

# WellCare Health Plans, Inc.

*The WellCare Group of Companies*

# Clinical Coverage Guideline

*WellCare Prescription Insurance, Inc.*



*'Ohana Health Plan, a Plan offered by  
WellCare Health Insurance of Arizona, Inc.*



*WellCare Health Insurance of Illinois, Inc.*

*WellCare Health Insurance of New York, Inc.*

*Harmony Behavioral Health, Inc.*

*Harmony Behavioral Health of Florida, Inc.*

*WellCare of Texas, Inc.*

*WellCare Health Plans of New Jersey, Inc.*

*WellCare of Florida, Inc.*

*HealthEase of Florida, Inc.*

*WellCare of Louisiana, Inc.*

*WellCare of New York, Inc.*

*WellCare of Connecticut, Inc.*

*WellCare of Georgia, Inc.*

*Harmony Health Plan of Illinois, Inc.*

*WellCare of Ohio, Inc.*

## Antepartum Fetal Surveillance

**Guideline Number: HS-111**

**Original Effective Date: 6/18/2009**

**Revision Date: n/a**

The Clinical Coverage Guideline is intended to supplement certain standard WellCare benefit plans. The terms of a member's particular Benefit Plan, Evidence of Coverage, Certificate of Coverage, etc., may differ significantly from this Coverage Position. For example, a member's benefit plan may contain specific exclusions related to the topic addressed in this Clinical Coverage Guideline. When a conflict exists between the two documents, the Member's Benefit Plan always supersedes the information contained in the Clinical Coverage Guideline. Additionally, Clinical Coverage Guidelines relate exclusively to the administration of health benefit plans and are NOT recommendations for treatment, nor should they be used as treatment guidelines. The application of the Clinical Coverage Guideline is subject to the benefit determinations set forth by the Centers for Medicare and Medicaid Services (CMS) National and Local Coverage Determinations and state-specific Medicaid mandates, if any.

# Clinical Coverage Guideline HS-111

## Antepartum Fetal Surveillance

Original Effective Date: 6/18/2009

Revised Date(s): n/a

### DISCLAIMER

The Clinical Coverage Guideline is intended to supplement certain standard WellCare benefit plans. The terms of a member's particular Benefit Plan, Evidence of Coverage, Certificate of Coverage, etc., may differ significantly from this Coverage Position. For example, a member's benefit plan may contain specific exclusions related to the topic addressed in this Clinical Coverage Guideline. When a conflict exists between the two documents, the Member's Benefit Plan always supersedes the information contained in the Clinical Coverage Guideline. Additionally, Clinical Coverage Guidelines relate exclusively to the administration of health benefit plans and are NOT recommendations for treatment, nor should they be used as treatment guidelines.

### APPLICATION STATEMENT

The application of the Clinical Coverage Guideline is subject to the benefit determinations set forth by the Centers for Medicare and Medicaid Services (CMS) National and Local Coverage Determinations and state-specific Medicaid mandates, if any.

### CLINICAL COVERAGE GUIDELINE

**The following procedures are included in the antepartum fetal surveillance guideline:**

- **CPT 76818** Biophysical Profile
- **CPT 76819** Modified Biophysical Profile
- **CPT 59020** Contraction Stress Test
- **CPT 76820** Fetal Umbilical Artery Doppler Velocimetry
- **CPT 76821** Fetal Middle Cerebral Artery Doppler Velocimetry
- **No Code** Maternal Uterine Artery Doppler Velocimetry

**A biophysical profile (76818) and the modified biophysical profile (76819) starting at 27 weeks gestation are considered medically necessary for the following indications:**

1) Maternal Conditions

- Antiphospholipid syndrome; **OR**,
- Poorly-controlled hyperthyroidism; **OR**,
- Hemoglobinopathies with significant anemia-hemoglobin SS, SC, or S-thalassemia; **OR**,
- Cyanotic heart disease; **OR**,
- Systemic lupus erythematosus; **OR**,
- Chronic renal disease; **OR**,
- Diabetes mellitus or gestational diabetes on anti-hyperglycemic agents; **OR**,
- Hypertensive disorders

2) Pregnancy-related Conditions

- Pre-eclampsia/eclampsia; **OR**,

- Decreased fetal movement; **OR**,
- Oligohydramnios (AFI < 7 cm); **OR**,
- Polyhydramnios (AFI > 24 cm); **OR**,
- Intrauterine growth restriction (EFW < 10th percentile growth); **OR**,
- Post-term pregnancy (greater than 41 weeks gestation); **OR**,
- Moderate to severe isoimmunization; **OR**,
- Previous fetal demise (unexplained or untreated recurrent risk); **OR**,
- Multiple gestation with significant growth discrepancy > 20%

**NOTE:** A biophysical or modified biophysical profile is generally authorized once a week unless non-reassuring, then it may be repeated twice a week.

**NOTE:** A contraction stress test is considered medically necessary following an abnormal non-stress test or modified biophysical profile.

**Fetal umbilical artery Doppler velocimetry (76820) is considered medically necessary for the following indications:**

- Fetal growth restriction (EFW < 10<sup>th</sup> percentile growth); **OR**,
- Monochorionic/diamniotic twins with significant growth discrepancy > 20%; **OR**,
- Twin-twin transfusion syndrome; **OR**,
- Oligohydramnios (AFI < 7 cm)

**NOTE:** Fetal umbilical artery doppler velocimetry is generally authorized every two weeks. The procedure may be performed more frequently if there is documentation of absent end diastolic velocity/flow, reserved flow or a flow index > 2 SD above the mean for gestational age.

**Fetal middle cerebral artery Doppler velocimetry (76821) is considered medically necessary for the following indications:**

- Risk of fetal anemia; red cell alloimmunization (Rh and non-Rh, parvovirus, fetal infection, feto-maternal hemorrhage); **OR**,
- Twin-twin transfusion syndrome

**Maternal uterine artery Doppler velocimetry is considered experimental and investigational.**

**BACKGROUND**

Several techniques for antepartum fetal surveillance currently in use are discussed in the ACOG bulletin. These include fetal movement assessment, non-stress test, contraction stress test, fetal biophysical profile, modified biophysical profile and umbilical artery Doppler velocimetry.

*Fetal Movement Assessment*

Fetal movement assessment occurs when the mother perceives a diminution in fetal movement. The mother counts fetal "kicks" as a means of antepartum fetal surveillance. The optimal number of movements and the ideal duration for counting movements have not been determined; however, numerous protocols have been reported and appear to be acceptable.

*Contraction Stress Test*

The contraction stress test is based on the response of the fetal heart rate to uterine contractions. It is believed that fetal oxygenation will be transiently worsened by uterine contractions. In the fetus with suboptimal oxygenation, the resulting

intermittent worsening in oxygenation will, in turn, lead to the fetal heart rate pattern of late decelerations. Uterine contractions also may provoke or accentuate a pattern of variable decelerations caused by fetal umbilical cord compression, which in some cases is associated with oligohydramnios.

The contraction stress test is interpreted by the presence or absence of late fetal heart rate decelerations, which are defined as decelerations that reach their nadir after the peak of the contraction and that usually persist beyond the end of the contraction. The results of the contraction stress test are categorized in the ACOG bulletin as follows:

- Negative. No late or significant variable decelerations.
- Positive. Late decelerations following 50 percent or more of contractions (even if the contraction frequency is fewer than three in 10 minutes).
- Equivocal-suspicious. Intermittent late decelerations or significant variable decelerations.
- Equivocal-hyperstimulatory. Fetal heart rate decelerations that occur in the presence of contractions that are more frequent than every two minutes or last longer than 90 seconds.
- Unsatisfactory. Fewer than three contractions in 10 minutes or a tracing that is not interpretable.

Relative contraindications to the contraction stress test usually include conditions that are associated with an increased risk of preterm labor and delivery, uterine rupture or uterine bleeding. According to ACOG, these conditions include the following:

- Preterm labor or certain patients at high risk of preterm labor.
- Preterm membrane rupture.
- History of extensive uterine surgery or classic cesarean delivery.
- Known placenta previa.

#### *Non-stress Test*

In the nonstress test, the heart rate of the fetus that is not acidotic or neurologically depressed will temporarily accelerate with fetal movement. Heart rate reactivity is believed to be a good indicator of normal fetal autonomic function. Loss of reactivity is commonly associated with a fetal sleep cycle but may result from any cause of central nervous system depression, including fetal acidosis.

Results of nonstress tests are classified as reactive or nonreactive. Various definitions of reactivity have been used. Most commonly, the nonstress test is considered reactive, or normal, if there are two or more fetal heart rate accelerations within a 20-minute period, with or without fetal movement discernible by the woman, according to ACOG. The nonreactive stress test lacks sufficient fetal heart rate accelerations over a 40-minute period. The nonstress test of the neurologically healthy preterm fetus is frequently nonreactive--from 24 to 28 weeks of gestation, up to 50 percent of nonstress tests may not be reactive, and from 28 to 32 weeks of gestation, 15 percent of nonstress tests are not reactive.

#### *Biophysical Profile*

The biophysical profile discussed in the ACOG bulletin is a nonstress test plus four observations made by real-time ultrasonography. The five components of the biophysical profile are as follows: (1) nonstress test; (2) fetal breathing movements (one or more episodes of rhythmic fetal breathing movements of 30 seconds or more within 30 minutes); (3) fetal movement (three or more discrete body or limb movements within 30 minutes); (4) fetal tone (one or more episodes of extension of a fetal extremity with return to flexion, or opening or closing of a hand; and (5) determination of the amniotic fluid volume (a single vertical pocket of amniotic fluid exceeding 2 cm is considered evidence of adequate

amniotic fluid).

Each of the components is given a score of 2 (normal or present as defined previously) or 0 (abnormal, absent or insufficient). A composite score of 8 or 10 is normal, a score of 6 is equivocal and a score of 4 or less is abnormal. In the presence of oligohydramnios, further evaluation is warranted regardless of the composite score.

#### *Modified Biophysical Profile*

During the late second or third trimester, amniotic fluid reflects fetal urine production. Placental dysfunction may cause diminished fetal renal perfusion, which can lead to oligohydramnios. Therefore, assessment of amniotic fluid volume can be used to evaluate long-term uteroplacental function. This led to the development of the modified biophysical profile.

The modified biophysical profile combines the nonstress test with the amniotic fluid index, which is the sum of measurements of the deepest cord-free amniotic fluid pocket in each of the abdominal quadrants, as an indicator of long-term function of the placenta. An amniotic fluid index of more than 5 cm is thought to be an adequate volume of amniotic fluid. The modified biophysical profile is considered normal if the nonstress test is reactive and the amniotic fluid index is greater than 5 cm and abnormal if the nonstress test is nonreactive or the amniotic fluid index is 5 cm or less.

#### *Umbilical Artery Doppler Velocimetry*

Doppler ultrasonography is used to assess the hemodynamic components of vascular impedance. Umbilical artery Doppler flow velocimetry has been adapted as a fetal surveillance technique because it is believed that flow velocity waveforms in the umbilical artery of fetuses with normal growth differ from those of fetuses with growth restriction. The umbilical flow velocity waveform of a normally growing fetus has high-velocity diastolic flow, while in cases of intrauterine growth restriction, the umbilical artery diastolic flow is diminished. With extreme intrauterine growth restriction, the flow may be absent or even reversed. There is a high perinatal mortality rate among such pregnancies.

## **CODING**

### **Covered CPT®\* Codes**

<b>59020</b>	Contraction Stress Test
<b>76818</b>	Biophysical Profile
<b>76819</b>	Modified Biophysical Profile
<b>76820</b>	Fetal Umbilical Artery Doppler Velocimetry
<b>76821</b>	Fetal Middle Cerebral Artery Doppler Velocimetry

### **ICD-9-CM Procedure Codes**

No applicable codes

### **HCPCS Codes**

No applicable codes

### **Covered ICD-9-CM Diagnosis Codes**

642.03	Benign Essential Hypertension; antepartum condition or complication
642.13	Hypertension secondary to renal disease; antepartum condition or complication
642.23	Pre-Existing Hypertension; antepartum condition or complication

642.33	Transient Hypertension of pregnancy, i.e. Gestational Hypertension; antepartum condition or complication
642.43	Mild Pre-eclampsia or unspecified; antepartum condition or complication
642.53	Severe Pre-eclampsia; antepartum condition or complication
642.63	Eclampsia; antepartum condition or complication
642.73	Pre-eclampsia or Eclampsia superimposed on Pre-existing Hypertension; antepartum condition or complication
645.13	Post Term pregnancy; greater than 41 weeks gestation
646.23	Unspecified renal disease in pregnancy without mention of hypertension; antepartum condition or complication
648.03	Diabetes mellitus; antepartum condition or complication
648.13	Thyroid dysfunction; antepartum condition or complication
648.23	Anemia and other hemoglobinopathies with significant SS, SC or S-Thalassemia; antepartum condition or complication
648.53	Congenital cardiovascular disorders; antepartum condition or complication
648.83	Abnormal glucose tolerance; antepartum condition or complication
649.33 and 289.81	Antiphospholipid Syndrome; Coagulation Defects; antepartum condition or complication
651.03	Twin pregnancy
651.13	Triplet pregnancy
651.23	Quadruplet pregnancy
651.33	Twin pregnancy with fetal loss and retention of one fetus
651.43	Triplet pregnancy with fetal loss and retention of one or more fetus(es)
651.53	Quadruplet pregnancy with fetal loss and retention of one or more fetus(es)
651.63	Other Multiple pregnancy with fetal loss and retention of one or more fetus(es)
651.73	Multiple gestation following (elective) fetal reduction
655.73	Decreased fetal movements; antepartum condition or complication
656.13	Rhesus isoimmunization affecting management of mother, antepartum condition or complication
656.23	Isoimmunization from other and unspecified blood-group incompatibility affecting management of mother, antepartum condition or complication
656.53	Poor fetal growth affecting management of mother; antepartum condition or complication
657.03	Polyhydramnios, antepartum condition or complication
658.03	Oligohydramnios, antepartum condition or complication
678.03	Fetal hematologic conditions, antepartum condition or complication
648.93 and 710.0	Systemic lupus erythematosus; antepartum condition or complication

**\*Current Procedural Terminology (CPT) 2009 American Medical Association: Chicago, IL.®©**

## REFERENCES

1. American College of Obstetricians and Gynecologists (ACOG), Committee on Practice Bulletins -- Obstetrics. Antepartum Fetal Surveillance. ACOG Practice Bulletin No. 9. Washington, DC: ACOG; October 1999.
2. Huddlestone JF. Intrapartum fetal assessment. A review. Clin Perinatol. 1999;26(3):549-568.
3. Penning S, Garite TJ. Management of fetal distress. Obstet Gynecol Clin N Am. 1999;26(2):259-274.
4. Dildy GA. The physiologic and medical rationale for intrapartum fetal monitoring. Biomed Instrum Technol. 1999;33(2):143-151.
5. Low JA. Predictive value of electronic fetal monitoring for intrapartum fetal asphyxia with metabolic acidosis. Obstet Gynecol. 1999;93(2):285-291.
6. Johnson TR, Paine LL, Strobino DM, et al. Population differences affect the interpretation of fetal nonstress test results. Am J Obstet Gynecol. 1998;179(3 Pt 1):779-783.
7. Kunzel W. Intrauterine fetal death during pregnancy: Limitations of fetal surveillance. J Obstet Gynaecol Res. 1998;24(6):453-460.
8. American College of Obstetricians and Gynecologists (ACOG). Special problems of multiple gestation. ACOG Technical Bulletin No. 253. Washington, DC: ACOG; November 1998.
9. Manning F. Fetal assessment based on fetal biophysical profile scoring. Am J Obstet Gynecol. 1998;178(4):698-706.

10. Horio H, Murakami M, Chiba Y, et al. Fetal monitor for non-stress-test screening at home. *Biomed Instrum Technol.* 1998;32(1):39-47.
11. Salamalekis E, Loghis C, Panayotopoulos N, et al. Non-stress test: A fifteen year clinical appraisal. *Clin Exp Obstet Gynecol.* 1997;24(2):79-81.
12. Smith-Leviton M, Petrikovsky B, Schneider EP. Practical guidelines for antepartum fetal surveillance. *Am Fam Physician.* 1997;56(8):1981-1988.
13. Ananth CV, Smulian JC, Vintzileos AM. Epidemiology of antepartum fetal testing. *Curr Opinion Obstet Gynecol.* 1997;9(2):101-106.
14. U.S. Preventative Services Task Force. Guide to clinical preventive services. 2nd ed. Baltimore, MD: Williams & Wilkins; 1996:433-442.
15. Thacker SB, Stroup DF, Peterson HB. Efficacy and safety of intrapartum electronic fetal monitoring: an update. *Obstet and Gynecol.* 1995;86(4 Pt 1):613 -620.
16. Crowe JA, Harrison A, Hayes-Gill BR. The feasibility of long-term fetal heart rate monitoring in the home environment using abdominal electrodes. *Physiol Meas.* 1995;16(3):195-202.
17. American College of Obstetricians and Gynecologists (ACOG). Fetal heart rate patterns: Monitoring, interpretation, and management. ACOG Technical Bulletin No. 207. Washington, DC: ACOG; July 1995.
18. American College of Obstetricians and Gynecologists (ACOG). Diabetes and pregnancy. ACOG Technical Bulletin No. 200. Washington, DC: ACOG; December 1994.
19. Naef RW 3rd, Morrison JC, Washburne JF, et al. Assessment of fetal well-being using nonstress test in the home setting. *Obstet Gynecol.* 1994;84(3):424-426.
20. Reece EA, Hagay Z, Garofalo J, Hobbins JC. A controlled trial of self-nonstress test versus assisted nonstress test in the evaluation of fetal well being. *Am J Obstet Gynecol.* 1992;166(2):489-492.
21. Gonen R, Braithwaite N, Milligan JE. Fetal heart rate monitoring at home and transmission by telephone. *Obstet Gynecol.* 1990;75(3 Pt 1):464-468.
22. Lacin S, Demir N, Koyuncu F, et al. Value of intraplacental villous artery Doppler measurements in severe preeclampsia. *J Postgrad Med.* 1996;42(4):101-104.
23. Ozcan T, Sbracia M, d'Ancona RL, et al. Arterial and venous Doppler velocimetry in the severely growth-restricted fetus and associations with adverse perinatal outcome. *Ultrasound Obstet Gynecol.* 1998;12(1):39-44.
24. van Asselt K, Gudmundsson S, Lindqvist P, et al. Uterine and umbilical artery velocimetry in pre-eclampsia. *Acta Obstet Gynecol Scand.* 1998;77(6):614-619.
25. Wang KG, Chen CP, Yang JM, et al. Impact of reverse end-diastolic flow velocity in umbilical artery on pregnancy outcome after the 28th gestational week. *Acta Obstet Gynecol Scand.* 1998;77(5):527-531.
26. American College of Obstetricians and Gynecologists (ACOG), Committee on Obstetric Practice. ACOG committee opinion. Utility of antepartum umbilical artery Doppler velocimetry in intrauterine growth restriction. Number 188, October 1997 (replaces no. 116, November 1992). *Int J Gynaecol Obstet.* 1997;59(3):269-270.
27. Harrington K, Carpenter RG, Goldfrad C, et al. Transvaginal Doppler ultrasound of the uteroplacental circulation in the early prediction of pre-eclampsia and intrauterine growth retardation. *Br J Obstet Gynaecol.* 1997;104(6):674-681.
28. Zimmermann P, Eirio V, Koskinen J, et al. Doppler assessment of the uterine and uteroplacental circulation in the second trimester in pregnancies at high risk for pre-eclampsia and/or intrauterine growth retardation: Comparison and correlation between different Doppler parameters. *Ultrasound Obstet Gynecol.* 1997;9(5):330-338.
29. Kingdom JC, Burrell SJ, Kaufmann P. Pathology and clinical implications of abnormal umbilical artery Doppler waveforms. *Ultrasound Obstet Gynecol.* 1997;9(4):271-286.
30. Mari GC, Deter RL, Carpenter R, et al. Noninvasive diagnosis by doppler ultrasonography of fetal anemia due to maternal alloimmunization. *N Engl J Med.* 2000;342:9-14.
31. Teixeira JM, Duncan K, Letsky E, et al. Middle cerebral artery peak systolic velocity in the prediction of fetal anemia. *Ultrasound Obstet Gynecol.* 2000;15:205-208.
32. Roberts AB, Mitchell JM, Lake Y, et al. Ultrasonographic surveillance in red blood cell alloimmunization. *Am J Obstet Gynecol.* 2001;184(6):1251-1255.
33. Bahado-Singh RO, Oz AU, Hsu C, et al. Middle cerebral artery Doppler velocimetric deceleration angle as a predictor of fetal anemia in Rh-alloimmunized fetuses without hydrops. *Am J Obstet Gynecol.* 2000;183(3):746-751.
34. Oepkes D. Invasive versus non-invasive testing in red-cell alloimmunized pregnancies. *Eur J Obstet Gynecol Reprod Biol.* 2000;92(1):83-89.
35. Laks MP, Cohen T. Noninvasive diagnosis of fetal anemia by Doppler ultrasonography. *N Engl J Med.* 2000;343(1):66-67; discussion 67-68.

36. Saade GR. Noninvasive testing for fetal anemia. *N Engl J Med.* 2000;342(1):52-53.
37. Sherer DM. Prenatal ultrasonographic assessment of the middle cerebral artery: A review. *Obstet Gynecol Surv.* 1997;52(7):444-455.
38. Sterne G, Shields LE, Dubinsky TJ. Abnormal fetal cerebral and umbilical Doppler measurements in fetuses with intrauterine growth restriction predicts the severity of perinatal morbidity. *J Clin Ultrasound.* 2001;29(3):146-151.
39. Westergaard HB, Langhoff-Roos J, Lingman G, et al. Critical appraisal of the use of umbilical artery Doppler ultrasound in high-risk pregnancies: Use of meta-analyses in evidence-based obstetrics. *Ultrasound Obstet Gynecol.* 2001;17(6):466-476.
40. Deren O, Onderoglu L. The value of middle cerebral artery systolic velocity for initial and subsequent management in fetal anemia. *Eur J Obstet Gynecol Reprod Biol.* 2002;101(1):26-30.
41. Mari G, Detti L, Oz U, et al. Accurate prediction of fetal hemoglobin by Doppler ultrasonography. *Obstet Gynecol.* 2002;99(4):589-593.
42. Goffinet F, Paris-Llado J, Nisand I, Breart G. Umbilical artery Doppler velocimetry in unselected and low risk pregnancies: A review of randomised controlled trials. *Br J Obstet Gynaecol.* 1997;104(4):425-430.
43. Yla-Outinen A. EBM (evidence-based medicine) guidelines. Ultrasound scanning during pregnancy. Helsinki, Finland: Duodecim Medical Publications Ltd.; April 3, 2000.
44. Erskine RL, Ritchie JW. Umbilical artery blood flow characteristics in normal and growth-retarded fetuses. *Br J Obstet Gynaecol.* 1985;92:605-610.
45. Gudmundsson S, Marsal K. Umbilical and uteroplacental blood flow velocity waveforms in pregnancies with fetal growth retardation. *Eur J Obstet Gynecol Reprod Biol.* 1988;27:187-196.
46. Reuwer PJ, Bruinse HW, Stoutenbeek P, Haspels AA. Doppler assessment of the fetoplacental circulation in normal and growth-retarded fetuses. *Eur J Obstet Gynecol Reprod Biol.* 1984;18:199-205.
47. Karsdorp VH, van Vugt JM, van Geijn HP, et al. Clinical significance of absent or reversed end diastolic velocity waveforms in umbilical artery. *Lancet.* 1994;344:1664-1668.
48. Giles WB, Trudinger BJ, Baird PJ. Fetal umbilical artery flow velocity waveforms and placental resistance: Pathological correlation. *Br J Obstet Gynaecol.* 1985;92:31-38.
49. Nicolaides KH, Bilardo CM, Soothill PW, Campbell S. Absence of end diastolic frequencies in umbilical artery: A sign of fetal hypoxia and acidosis. *BMJ.* 1988;297:1026-1027.
50. Almstrom H, Axelsson O, Cnattingius S, et al. Comparison of umbilical-artery velocimetry and cardiotocography for surveillance of small-for-gestational-age fetuses. *Lancet.* 1992;340:936-940.
51. Johnstone FD, Prescott R, Hoskins P, et al. The effect of introduction of umbilical Doppler recordings to obstetric practice. *Br J Obstet Gynaecol.* 1993;100:733-741.
52. Newnham JP, O'Dea MR, Reid KP, Diepeveen DA. Doppler flow velocity waveform analysis in high risk pregnancies: A randomized controlled trial. *Br J Obstet Gynaecol.* 1991;98:956-963.
53. Omtzigt AM, Reuwer PJ, Bruinse HW. A randomized controlled trial on the clinical value of umbilical Doppler velocimetry in antenatal care. *Am J Obstet Gynecol.* 1994;170:625-634.
54. Pattinson RC, Norman K, Odendaal HJ. The role of Doppler velocimetry in the management of high risk pregnancies. *Br J Obstet Gynaecol.* 1994;101:114-120.
55. Trudinger BJ, Cook CM, Giles WB, et al. Umbilical artery flow velocity waveforms in high-risk pregnancy. Randomised controlled trial. *Lancet.* 1987;1(8526):188-190.
56. Tyrrell SN, Lilford RJ, Macdonald HN, et al. Randomized comparison of routine vs highly selective use of Doppler ultrasound and biophysical scoring to investigate high risk pregnancies. *Br J Obstet Gynaecol.* 1990;97:909-916.
57. Haley J, Tuffnell DJ, Johnson N. Randomised controlled trial of cardiotocography versus umbilical artery Doppler in the management of small for gestational age fetuses. *Br J Obstet Gynaecol.* 1997;104:431-435.
58. Nienhuis SJ, Vles JS, Gerver WJ, Hoogland HJ. Doppler ultrasonography in suspected intrauterine growth retardation: A randomized clinical trial. *Ultrasound Obstet Gynecol.* 1997;9:6-13.
59. Mason GC, Lilford RJ, Porter J, et al. Randomised comparison of routine versus highly selective use of Doppler ultrasound in low risk pregnancies. *Br J Obstet Gynaecol.* 1993;100:130-133.
60. Mari G, Deter RL. Middle cerebral artery flow velocity waveforms in normal and small-for-gestational-age fetuses. *Am J Obstet Gynecol.* 1992;166:1262-1270.
61. Ott WJ, Mora G, Arias F, et al. Comparison of the modified biophysical profile to a 'new' biophysical profile incorporating the middle cerebral artery to umbilical artery velocity flow systolic/diastolic ratio. *Am J Obstet Gynecol.* 1998;178:1346-1353.
62. Neilson JP, Alfirevic Z. Doppler ultrasound for fetal assessment in high risk pregnancies (Cochrane Review). In: *The Cochrane Library, Issue 1, 2003.* Oxford, UK: Update Software.

63. Irion O, Masse J, Forest JC, Moutquin JM. Prediction of pre-eclampsia, low birthweight for gestation and prematurity by uterine artery blood flow velocity waveform analysis in low risk nulliparous women. *Br J Obstet Gynaecol.* 1998;105:422-429.
64. Friedman SA, Lindheimer MD. Prediction and differential diagnosis. In: Chesley's hypertensive disorders in pregnancy. 2nd ed. MD Lindheimer, JM Roberts, FG Cunningham, eds. Stamford, CT: Appleton & Lange; 1999:201-227.
65. American College of Radiology (ACR), Expert Panel on Women's Imaging. Growth disturbances: Risk of intrauterine growth restriction. Reston, VA: ACR; 2001.
66. American College of Obstetricians and Gynecologists (ACOG), Committee on Practice Bulletins -- Obstetrics. Diagnosis and management of preeclampsia and eclampsia. ACOG Practice Bulletin No. 33. Washington, DC: ACOG; January 2002.
67. American College of Obstetricians and Gynecologists (ACOG), Committee on Practice Bulletins -- Obstetrics. Intrauterine growth restriction. ACOG Practice Bulletin No. 12. Washington, DC: ACOG; January 2000.
68. Banta DH, Thacker SB. Historical controversy in health technology assessment: The case of electronic fetal monitoring. *Obstet Gynecol Surv.* 2001;56(11):707-719.
69. Myers ER, Blumrick R, Christian AL, et al. Management of prolonged pregnancy. Evidence Report/Technology Assessment No. 53. Prepared by the Duke Evidence-based Practice Center under Contract No. 290-97-0014. AHRQ Publication No. 02-E018. Rockville, MD: Agency for Healthcare Research and Quality (AHRQ); May 2002.
70. Fretts RC, Elkin EB, Myers ER, Heffner LJ. Should older women have antepartum testing to prevent unexplained stillbirth? *Obstet Gynecol.* 2004;104(1):56-64.
71. Chauhan SP, Doherty DD, Magann EF, et al. Amniotic fluid index vs single deepest pocket technique during modified biophysical profile: A randomized clinical trial. *Am J Obstet Gynecol.* 2004;191(2):661-667; discussion 667-668.
72. Audibert F, Benchimol Y, Benattar C, et al. Prediction of preeclampsia or intrauterine growth restriction by second trimester serum screening and uterine Doppler velocimetry. *Fetal Diagn Ther.* 2005;20(1):48-53.
73. Madazli R, Kuseyrioglu B, Uzun H, et al. Prediction of preeclampsia with maternal mid-trimester placental growth factor, activin A, fibronectin and uterine artery Doppler velocimetry. *Int J Gynaecol Obstet.* 2005;89(3):251-257.
74. Barkehall-Thomas A, Wilson C, Baker L, et al. Uterine artery Doppler velocimetry for the detection of adverse obstetric outcomes in patients with elevated mid-trimester beta-human chorionic gonadotrophin. *Acta Obstet Gynecol Scand.* 2005;84(8):743-747.
75. American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 75: Management of alloimmunization. *Obstet Gynecol.* 2006;108(2):457-464.
76. Mahboob U, Mazhar SB. Role of Kleihauer test in Rhesus negative pregnancy. *J Coll Physicians Surg Pak.* 2006;16(2):120-123.
77. Ozcan T, Thornburg L, Mingione M, Pressman E. Use of middle cerebral artery peak systolic velocity and intrauterine transfusion for management of twin-twin transfusion and single fetal intrauterine demise. *J Matern Fetal Neonatal Med.* 2006;19(12):807-809.
78. Senat MV, Loizeau S, Couderc S, et al. The value of middle cerebral artery peak systolic velocity in the diagnosis of fetal anemia after intrauterine death of one monochorionic twin. *Am J Obstet Gynecol.* 2003;189(5):1320-1324.
79. Martinez JM, Bermudez C, Becerra C, et al. The role of Doppler studies in predicting individual intrauterine fetal demise after laser therapy for twin-twin transfusion syndrome. *Ultrasound Obstet Gynecol.* 2003;22(3):246-251.
80. Ohkuchi A, Minakami H, Shiraishi H, et al. Intrauterine death of one twin, with rescue of the other, in twin-twin transfusion syndrome. *Ultrasound Obstet Gynecol.* 2002;19(3):293-296.
81. Ropacka M, Markwitz W, Ginda W, Breborowicz GH. Ultrasound in the diagnosis of twin-to-twin transfusion syndrome--a preliminary report. *Acta Genet Med Gemellol (Roma).* 1998;47(3-4):227-237.
82. Suzuki S, Sawa R, Yoneyama Y, et al. Fetal middle cerebral artery Doppler waveforms in twin-twin transfusion syndrome. *Gynecol Obstet Invest.* 1999;48(4):237-240.
83. Hecher K, Ville Y, Nicolaidis KH. Fetal arterial Doppler studies in twin-twin transfusion syndrome. *J Ultrasound Med.* 1995;14(2):101-108.
84. American College of Obstetricians and Gynecologists (ACOG). Multiple gestation: Complicated twin, triplet, and high-order multifetal pregnancy. ACOG Practice Bulletin No. 56. Washington, DC: ACOG; October 2004.
85. Kontopoulos EV, Quintero RA, Chmait RH, et al. Percent absent end-diastolic velocity in the umbilical artery waveform as a predictor of intrauterine fetal demise of the donor twin after selective laser photocoagulation of communicating vessels in twin-twin transfusion syndrome. *Ultrasound Obstet Gynecol.* 2007;30(1):35-39.
86. Chang YL, Chmait RH, Bornick PW, et al. The role of laser surgery in dissecting the etiology of absent or reverse

- end-diastolic velocity in the umbilical artery of the donor twin in twin-twin transfusion syndrome. *Am J Obstet Gynecol.* 2006;195(2):478-483.
87. American College of Obstetricians and Gynecologists (ACOG) Committee on Obstetric Practice, American Academy of Pediatrics (AAP) Committee on Fetus and Newborn. *Guidelines for Perinatal Care.* 6th Ed. Washington, DC: ACOG; 2007.
  88. Meads CA, Crossen JS, Meher S, et al. Methods of prediction and prevention of pre-eclampsia: Systematic reviews of accuracy and effectiveness literature with economic modelling. *National Coordinating Centre for Health Technology Assessment (NCCHTA). Health Technol Assess.* 2008;12(6):1-270.
  89. Nabhan AF, Abdelmoula YA. Amniotic fluid index versus single deepest vertical pocket as a screening test for preventing adverse pregnancy outcome. *Cochrane Database Syst Rev.* 2008;(3):CD006593.
  90. Frøen JF, Heazell AE, Tveit JV, et al. Fetal movement assessment. *Semin Perinatol.* 2008;32(4):243-246.
  91. Lalor JG, Fawole B, Alfirevic Z, Devane D. Biophysical profile for fetal assessment in high risk pregnancies. *Cochrane Database Syst Rev.* 2008;(1):CD000038.