

Guidelines for the management of the pregnant woman with COVID-19 admitted to the intensive care unit (ICU)

Important considerations regarding these guidelines:

- This is a reference document produced by a multidisciplinary medical team from the Maternal-Child University Network in conjunction with the Quebec Maternal-Fetal Medicine group (GMFMQ) for the COVID-19 pandemic.
- The information in this document should be used in conjunction with clinical judgment applicable to each individualized case.
- The information in this document should be adapted to the reality and logistics of each institution.
- The date of this document should be considered because available clinical data at the beginning of the pandemic is limited and may evolve very rapidly

Objective: to provide specific recommendations for the management of the critically ill COVID positive pregnant woman admitted to the Intensive Care Unit (ICU).

Justification: Pregnant women are usually more vulnerable to lung infections (influenza, H1N1, etc.). Pregnant women with COVID-19 appear to have a complication rate equivalent to that of adults in the general population. On the other hand, the mortality rate may be comparable to that of the general population aged 50-60 with COVID-19. The admission rate for critical care appears to vary between 8-25% according to data from affected countries.

Early data on pregnant women with COVID-19 also show an increased risk of miscarriage, preterm labour, premature rupture of membranes, pre-eclampsia and caesarean delivery, particularly if they are hospitalized for pneumonia. Their babies are at higher risk of in utero fetal demise, respiratory distress and admission to the neonatal intensive care (NICU). It is not clear at this time whether there is vertical transmission or not.

All critically ill COVID-19 patients should be in isolation with appropriate personal protective equipment (PPE) as per hospital protocol. A multidisciplinary approach is an essential part of the management of these cases.

Medical care in the ICU: Medical care should be coordinated by a multidisciplinary medical team involving:

- Critical care specialists
- OB/GYN - Maternal-fetal medicine (MFM)
- Infectious disease
- Anesthesia
- Neonatology
- Obstetrical internal medicine (MOG)
- Other specialists as indicated

Key points:

- The pregnant patient with respiratory symptoms should, in addition to close monitoring, be quickly transferred to a dedicated centre with the possibility of rapid access to critical care.
- All pregnant patients admitted to the ICU require an ongoing multidisciplinary approach
 - Consultation with MFM/neonatology regarding the use of steroids for fetal maturity, tocolysis, magnesium sulfate and delivery
- Ensure a trajectory for the possibility of an emergency caesarean delivery involving the appropriate teams (anesthesia)
- Gestational age is a critical element to consider in clinical decision making
- Continuous fetal monitoring is recommended in the ICU setting
- The intensity of fetal heart monitoring may be adjusted by the OB/GYN-MFM team based on maternal status and gestational age
- A maternal SaO₂ ≥96% is recommended in pregnancy in order to optimize fetal oxygenation
- The patient should be positioned with a left lateral tilt (if no other position is required for treatment, such as prone position) to relieve the pressure of the pregnant uterus on venous return.

NB. prone position is not contraindicated in pregnancy

- Thromboprophylaxis with low molecular weight heparin (LMWH) is recommended; dose based on medical condition
- ECMO (extracorporeal membrane oxygenation) is not contraindicated in pregnancy

A rapid transfer to the ICU and a multidisciplinary approach is paramount in the management of the critically ill pregnant women with COVID-19.

Criteria for ICU admission (specifically for pregnant women) are:

- Respiratory distress
- RR \geq 22/min
- O₂ saturation < 95% despite 3L NP
- Rapid deterioration in respiratory status
- Other usual admission criteria:
 - Altered neurologic status
 - Hemodynamic instability
 - Comorbidities associated with deterioration or exacerbation of a critical condition

Maternal and fetal monitoring:

- Monitoring of pregnant women in the ICU should be equivalent to that of the general population for most aspects of critical care, adapted to the physiological changes of pregnancy (Appendix 1)
- Continuous fetal surveillance (fetal heart monitoring) is necessary, especially during periods of maternal instability, and may only be modified by the OB/GYN-MFM
- Close monitoring of signs and symptoms of preterm labour is recommended in the ICU setting and may require a dedicated competent professional (e.g. maternity nurse):
 - Contractions (monitor or uterine palpation)
 - Vaginal bleeding
 - Unexplained maternal agitation may be a sign of labour
 - Loss of amniotic fluid

- Intubation of the pregnant woman must be done by a competent professional experienced in intubating pregnant women, given the particularities and technical difficulties associated with this clientele (Appendix 2)

Delivery considerations

- In general, COVID-19 is not in itself an indication for delivery
- Delivery should be considered at an advanced gestational age to optimize maternal cardiopulmonary physiology, taking into account maternal disease severity and clinical evolution balanced with the best possible neonatal outcome.
 - <23 weeks (pre-viable): maternal condition is prioritized for all medical decisions
 - 23-32 weeks (prematurity): multidisciplinary approach taking into account maternal and fetal condition
 - >32-34 weeks: delivery is strongly advised
 - In critical cases, delivery by caesarean section is preferred considering:
 - Vaginal birth is complicated in a critically ill, intubated woman and may require an instrumental delivery
 - Increased risk of fetal distress in labor
 - Delayed intervention in pregnant women with COVID19 may be associated with increased neonatal morbidity and mortality
- As much as possible; try to anticipate maternal and fetal emergencies and avoid an emergency caesarean section outside the operating theatre.

Maternal resuscitation

- During cardiopulmonary resuscitation of the pregnant woman, an in situ ("crash") caesarean section within 4 minutes from the start of maternal resuscitation should be considered in order to relieve aorto-caval compression and thus improve maternal survival (Appendix 3)
- A scalpel should be available in the resuscitation cart

Medications in pregnancy

a) Antenatal corticosteroids

Because of the association between steroids and worsening morbidity of viral pneumonia and specifically COVID-19, steroids for fetal lung maturity should be used judiciously.

- Antenatal corticosteroids should be limited to those at high risk for preterm delivery within 7 days, and only between 23 and 33+6 weeks gestation
- Corticosteroids may be considered in the management of severe COVID infection ("cytokine storm" type) as for the general population

b) Magnesium sulfate

- Indications for magnesium sulfate in pregnancy:
 - Fetal neuroprotection when delivery is anticipated < 32-34 weeks
 - Pre-eclampsia/eclampsia prophylaxis
- Given the potential for respiratory depression with magnesium sulfate, it should be used judiciously in the setting of severe respiratory symptoms

c) Acetaminophen

- Use of acetaminophen in pregnancy, including in the first trimester, has been shown overall to be safe and may attenuate the pregnancy risks associated with fever exposure.

d) NSAIDS

Use of NSAIDS is not recommended in pregnancy and their use in the post partum period should be avoided.

e) Aspirin

- ASA prophylaxis for obstetrical reasons may be ceased according to the treating team.

f) Thromboprophylaxis

- LMWH is the first choice for thromboprophylaxis in the ICU.
- Intermittent pneumatic compression is safe and may be considered in cases where LMWH is contraindicated.

g) Experimental medications for COVID-19

- Pharmacologic treatment may be used only in the context of a research project
- Pregnancy or the postpartum period should not systematically represent an exclusion criteria from all research projects involving different therapeutic options for critically ill COVID-19 patients

Bloodwork:

- Although COVID-19 may be associated with transaminitis and thrombocytopenia, it is important to maintain a high suspicion for the DDx in pregnancy, including preeclampsia/ HELLP syndrome

Imaging:

- All medically-indicated imaging procedures that are rationale and clinically relevant may be performed in pregnancy, particularly during a pandemic
 - A CXR and a CT chest carry a low dose of radiation
 - Bedside examinations (CXR, ultrasound) are preferable

References:

Boelig RC, Saccone G, Bellussi F, Berghella V, MFM Guidance for COVID-19, American Journal of Obstetrics & Gynecology MFM (2020), doi: <https://doi.org/10.1016/j.ajogmf.2020.100106>.

Boelig RC, Manuck T, Oliver EA, Di Mascio D, Saccone G, Bellussi F, Berghella V, Labor and Delivery Guidance for COVID-19, American Journal of Obstetrics & Gynecology MFM (2020), doi: <https://doi.org/10.1016/j.ajogmf.2020.100110>.

Coronavirus (COVID-19) and Pregnancy: What Maternal-Fetal Medicine Subspecialists Need to Know. The Society for Maternal-Fetal Medicine (SMFM); Sarah Dotters-Katz, MD, MMHPE; and Brenna L. Hughes, MD, MSc

Coronavirus disease 2019 (COVID-19): Pregnancy issues: Berghella V, Lockwood CJ, Barss V. UpToDate. This topic last updated : Apr 10, 2020.

Appendix 1: Normal physiologic changes in pregnancy and target values

Cardiovascular system																			
Cardiac output	↑ 30 to 50% (1,8 L/min) ↑ Blood volume 20-30% ↑ RBC mass 15-20% = dilutional anemia																		
Heart rate	↑ 15-20 %																		
Blood pressure	↓ Peripheral and pulmonary vascular resistance ↓ Arterial blood pressure <ul style="list-style-type: none"> • Nadir ~ 22 weeks' gestation • Systolic BP: ↓ 3-5 mmHg • Diastolic BP: ↓ 5-10 mmHg Aorto-cave compression syndrome from the 20th week of pregnancy																		
Cardiac anatomy	Left axial deviation of the heart ↑ OG and VG size ↑ VG walls Pulmonary insufficiency, physiological tricuspid and mitral																		
Pulmonary system																			
Oxygen consumption	↑ 20-30 %																		
Pulmonary system	Diaphragm elevation Airway soft tissue edema More friable mucosa 50% minute ventilation																		
ARTERIAL GAS PARAMETERS																			
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #d9e1f2;"></th> <th style="background-color: #d9e1f2;">PREGNANCY</th> <th style="background-color: #d9e1f2;">NO PREGNANCY</th> </tr> </thead> <tbody> <tr> <td style="background-color: #d9e1f2;">PH</td> <td style="background-color: #d9e1f2;">7,40-7,45</td> <td style="background-color: #d9e1f2;">7,35-7,45</td> </tr> <tr> <td style="background-color: #d9e1f2;">PaO₂</td> <td style="background-color: #d9e1f2;">104-108 mmHg</td> <td style="background-color: #d9e1f2;">90-100 mmHg</td> </tr> <tr> <td style="background-color: #d9e1f2;">PaCO₂</td> <td style="background-color: #d9e1f2;">27-32 mmHg</td> <td style="background-color: #d9e1f2;">35-45 mmHg</td> </tr> <tr> <td style="background-color: #d9e1f2;">HCO₃</td> <td style="background-color: #d9e1f2;">18-22 meq/L</td> <td style="background-color: #d9e1f2;">22-26 mmHg</td> </tr> <tr> <td style="background-color: #d9e1f2;">SaO₂</td> <td style="background-color: #d9e1f2;">98-100%</td> <td style="background-color: #d9e1f2;">96-99%</td> </tr> </tbody> </table>		PREGNANCY	NO PREGNANCY	PH	7,40-7,45	7,35-7,45	PaO ₂	104-108 mmHg	90-100 mmHg	PaCO ₂	27-32 mmHg	35-45 mmHg	HCO ₃	18-22 meq/L	22-26 mmHg	SaO ₂	98-100%	96-99%
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Residual functional capacity of ↓15-25% ↓ of the oxygen reserve ↓ Oncotic pressure (15%) - ↑ risk of pulmonary edema																			

MF : S.Klam (HGJ), C-E.Jacob (CHUM), I.Vachon (CHSC), A.Ouellet (CHUS). **ISU** : Y.Poulin (CHUS), M-J.Dubois (CHUM). **MOG** : I.Malhamé (CUSM), F.Morin (CHUSJ), A.Cumyn (CHUS).

Other systems	
Gastrointestinal system	Delayed gastric emptying
Renal system	↑ 50% Glomerular filtration (Creatinine 45- 60μmol/l and Uric acid < 300) Proteinuria (ad 300mg/day) and Glycosuria
Coagulation system	↑ Coagulation factors and Fibrinogen <ul style="list-style-type: none">• ↓ Protein S• ↑ Coagulation factors I, II, VII, X, XII• ↑ Protein C activated

References

- (Nan H. Troiano, 209)
- UpToDate 2020

Appendix 2: Intubation and Ventilation of the pregnant woman with COVID-19

Key points

- Aim for saturation > 92-95%, ideally > 95%
- **Intubation:** (cf intubation protocols for each centre)
 - Negative pressure room if available
 - Aerosol-droplet precautions
 - Risk of aerosol generating medical procedures (AGMP)
 - Rapid sequence with video laryngoscopy
- **Ventilation strategies same as for any adult in critical care**
 - Keep in mind that the gravid uterus can lead to restricted ventilation volumes
- **Targets to consider in pregnancy:**
 - PaO₂ > 60-65 mmHg
 - PaCO₂ > 27-32 mmHg
 - SaO₂ > 95%
 - Hemoglobin: > 90g/L in pregnancy (> 70g/L in post-partum if stable)

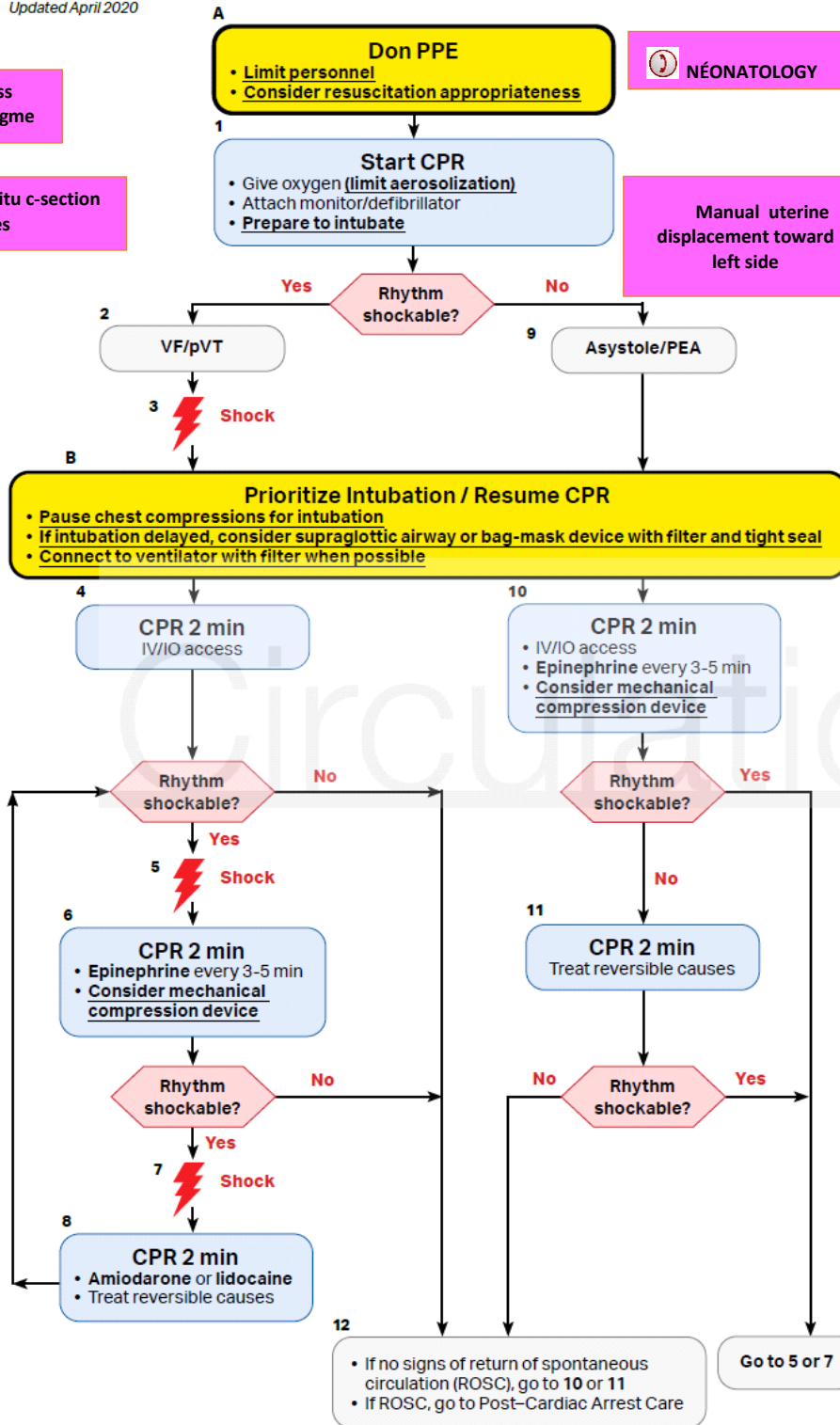
Annexe 3

ACLS Cardiac Arrest Algorithm for Suspected or Confirmed COVID-19 Patients

Updated April 2020

Venous access over diaphragme

Consider in situ c-section at 4 minutes



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CPR Quality

- Push hard (at least 2 inches [5 cm]) and fast (100-120/min) and allow complete chest recoil.
- Minimize interruptions in compressions.
- Avoid excessive ventilation.
- Change compressor every 2 minutes, or sooner if fatigued.
- If no advanced airway, 30:2 compression-ventilation ratio.
- Quantitative waveform capnography
 - If PETCO₂ <10 mm Hg, attempt to improve CPR quality.
 - Intra-arterial pressure
 - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality.

Shock Energy for Defibrillation

- **Biphasic:** Manufacturer recommendation (eg, initial dose of 120-200 J); if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- **Monophasic:** 360 J

Advanced Airway

- Minimize closed-circuit disconnection
- Use intubator with highest likelihood of first pass success
- Consider video laryngoscopy
- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement
- Once advanced airway in place, give 1 breath every 6 seconds (10 breaths/min) with continuous chest compressions

Drug Therapy

- **Epinephrine IV/IO dose:** 1 mg every 3-5 minutes
- **Amiodarone IV/IO dose:** First dose: 300 mg bolus. Second dose: 150 mg, or
- **Lidocaine IV/IO dose:** First dose: 1-1.5 mg/kg. Second dose: 0.5-0.75 mg/kg.

Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Abrupt sustained increase in PETCO₂ (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

Reversible Causes

- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

Prioritize massage with 100% oxygen mask Ventilation with mask only (4hands)

Bleeding Embolism : air, liquide amniotic fluid
 Thromboembolism : consider alteplase (rt-Pa) 50 mg iv
 Drugs : illicite, magnesium sulph, narcotic, insulin, oxytocin
 Anesthesia :high bloc,
 Toxicity; local (intralipids 20% : bolus 1.5ml/Kg and perfusion 0,25ml/Kg/min)
 Cardiovasc : cardiomyopathy, infarctus, Ao dissection
 Preeclampsia (intracranial bleeding)