Security Agency. COVID-19 vaccine surveillance report: 18 November 2021 (week 46). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1034383/Vaccine-surveillance-report-week-46.pdf.

86. Abu-Raddad LJ, Chemaitelly H, Butt AA; National Study Group for COVID-19 Vaccination. Effectiveness of the BNT162b2 Covid-19 Vaccine against the B.1.1.7 and B.1.351 Variants. *N Engl J Med.* 07 08 2021;385(2):187-189. doi:10.1056/NEJMc2104974.

87. Bernal JL, Andrews N, Gower C, et al. Effectiveness of COVID-19 vaccines against the B.1.617.2 variant. *medRxiv.* 2021:2021.05.22.21257658. doi:10.1101/2021.05.22.21257658.

88. UK Health Security Agency. Investigation of SARS-CoV-2 variants: technical briefings. https://www.gov.uk/government/publications/investigation-of-sars-cov-2-variants-technical-briefings.

89. Ren SY, Wang WB, Gao RD, Zhou AM. Omicron variant (B.1.1.529) of SARS-CoV-2: Mutation, infectivity, transmission, and vaccine resistance. *World J Clin Cases*. Jan 07 2022;10(1):1-11. doi:10.12998/wjcc.v10.i1.1.

90. Centers for Disease Control and Prevention. Myocarditis and Pericarditis After mRNA COVID-19 Vaccination. CDC; 2021. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/myocarditis.html

91. Knight M, UK Obstetric Surveillance System. Personal Communication, 2022.

92. Department of Health and Social Care. Joint Committee on Vaccination and Immunisation: advice on priority groups for COVID-19 vaccination, 30 December 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.

93. Centers for Disease Control and Prevention. V-safe COVID-19 Vaccine Pregnancy Registry. CDC; 2021. https://www.cdc.gov/coronavirus/2019-ncov/vaccines/safety/vsafepregnancyregistry.html.

94. Public Health Scotland. COVID-19 statistical report. PHS; 2021. https://publichealthscotland.scot/publications/covid-19-statistical-report/covid-19-statistical-report-2-february-2022/.

95. Lipkind HS, Vazquez-Benitez G, DeSilva M, et al. Receipt of COVID-19 Vaccine During Pregnancy and Preterm or Small-for-Gestational-Age at Birth - Eight Integrated Health Care Organizations, United States, December 15, 2020-July 22, 2021. *MMWR Morb Mortal Wkly Rep*. Jan 07 2022;71(1):26-30. doi:10.15585/mmwr.mm7101e1.

96. Public Health Wales. Wales COVID-19 Vaccination Enhanced Surveillance. https://www2.nphs.wales.nhs.uk/CommunitySurveillanceDocs.nsf/61c1e930f9121fd080256f2a004937ed/e61c928e715ece3180258680003449c3/$FILE/Wales%20COVID-19%20vaccination%20enhanced%20surveillance%20-%20equality%20report.pdf.

97. Plotkin S, Orenstein W, Offit P. General immunization practices. In: Plotkin S, Orenstein W, Offit P, eds. Vaccines. 6th ed. Saunders; 2012: p. 88.

98. Shimabukuro TT, Kim SY, Myers TR, et al. Preliminary Findings of mRNA Covid-19 Vaccine Safety in Pregnant Persons. *N Engl J Med.* 06 17 2021;384(24):2273-2282. doi:10.1056/NEJMoa2104983.

99. Collier AY, McMahan K, Yu J, et al. Immunogenicity of COVID-19 mRNA Vaccines in Pregnant and Lactating Women. *JAMA.* 06 15 2021;325(23):2370-2380. doi:10.1001/jama.2021.7563.

100. Gray KJ, Bordt EA, Atyeo C, et al. Coronavirus disease 2019 vaccine response in pregnant and lactating women: a cohort study. *Am J Obstet Gynecol.* 09 2021;225(3):303.e1-303.e17. doi:10.1016/j.ajog.2021.03.023.

101. Greinacher A, Thiele T, Warkentin TE, Weisser K, Kyrle PA, Eichinger S. Thrombotic Thrombocytopenia after ChAdOx1 nCov-19 Vaccination. *N Engl J Med*. 06 03 2021;384(22):2092-2101. doi:10.1056/NEJMoa2104840.

102. Pavord S, Scully M, Hunt BJ, et al. Clinical Features of Vaccine-Induced Immune Thrombocytopenia and Thrombosis. *N Engl J Med.* 2021;385(18):1680-1689. doi:10.1056/NEJMoa2109908.

103. World Health Organization. Statement of the COVID-19 subcommittee of the WHO Global Advisory Committee on Vaccine Safety (GACVS) on safety signals related to the Johnson & Johnson/Janssen COVID-19 vaccine. 2021. https://www.who.int/news/item/19-05-2021-statement-gacvs-safety-johnson-johnson-janssen-covid-19-vaccine.

104. Department of Health and Social Care. Use of the AstraZeneca COVID-19 (AZD1222) vaccine: updated JCVI statement, 7 May 2021. DHSC; 2021. https://www.gov.uk/government/publications/use-of-the-astrazeneca-covid-19-vaccine-jcvi-statement-7-may-2021/use-of-the-astrazeneca-covid-19-azd1222-vaccine-updated-jcvi-statement-7-may-2021.

105. National Institute for Health and Care Excellence. COVID-19 rapid guideline: vaccine-induced immune thrombocytopenia and thrombosis (VITT). NICE; 2021. https://www.nice.org.uk/guidance/ng200.

106. Pavord S, Hunt BJ, Horner D, Bewley S, Karpusheff J. Vaccine induced immune thrombocytopenia and thrombosis: summary of NICE guidance. *BMJ.* 2021;375:n2195. doi:10.1136/bmj.n2195.

107. Cines DB, Bussel JB. SARS-CoV-2 Vaccine-Induced Immune Thrombotic Thrombocytopenia. *N Engl J Med.* 06 10 2021;384(23):2254-2256. doi:10.1056/NEJMe2106315.

108. Medicines and Healthcare products Regulatory Agency. Coronavirus vaccine - weekly summary of Yellow Card reporting. https://www.gov.uk/government/publications/coronavirus-covid-19-vaccine-adverse-reactions/coronavirus-vaccine-summary-of-yellow-card-reporting.

109. Husby A, Hansen JV, Fosbøl E, et al. SARS-CoV-2 vaccination and myocarditis or myopericarditis: population based cohort study. *BMJ.* 2021;375:e068665. doi:10.1136/bmj-2021-068665.

110. Singer ME, Taub IB, Kaelber DC. Risk of Myocarditis from COVID-19 Infection in People Under Age 20: A Population-Based Analysis. *medRxiv.* Jul 27 2021;doi:10.1101/2021.07.23.21260998.

111. Magnus MC, Gjessing HK, Eide HN, Wilcox AJ, Fell DB, Håberg SE. Covid-19 Vaccination during Pregnancy and First-Trimester Miscarriage. *N Engl J Med.* 2021;385(21):2008-2010. doi:10.1056/NEJMc2114466.

112. Hillson K, Clemens SC, Madhi SA, et al. Fertility rates and birth outcomes after ChAdOx1 nCoV-19 (AZD1222) vaccination. *Lancet.* 11 06 2021;398(10312):1683-1684. doi:10.1016/S0140-6736(21)02282-0.

113. Trostle ME, Limaye MA, Avtushka V, Lighter JL, Penfield CA, Roman AS. COVID-19 vaccination in pregnancy: early experience from a single institution. *Am J Obstet Gynecol MFM.* 11 2021;3(6):100464. doi:10.1016/j.ajogmf.2021.100464.

114. Kachikis A, Englund JA, Singleton M, Covelli I, Drake AL, Eckert LO. Short-term Reactions Among Pregnant and Lactating Individuals in the First Wave of the COVID-19 Vaccine Rollout. *JAMA Netw Open.* 08 02 2021;4(8):e2121310. doi:10.1001/jamanetworkopen.2021.21310.

115. Zauche LH, Wallace B, Smoots AN, et al. Receipt of mRNA Covid-19 Vaccines and Risk of Spontaneous Abortion. *N Engl J Med.* 10 14 2021;385(16):1533-1535. doi:10.1056/NEJMc2113891.

116. Juncker HG, Romijn M, Loth VN, et al. Antibodies Against SARS-CoV-2 in Human Milk: Milk Conversion Rates in the Netherlands. *J Hum Lact.* 08 2021;37(3):469-476. doi:10.1177/0890334421101818 5.

117. Golan Y, Prahl M, Cassidy A, et al. Immune response during lactation after anti-SARS-CoV2 mRNA vaccine. *medRxiv.* 2021:2021.03.09.21253241. doi:10.1101/2021.03.09.21253241.

118. British Fertility Society and Association of Reproductive and Clinical Scientists COVID working group. Update to guidance on fertility treatment during the Covid-19 pandemic. BFS/ARCS: February 2022. https://www.britishfertilitysociety.org.uk/2022/02/28/update-to-the-association-of-reproductive-and-clinical-scientists-arcs-and-british-fertility-society-bfs-u-k-best-practice-guidelines-for-fertility-clinics-during-the-covid-19-pandemic-2/.

119. Medicines and Healthcare products Regulatory Agency. Information for Healthcare Professionals on COVID-19 Vaccine Pfizer/BioNTech (Regulation 174). MHRA; 2021. https://www.gov.uk/government/publications/regulatory-approval-of-pfizer-biontech-vaccine-for-covid-19/information-for-healthcare-professionals-on-pfizerbiontech-covid-19-vaccine.

120. Medicines and Healthcare products Regulatory Agency. Summary of Product Characteristics for Spikevax. MHRA; 2021. https://www.gov.uk/government/publications/regulatory-approval-of-covid-19-vaccine-moderna/information-for-healthcare-professionals-on-covid-19-vaccine-moderna.

121. Medicines and Healthcare products Regulatory Agency. Information for Healthcare Professionals on COVID-19 Vaccine AstraZeneca (Regulation 174). MHRA; 2021. https://www.gov.uk/government/publications/regulatory-approval-of-covid-19-vaccine-astrazeneca/information-for-healthcare-professionals-on-covid-19-vaccine-astrazeneca-regulation-174.

122. Aharon D, Canon CM, Hanley WJ, et al. MRNA COVID-19 vaccines do not compromise implantation of euploid embryos. *Fertility and Sterility.* 2021;116(3):e77-e77. doi:10.1016/j.fertnstert.2021.07.215.

123. NHS England and NHS Improvement. Shared Decision Making. Summary guide. NHS; 2019. https://www.england.nhs.uk/wp-content/uploads/2019/01/shared-decision-making-summary-guide-v1.pdf.

124. National Institute for Health and Care Excellence. Shared decision making. NICE guideline [NG197]. NICE; 2021. https://www.nice.org.uk/guidance/ng197.

125. ClinicalTrials.gov U.S. National Library of Medicine. Study to Evaluate the Safety, Tolerability, and Immunogenicity of SARS CoV-2 RNA Vaccine Candidate (BNT162b2) Against COVID-19 in Healthy Pregnant Women 18 Years of Age and Older. https://clinicaltrials.gov/ct2/show/NCT04754594

126. ClinicalTrials.gov, U.S. National Library of Medicine. A Study of Ad26.COV2.S in Healthy Pregnant Participants (COVID-19) (HORIZON 1). 2021. https://clinicaltrials.gov/ct2/show/NCT04765384.

127. St George's Vaccine Institute. Preg Cov-Trial. https://vaccine.ac.uk/research/preg-cov-trial/.

128. Dowswell T, Carroli G, Duley L, et al. Alternative versus standard packages of antenatal care for low-risk pregnancy. *Cochrane Database Syst Rev.* Jul 16 2015;(7):CD000934. doi:10.1002/14651858.CD000934.pub3.

129. Knight M, Bunch K, Tuffnell D, et al., on behalf of MBRRACE-UK. Saving Lives, Improving Mothers' Care. Lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2014–16. MBRRACE-UK; 2018. https://www.npeu.ox.ac.uk/assets/downloads/mbrrace-uk/reports/MBRRACE-UK%20Maternal%20Report%202018%20-%20Web%20Version.pdf.

130. National Institute for Health and Care Excellence. Antenatal care. NICE clinical guideline [NG201]. NICE; 2021. https://www.nice.org.uk/guidance/ng201.

131. Reale SC, Fields KG, Lumbreras-Marquez MI, et al. Association Between Number of In-Person Health Care Visits and SARS-CoV-2 Infection in Obstetrical Patients. *JAMA*. Sep 22 2020;324(12):1210-1212. doi:10.1001/jama.2020.15242.

132. Quinn LM, Olajide O, Green M, Sayed H, Ansar H. Patient and Professional Experiences With Virtual Antenatal Clinics During the COVID-19 Pandemic in a UK Tertiary Obstetric Hospital: Questionnaire Study. *J Med Internet Res.* 08 31 2021;23(8):e25549. doi:10.2196/25549.

133. Jeganathan S, Prasannan L, Blitz MJ, Vohra N, Rochelson B, Meirowitz N. Adherence and acceptability of telehealth appointments for high-risk obstetrical patients during the coronavirus disease 2019 pandemic. *Am J Obstet Gynecol MFM.* 11 2020;2(4):100233. doi:10.1016/j.ajogmf.2020.100233.

134. NHS England and NHS Improvement. Video consultations for secondary care. NHSE/NHSI 2021. https://www.england.nhs.uk/coronavirus/publication/video-consultations-for-secondary-care/.

135. Scottish Perinatal Network and NHS Scotland. NHS Near Me. https://www.perinatalnetwork.scot/maternity/maternitynearme/.

136. Peahl AF, Smith RD, Moniz MH. Prenatal care redesign: creating flexible maternity care models through virtual care. *Am J Obstet Gynecol.* 09 2020;223(3):389.e1-389.e10. doi:10.1016/j.ajog.2020.05.029.

137. National Institute for Health and Care Excellence. Diabetes in pregnancy: management from preconception to the postnatal period. NICE; 2015, Updated 2020. www.nice.org.uk/guidance/ng3.

138. van-de-l'Isle Y, Steer PJ, Watt Coote I, Cauldwell M. Impact of changes to national UK Guidance on testing for gestational diabetes screening during a pandemic: a single-centre observational study. *BJOG.* 04 2021;128(5):917-920. doi:10.1111/1471-0528.16482.

139. McIntyre HD, Gibbons KS, Ma RCW, et al. Testing for gestational diabetes during the COVID-19 pandemic. An evaluation of proposed protocols for the United Kingdom, Canada and Australia. *Diabetes Res Clin Pract.* Jul 30 2020;167:108353. doi:10.1016/j.diabres.2020.108353.

140. Meek CL, Lindsay RS, Scott EM, et al. Approaches to screening for hyperglycaemia in pregnant women during and after the COVID-19 pandemic. *Diabet Med.* 01 2021;38(1):e14380. doi:10.1111/dme.14380.

141. Chodosh J, Weinstein BE, Blustein J. Face masks can be devastating for people with hearing loss. *BMJ.* 07 09 2020;370:m2683. doi:10.1136/bmj.m2683.

142. Henderson J, Gao H, Redshaw M. Experiencing maternity care: the care received and perceptions of women from different ethnic groups. *BMC Pregnancy Childbirth.* Oct 22 2013;13:196. doi:10.1186/1471-2393-13-196.

143. Raleigh VS, Hussey D, Seccombe I, Hallt K. Ethnic and social inequalities in women's experience of maternity care in England: results of a national survey. *J R Soc Med.* May 2010;103(5):188-98. doi:10.1258/jrsm.2010.090460.

144. Vardavas CI, Nikitara K. COVID-19 and smoking: A systematic review of the evidence. *Tob Induc Dis.* 2020;18:20. doi:10.18332/tid/119324.

145. World Health Organization. Smoking and COVID-19. https://www.who.int/publications/i/item/WHO-2019-nCoV-Sci_Brief-Smoking-2020.2.

146. Mertz D, Geraci J, Winkup J, Gessner BD, Ortiz JR, Loeb M. Pregnancy as a risk factor for severe outcomes from influenza virus infection: A systematic review and meta-analysis of observational studies. *Vaccine.* 01 23 2017;35(4):521-528. doi:10.1016/j.vaccine.2016.12.012.

147. Quach THT, Mallis NA, Cordero JF. Influenza Vaccine Efficacy and Effectiveness in Pregnant Women: Systematic Review and Meta-analysis. *Matern Child Health J.* Feb 2020;24(2):229-240. doi:10.1007/s10995-019-02844-y.

148. Cuadrado-Payán E, Montagud-Marrahi E, Torres-Elorza M, et al. SARS-CoV-2 and influenza virus co-infection. *Lancet.* 05 16 2020;395(10236):e84. doi:10.1016/S0140-6736(20)31052-7.

149. Corbett GA, Milne SJ, Hehir MP, Lindow SW, O'Connell M P. Health anxiety and behavioural changes of pregnant women during the COVID-19 pandemic. *Eur J Obstet Gynecol Reprod Biol.* Jun 2020;249:96-97. doi:10.1016/j.ejogrb.2020.04.022.

150. Wu Y, Zhang C, Liu H, et al. Perinatal depressive and anxiety symptoms of pregnant women during the coronavirus disease 2019 outbreak in China. *Am J Obstet Gynecol.* 08 2020;223(2):240.e1-240.e9. doi:10.1016/j.ajog.2020.05.009.

151. Institute for Fiscal Studies. The mental health effects of the first two months of lockdown and social distancing during the Covid-19 pandemic in the UK. *IFS Working Paper W20/16*. 2020;doi:10.1920/wp.ifs.2020.1620.

152. Etheridge B, Spantig L; Institute for Social & Economic Research. The Gender Gap in Mental Well-Being During the Covid-19 Outbreak: Evidence from the UK. ISER Working Paper Series 2020-08. ISER; 2020. https://www.iser.essex.ac.uk/research/publications/working-papers/iser/2020-08.

153. Saccone G, Florio A, Aiello F, et al. Psychological impact of coronavirus disease 2019 in pregnant women. *Am J Obstet Gynecol.* 08 2020;223(2):293-295. doi:10.1016/j.ajog.2020.05.003.

154. Lebel C, MacKinnon A, Bagshawe M, Tomfohr-Madsen L, Giesbrecht G. Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. *J Affect Disord.* 12 01 2020;277:5-13. doi:10.1016/j.jad.2020.07.126.

155. Royal College of Midwives. Domestic Abuse. Accessed 27 May, 2020. https://www.rcm.org.uk/media/4067/identifying-caring-for-and-supporting-women-at-risk-of_victims-of-domestic-abuse-during-covid-19-v1__13052020final.pdf.

156. Liu CH, Hyun S, Erdei C, Mittal L. Prenatal distress during the COVID-19 pandemic: clinical and research implications. *Arch Gynecol Obstet.* Oct 30 2021;doi:10.1007/s00404-021-06286-2.

157. Hinds C, Lindow SW, Abdelrahman M, Hehir MP, O'Connell MP. Assessment of antenatal anxiety, depression and obsessive-compulsive disorder in pregnant women in the COVID-19 era. *Ir J Psychol Med.* Aug 26 2021:1-7. doi:10.1017/ipm.2021.57.

158. Roesch E, Amin A, Gupta J, García-Moreno C. Violence against women during covid-19 pandemic restrictions. *BMJ.* May 07 2020;369:m1712. doi:10.1136/bmj.m1712.

159. Royal College of Obstetricians and Gynaecologists. Reducing the Risk of Venous Thromboembolism during Pregnancy and the Puerperium. Green-top Guideline 37a. RCOG; 2015. https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg37a/.

160. UK Health Security Agency. COVID-19: infection prevention and control. https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control.

161. Royal College of Midwives. Personal Protective Equipment: Know your rights. https://www.rcm.org.uk/media/4060/ppe-know-your-rights-may-2020.pdf.

162. Baracy M, Afzal F, Szpunar SM, et al. Coronavirus disease 2019 (COVID-19) and the risk of hypertensive disorders of pregnancy: a retrospective cohort study. *Hypertens Pregnancy*. Aug 2021;40(3):226-235. doi:10.1080/10641955.2021.1965621.

163. Madden N, Emeruwa UN, Polin M, Bejerano S, Gyamfi-Bannerman C, Booker WA. SARS-CoV-2 and hypertensive disease in pregnancy. *Am J Obstet Gynecol MFM*. 01 2022;4(1):100496. doi:10.1016/j.ajogmf.2021.100496.

164. Sun S, Savitz DA, Wellenius GA. Changes in Adverse Pregnancy Outcomes Associated With the COVID-19 Pandemic in the United States. *JAMA Netw Open*. 10 01 2021;4(10):e2129560. doi:10.1001/jamanetworkopen.2021.29560.

165. Hill J, Patrick HS, Ananth CV, et al. Obstetrical outcomes and follow-up for patients with asymptomatic COVID-19 at delivery: a multicenter prospective cohort study. *Am J Obstet Gynecol MFM*. 11 2021;3(6):100454. doi:10.1016/j.ajogmf.2021.100454.

166. Bremme KA. Haemostatic changes in pregnancy. *Best Pract Res Clin Haematol*. Jun 2003;16(2):153-68. doi:10.1016/s1521-6926(03)00021-5.

167. Royal College of Obstetricians and Gynaecologists. Thromboembolic Disease in Pregnancy and the Puerperium: Acute Management. Green-top Guideline 37b. RCOG; 2015. https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg37b/.

168. Bikdeli B, Madhavan MV, Jimenez D, et al. COVID-19 and Thrombotic or Thromboembolic Disease: Implications for Prevention, Antithrombotic Therapy, and Follow-Up: JACC State-of-the-Art Review. *J Am Coll Cardiol*. 06 16 2020;75(23):2950-2973. doi:10.1016/j.jacc.2020.04.031.

169. D'Souza R, Malhamé I, Teshler L, Acharya G, Hunt BJ, McLintock C. A critical review of the pathophysiology of thrombotic complications and clinical practice recommendations for thromboprophylaxis in pregnant patients with COVID-19. *Acta Obstet Gynecol Scand*. 09 2020;99(9):1110-1120. doi:10.1111/aogs.13962.

170. Freedman RL, Lucas DN. MBRRACE-UK: saving lives, improving mothers' care - implications for anaesthetists. *Int J Obstet Anesth*. May 2015;24(2):161-73. doi:10.1016/j.ijoa.2015.03.004.

171. Chen H, Guo J, Wang C, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. *Lancet*. Mar 7 2020;395(10226):809-815. doi:10.1016/s0140-6736(20)30360-3.

172. Zhu H, Wang L, Fang C, et al. Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. *Transl Pediatr.* Feb 2020;9(1):51-60. doi:10.21037/tp.2020.02.06.

173. National Institute for Health and Care Excellence. Intrapartum care for healthy women and babies. NICE clinical guideline [CG190]. NICE; 2014, Updated 2017. https://www.nice.org.uk/guidance/cg190.

174. Zimmermann P, Curtis N. COVID-19 in Children, Pregnancy and Neonates: A Review of Epidemiologic and Clinical Features. *Pediatr Infect Dis J.* 06 2020;39(6):469-477. doi:10.1097/INF.0000000000002700.

175. Yang Z, Wang M, Zhu Z, Liu Y. Coronavirus disease 2019 (COVID-19) and pregnancy: a systematic review. *J Matern Fetal Neonatal Med.* Apr 30 2020:1-4. doi:10.1080/14767058.2020.1759541.

176. Vouga M, Favre G, Martinez-Perez O, et al. Maternal and Obstetrical Outcomes in a Cohort of Pregnant Women Tested for SARS-CoV-2: Interim Results of the COVI-Preg International Registry. *SSRN Electronic Journal.* 11/30 2020;doi:10.2139/ssrn.3684424.

177. Bohren MA, Hofmeyr GJ, Sakala C, Fukuzawa RK, Cuthbert A. Continuous support for women during childbirth. *Cochrane Database Syst Rev.* Jul 6 2017;7(7):CD003766. doi:10.1002/14651858.CD003766.pub6.

178. Bohren MA, Berger BO, Munthe-Kaas H, Tunçalp Ö. Perceptions and experiences of labour companionship: a qualitative evidence synthesis. *Cochrane Database Syst Rev.* 03 18 2019;3:CD012449. doi:10.1002/14651858.CD012449.pub2.

179. Shakibazadeh E, Namadian M, Bohren MA, et al. Respectful care during childbirth in health facilities globally: a qualitative evidence synthesis. *BJOG.* Jul 2018;125(8):932-942. doi:10.1111/1471-0528.15015.

180. Ravaldi C, Wilson A, Ricca V, Homer C, Vannacci A. Pregnant women voice their concerns and birth expectations during the COVID-19 pandemic in Italy. *Women Birth.* Jul 2021;34(4):335-343. doi:10.1016/j.wombi.2020.07.002.

181. Hui PW, Ma G, Seto MTY, Cheung KW. Effect of COVID-19 on delivery plans and postnatal depression scores of pregnant women. *Hong Kong Med J.* 04 2021;27(2):113-117. doi:10.12809/hkmj208774.

182. NHS. Visiting healthcare inpatient settings during the COVID-19 pandemic. https://www.england.nhs.uk/coronavirus/publication/visitor-guidance/.

183. NHS. Pregnancy and coronavirus (COVID-19). https://www.nhs.uk/conditions/coronavirus-covid-19/people-at-higher-risk/pregnancy-and-coronavirus/.

184. Bisht R, Kandalgaonkar VP, KK S. Cesarean Section Rate among COVID-19 Mothers and Its Classification through Robson's Criteria. *J South Asian Feder Obs Gynae.* 2021;13(5):342-346. doi:10.5005/jp-journals-10006-1921.

185. Cuerva MJ, Carbonell M, Martin Palumbo G, Lopez Magallon S, De La Calle M, Bartha JL. Personal Protective Equipment during the COVID-19 pandemic and operative time in cesarean section: retrospective cohort study. *J Matern Fetal Neonatal Med*. Jul 14 2020:1-4. doi:10.1080/14767058.2020.1793324.

186. Lowe B, De Araujo V, Haughton H, Schweitzer J, Brazil V. Preparing maternity for COVID-19: A translational simulation approach. *Aust N Z J Obstet Gynaecol*. 08 2020;60(4):628-632. doi:10.1111/ajo.13185.

187. Royal College of Midwives. Clinical Briefing Sheet – Waterbirth during the COVID-19 Pandemic. 2021. https://www.rcm.org.uk/media/5166/waterbirth-in-a-time-of-covid.pdf.

188. Amirian ES. Potential fecal transmission of SARS-CoV-2: Current evidence and implications for public health. *Int J Infect Dis*. Jun 2020;95:363-370. doi:10.1016/j.ijid.2020.04.057.

189. Wang W, Xu Y, Gao R, et al. Detection of SARS-CoV-2 in Different Types of Clinical Specimens. *JAMA*. May 12 2020;323(18):1843-1844. doi:10.1001/jama.2020.3786.

190. Morau E, Bouvet L, Keita H, et al. Anaesthesia and intensive care in obstetrics during the COVID-19 pandemic. *Anaesth Crit Care Pain Med*. 06 2020;39(3):345-349. doi:10.1016/j.accpm.2020.05.006.

191. Bhatia K, Columb M, Bewlay A, et al. The effect of COVID-19 on general anaesthesia rates for caesarean section. A cross-sectional analysis of six hospitals in the north-west of England. *Anaesthesia*. 03 2021;76(3):312-319. doi:10.1111/anae.15313.

192. Public Health England. Coronavirus (COVID-19): personal protective equipment (PPE) hub. https://www.gov.uk/government/collections/coronavirus-covid-19-personal-protective-equipment-ppe.

193. Royal College of Anaesthetists, Obstetric Anaesthetists Association, Association of Anaesthetists, Intensive Care Society, The Faculty of Intensive Care Medicine. Management of pregnant women with known or suspected COVID-19. https://icmanaesthesiacovid-19.org/management-of-pregnant-women-with-known-or-suspected-covid-19.

194. Hampton T, Crunkhorn R, Lowe N, et al. The negative impact of wearing personal protective equipment on communication during coronavirus disease 2019. *J Laryngol Otol*. Jul 2020;134(7):577-581. doi:10.1017/s0022215120001437.

195. Royal College of Obstetricians and Gynaecologists. Bacterial sepsis in pregnancy. Green-top Guideline No. 64a. RCOG; 2012. https://www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg64a/.

196. Yang H, Hu B, Zhan S, Yang LY, Xiong G. Effects of Severe Acute Respiratory Syndrome Coronavirus 2 Infection on Pregnant Women and Their Infants. *Arch Pathol Lab Med*. 10 01 2020;144(10):1217-1222. doi:10.5858/arpa.2020-0232-SA.

197. Shi L, Wang Y, Yang H, Duan G. Laboratory Abnormalities in Pregnant Women with Novel Coronavirus Disease 2019. *Am J Perinatol*. 08 2020;37(10):1070-1073. doi:10.1055/s-0040-1712181.

198. NHS. Suspected coronavirus (COVID-19): Important information to keep you safe while isolating at home. Version 6: February 2022. https://www.england.nhs.uk/coronavirus/publication/suspected-coronavirus-covid-19-important-information-to-keep-you-safe-while-isolating-at-home/.

199. NHS. How to look after yourself at home if you have coronavirus (COVID-19). https://www.nhs.uk/conditions/coronavirus-covid-19/self-isolation-and-treatment/how-to-treat-symptoms-at-home/.

200. Sjoding MW, Dickson RP, Iwashyna TJ, Gay SE, Valley TS. Racial Bias in Pulse Oximetry Measurement. *N Engl J Med*. 12 17 2020;383(25):2477-2478. doi:10.1056/NEJMc2029240.

201. World Health Organization. Clinical management of severe acute respiratory infection when novel coronavirus (nCoV) infection is suspected. https://www.who.int/publications/i/item/10665-332299.

202. National Institute for Health and Care Excellence. COVID-19 rapid guideline: critical care in adults. NICE guideline [NG159]. NICE; 2020, Updated 2021. https://www.nice.org.uk/guidance/ng159.

203. Scottish Government. COVID-19 position statement: Maternal critical care provision. 2020. https://www.sign.ac.uk/media/1787/sg-maternal-critical-care-provision_v33.pdf.

204. Lippi G, Plebani M, Henry BM. Thrombocytopenia is associated with severe coronavirus disease 2019 (COVID-19) infections: A meta-analysis. *Clin Chim Acta.* Jul 2020;506:145-148. doi:10.1016/j.cca.2020.03.022.

205. Gavillet M, Rolnik DL, Hoffman MK, Panchaud A, Baud D. Should we stop aspirin prophylaxis in pregnant women diagnosed with COVID-19? *Ultrasound Obstet Gynecol.* Jun 2020;55(6):843-844. doi:10.1002/uog.22063.

206. Abani O, Abbas A, Abbas F, et al. Aspirin in patients admitted to hospital with COVID-19 (RECOVERY): a randomised, controlled, open-label, platform trial. *Lancet*. 2022;399(10320):143-151. doi:10.1016/S0140-6736(21)01825-0.

207. Pachtman Shetty SL, Meirowitz N, Blitz MJ, Gadomski T, Weinberg CR. Myocardial injury associated with coronavirus disease 2019 in pregnancy. *Am J Obstet Gynecol.* 02 2021;224(2):229-232. doi:10.1016/j.ajog.2020.10.014.

208. National Institute for Health and Care Excellence. COVID-19 rapid guideline: managing COVID-19. NICE guideline [NG191]. NICE; 2021, Updated 2022. https://www.nice.org.uk/guidance/ng191.

209. Intensive Care Society. COVID-19 Proning Quick Guide. https://www.ics.ac.uk/Society/COVID-19/PDFs/Proning_Quick_Guide.

210. Tolcher MC, McKinney JR, Eppes CS, et al. Prone Positioning for Pregnant Women With Hypoxemia Due to Coronavirus Disease 2019 (COVID-19). *Obstet Gynecol*. 08 2020;136(2):259-261. doi:10.1097/aog.0000000000004012.

211. Fenner S, Specialist Pharmacy Service. Safety in Lactation: Corticosteroids. https://www.sps.nhs.uk/articles/safety-in-lactation-corticosteroids/.

212. Camporota L, Meadows C, Ledot S, et al. Consensus on the referral and admission of patients with severe respiratory failure to the NHS ECMO service. *Lancet* Respir Med. 02 2021;9(2):e16-e17. doi:10.1016/S2213-2600(20)30581-6.

213. Goligher EC, Bradbury CA, McVerry BJ, et al. Therapeutic Anticoagulation with Heparin in Critically Ill Patients with Covid-19. *N Engl J Med.* Aug 26 2021;385(9):777-789. doi:10.1056/NEJMoa2103417.

214. Lawler PR, Goligher EC, Berger JS, et al. Therapeutic Anticoagulation with Heparin in Noncritically Ill Patients with Covid-19. *N Engl J Med.* Aug 26 2021;385(9):790-802. doi:10.1056/NEJMoa2105911.

215. Horby P, Lim WS, Emberson JR, et al. Dexamethasone in Hospitalized Patients with Covid-19. *N Engl J Med.* Feb 25 2021;384(8):693-704. doi:10.1056/NEJMoa2021436.

216. ClinicalTrials.gov, U.S. National Library of Medicine. Randomised Evaluation of COVID-19 Therapy (RECOVERY). https://clinicaltrials.gov/ct2/show/NCT04381936.

217. Saad AF, Chappell L, Saade GR, Pacheco LD. Corticosteroids in the Management of Pregnant Patients With Coronavirus Disease (COVID-19). *Obstet Gynecol.* 10 2020;136(4):823-826. doi:10.1097/AOG.0000000000004103.

218. Thevathasan I, Said JM. Controversies in antenatal corticosteroid treatment. *Prenat Diagn*. 08 2020;40(9):1138-1149. doi:10.1002/pd.5664.

219. World Health Organization. Therapeutics and COVID-19: living guideline. https://www.who.int/publications/i/item/WHO-2019-nCoV-therapeutics-2022.1.

220. The WHO Rapid Evidence Appraisal for COVID-19 Therapies Working Group. Association Between Administration of IL-6 Antagonists and Mortality Among Patients Hospitalized for COVID-19: A Meta-analysis. *JAMA*. 2021;326(6):499-518. doi:10.1001/jama.2021.11330.

221. Zeraatkar D, Cusano E, Martinez JPD, et al. Tocilizumab and sarilumab alone or in combination with corticosteroids for COVID-19: A systematic review and network meta-analysis. *medRxiv;* 2021.

222. Veiga VC, Prats JAGG, Farias DLC, et al. Effect of tocilizumab on clinical outcomes at 15 days in patients with severe or critical coronavirus disease 2019: randomised controlled trial. *BMJ.* 01 20 2021;372:n84. doi:10.1136/bmj.n84.

223. McCreary EK, Meyer NJ. Covid-19 controversies: the tocilizumab chapter. *BMJ.* 01 27 2021;372:n244. doi:10.1136/bmj.n244.

224. The REMAP-CAP Investigators, Gordon AC, Mouncey PR, et al. Interleukin-6 Receptor Antagonists in Critically Ill Patients with Covid-19 – Preliminary report. *medRxiv.* 2021:2021.01.07.21249390. doi:10.1101/2021.01.07.21249390.

225. Sivapalasingam S, Lederer DJ, Bhore R, et al. A Randomized Placebo-Controlled Trial of Sarilumab in Hospitalized Patients with Covid-19. *medRxiv.* 2021:2021.05.13.21256973. doi:10.1101/2021.05.13.21256973.

226. Hoeltzenbein M, Beck E, Rajwanshi R, et al. Tocilizumab use in pregnancy: Analysis of a global safety database including data from clinical trials and post-marketing data. *Semin Arthritis Rheum.* 10 2016;46(2):238-245. doi:10.1016/j.semarthrit.2016.05.004.

227. Nakajima K, Watanabe O, Mochizuki M, Nakasone A, Ishizuka N, Murashima A. Pregnancy outcomes after exposure to tocilizumab: A retrospective analysis of 61 patients in Japan. *Mod Rheumatol.* Sep 2016;26(5):667-71. doi:10.3109/14397595.2016.1147405.

228. Saito J, Yakuwa N, Kaneko K, et al. Tocilizumab during pregnancy and lactation: drug levels in maternal serum, cord blood, breast milk and infant serum. *Rheumatology (Oxford).* 08 01 2019;58(8):1505-1507. doi:10.1093/rheumatology/kez100.

229. Lescure FX HH, Fowler RA, Lazar JS, Shi G, Wung P, Patel N, Hagino O, Group SC-GS. Sarilumab in patients admitted to hospital with severe or critical COVID-19: a randomised, double-blind, placebo-controlled, phase 3 trial. *Lancet Respir Med.* 2021;9(5):522-532. doi:10.1016/s2213-2600(21)00099-0.

230. The REMAP-CAP Investigators, Derde LPG. Effectiveness of Tocilizumab, Sarilumab, and Anakinra for critically ill patients with COVID-19 The REMAP-CAP COVID-19 Immune Modulation Therapy Domain Randomized Clinical Trial. *medRxiv.* 2021:2021.06.18.21259133. doi:10.1101/2021.06.18.21259133.

231. Medicines & Healthcare products Regulatory Agency Central Alerting System. Interleukin IL-6 inhibitors (tocilizumab or sarilumab) for adults patients hospitalised due to COVID-19. https://www.cas.mhra.gov.uk/ViewandAcknowledgment/ViewAlert.aspx?AlertID=103194.

232. Medicines & Healthcare products Regulatory Agency Central Alerting System. Neutralising monoclonal antibody and intravenous antiviral treatments for patients in hospital with COVID-19 infection. https://www.cas.mhra.gov.uk/ViewandAcknowledgment/ViewAlert.aspx?AlertID=103189.

233. Chambers CD, Johnson DL, Xu R, et al. Birth outcomes in women who have taken adalimumab in pregnancy: A prospective cohort study. *PLoS One.* 2019;14(10):e0223603. doi:10.1371/journal.pone.0223603.

234. Puchner A, Gröchenig HP, Sautner J, et al. Immunosuppressives and biologics during pregnancy and lactation : A consensus report issued by the Austrian Societies of Gastroenterology and Hepatology and Rheumatology and Rehabilitation. *Wien Klin Wochenschr.* Jan 2019;131(1-2):29-44. doi:10.1007/s00508-019-1448-y.

235. Jiménez-Lozano I, Caro-Teller JM, Fernández-Hidalgo N, et al. Safety of tocilizumab in COVID-19 pregnant women and their newborn: A retrospective study. *J Clin Pharm Ther.* Aug 2021;46(4):1062-1070. doi:10.1111/jcpt.13394.

236. Group RC, Horby PW, Mafham M, et al. Casirivimab and imdevimab in patients admitted to hospital with COVID-19 (RECOVERY): a randomised, controlled, open-label, platform trial. *medRxiv.* 2021:2021.06.15.21258542. doi:10.1101/2021.06.15.21258542.

237. Hoffmann M KN, Schulz S, et al. The Omicron variant is highly resistant against antibody-mediated neutralisation – implications for control of the COVID-19 pandemic. *bioRxiv.* 2021;12.12.472286(Preprint)doi:https://doi.org/10.1101/2021.12.12.472286.

238. Drugs and Lactation Database (LactMed). 2006.

239. Gupta A, Gonzalez-Rojas Y, Juarez E, et al. Early Treatment for Covid-19 with SARS-CoV-2 Neutralizing Antibody Sotrovimab. *N Engl J Med.* 11 18 2021;385(21):1941-1950. doi:10.1056/NEJMoa2107934.

240. Gottlieb RL, Vaca CE, Paredes R, et al. Early Remdesivir to Prevent Progression to Severe Covid-19 in Outpatients. *N Engl J Med.* Dec 22 2021;doi:10.1056/NEJMoa2116846.

241. Beigel JH, Tomashek KM, Dodd LE, et al. Remdesivir for the Treatment of Covid-19 - Final Report. *N Engl J Med.* 11 05 2020;383(19):1813-1826. doi:10.1056/NEJMoa2007764.

242. Merck. Merck and Ridgeback's Investigational Oral Antiviral Molnupiravir Reduced the Risk of Hospitalization or Death by Approximately 50 Percent Compared to Placebo for Patients with Mild or Moderate COVID-19 in Positive Interim Analysis of Phase 3 Study. News Release. 2021. https://www.merck.com/news/merck-and-ridgebacks-investigational-oral-antiviral-molnupiravir-reduced-the-risk-of-hospitalization-or-death-by-approximately-50-percent-compared-to-placebo-for-patients-with-mild-or-moderat/.

243. Stuebe A. Should Infants Be Separated from Mothers with COVID-19? First, Do No Harm. *Breastfeed Med.* May 2020;15(5):351-352. doi:10.1089/bfm.2020.29153.ams.

244. Gale C, Quigley MA, Placzek A, et al. Characteristics and outcomes of neonatal SARS-CoV-2 infection in the UK: a prospective national cohort study using active surveillance. *Lancet Child Adolesc Health.* 02 2021;5(2):113-121. doi:10.1016/s2352-4642(20)30342-4.

245. Royal College of Paediatrics and Child Health. British Association of Perinatal Medicine - COVID-19 pandemic: Frequently asked questions within neonatal services. https://www.rcpch.ac.uk/resources/bapm-covid-19-pandemic-frequently-asked-questions-within-neonatal-services.

246. Renfrew MJ, Cheyne H, Dykes F, et al.; RCM Professional Advisory Group. Optimising mother-baby contact and infant feeding in a pandemic. In: Group RPA, editor. Rapid review Version 2. London: Royal College of Midwives; 2020. https://www.rcm.org.uk/media/4142/optimising-mother-baby-contact-and-infant-feeding-in-a-pandemic-version-2-final-24th-june-2020.pdf.

247. UNICEF UK. Statements on infant feeding. https://www.unicef.org.uk/babyfriendly/infant-feeding-during-the-covid-19-outbreak/.

248. World Health Organization. Breastfeeding and COVID-19. https://www.who.int/publications/i/item/WHO-2019-nCoV-Sci_Brief-Breastfeeding-2020.1.

249. Pérez-Bermejo M, Peris-Ochando B, Murillo-Llorente MT. COVID-19: Relationship and Impact on Breastfeeding-A Systematic Review. *Nutrients.* 2021;13(9):2972. doi:10.3390/nu13092972.

250. Department of Health and Social Care and Cabinet Office. Face coverings: when to wear one, exemptions, and how to make one. UK Government. https://www.gov.uk/government/publications/face-coverings-when-to-wear-one-and-how-to-make-your-own.

251. National Institute for Health and Care Excellence. Postnatal care. NICE; 2021. https://www.nice.org.uk/guidance/ng194.

252. Crovetto F, Crispi F, Llurba E, et al. Impact of SARS-CoV-2 Infection on Pregnancy Outcomes: A Population-Based Study. *Clin Infect Dis.* Feb 08 2021;doi:10.1093/cid/ciab104.

253. Molenaar NM, Rommel A-S, Witte Ld, et al. Seroprevalence of SARS-CoV-2 during pregnancy and associated outcomes: results from an ongoing prospective cohort study, New York City. *medRxiv.* 2021:2021.02.01.21250943. doi:10.1101/2021.02.01.21250943.

254. Savirón-Cornudella R, Villalba A, Esteban LM, et al. Screening of severe acute respiratory syndrome coronavirus-2 infection during labor and delivery using polymerase chain reaction and immunoglobulin testing. *Life Sci.* Apr 15 2021;271:119200. doi:10.1016/j.lfs.2021.119200.

255. Abedzadeh-Kalahroudi M, Sehat M, Vahedpour Z, Talebian P. Maternal and neonatal outcomes of pregnant patients with COVID-19: A prospective cohort study. *Int J Gynaecol Obstet.* Jun 2021;153(3):449-456. doi:10.1002/ijgo.13661.

256. Trahan MJ, Malhamé I, O'Farrell P, et al. Obstetrical and Newborn Outcomes Among Patients With SARS-CoV-2 During Pregnancy. *J Obstet Gynaecol Can.* 07 2021;43(7):888-892.e1. doi:10.1016/j.jogc.2021.03.012.

257. Zgutka K, Prasanth K, Pinero-Bernardo S, et al. Infant outcomes and maternal COVID-19 status at delivery. *J Perinat Med.* Jul 27 2021;49(6):691-696. doi:10.1515/jpm-2020-0481.

258. Katz D, Bateman BT, Kjaer K, et al. The Society for Obstetric Anesthesia and Perinatology Coronavirus Disease 2019 Registry: An Analysis of Outcomes Among Pregnant Women Delivering During the Initial Severe Acute Respiratory Syndrome Coronavirus-2 Outbreak in the United States. *Anesth Analg.* 08 01 2021;133(2):462-473. doi:10.1213/ane.0000000000005592.

259. Martinez-Perez O, Prats Rodriguez P, Muner Hernandez M, et al. The association between SARS-CoV-2 infection and preterm delivery: a prospective study with a multivariable analysis. *BMC Pregnancy Childbirth.* Apr 01 2021;21(1):273. doi:10.1186/s12884-021-03742-4.

260. Hcini N, Maamri F, Picone O, et al. Maternal, fetal and neonatal outcomes of large series of SARS-CoV-2 positive pregnancies in peripartum period: A single-center prospective comparative study. *Eur J Obstet Gynecol Reprod Biol.* Feb 2021;257:11-18. doi:10.1016/j.ejogrb.2020.11.068.

261. Adhikari EH, Moreno W, Zofkie AC, et al. Pregnancy Outcomes Among Women With and Without Severe Acute Respiratory Syndrome Coronavirus 2 Infection. *JAMA Netw Open.* 11 02 2020;3(11):e2029256. doi:10.1001/jamanetworkopen.2020.29256.

262. Soto-Torres E, Hernandez-Andrade E, Huntley E, Mendez-Figueroa H, Blackwell SC. Ultrasound and Doppler findings in pregnant women with SARS-CoV-2 infection. *Ultrasound Obstet Gynecol.* 07 2021;58(1):111-120. doi:10.1002/uog.23642.

263. Aabakke AJM, Krebs L, Petersen TG, et al. SARS-CoV-2 infection in pregnancy in Denmark-characteristics and outcomes after confirmed infection in pregnancy: A nationwide, prospective, population-based cohort study. *Acta Obstet Gynecol Scand.* Nov 2021;100(11):2097-2110. doi:10.1111/aogs.14252.

264. Tadas MP, Prashanthi SVSR, Waikar M. Maternal and Neonatal Outcomes of Pregnant Women with COVID-19: A Case Control Study at a Tertiary Care Center in India. *Journal of SAFOG.* 2021;13:44-49.

265. Akbar MIA, Gumilar KE, Andriya R, et al. Clinical manifestations and pregnancy outcomes of COVID-19 in indonesian referral hospital in central pandemic area. *Obstet Gynecol Sci.* Jan 2022;65(1):29-36. doi:10.5468/ogs.21135.

266. Papageorghiou AT, Deruelle P, Gunier RB, et al. Preeclampsia and COVID-19: results from the INTERCOVID prospective longitudinal study. *Am J Obstet Gynecol.* 09 2021;225(3):289.e1-289.e17. doi:10.1016/j.ajog.2021.05.014.

267. Teixeira MLB, Costa Ferreira Júnior OD, João E, et al. Maternal and Neonatal Outcomes of SARS-CoV-2 Infection in a Cohort of Pregnant Women with Comorbid Disorders. *Viruses.* 06 30 2021;13(7)doi:10.3390/v13071277.

268. Saadia Z, Farrukh R, Kanwal S, Shahzad Q. Clinical Profiles, Demographic Features, and Maternal Outcomes among Coronavirus Disease Positive Pregnant Women: A Cross-sectional Study. *Open Access Macedonian Journal of Medical Sciences.* 2021;9.

269. Ruggiero M, Somigliana E, Tassis B, et al. Clinical relevance of SARS-CoV-2 infection in late pregnancy. *BMC Pregnancy Childbirth.* Jul 12 2021;21(1):505. doi:10.1186/s12884-021-03985-1.

270. Timircan M, Bratosin F, Vidican I, et al. Exploring Pregnancy Outcomes Associated with SARS-CoV-2 Infection. *Medicina (Kaunas).* Aug 01 2021;57(8)doi:10.3390/medicina57080796.

271. Karasek D, Baer RJ, McLemore MR, et al. The association of COVID-19 infection in pregnancy with preterm birth: A retrospective cohort study in California. *Lancet Reg Health Am.* Oct 2021;2:100027. doi:10.1016/j.lana.2021.100027.

272. Chinn J, Sedighim S, Kirby KA, et al. Characteristics and Outcomes of Women With COVID-19 Giving Birth at US Academic Centers During the COVID-19 Pandemic. *JAMA Netw Open.* 08 02 2021;4(8):e2120456. doi:10.1001/jamanetworkopen.2021.20456.

273. Cuñarro-López Y, Larroca SG, Pintado-Recarte P, et al. Influence of the Human Development Index on the Maternal-Perinatal Morbidity and Mortality of Pregnant Women with SARS-CoV-2 Infection: Importance for Personalized Medical Care. *J Clin Med.* Aug 17 2021;10(16)doi:10.3390/jcm10163631.

274. Son M, Gallagher K, Lo JY, et al. Coronavirus Disease 2019 (COVID-19) Pandemic and Pregnancy Outcomes in a U.S. Population. *Obstet Gynecol.* 10 01 2021;138(4):542-551. doi:10.1097/AOG.0000000000004547.

275. Overtoom EM, Rosman AN, Zwart JJ, et al. SARS-CoV-2 infection in pregnancy during the first wave of COVID-19 in the Netherlands: a prospective nationwide population-based cohort study (NethOSS). *BJOG.* 01 2022;129(1):91-100. doi:10.1111/1471-0528.16903.

276. Blitz MJ, Gerber RP, Gulersen M, et al. Preterm birth among women with and without severe acute respiratory syndrome coronavirus 2 infection. *Acta Obstet Gynecol Scand.* 12 2021;100(12):2253-2259. doi:10.1111/aogs.14269.

277. Lankford A, Berger J, Benjenk I, Jackson A, Ahmadzia H, Mazzeffi M. Outcomes of cesarean delivery in obstetric patients with SARS-CoV-2 infection. *Int J Gynaecol Obstet.* Dec 2021;155(3):547-548. doi:10.1002/ijgo.13927.

278. Harel L, Eliasi E, Jaffe Lifshitz S, et al. Does the presence of symptoms affect pregnancy outcomes in third trimester in women with SARS-CoV-2. *J Matern Fetal Neonatal Med.* Oct 10 2021:1-8. doi:10.1080/14767058.2021.1956895.

279. Budhram S, Vannevel V, Botha T, et al. Maternal characteristics and pregnancy outcomes of hospitalized pregnant women with SARS-CoV-2 infection in South Africa: An International Network of Obstetric Survey Systems-based cohort study. *Int J Gynaecol Obstet*. Dec 2021;155(3):455-465. doi:10.1002/ijgo.13917.

280. Gupta N, Nigam A, Bedi N, Bhardwaj N, Panesar S. Effect of coronavirus-19 infection on maternal and perinatal outcome: A case control study. *Obstetric Medicine*. 2021:1753495X211041482. doi:10.1177/1753495X211041482.

281. Epelboin S, Labrosse J, De Mouzon J, et al. Obstetrical outcomes and maternal morbidities associated with COVID-19 in pregnant women in France: A national retrospective cohort study. *PLoS Med.* 11 2021;18(11):e1003857. doi:10.1371/journal.pmed.1003857.

282. Khoiwal K, Agarwal A, Gaurav A, et al. Obstetric and perinatal outcomes in pregnant women with COVID-19: an interim analysis. *Women Health.* Jan 2022;62(1):12-20. doi:10.1080/03630242.2021.2007199.

283. Vera von Bargen H, Espinosa Serrano M, Martin Navarrete D, et al. Analysis of prevalence and sociodemographic conditions among women in labor with and without COVID-19 in public hospitals in Chile. *J Perinat Med.* Dec 06 2021;doi:10.1515/jpm-2021-0286.

284. Vizheh M, Allahdadian M, Muhidin S, et al. Impact of COVID-19 Infection on Neonatal Birth Outcomes. *J Trop Pediatr.* 10 06 2021;67(5)doi:10.1093/tropej/fmab094.

285. Regan AK, Arah O, Fell DB, Sullivan SG. SARS-CoV-2 infection during pregnancy and associated perinatal health outcomes: a national US cohort study. *J Infect Dis*. Dec 27 2021;doi:10.1093/infdis/jiab626.

286. Ali N, Rashid S, Quraishi ZuN, Waheed A, Ghafoor S, Saleh F. Maternal and neonatal outcomes in pregnant women presented with or without covid-19 disease. *Medical Forum Monthly.* 2021/00 2021;32(6):112-115.

287. Akyıldız D, Çamur Z. Comparison of early postnatal clinical outcomes of newborns born to pregnant women with COVID-19: a case-control study. *J Matern Fetal Neonatal Med.* Nov 03 2021:1-8. doi:10.1080/14767058.2021.1998440.

288. Lucovnik M, Druskovic M, Vidmar Simic M, et al. Perinatal outcomes in women with severe acute respiratory syndrome coronavirus 2 infection: comparison with contemporary and matched pre-COVID-19 controls. *J Perinat Med.* Dec 09 2021;doi:10.1515/jpm-2021-0313.

289. Zambrano LD, Ellington S, Strid P, et al. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status - United States, January 22-October 3, 2020. *MMWR Morb Mortal Wkly Rep.* Nov 06 2020;69(44):1641-1647. doi:10.15585/mmwr.mm6944e3.

290. Artymuk NV, Belokrinitskaya TE, Filippov OS, Frolova NI, Surina MN. Perinatal outcomes in pregnant women with COVID-19 in Siberia and the Russian Far East. *J Matern Fetal Neonatal Med*. Feb 02 2021:1-4. doi:10.1080/14767058.2021.1881954.

291. Behrens E WS, Thomas J, Pombar X, Gezer S, Venugopal P, Jain S. Thrombosis and Mortality in Pregnant Patients with COVID-19. *Blood.* 2020 Nov 5 2020;136:8-9. doi:10.1182/blood-2020-137779.

292. Vizheh M, Muhidin S, Aghajani F, et al. Characteristics and outcomes of COVID-19 pneumonia in pregnancy compared with infected nonpregnant women. *Int J Gynaecol Obstet.* Jun 2021;153(3):462-468. doi:10.1002/ijgo.13697.

293. Qeadan F, Mensah NA, Tingey B, Stanford JB. The risk of clinical complications and death among pregnant women with COVID-19 in the Cerner COVID-19 cohort: a retrospective analysis. *BMC Pregnancy Childbirth.* Apr 16 2021;21(1):305. doi:10.1186/s12884-021-03772-y.

294. Crossette-Thambiah C, Nicolson P, Rajakaruna I, et al. The clinical course of COVID-19 in pregnant versus non-pregnant women requiring hospitalisation: results from the multicentre UK CA-COVID-19 study. *Br J Haematol.* 10 2021;195(1):85-89. doi:10.1111/bjh.17579.

295. Cojocaru L, Noe M, PahlavaN A, et al. Increased Risk of Severe COVID-19 Disease in Pregnancy in a Multicenter Propensity Score-Matched Study. *medRxiv.* 2021:2021.06.18.21258899. doi:10.1101/2021.06.18.21258899.

296. Scheler CA, Discacciati MG, Vale DB, Lajos GJ, Surita F, Teixeira JC. Mortality in pregnancy and the postpartum period in women with severe acute respiratory distress syndrome related to COVID-19 in Brazil, 2020. *Int J Gynaecol Obstet.* Dec 2021;155(3):475-482. doi:10.1002/ijgo.13804.

297. Knobel R, Takemoto MLS, Nakamura-Pereira M, et al. COVID-19-related deaths among women of reproductive age in Brazil: The burden of postpartum. *Int J Gynaecol Obstet.* Oct 2021;155(1):101-109. doi:10.1002/ijgo.13811.

298. Serra FE, Francisco RPV, de Rossi P, de Lourdes Brizot M, Rodrigues AS. COVID-19 outcomes in hospitalized puerperal, pregnant, and neither pregnant nor puerperal women. *PLoS One.* 2021;16(11):e0259911. doi:10.1371/journal.pone.0259911.

299. Hazari KS, Abdeldayem R, Paulose L, et al. Covid-19 infection in pregnant women in Dubai: a case-control study. *BMC Pregnancy Childbirth.* Sep 28 2021;21(1):658. doi:10.1186/s12884-021-04130-8.

300. Januszewski M, Ziuzia-Januszewska L, Jakimiuk AA, et al. Is the Course of COVID-19 Different during Pregnancy? A Retrospective Comparative Study. *Int J Environ Res Public Health*. 11 16 2021;18(22)doi:10.3390/ijerph182212011.

301. Strid P, Zapata L, Tong V, et al. COVID-19 Severity among Women of Reproductive Age with Symptomatic Laboratory-Confirmed SARS-CoV-2 by Pregnancy Status – United States, Jan 1, 2020 – Sep 30, 2021. 2021.

302. Leung C, de Paiva KM. Is pregnancy a risk factor for in-hospital mortality in reproductive-aged women with SARS-CoV-2 infection? A nationwide retrospective observational cohort study. *Int J Gynaecol Obstet.* Dec 09 2021;doi:10.1002/ijgo.14066.

303. Gonçalves BMM, Franco RPV, Rodrigues AS. Maternal mortality associated with COVID-19 in Brazil in 2020 and 2021: Comparison with non-pregnant women and men. *PLoS One.* 2021;16(12):e0261492. doi:10.1371/journal.pone.0261492.

DISCLAIMER: The Royal College of Obstetricians and Gynaecologists (RCOG) has produced this guidance as an aid to good clinical practice and clinical decision-making. This guidance is based on the best evidence available at the time of writing, and the guidance will be kept under regular review as new evidence emerges. This guidance is not intended to replace clinical diagnostics, procedures or treatment plans made by a clinician or other healthcare professional and RCOG accepts no liability for the use of its guidance in a clinical setting. Please be aware that the evidence base for COVID-19 and its impact on pregnancy and related healthcare services is developing rapidly and the latest data or best practice may not yet be incorporated into the current version of this document. RCOG recommends that any departures from local clinical protocols or guidelines should be fully documented in the patient's case notes at the time the relevant decision is taken.

@RCObsGyn @rcobsgyn @RCObsGyn

Royal College of Midwives

Royal College of Obstetricians & Gynaecologists

Royal College of Obstetricians and Gynaecologists, 10-18 Union Street, London, SE1 1SZ

T: +44 (0) 20 7772 6200 E: covid-19@rcog.org.uk W: rcog.org.uk Registered Charity No. 213280