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Conceptualized framework for levels of obstetric care

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It has been demonstrated that risk-appropriate perinatal and obstetric care can improve perinatal morbidity and mortality. Recently, various studies focus on the importance of evaluation for maternal conditions and allocation of high risk pregnant women to highly qualified facilities. Therefore, it is necessary to develop the conceptualized framework for levels of obstetric care and establish the guidelines for the situations that should be cared in each level of facility. In this review article, we reviewed several classifications of obstetric care in eastern and western countries, and conditions in which transfer should be recommended depending on the risk and capacity of centers.

Keywords: Maternal care; Hospital referral; High-risk pregnancy

Introduction

It is obvious that to initiate timely appropriate management can improve maternal and fetal outcomes in obstetric care. The role of health care providers is critically important for the better prognosis in obstetric care. Medical doctors, especially obstetricians must make decision clearly and promptly whether to manage at their institution or to transfer to high level facilities in each obstetric patient. If they decide that their institution is not appropriate for managing pregnancy woman or fetus in any reason because of facility system, lack of delivery system, operation room or blood bank, unavailability of medical and/or surgical anesthesia consultation or intensive care unit (ICU), then they should transfer the patient without any delay.

It has been demonstrated that timely appropriate transfer can improve the neonatal outcomes [1]. The survival of preterm birth infants were higher when they were delivered in higher level of hospitals than that in lower level of hospitals and the differential outcome persisted even after neonatal period, suggesting the importance of maternal transport [2,3]. These evidences support the necessity for classification system of maternal care, which is complementary but different from that in neonatal care.

In this review, we will compare classification systems of obstetric care facilities in eastern and western countries and the evaluation system of maternal/obstetric severity to determine the necessities of transfer in both inpatient and outpatient obstetric services.

Classification systems of obstetric care facilities

The range of medical care may vary depending on each level of health care center's capacity to manage pregnant woman and fetus. Therefore, it is essential to evaluate an institution's management capacity based on its facility, device, and medical personnel.

In USA, most states have developed regional systems on perinatal care, but they are using inconsistent systems of classification and definitions [4-6]. To develop standardized care, American College of Obstetricians and Gynecologists (ACOG) and Society for Maternal-Fetal Medicine suggested uniform classification system for levels of maternal care [7]. This system includes birth centers, basic care, specialty care, subspecialty care, and regional perinatal health care centers. The definition

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Table 1. Levels of maternal care: definitions, capabilities, and examples of patients [7] (modified from American College of Obstetricians and Gynecologists 2015)

Level	Definition, capabilities, and examples of patients
Birth center (level 0)	Definition: care for low risk, uncomplicated, singleton, vertex presentation, term pregnancy
	Capabilities: ready to initiate emergency procedure immediately
	Indication: term, singleton, head presentation
Basic care (level 1)	Definition: possible to detect, stabilize, begin management of unexpected maternal and fetal complications in uncomplicated pregnancy until patient can be transferred
	Capabilities: well organized system to operate emergency cesarean section, available of lab test, blood bank supply, obstetric ultrasonographic evaluation at all the times, possible for massive transfusion, emergency release of blood products
	Indication: twin term pregnancy, uncomplicated cesarean section, try to expect labor in previous cesarean section history, preeclampsia without any severe symptom in term
Specialty care (level 2)	Definition: care of high risk pregnancy including antepartum, intrapartum, postpartum care
	Capabilities: imaging system including CT, MRI, obstetric and fetal ultrasonography, special equipment for obese women
	Indication: severe preeclampsia, placenta previa without any previous uterine surgery
Subspeciality level (level 3)	Definition: providing care of more complex medical, obstetrical, fetal complications
	Capabilities: available 24 hours advanced imaging evaluation system, medical intensive care unit, surgical intensive care unit, critical and emergency care system, proper system including equipment and health provider onsite to monitor and ventilate during delivery
	Indication: placenta previa/accreta with prior uterine surgery, placenta percreta, adult respiratory failure or syndrome, early severe preeclampsia less than 34 weeks of gestation
Regional perinatal health care centers (level 4)	Definition: providing medical and surgical care for most severe maternal and fetal complication
	Capabilities: onsite ICU, medical and surgical care available in most complex conditions and complications, regional representative in maternal health care
	Indication: severe maternal cardiac problems, severe maternal pulmonary problems including pulmonary hypertension, maternal liver failure, pregnant woman who needs to get major surgery (neurosurgery or cardiac surgery), pregnant woman under unstable condition and requiring organ transplant

CT, computed tomography; MRI, magnetic resonance imaging; ICU, intensive care unit.

and requirements for each center are summarized in Table 1.

In UK, multidisciplinary working group developed models of maternal care in 2011. Several committee including Royal College of Obstetricians and Gynaecologists, British Maternal and Fetal Medicine Society, Royal College of Midwives, Obstetric Anaesthetists Association, Royal College of Anaesthetists, Intensive Care Society, Department of Health participated in developing maternal health care system and the results are shown in Table 2 [8,9].

Japan has established proper transfer system between integrated centers for high-risk pregnancy. In Japan, there are 4 levels of facilities in prenatal care system; primary unit, secondary (local) center, tertiary (regional) center, quarternary (super perinatal) center. The requirement for each center is shown in Table 3 [10-12].

In Korea, maternal-neonatal integrated center system was also suggested by Park [12] and Lee [13] in 2015. In this report, the importance of nationwide transfer system for integrated approach was emphasized for high-risk pregnancy woman and infant care. This report proposed the necessity of classification in perinatal care depending on capabilities of obstetric and pediatric department. Three levels of maternal care system suggested are shown in Table 4 [12,13].

Evaluation of pregnant women in inpatient services

Pregnant women can visit any levels of facilities, and health care providers in maternal care should be qualified for determination of pregnant women. In evaluation of pregnant women who visit emergency department or labor/delivery

Table 2. Levels of maternal care in UK (modified from "Providing equity of critical and maternity care for the critically ill pregnant or recently pregnant woman," 2011 [8])

Level of care	Maternity example
Normal ward care (level 0)	Low risk mother
Additional monitoring or intervention, or step down from higher level of care (level 1)	Mother at risk of hemorrhage Mother with oxytocin infusion Mother with mild preeclampsia on oral anti-hypertensives/fluid restriction Maternal medical condition such as congenital heart disease, diabetic on insulin
Single organ support (level 2)	1) BRS - 50% or more oxygen via face-mask to maintain oxygen saturation - CPAP, BIPAP 2) BCVS - Intravenous anti-hypertensives, to control blood pressure in pre-eclampsia - Arterial line used for pressure monitoring or sampling - CVP line used for fluid management and CVP monitoring to guide therapy 3) ACVS - Simultaneous use of at least 2 intravenous, anti-arrhythmic/antihypertensive/vasoactive drugs, one of which must be a vasoactive drug - Need to measure and treat cardiac output 4) Neurological support - Magnesium infusion to control seizures (not prophylaxis) - Intracranial pressure monitoring - Hepatic support - Management of acute fulminant hepatic failure, e.g., from HELLP syndrome
Advanced respiratory support alone, or support of 2 or more organ systems above (level 3)	1) Advanced respiratory support - Invasive mechanical ventilation 2) Support of 2 or more organ systems - Renal support and BRS - BRS/BCVS and an additional organ supported

BRS, basic respiratory support; CPAP, continuous positive airway pressure; BIPAP, bi-level positive airway pressure; BCVS, basic cardiovascular support; CVP, central venous pressure; ACVS, advanced cardiovascular support; HELLP, hemolysis, elevated liver enzymes, and low platelets.

unit, ACOG addressed the necessity for the development of hospital-based triage of pregnant patients [14]. In the suggested maternal-fetal triage index, patients are classified into 5 levels, according to their condition (Table 3).

According to this triage, obstetrician should decide the appropriate location and timing of treatment, based on the urgency of obstetric problem and the risk and benefit of transfer; whether the patient is unstable and needs prompt treatment, or the patient is stable but need transfer for management in high level of maternal care, or she is stable and can be treated in their unit [15,16]. For example, patients with placental abruption at 37 weeks of gestation may need emergent cesarean delivery at the initial hospital, whereas patients with premature preterm rupture of membranes at 32 weeks of gestation without active labor pain can be transferred to high level facilities for neonatal ICU care.

Before making a decision, obstetricians should stabilize the patient or transfer the patient to higher level of facilities immediately. Every patient must be transferred only when the benefits outweigh the risks [17,18]. Two other factors should be considered in order to make a proper decision regarding transfer. First, all of the process was initiated after informed consent. Second, when transfer to high level facilities is decided, the patient is under the care by qualified personnel with

Table 3. Maternal-fetal triage index (modified from American College of Obstetricians and Gynecologists 2016)

Priority 1/STAT	1) Abnormal vital signs: maternal HR <40 or 130/apneic/SpO_2 <93%, SBP ≥160 or DBP ≥110/DBP <60/palpable
	2) Maternal condition
	- CRP: cardiac compromise or severe respiratory distress
	- Seizing
	- Acute mental status change
	- Hemorrhage
	3) Obstetric condition
	- FHR not detected by doppler/FHR <110 bpm for >60 seconds
	- Signs of placental abruption
	- Signs of uterine rupture
	- Prolapsed cord
	- Imminent birth: fetal parts visible on the perineum/active maternal bearing-down efforts
Priority 2/Urgent	1) Abnormal vital signs: maternal HR <50 or 120/BT ≥38.3 degree/RR >26 or 12/SpO_2 <95%/SBP ≥140 or DBP ≥90 with symptomatic condition/BP <80/40
	2) Maternal condition
	- Severe abdominal pain (NRS ≥7) with no correlation with cervical change
	- Unstable medical condition
	- Difficult to breath
	- Mental status change
	- Suicidal or homicidal
	- Recent trauma
	3) Obstetric condition
	- Decrease fetal movement
	- Repeated FHR >160 for 60 seconds
	- Fetal deceleration
	- Active vaginal bleeding (not spotting or show)
	- In <34 GA, cervical change/PROM
	- In ≥34 GA with labor/ROM: HIV, malpresentation, multiple gestations, placental previa, planned elective cesarean section
Priority 3/Prompt	1) Abnormal vital signs: BT ≥38.3 degree without symptom/SBP ≥140 or DBP ≥90 without symptom
	2) Obstetric condition
	- In >34 GA, active labor/labor with HSV/labor with previous cesarean section, irregular uterine contraction in multiple gestation
	- In 34–37 GA, early labor and/or ROM
Priority 4/Non-urgent	1) Obstetric condition
	- In ≥ 37 GA, early labor/ROM
	- Common discomfort of pregnancy, vaginal discharge, constipation, nausea, anxiety
Priority 5/Scheduled	1) Medical and obstetric condition
	- Missed outpatient service
	- Scheduled visit

HR, heart rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; CRP, C-reactive protein; FHR, fetal heart rate; BT, body temperature; RR, respiratory rate; NRS, numeric rating scale; GA, gestational age; PROM, premature rupture of membranes; ROM, rupture of membranes; HIV, human immunodeficiency virus; HSV, herpes simplex virus.

Table 4. Levels of maternal care in Japan

Level	Requirements and examples of patients
Primary unit	Care of low risk pregnancy women
Secondary (local) center	Connecting center between primary unit to high level of facilities
	Requirements: obstetrician, pediatrician
Tertiary (regional) center	Center taking care of complicated delivery or pregnancy with fetal anomaly
	Requirements: obstetrician, pediatrician, anesthesiologist, other medical specialists
Quarternary (super perinatal) center	Center taking care of pregnancy with the most complex problems, maternal complication such as neurovascular disease, cardiac problems, sepsis, severe trauma, etc.
	Requirements: obstetrician, pediatrician, anesthesiologist, pediatric surgeon, pediatric cardiologist, neurosurgeon and other medical specialists

Table 5. Levels of maternal-neonatal integrated center in Korea, suggested in 2015

Level of center	Management, capability, and required operation system
Local	Management: complicated pregnancy, low birth weight, congenital fetal anomaly
	Capability: ≥5 beds in MFICU, ≥15 beds in NICU, ≥3 obstetricians and ≥3 pediatrician all the time
	Required operation system: continuous availability of delivery all the time
Regional	Management: more complicated pregnancy than that in local center
	Capability: ≥10 beds in MFICU, ≥20–25 beds in NICU, ≥3–4 obstetricians and ≥34 pediatrician all the time
	Required operation system: able to initiate emergency obstetric interventions within 30 minutes
National center	Management: most complicated pregnancy (≤24 gestational weeks), combine fetal anomalies
	Capability: ≥10 beds in MFICU, ≥30 beds in NICU, ≥5 obstetricians and ≥5 pediatrician all the time
	Required operation system: more than 2 extra beds in NICU and more than 2 extra beds in MFICU for unexpected emergency transfer

MFICU, maternal-fetal intensive care unit; NICU, neonatal intensive care unit.

proper transportation equipment.

Evaluation of pregnant women in outpatient services

The definition of high-risk pregnancy has not been specified and may be variable according to the health care system of each country. In 2012, the Korean Society of Maternal Fetal Medicine suggested 3 grades of high-risk pregnancy for several obstetric conditions depending on several experts' opinions, and these criteria have been revised in 2016 by Korean Society of Obstetrics and Gynecology [19,20]. The conditions considered as mild problems are classified into grade 1, whereas moderate states are regarded as grade 2, severe diseases are defined as grade 3. The primary physician in local clinics may decide to transfer the patient or not and choose the level of obstetric care facilities to transfer according to this grading system of high risk pregnancies (Table 5).

In 2015, ACOG showed the example of patients according to the level of obstetric care facilities. In this suggestion, birth center can take care of term, singleton, vertex presentation, whereas term twin gestation may be appropriate for level 1 (basic care) facilities. The examples of patients who should be managed in level IV (regional perinatal health care centers) facilities are severe maternal cardiac conditions, severe pulmonary hypertension or liver failure, pregnant women requiring neurosurgery or cardiac surgery, or patients in unstable condition and in need of an organ transplant [7].

In 2012, New Zealand Ministry of Health also proposed specific guidelines for consultation or transfer. There are 4 categories: primary, consult, transfer, and emergency condition. In this process maps, primary, consultation, transfer, emergent conditions are defined as follows. First, primary means the condition that the Lead Maternity Center (LMC) may consider as referral to another primary physician. Second, consult is the condition that requires consultation with another specialist. Third, transfer is a situation in which LMC should transfer

Table 6. Grade of high-risk pregnancy (Korean Society of Maternal-Fetal Medicine 2012 grade, Korean Society of Obstetrics and Gynecology; 2016 opinion, American College of Obstetricians and Gynecologists/Society of Maternal-Fetal Medicine 2014 guideline, New Zealand 2012 guidelines)

Disease	KSMFM 2012	KSOG 2016	ACOG/SMFM 2014	New Zealand 2012
Obstetric risk factors				
Previous preeclampsia	I	I		Consult
Previous fetal anomaly	I	I		Consult
Previous cerclage		I		Transfer
Previous GDM		I		
Recurrent abortion	II	II		Consult
Previous eclampsia	II	II		Consult
Previous cesarean section	II	II		Consult
Previous uterine surgery	II	II		Consult
Previous preterm birth		II		Consult
Previous placenta accreta		II		
Familial chromosomal abnormality		II		
Previous HIFU		II		
Previous stillbirth	III	III		Primary
Previous neonatal death	III	III		Consult
Fetal transfusion d/t hemolysis	III	III		
Obstetric hemorrhage		III		Consult
History of trachelectomy		III		Consult
Medical problem				
Family history of DM	I	I		
Rh negative (maternal)		I		
Epilepsy	II	II		Primary/transfer[a]
Heart failure, NYHA class I	II	II		
Sexual transmission disease	II	II		Consult
Pulmonary problem	II	II	III or IV	
Thyroid disease	II	II		Primary/consult
Autoimmune disease	II	II		Consult/transfer
Chronic hypertension	III	III		Consult/transfer
Heart failure, NYHA II–IV	III	III	IV	
Diabetes mellitus	III	III		Transfer
Renal disease (moderate to severe)	III	III		Transfer
Rh sensitized women		III		
Risk factors				
Maternal age (35–39, <15/19 yr)[b]	II	II		
Underweight (BMI <18.5 kg/m^2)		I		
Overweight (BMI 23–25 kg/m^2)		I		
Obesity (BMI 25–30 kg/m^2)		II		
Obesity (BMI >30 kg/m^2)	II	III		Consult/transfer
Narrow pelvic outlet	II			
Multiparity (>3 or >4 cm)[c]	II	II		
Short cervix (<2.5 cm)		II		

Table 6. Continued

Disease	KSMFM 2012	KSOG 2016	ACOG/SMFM 2014	New Zealand 2012
Myoma (≥5 cm), adenomyosis		II		
IIOC	III	III		
Uterine anomaly	III	III		
Maternal age (≥40 yr)	III	III		
Current pregnancy				
Cystitis	I			
Anemia (Hb ≥9 g/dL)	I	I		Consult
Hyperemesis		I		
Threatened abortion		I		
Smoking (≥1 pack/day)	II	I		
Psychiatric problem	II	I		Primary/consult
Drug/alcohol abuse	II	II		Primary
Pyelonephritis	II	II		Consult
Anemia (Hb <9 g/dL)	II	II		
Viral infection	II	II		Consult/transfer
GDM without insulin		II		Consult
GA ≥42 wk	II	II		Consult
PPROM (34–36 GA)	II	II		Consult
PTL (34–36 GA)	II	II		Consult
Malpresentation	II	II		Consult
Polyhydramnios	II	II		Transfer
Oligohydramnios	II	II		Consult
Chorioamnionitis	II	II		
Fetal anomaly	II	III		Consult
Twin pregnancy		II		Transfer
FDIU		II		Consult
Preterm labor (<34 GA)	III	III		Transfer
PPROM (<34 GA)	III	III		
IUGR	III	III		Consult/transfer
LGA	III	II		Consult
Gestational hypertensive disease	III	III	II or III	Consult/emergency
Multiple pregnancy	III	III[d]		Transfer
Placental abruption	III	III		
Placenta previa	III	III	II or III	Transfer
Uterine rupture	III	III		
Obstetric hemorrhage	III	III		
Embolism	III	III		
Low birth weight (<2.5 kg)		III		
GDM with insulin		III		Transfer

In KSMFM (2012) and KSOG (2016), there are 3 grades: grade I is mild, grade II is moderate, grade III is severe. In ACOG/SMFM (2014), there are 5 levels of facilities, from level 0 to level IV as shown in Table 1.
HIFU, high intensity focused ultrasound; GDM, gestational diabetes mellitus; DM, diabetes mellitus; NYHA, New York Heart Association; BMI, body mass index; IIOC, incompetent internal os of cervix; Hb, hemoglobin; GA, gestational age; PPROM, preterm premature rupture of membranes; PTL, preterm labor; FDIU, fetal death *in utero*; IUGR, intrauterine growth restriction; LGA, large for gestational age.
[a]Primary if controlled, transfer if no controlled; [b]35–39, 15 years old in KSMFM (2012), 35–39, <19 years old in KSOG (2016); [c]Multiparity defined as >3 parity in KSMFM (2012), while >4 parity in KSOG (2016); [d]Only for triplets.

to another specialist in order to allocate clinical responsibility to specialist. Fourth, emergency is criteria that needs prompt transfer of medical responsibilities to the most proper practitioners. In this system, medical or obstetric high risk conditions are classified as conditions that need referral to another primary physician, consultation with a specialist, transfer of responsibility to specialists, or emergent condition [21].

In Table 6, we compared these evaluation systems of pregnant women in outpatient services from Korea, USA, and New Zealand.

Conclusion

The evaluation of maternal condition and selection of the high-risk pregnancy that requires high level of cares are essential in order to reduce perinatal morbidity and mortality. Furthermore, unified classification of obstetric care depending on the capabilities of facilities is essential for the better outcomes in perinatal care. The guidelines and examples of the conditions that can be managed in each level can be helpful to make a proper decision in providing maternal health care. The goal of conceptualized framework for maternal care and effort to establish the high risk maternal conditions is for high risk pregnant women to receive appropriate care in institutions that are ready to provide specialized care, thereby improving perinatal mortality and morbidity.

In addition, many problems related to high-risk pregnancy are originated from not only transfer system but also low insurance and lack of manpower [22-24]. Many obstetricians experience malpractice burden and decide to discontinue obstetric care due to financial problem. In USA, the government had assigned Critical Access Hospital (CAH) as a part of supporting obstetricians and hospitals in rural area through financial support and educational program. One of the policies converting rural hospital into CAH is Medicare Rural Hospital Flexibility Grant Program, which finally makes it possible to improve quality of medical service. There are several more projects such as National Rural Health Resource Center, Health Care Services Outreach Grant Program, Delta Rural Hospital Performance Improvement Project in order to support obstetricians to supplement manpower and resource in obstetric care in USA [25]. Therefore, we should focus on developing both transfer system and support program in obstetric care.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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