

Clinical Concepts in Obstetrics, LLC

Simulation to Prepare for the Critically Ill Pregnant Woman with COVID-19 Requiring Mechanical Ventilation

This is interim guidance based on expert opinion and published recommendations from the literature, World Health Organization (WHO), Centers for Disease Control (CDC), American College of Obstetricians and Gynecologists (ACOG), Society for Maternal Fetal Medicine (SMFM), Association of Women’s Health Obstetrics and Neonatal Nursing (AWHONN), American Association of Pediatrics, and Society for Obstetrics Anesthesia and Perinatology (SOAP). The understanding of this virus is rapidly evolving. Please continue to consult with above listed agencies regarding guidelines for healthcare workers and rapidly changing recommendations. Hospitals may adapt these guidelines to meet patient care needs specific at each facility. The information contained in these guidelines does not define a standard of care, nor is it intended to dictate an exclusive course of management. Participants should follow all guidelines for meetings and gatherings in your hospital. Determine the need for simulation vs. risk to staff. Several options are included that allow for video conferencing or meetings maintaining social distance. All simulations need to be run with unit staff in protective gear as would be used with an isolated woman.

BACKGROUND

- COVID-19 is a new disease with limited data regarding the spectrum of clinical illness and management during pregnancy and the postpartum period.
- Testing for COVID-19 varies according to state and local public health policy and procedure.
- Most common mode of transmission is via respiratory droplets during close exposure to a person infected with COVID-19.
- There are no data that recommends scheduled cesarean birth due to infection with COVID-19. Cesarean birth should follow obstetric indications.
- Based on emerging evidence, vertical transmission to newborn may be possible, although probability and effect on newborn outcome is not clear.
- Infants born to mothers with confirmed COVID-19 are considered persons under investigation (PUIs) and should be isolated according to hospital protocol. The risk/benefit of separation of the newborn from the mother should be discussed and determined on a case by case basis considering maternal disease severity, newborn condition, and laboratory test results.
- Much is unknown regarding breastmilk and feeding practices in women positive for COVID-19. To date, breastmilk does not appear to harbor virus in infected mothers. Breast milk is the best source of nutrition for most infants and provides protection against many illnesses. There are rare exceptions when breastfeeding and/or feeding expressed breast milk is not recommended. Care should be taken to use all precautions to decrease the risk of transmission to the newborn.

PURPOSE

To proactively prepare for a critically ill pregnant woman with COVID-19 requiring mechanical ventilation. All hospitals are unique with different resources and systems. This document should be used as a guide to determine how to best use the resources in your hospital to meet the needs of the pregnant woman requiring mechanical ventilation.

CONSIDERATIONS BEFORE SIMULATION

Issue	Question(s)	Details
Level of Maternal Care	Will this woman stay at your hospital or be transferred? Who will be involved in this decision?	Primary physician, ICU intensivist, anesthesiologist, nursing, transport nurse, receiving hospital
Condition of Patient	What is the status of the woman?	Labor status, cervical exam, hemodynamic status, respiratory status, fetal status
Location of Care	Where is the best location in your hospital to care for this woman?	ICU vs. Obstetrics unit
Supplies	In this location, what supplies will be needed?	L&D: ventilator, room that supports mechanical ventilator, supplies and resources including staff to support mechanical ventilation, critical care medications and supplies, supplies and resources if complications occur (endotracheal tube displacement {ETT}, mechanical dysfunction, pneumothorax) ICU: supplies for obstetric care including fetal monitor, birth, OB medications, newborn resuscitation, common complications of birth including hemorrhage
Providers	Who needs to be present/consulted to care for this woman?	<u>Nursing:</u> discipline and number <u>Physicians:</u> MFM, primary OB, ICU intensivist/pulmonologist, Anesthesiologist,

		Infectious disease, Neonatologist/pediatrician
Potential Complications	What is the most likely complication this woman may have?	Define potential complications.
	What are early signs of this complication?	Define early warning signs of maternal compromise.
	When does the physician need to be notified?	Determine when the RN would call the provider to the bedside.

SIMULATION CONSIDERATIONS

Table-top: representatives from all disciplines gather and talk through a scenario either in a large room to maintain distance or by video

Advantages

- Does not use space on patient care unit
- Discussion of details of care can uncover system issues that need to be addressed
- Can be modified and done during rounds on the unit

Disadvantages

- Not actually completing all actions may not uncover all system issues
 - Example: Is the room big enough for all equipment? Does the room support the ventilator?
- Issues with team skills may not be fully addressed
 - Example: Who will be the leader in an emergency? What issues will the staff face communicating with protective gear in place?

Simulation in a Center vs. In Situ:

Remote Simulation Center/Room

Advantages - More realistic than a tabletop simulation but does not take up space on the patient care unit, manikin does not have to be moved

Disadvantages – May not accurately reflect physical set up of the unit, may be difficult to get all staff to the simulation

In situ Simulation

Advantages – accurate reflection of space, size and equipment to uncover system issues. Easier for staff to attend

Disadvantages – requires space on the unit, may be cancelled due to lack of space, need to carefully keep simulation supplies separate from patient care supplies, manikin has to be moved to patient care unit

TIPS FOR SIMULATION

- Video record the simulation to allow staff to accurately review communication and any issues that occurred (versus trying to recall exactly what happened)
 - Set up camera to capture interaction between patient and staff plus wide angle of the room to determine adequacy of space and placement of equipment
 - Stress confidentiality and follow guidelines from Quality Improvement or hospital attorney to ensure non-discoverable status of simulation and findings
 - Record issues uncovered during the scenario or debriefing on large “post it” paper or on a board so all in the debriefing can confirm accuracy
 - Once a plan of care or strategy is developed have a method to communicate the plan to all care givers
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SIMULATION SCENARIOS AND GOALS

Four different scenarios are outlined below. The intent of these scenarios is to address a wide variety of needs for hospitals of different levels. Scenario 1 is most appropriate for a Level 1 hospital and Scenarios 3 and 4 most appropriate for Level 3-4 hospitals. The scenarios are meant to be a template to quickly devise a scenario that best suits each hospital and their objectives for running the scenario. If needed, a sample case study is included following the four scenarios. Shorter scenarios and debriefing targeted to explore specific questions will reduce the time for the simulation.

Scenario #1: Woman meets criteria for transport (Level 1-2 hospitals)

Goals

- Clarify what parameters need to be assessed and clear early warning criteria with team. Including the receiving hospital in this discussion ensures they are aware of potential transport and can plan accordingly. The receiving hospital may also contribute to determining parameter criteria for transport.
- Communication when early warning criteria are met; SBAR to primary provider, notification of receiving hospital and transport team
- Determine impact of need for personal protective equipment (PPE) on care of the woman
 - Extra time for staff to don PPE, communication or team work issues arising from staff wearing PPE
- Tasks needed to prepare woman for transport delegated to specific staff for completion to quickly and efficiently prepare for transport including who will accompany woman and how staff will be returned to their unit after transport

- Use of PPE during transport to protect staff and other patients

Measurable Learning Objectives

- Assessment parameters
 - Maternal heart rate and respiratory rate counted with a stethoscope for a minute, Fowlers position for blood pressure with properly fitted cuff at the level of the heart
 - Fully electronic manikin will have HR and RR plus other vital signs, alternative – have staff auscultate for a full minute and give the HR and RR plus other vital signs to them
 - Changes in auscultation of the lungs
 - Fully electronic manikin will have different lung sounds, alternative – have staff auscultate appropriate locations on the chest and tell them what the lungs sound like
 - Changes in uterine activity or fetal heart rate pattern
 - Fully electronic manikin will provide this in the form of an electronic fetal monitor tracing, alternative – draw uterine pattern on blank EFM paper, tap on the US of the EFM to mimic FHR
 - Communication
 - SBAR communication about changes in assessment parameters
 - Verbalization of process for notification of receiving hospital and transport team
 - Preparation for transport
 - Utilize hospital protocol for transport or develop a checklist if no protocol exists for transport of woman requiring isolation precautions
 - Divide tasks among staff to most effectively prepare woman for transport
 - Delegate tasks and perform them during scenario

Sample Debriefing Questions

- What circumstances either made it difficult or facilitated obtaining accurate assessments of the woman?
- What information needs to be communicated to the provider about the assessment? (*Get perspective of nurses and providers*)
- How did use of PPE impact care of the woman?
- What is the process for preparing a woman in isolation for transport?
- How can the tasks required to prepare for transport be delegated to make the process as efficient and timely as possible?

Scenario #2: Woman meets criteria for ventilation (Level 2-4 hospitals)

Goals

- Clarify what needs to be assessed, clear early warning criteria discussed with team including nursing, MFM, anesthesiologist, ICU intensivist/pulmonologist
- Determine who is best qualified to perform maternal intubation and what equipment they will need
- Communication when early warning criteria is met; SBAR to primary provider and anesthesiologist, notification of ICU team, staff that reassign patients to the ICU (unless woman to stay in L&D)
- Tasks needed to prepare woman for transport to the ICU if this is best location or equipment needed for intubation in L&D

Measurable Learning Objectives

- Assessment parameters
 - Maternal heart rate and respiratory rate counted with a stethoscope for a minute, Fowlers position for blood pressure with properly fitted cuff at the level of the heart
 - Fully electronic manikin will have HR and RR plus other vital signs, alternative – have staff auscultate for a full minute and give the HR and RR plus other vital signs to them
 - Changes in auscultation of the lungs
 - Fully electronic manikin will have different lung sounds, alternative – have staff auscultate appropriate locations on the chest and tell them what the lungs sound like
 - Changes in uterine activity or fetal heart rate pattern
 - Fully electronic manikin will provide this in the form of an electronic fetal monitor tracing, alternative – draw uterine pattern on blank EFM paper, tap on the US of the EFM to mimic FHR
- Communication
 - SBAR communication about changes in assessment parameters
 - Verbalization of best location for intubation, best provider to perform intubation and equipment needed. Verbalization helps team to maintain a shared mental model
- Preparation for intubation
 - Utilize hospital process for transport of woman in isolation before intubation if requested
 - Attention to early changes in the woman's status may allow for transport before intubation is necessary
 - Divide tasks among staff to most effectively prepare woman for intubation
 - Delegate roles and perform them during scenario
 - Debriefing Questions

- What circumstances either made it difficult or facilitated obtaining accurate assessments of the woman?
- What information needs to be communicated to the provider about the assessment? (*Get perspective of nurses and providers*)
- Which providers are the most experienced at performing maternal intubation?
 - What is the preferred location for intubation?
 - If different than current location what parameters will prompt woman to be moved?
 - What staff skill mix and equipment is needed?
- What is the process for preparing a woman for intubation?
- How did the use of PPE impact care of the woman?
 - What PPE is required for intubation?
- How can the tasks required to prepare for intubation be delegated to make the process as efficient and timely as possible?

Scenario #3: Woman on ventilator begins to decompensate with evidence of fetal stress

Goals

- Optimal ventilator settings for pregnant woman considering the physiologic and anatomic changes during pregnancy
- Determining roles during an emergency
 - All activities during patient care need to be done as accurately as possible
- Thoughtful discussion among the team about how fetal stress will be managed.

Measurable Learning Objectives

- Verbalize optimal ventilator settings during pregnancy
- Verbally assign roles including the leader announcing their role (if two leaders both need to announce their role)
- Communication by a team leader or member about status of the woman and the plan of care that is heard and acknowledged by the team

Debriefing Questions

- What are optimal ventilator settings during pregnancy?
 - How does this differ from usual ventilator settings for a non-pregnant adult?
 - How does this impact early signs of decompensation that need to be reported to the provider?
- What tasks need to be done when the woman decompensates?
 - How can tasks be divided between ICU and OB staff to most efficiently care for the woman?

- What information needs to be communicated to the provider about the assessment? (*Get perspective of nurses and providers*)
- How did the use of PPE impact care of the woman?
- Which provider was the leader?
 - What information needs to be shared with the team if more than one leader?
- If the woman decompensates and fetal heart rate indicates the fetus is also decompensating, what actions need to be done?
 - If these actions do not correct the fetal heart rate what course of action, should the team follow?
 - Typically, with signs of a Category II EFM strip, intrauterine resuscitation is done and if that is not successful then the team moves to emergent birth (Note: oxygen for use with intrauterine resuscitation is not recommended at this time due to risk of aerosol transmission of COVID-19). *However, in the situation of a critically ill woman, her respiratory and hemodynamic status must be considered.* Will the woman be able to tolerate birth, particularly a cesarean birth with the use of anesthesia and the increased risk of hemorrhage? Once a plan of care has been decided upon or criteria to determine a course of action established, the plan and rationale need to be clearly communicated and noted for all staff assigned to the woman.

Scenario #4: Woman on ventilator goes into labor

Goals

- Review signs of labor in woman who is ventilated (paralyzed and narcotized) – periodic, rhythmic change in any of the following: elevation of HR and/or RR, desaturation of SaO₂, and fighting or ‘bucking’ the ventilator if not fully sedated.
 - Due to the effect of paralytic and narcotic agents, the neonate will not behave in a normal fashion at birth and will require advanced resuscitation. Therefore, notification of the Neonatal team to be present at birth is essential.
 - Close monitoring for signs of labor is necessary
- Evaluate the woman to determine labor status
- Prepare for birth if labor progressing
- Communicate labor status to team that will be present for birth: primary provider and anesthesiologist, ICU intensivist, neonatal/pediatric resuscitation team

Measurable Learning Objectives

- Assessment parameters
 - Maternal heart rate and respiratory rate (if voluntary) counted with a stethoscope for a minute, maternal position (side-lying or with a wedge under hip) noted for blood pressure with properly fitted cuff at the level of the heart

- Fully electronic manikin will have HR and RR plus other vital signs, alternative – have staff auscultate for a full minute and give the HR and RR plus other vital signs to them
 - Changes in auscultation of the lungs
 - Fully electronic manikin will have different lung sounds, alternative – have staff auscultate appropriate locations on the chest and tell them what the lungs sound like
 - Changes in uterine activity or fetal heart rate pattern
 - Fully electronic manikin will provide this in the form of an electronic fetal monitor tracing, alternative – draw uterine pattern on blank EFM paper, tap on the US of the EFM to mimic FHR
- Communication
 - SBAR communication to the team attending the birth about progressing labor and impending birth
 - Verbal delegation of roles to prepare for birth and during birth
- Preparation for birth
 - Equipment for birth: delivery cart, forceps/vacuum, medications for hemorrhage, placenta container for lab analysis if ordered
 - Preparation for neonatal resuscitation
 - Tasks divided among ICU and OB staff to most effectively monitor and support woman during birth

Debriefing Questions

- What circumstances either made it difficult OR facilitated obtaining accurate assessments of the woman?
- What information needs to be communicated to the provider about the assessment? (*Get perspective of nurses and providers*)
- How did the use of PPE impact care of the woman?
- What challenges were encountered in preparing for birth?
- Which providers are needed in the room for birth?
- How were tasks and roles delegated during birth?
- Which provider was the leader?
 - What needs to be communicated to the leader during birth?
- If a complication of birth occurs such as hemorrhage what other staff, equipment and medications or fluids need to be assembled?
 - ***If the team decides to run a scenario with hemorrhage in addition to birth, a word of caution, run the birth scenario first and correct any issues found there then run the hemorrhage scenario for two reasons; will be able to see if changes from birth scenario resulted in an improvement and will decrease frustration of those in the scenario ie..we have enough wrong here and now we have another emergency.***

SAMPLE CASE

We recommend using a case study from an actual woman who required mechanical ventilation; however, if a case like this does not exist, here is a sample case to use as a basis for simulation

History

- 28 year-old G2 P1 at XX weeks gestation, married, one healthy child at home
 - Alter the gestational age (or any other parameter) to suit your learning objectives and hospital
- Medical history
 - Asthma since childhood, uses inhaler 1-2 times a month for seasonal allergies
 - Medical history may be altered, but **a word of caution**: making the scenario too complex may detract from the major goal of practicing mechanical ventilation during pregnancy
- OB history
 - Previous uncomplicated vaginal birth 3 years ago
 - Prenatal labs and 2nd trimester ultrasound all within normal limits
- Recent history
 - Exposed to COVID-19 by co-worker a week ago, notified OB provider, tested for virus but no results yet. Developed a fever this morning of 100°F, experienced an episode of difficulty breathing that was not resolved with inhaler. Advised to go to L&D for further evaluation

Arrival on L&D (SCENARIO 1 STARTS HERE)

- Vital signs: BP 100/70, P 96, RR 24, SaO₂ 98%, T 99.6°F (37.5°C) (took acetaminophen 2 tablets po an hour ago)
- FHR: normal baseline rate and moderate variability without decelerations, irregular uterine contractions lasting 30 seconds that are mild per palpation and report
- Physical exam: Lungs clear bilaterally, rest of exam unremarkable
- Woman placed in isolation with her husband staying in the room with her

Two hours after arrival

- Vital signs: BP 100/70, P 110, RR 26, SaO₂ 95%, T 99.6°F (37.5°C)
- FHR and uterine activity unchanged
- Although lungs remain clear, woman reports occasional difficulty breathing and increasing body aches

(SCENARIO 1 ENDS HERE INCLUDING ACTIVITIES IN PREPARATION OF TRANSPORT)

Three hours after arrival (SCENARIO 2 STARTS HERE)

- Vital signs: BP 96/64, P 120, RR 30, SaO₂ 93%, T 100.6°F (38.1°C)

- Uterine contractions every 6 minutes lasting 45 seconds of mild intensity, FHR with moderate variability but baseline of 160-170 bpm
- Woman reports difficulty breathing and is anxious

(SCENARIO 2 ENDS HERE INCLUDING NOTIFICATION OF INTUBATOR AND INTUBATION OF WOMAN)

Four hours after arrival/One hour after intubation (SCENARIO 3 STARTS HERE)

- Woman is on narcotic and paralytic medications.
- Vent settings: SIMV with PS; Rate 12 breaths per minute (set), Tidal volume 6 ml/Kg, PEEP 5 cm H₂O, FiO₂ .40
- Oxygenation values: Hgb 8 g/dL, PaO₂ 55 mmHg, SaO₂ 95%, PaCO₂ 35 mmHg
- Vital signs: BP 90/60, P 112, RR 24, SaO₂ 95%
- Uterine contractions every 3 minutes lasting 60 seconds of mild intensity, FHR with minimal variability, baseline of 110 bpm, late decelerations with uterine contractions

(SCENARIO 3 ENDS HERE INCLUDING ADJUSTMENT OF VENTILATOR SETTINGS AND DISCUSSION ABOUT COURSE OF ACTION IF FETAL TRACING DOES NOT IMPROVE)

Six hours after arrival/Three hours after intubation (SCENARIO 4 STARTS HERE)

- Woman is on narcotic and paralytic medications.
- Vent settings: SIMV with PS; Rate 16 breaths per minute (set), Tidal volume 7 ml/Kg, PEEP 5 cm H₂O, FiO₂ .50
- Oxygenation values: Hgb 8 g/dL (unless blood given in last scenario then adjust value), PaO₂ 75 mmHg, SaO₂ 99%, PaCO₂ 27 mmHg
- Vital signs: BP 90/60, P 106, RR 16, SaO₂ 94%
 - Every 2 minutes desaturation to 88% and elevation of HR to 110 noted. Also patient has been restless requiring more narcotic and paralytic medication to remain calm.
- Uterine contractions every 2 minutes lasting 90 seconds of strong intensity, FHR with minimal variability, baseline of 155 bpm, variable decelerations with uterine contractions
- Cervical exam – complete dilation, presenting part at +3 station
- At birth neonate is paralyzed and apneic with HR of 100

(SCENARIO 4 ENDS HERE INCLUDING FORCEPS ASSISTED BIRTH AND NEONATAL RESUSCITATION REQUIRING INTUBATION FOR APNEA)

OBSTETRIC CLINICAL CARE GUIDELINES

REACT Obstetric Early Warning Signs

If the patient exhibits ANY of the following EARLY WARNING SIGNS , call the Physician without delay and consider activating Rapid Response Team	
Respiratory Rate	Sustained RR less than 12 or greater than 24
Heart Rate	Sustained HR less than 60 bpm or greater than 120 bpm
Blood Pressure	Sustained Systolic BP less than 90 mmHg Sustained Systolic BP greater than 160 mmHg Sustained Diastolic BP less than 60 mmHg Sustained Diastolic BP greater than 110 mmHg
Change in Oxygenation	Sustained pulse oximeter below 95%
Labored Breathing	The patient's breathing becomes labored
Level of Consciousness	The patient becomes somnolent, difficult to arouse, confused, or obtunded
Onset of Agitation or Delirium	The patient becomes agitated or delirious
Seizure	The patient has a seizure
Other Alterations in Consciousness	Any other changes in mental status or CNS status - such as a sudden blown pupil, onset of slurred speech, onset of unilateral limb or facial weakness
Hemorrhage	The patient develops uncontrollable bleeding from any site
Urine output	Urine output drops below 30 mL/hour for 2 consecutive hours
Temperature	Temperature < 96 ° or > 100.4 °
Worried or Concerned	"THE PATIENT DOES NOT LOOK/ACT RIGHT", gut instinct that patient is beginning a downward spiral even if none of the physiological triggers have yet occurred

Baird, S.M. & Graves, C. (2015) REACT: an interprofessional education and safety program to recognize and manage the compromised obstetric patient. *Journal of Perinatal and Neonatal Nursing*, 29(2), 138-148.

Indications for Intubation and Mechanical Ventilation

Parameter	Indications	
Mechanics	Respiratory rate	> 35 breaths/minute
	Vital capacity	< 15 mL/kg body weight ^a
	Inspiratory force	< 25 cm/H ₂ O
	Compliance	< 25 mL/cmH ₂ O
	FEV ₁	< 10 mL/kg body weight ^a
Oxygenation	PaO ₂	< 70 torr ^b
	P _(A-a) O ₂	> 450 torr ^c
	Q _s /Q _t	> 20%
Ventilation	PaCO ₂	> 55 torr ^d
	V _d /V _t	0.2-0.3

References:

Troiano, N.H. & Bandi, V.D.P. (2018) Mechanical ventilation during pregnancy. In Troiano, N.H., Wicher, P. & Baird, S.M. (Eds.) *AWHONN's High Risk and Critical Care Obstetrics, 4th edition*. Philadelphia, PA: Wolters Kluwer/Lippincott;67-80.

Pacheco, L.D. & Saad, A. (2018) Ventilator management in critical illness. In Phelan, J.P., Pacheco, L.D., Foley, M.R., Saade, G.R., Dildy, G.A., & Belfort, M.A. (Eds.) *Critical Care Obstetrics, 6th edition*. Boston, MA: Blackwell Publications;215-248.

General Guidelines for Initial Ventilator Settings in Pregnancy

Settings		
Initial	Mode	SIMV with pressure support
	Rate	14-16 breaths/minute (set)
	Tidal volume (V _t)	6-10 mL/kg
	PEEP	5 cm H ₂ O
	FiO ₂	Varies; depends on reasons for intubation
Goals	PaO ₂	> 60 mmHg
	SpO ₂	> 95%
	PaCO ₂	27-32 mmHg
	FiO ₂	< 0.50 mmHg

Reference: Troiano, N.H. & Bandi, V.D.P. (2018) Mechanical ventilation during pregnancy. In Troiano, N.H., Wicher, P. & Baird, S.M. (Eds.) *AWHONN's High Risk and Critical Care Obstetrics, 4th edition*. Philadelphia, PA: Wolters Kluwer/Lippincott;67-80.