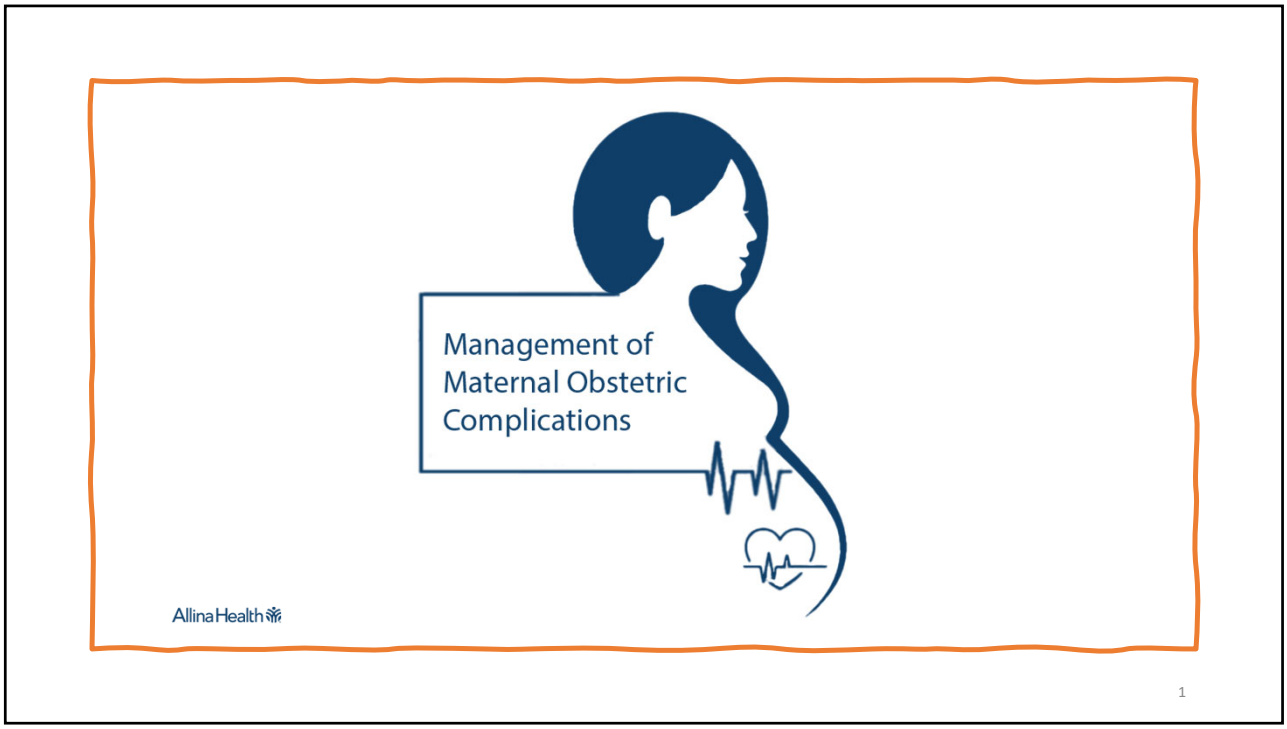
Management of
Maternal Obstetric
Complications
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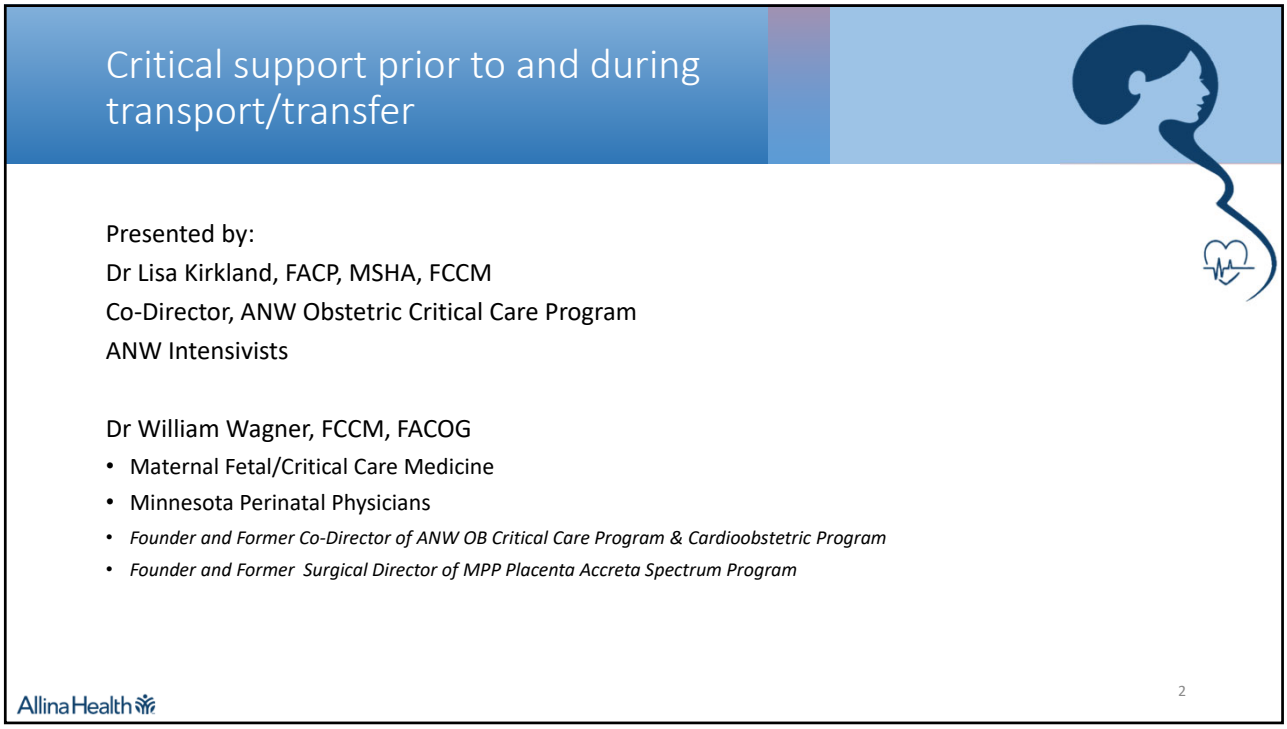
Critical support prior to and during transport/transfer
Presented by:
Dr Lisa Kirkland, FACP, MSHA, FCCM
Co-Director, ANW Obstetric Critical Care Program
ANW Intensivists
Dr William Wagner, FCCM, FACOG
• Maternal Fetal/Critical Care Medicine
• Minnesota Perinatal Physicians
• Founder and Former Co-Director of ANW OB Critical Care Program & Cardioobstetric Program
• Founder and Former Surgical Director of MPP Placenta Accreta Spectrum Program
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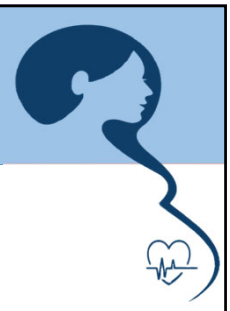
Disclosures



- Dr Kirkland – None
- Dr Wagner - None

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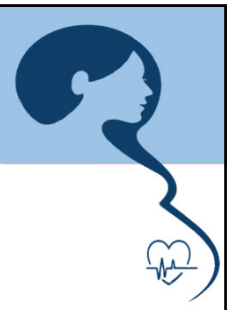
Objectives



- To describe recent advances in transport of critically ill patient
- To describe the unique needs for transporting critically ill pregnant patients
- To describe initial therapies indicated prior to transport

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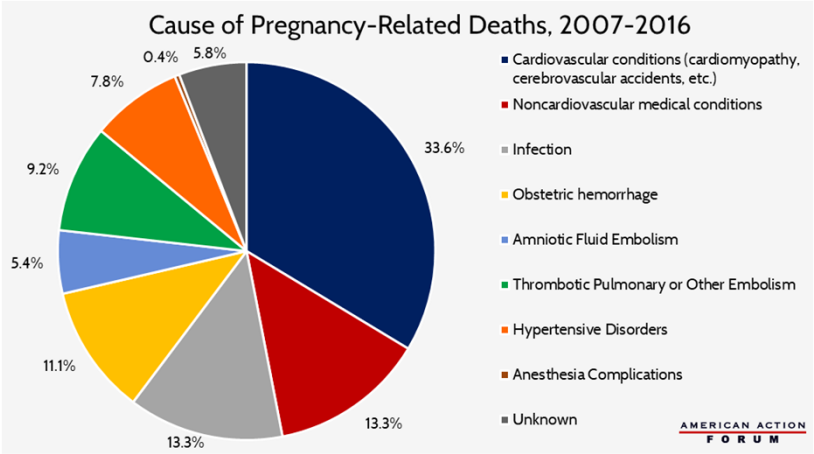
Maternal Mortality



- the most common causes of pregnancy-related deaths were cardiovascular conditions:
  - congenital heart disease,
  - ischemic heart disease
  - cardiac valvular disease
  - hypertensive heart disease,
  - congestive heart failure

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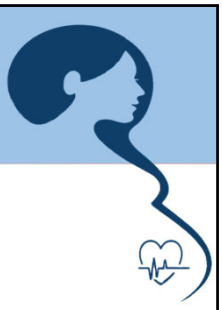
DON'Ts



- Do not give barbiturates for seizures or intubation induction! Due to risk of difficult/unsuccessful airway
- Do not give Ondansetron for hyperemesis without knowing what the QTc is! Due to risk of undiagnosed long QT
- Do not give terbutaline in preterm labor! No longer recommended
- Don't hesitate to call a Level IV maternal care center for help with patient management! Even if they can't accept, they can still advise.

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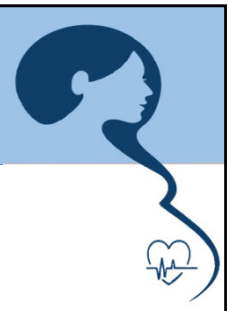
6

6

REMEMBER…



Any patient either pregnant or within 6 weeks of delivery is at greater risk of early physiologic decline than a nonpregnant/nonpostpartum patient, based on the adaptive changes of pregnancy

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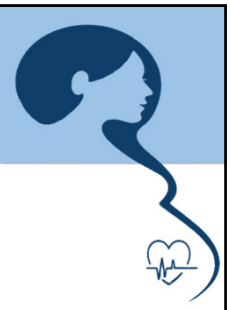
7

When considering transport…



EMTALA ties the responsibility for patient care, interfacility transport team composition, equipment, and selection to the ***sending*** physician

Adverse events occur in 5–28% of critical care transports.

Transport less than 50 miles (80 km) by ground ambulance,

50–150 miles (80–240 km) by helicopter, and

greater than 150 miles (> 240 km) by fixed-wing aircraft.

Assess total transport time, particularly for time-sensitive conditions such as myocardial ischemia, intracranial hemorrhage, stroke, or severe injury in which time may be saved by using aeromedical CCT even over short geographical distances

Wilcox SR, et al. Interfacility Transport of Critically Ill Patients. 2022 • Volume 50 • Number 10

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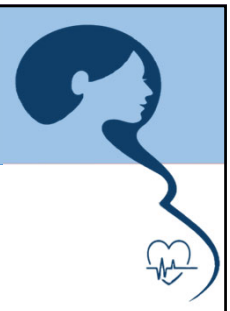
8

8

Regionalization of Obstetric Care
Examples of Appropriate Patient by Level



ACOG, SMFM, CDC, Arizona Perinatal Trust, National Perinatal Information Center developed Levels of Maternal Care verification program published in 2018.

Accredited birth Center: uncomplicated singleton vertex fetus, expected uncomplicated birth

Level 1: low risk women with uncomplicated pregnancy

higher risk: uncomplicated twin gestation, uncomplicated cesarean delivery, preeclampsia, well-controlled gestational diabetes

Level II: placenta previa with no previous uterine surgery,

maternal conditions needed monitoring: pregestational diabetes, poorly controlled asthma, poorly controlled/complicated HTN

anticipated complicated C section

http://dx.doi.org/10.1016/j.ajog.2014.12.030

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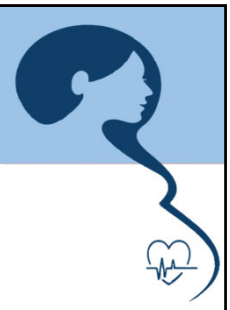
Examples of Appropriate Patient by Level



Level III: moderate maternal cardiac disease, accreta/previa and prior uterine surgery, suspected percreta, ventilatory support, acute fatty liver of pregnancy, coagulation disorders, complex hematologic or autoimmune disease, preeclampsia with severe features remote from term

Level IV: severe maternal cardiac conditions, severe pulmonary HTN, neurosurgery or cardiac surgery, unstable and in need of organ transplant

Has all specialties + 24/7 Maternal Fetal Medicine specialists' availability

Abbott Northwestern Hospital is a Level IV Maternal Care Center

United and Mercy Hospitals are not Level IV

http://dx.doi.org/10.1016/j.ajog.2014.12.030

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Obstetric Care Consensus: Levels of Maternal Care. OB GYN 2019 134(2)

TABLE 2
Levels of maternal care by services

Required service	Level of maternal care: Birth centers	Level I	Level II	Level III	Level IV
Nursing	Adequate numbers of qualified professionals with competence in level I care criteria	Continuously available RNs with competence in level I care criteria Nursing leadership has expertise in perinatal nursing care	Continuously available RNs with competence in level II care criteria Nursing leadership has formal training and experience in perinatal nursing care and coordinates with respective neonatal care services	Continuously available nursing leaders and RNs with competence in level III care criteria and have special training and experience in the management of women with complex maternal illnesses and obstetric complications	Continuously available RNs with competence in level IV care criteria Nursing leadership has expertise in maternal intensive and critical care
Minimum primary delivery provider to be available	CNMs, CMs, CPMs, and licensed midwives	Obstetric provider with privileges to perform emergency cesarean delivery	Ob-gyns or MFMs	Ob-gyns or MFMs	Ob-gyns or MFMs
Obstetrics surgeon		Available for emergency cesarean delivery	Ob-gyn available at all times	Ob-gyn onsite at all times	Ob-gyn onsite at all times
MFMs			Available for consultation onsite, by phone, or by telemedicine, as needed	Available at all times onsite, by phone, or by telemedicine with inpatient privileges	Available at all times for onsite consultation and management
Director of obstetric services			Board-certified ob-gyn with experience and interest in obstetrics	Board-certified ob-gyn with experience and interest in obstetrics	Board-certified MFM or board-certified ob-gyn with expertise in critical care obstetrics
Anesthesia		Anesthesia services available	Anesthesia services available at all times Board-certified anesthesiologist with special training or experience in obstetrics, available for consultation	Anesthesia services available at all times Board-certified anesthesiologist with special training or experience in obstetrics is in charge of obstetric anesthesia services	Anesthesia services available at all times Board-certified anesthesiologist with special training or experience in obstetrics is in charge of obstetric anesthesia services
Consultants	Established agreement with a receiving hospital for timely transport, including determination of conditions necessitating consultation and referral	Established agreement with a higher-level receiving hospital for timely transport, including determination of conditions necessitating consultation and referral	Medical and surgical consultants available to stabilize	Full complement of subspecialists available for inpatient consultation, including critical care, general surgery, infectious disease, hematology, cardiology, nephrology, neurology, and neonatology	Adult medical and surgical specialty and subspecialty consultants available onsite at all times, including those indicated in level III and advanced neurosurgery, transplant, or cardiac surgery

ACOG. Levels of maternal care. Am J Obstet Gynecol 2015. *(continued)*

http://dx.doi.org/10.1016/j.ajog.2014.12.030
11

11

Critical Care Transport Since 2004

Interventions	Examples
Substantial growth in rural based helicopters	Rapid changes in helicopter density from 545 in 2003 over 1200 in 2021 (12)
Development of national and international transport agencies	AirMed International; DOD Adult ECMO Transport Tea
Increasing regionalization of healthcare	Development of high-volume centers of excellence (e.g., trauma centers, stroke centers) (3, 13)
Emphasis on interprofessional approach	Maximizing scope of practice for nonphysician teams, off-line medical direction. Examples include rapid se quence intubation (14), finger thoracostomy (15)
Telemedicine	Use of videoconferencing to allow the team to directly communicate with the receiving hospital (16)
Adaptation of military procedures	Many critical care transport services now carry packed RBCs and plasma (17, 18) Use of tranexamic acid for early hemorrhagic shock, minor traumatic brain injury (19, 20) Use of hemostatic gauze (21)
Advances in airway management	Use of videolaryngoscopy (22) Increased use of noninvasive ventilation (23)
Application of modern critical care management to transport	Use of lung-protective ventilation in transport (24) Transport on ECMO and other mechanical circulatory support devices (25–27) Enhanced strategies to manage transport of patients v highly contagious pathogens (28, 29)

Crit Care Med. 2022 Oct 1;50(10):1461-1476

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12

12

Essential Equipment for Critical Care Transport

Category	Examples
Monitoring of vital signs	Continuous rate and rhythm monitoring, O_2 saturation, noninvasive blood pressure, and respiratory rate. Continuous or intermittent 12-lead electrocardiogram monitoring in cardiac or toxicology patients. Continuous or intermittent temperature measurement in targeted temperature management patients. Invasive hemodynamic monitoring (arterial line, pulmonary artery catheter). Quantitative end-tidal carbon dioxide monitoring for all intubated patients. Fetal heart rate checks for pregnant patients (128, 129).
O_2 and respiratory support	Supply of O_2 in the vehicle and in moving the patient between the vehicle and facilities. Basic airway management equipment, such as a bag-mask ventilation device and oral/nasal airways, supraglottic airways, and functioning suction. Difficult airway equipment, including video laryngoscopes and instruments for surgical airways. Critical care transport transport ventilators with controlled and spontaneous breathing mode options, appropriate volume and pressure alarms, and ability to deliver positive end-expiratory pressure to at least 20 cm H_2O.
Medications and delivery devices	Infusion pumps—types will vary depending on the scope of practice of the team. Medications, including sedation agents, analgesics, vasopressors, inotropes, neuromuscular blockers, antimicrobial agents, antiarrhythmics, bronchodilators, heparin infusions, and insulin (130).
Diagnostic equipment	Point-of-care laboratory testing (131–134). Point-of-care ultrasound for diagnostic purposes and image-guided procedures during transport (135, 136).

Crit Care Med. 2022 Oct 1;50(10):1461-1476

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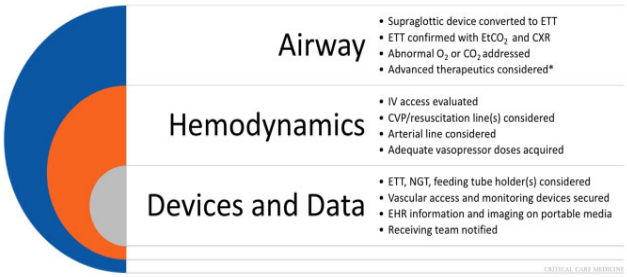

Wilcox, Susan R.; Wax, Randy S.; Meyer, Michael T.; Stocking, Jacqueline C.; Baez, Amado Alejandro; Cohen, Jason; Moss, M. Michele; Frakes, Michael A.; Scruth, Elizabeth A.; Weir, William B.; Zonies, David; Guyette, Francis X.; Kaplan, Lewis J.; Cannon, Jeremy W.

Critical Care Medicine50(10):1461-1476, October 2022.

doi: 10.1097/CCM.0000000000005639

This graphic conveys key pretransport interventions to support optimization as well as transport safety including those related to airway security, hemodynamic performance, device security to prevent premature removal during transport, and essential data transmission. *Advanced therapeutics include pulmonary artery vasodilators, vasopressors, invasive devices such as an intra-aortic balloon pump, or ventricular assist device, or extracorporeal membrane oxygenation. CVP = central venous pressure, CXR = chest radiograph, EHR = electronic health record, Etco2 = end-tidal carbon dioxide, ETT = endotracheal tube, NGT = nasogastric tube.

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14

14

Adaptive changes of pregnancy and how they can mask acute illness

Table 1. Physiologic Changes during Pregnancy

System	Changes	Physiologic Impact
Cardiovascular	Increased heart rate and cardiac output Decreased arterial pressure	Masking signs of sepsis Increased hypoperfusion
Hematology	Increased plasma volume Increased factors VII, VIII, IX, X, XII and vWF	Physiologic anemia, less O2 supply to tissues Increased risk of DIC and DVT
Respiratory	Increased tidal volume and minute ventilation Decreased residual volume due to elevated diaphragm	Decreased PaCO2 ("normal" blood gas may be sign of impending respiratory failure) Impaired oxygenation and faster desaturation
Renal	Increased vesicoureteral reflux Increased renal plasma flow and GFR	Delayed identification of renal injury secondary to sepsis Conditions favorable to pyelonephritis
Gastrointestinal	Delayed gastric emptying	Increased risk of aspiration
GU	Decreased vaginal pH	Increased risk of chorioamnionitis

Adapted from: Cordioli. Sepsis and Pregnancy: Do We Know How to Treat This Situation? Rev Bras Ter Intensiva 2013.

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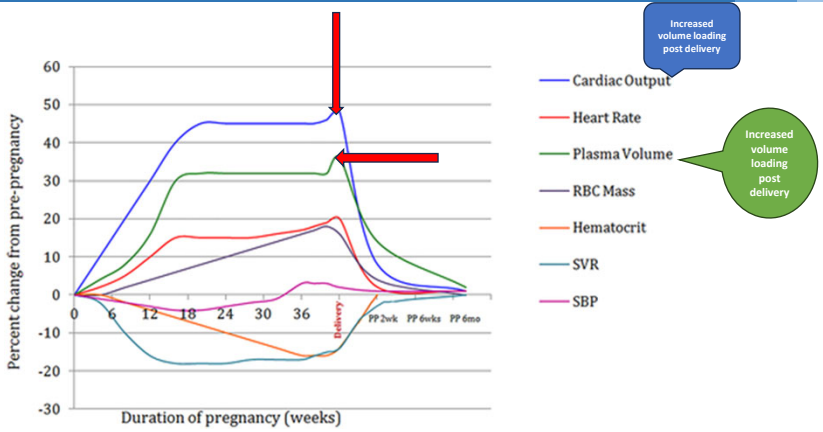
15

15

Adaptive changes in pregnancy affecting pre-transport care - Hemodynamics



Greatest risk for pulmonary edema and heart failure first 24 hours post delivery!

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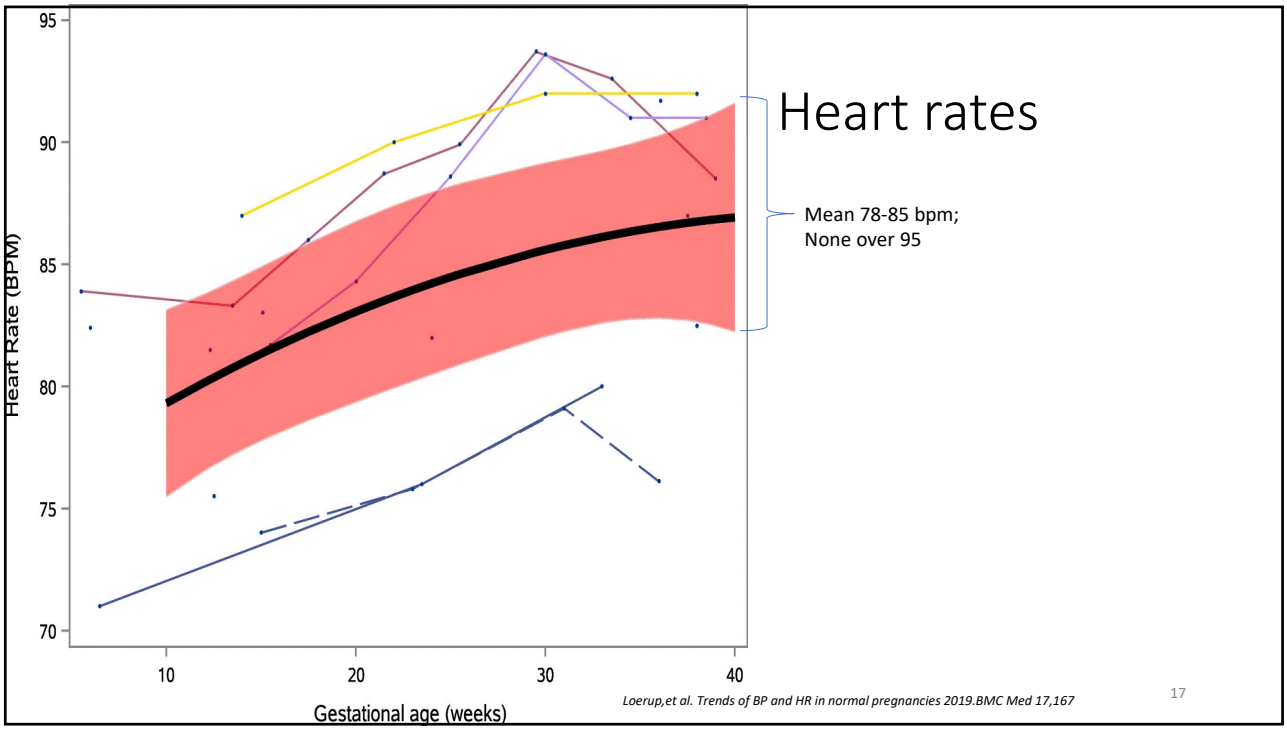
16

16


Heart rates
Mean 78-85 bpm;
None over 95
Heart Rate (BPM)
95
90
85
80
75
70
10
20
30
40
Gestational age (weeks)
Loerup,et al. Trends of BP and HR in normal pregnancies 2019.BMC Med 17,167
17

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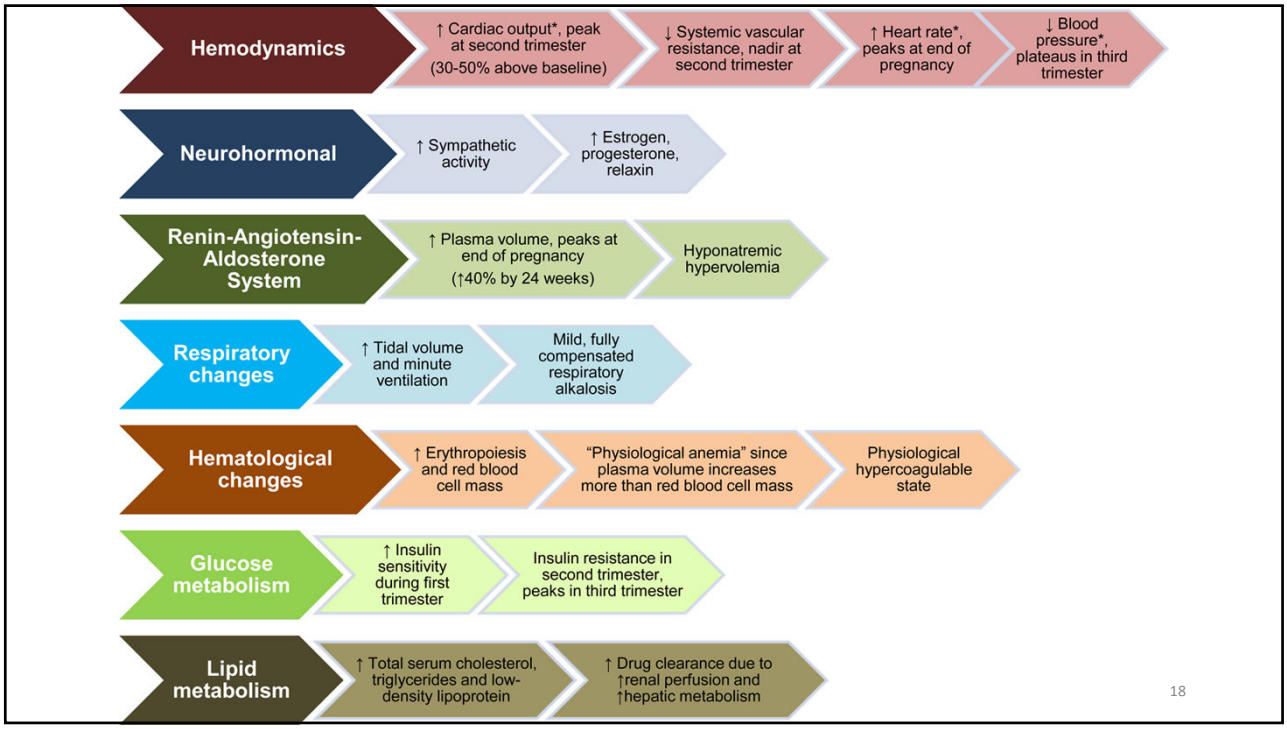
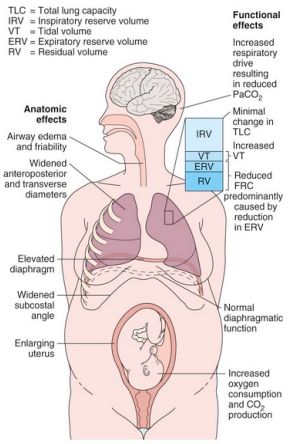
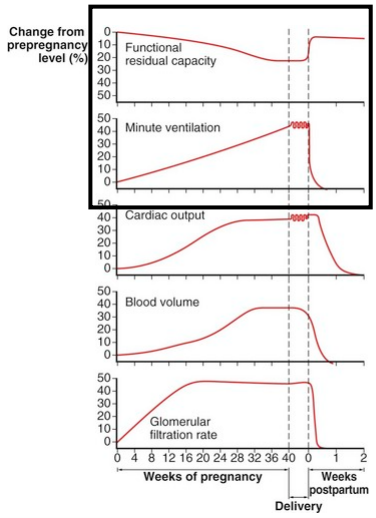

Hemodynamics
↑ Cardiac output*, peak at second trimester (30-50% above baseline)
↓ Systemic vascular resistance, nadir at second trimester
↑ Heart rate*, peaks at end of pregnancy
↓ Blood pressure*, plateaus in third trimester
Neurohormonal
↑ Sympathetic activity
↑ Estrogen, progesterone, relaxin
Renin-Angiotensin-Aldosterone System
↑ Plasma volume, peaks at end of pregnancy (↑40% by 24 weeks)
Hyponatremic hypervolemia
Respiratory changes
↑ Tidal volume and minute ventilation
Mild, fully compensated respiratory alkalosis
Hematological changes
↑ Erythropoiesis and red blood cell mass
"Physiological anemia" since plasma volume increases more than red blood cell mass
Physiological hypercoagulable state
Glucose metabolism
↑ Insulin sensitivity during first trimester
Insulin resistance in second trimester, peaks in third trimester
Lipid metabolism
↑ Total serum cholesterol, triglycerides and low-density lipoprotein
↑ Drug clearance due to ↑renal perfusion and ↑hepatic metabolism
18

18

Adaptive changes of pregnancy affecting pre-transport care – Pulmonary





- Progressive decrease in functional residual capacity (FRC) by 10% to 25% by term
- Major change is decreased expiratory reserve volume.
- Chest wall and total respiratory compliance reduced in the third trimester from chest wall changes and increased abdominal pressure.
- Minute ventilation increases 20-40%,driven by increased tidal volume from progesterone, causing respiratory alkalosis with compensatory metabolic acidosis
- Decreased FRC, ERV + increased oxygen consumption increase risk of hypoxia, and rapid desaturation with sedation

Lapinsky.Pregnancy. https://thoracickey.com/pregnancy/ Accessed 8/17/2024

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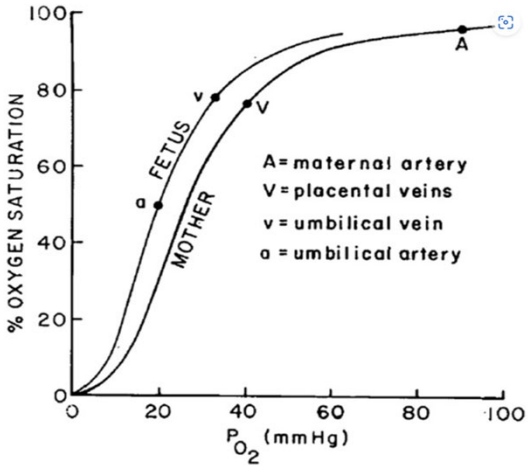
19

19

Oxyhemoglobin dissociation curve in pregnancy



Figure

Caption

Oxyhemoglobin dissociation curves of maternal and fetal blood. The position of the fetal curve allows for greater binding of oxygen at lower PO2. (From: Meschia, G. J Reproductive Med 1979;23(4);165) Used with permission from Hindawi

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20

20