Antenatal Fetal Surveillance
• (1) fetal movement counting
• (2) non-stress test
• (3) contraction stress test
• (4) biophysical profile and/or amniotic fluid volume
• (5) maternal uterine artery Doppler, and
• (6) fetal umbilical artery Doppler.

The only antenatal surveillance technique recommended for all pregnant women, with and without risk factors, is maternal awareness of fetal movements.
Recommendation

• *Fetal Movement Counting*

• 1. Daily monitoring of fetal movements starting at 26 to 32 weeks should be done in all pregnancies with risk factors for adverse perinatal outcome.

• 2. Healthy pregnant women without risk factors for adverse perinatal outcomes should be made aware of the significance of fetal movements in the third trimester and asked to perform a fetal movement count if they perceive decreased movements.

• 3. Women who do not perceive six movements in an interval of two hours require further antenatal testing and should contact their caregivers or hospital as soon as possible.
All women WITHOUT risk factors: Awareness of fetal movements beginning at 26–32 weeks and daily monitoring/counting of fetal movements if they perceive decreased fetal movement.

OR

All women WITH risk factors: daily monitoring/counting of fetal movements beginning at 26–32 weeks.

Fetal movements < 6 in 2 hours
Tell woman to
- Contact primary care giver
  OR
- go to hospital

NST

Normal NST
NO Risk Factors
Continue with fetal movement counting

Normal NST
WITH Risk Factors or Clinical Suspicion of IUGR/Oligohydramnios
BPP or AFV within 24 hours

Atypical/Abnormal NST
BPP or CST as soon as possible

Determine future management and need for delivery based on ultrasound findings, NST findings, and overall clinical picture.
INTRODUCTION

• Fetal health is evaluated, in part, by assessment of fetal heart rate patterns.

• The primary goal of antepartum fetal surveillance (antepartum testing) with the non stress test (NST) and the contraction stress test (CST) is to identify fetuses at risk of hypoxic injury or death and intervene to prevent these adverse outcomes, if possible.

• The secondary goal is to identify normally oxygenated fetuses so that pregnancy can be continued safely, and unnecessary intervention can be avoided.
Effect of gestational age on fetal heart rate

- The parasympathetic and sympathetic nervous systems exert a progressively greater influence on the FHR as gestational age advances.

- Parasympathetic innervation of the heart is mediated primarily by the vagus nerve, which influences the sinoatrial (SA) and atrioventricular (AV) nodes.

- Parasympathetic stimulation slows the FHR, and blockade by parasympatholytic medications (eg, atropine) increases FHR. Sympathetic stimulation of the heart increases the FHR, and blockade of sympathetic activity slows the FHR.
• With advancing gestational age, the maturation of the parasympathetic system causes slowing of the baseline heart rate but usually not below the normal range of 110 to 160 beats per minute
• Maturation of the sympathetic system causes an increase in the frequency and amplitude of FHR accelerations

• \( \rightarrow 50 \) percent of normal fetuses demonstrated accelerations with fetal movements at 24 weeks, while over 95 percent demonstrated accelerations at 30 weeks of gestation, in one study

• Before 32 weeks, accelerations may increase by only 10 beats per minute above the baseline and last 10 seconds, whereas later in gestation, accelerations of 15 beats per minute above the baseline and lasting 15 seconds are expected
Cardiovascular response to hypoxemia

• Fetal oxygenation depends upon the adequate transfer of oxygen from the environment to the fetal tissues.

• Oxygen is transferred from the environment to fetal tissues by maternal and fetal blood along a pathway that includes the maternal lungs, heart, vasculature, and uterus and the fetal placenta and umbilical cord.

• Fetal hypoxemia (usually expressed as the partial pressure of oxygen dissolved in blood, or PO2) can result from interruption of the transfer of oxygen from the environment to fetal tissue at any point along this pathway.
The FHR response to hypoxemia depends on the cause:

- Transient fetal hypoxemia associated with uterine contractions can cause late decelerations.

- Stimulation of chemoreceptors in the fetal carotid arteries and aortic arch leads to reflex vasoconstriction of blood vessels in nonvital peripheral areas so more blood flow is available to vital organs (e.g., adrenal glands, heart, brain).

- Vasoconstriction causes elevated fetal blood pressure and, in turn, stimulation of baroreceptors in the fetal carotid arteries and aortic arch, resulting in vagally mediated slowing of FHR shortly after the beginning of the contraction.

- Chemoreceptors → tachycardia → Baroreceptors → vagal stimulation → bradychardia
Indications

- **Diabetes** → Preexisting or gestational diabetes treated with antihyperglycemic drugs.

  Gestational diabetes in which glucose levels are normal on nutritional therapy does not appear to be associated with an increased risk of stillbirth, so antepartum fetal testing can be omitted

- **Hypertensive disorders** →

  Chronic hypertension or pregnancy-induced hypertension

- **Fetal growth restriction**

- **Twin pregnancy**

- **Postterm pregnancy** → Testing may be initiated at estimated gestational age of 39 to 40 weeks in a suboptimally dated pregnancy
• Decreased fetal activity
• Systemic lupus erythematosus
• Antiphospholipid syndrome
• Sickle cell disease
• Alloimmunization
• Oligohydramnios or polyhydramnios
• Prior fetal demise

• Preterm prelabor rupture of membranes → The goal of antenatal testing in this setting is early recognition of intraamniotic infection necessitating delivery
• **Other** → Nonimmune hydrops, maternal cyanotic heart disease, poorly controlled maternal hyperthyroidism, and maternal vascular diseases are associated with an increased risk of fetal demise

• *Possible indications for antenatal testing* → ??

  • Advanced maternal age
  
  • Obesity
  
  • Major fetal structural anomalies
  
  • Abnormalities in first- and second-trimester maternal biochemical Down syndrome screening results
POTENTIAL BENEFITS AND HARMS

- **False-positive** tests that lead the provider to unnecessary additional fetal evaluation and/or intervention (particularly iatrogenic preterm birth) is a major potential harm of fetal surveillance. (55 to 90 percent)

- **False-negative** tests that do not alert the provider to the need for further fetal evaluation and/or intervention is another potential harm. (0.2 to 0.65 percent)
Timing

- NSTs and CSTs are initiated at the gestational age that the fetus is believed to be at increased risk of death as long as the age is sufficiently advanced that delivery for perinatal benefit would be considered. For the NST, fetal neurologic maturity should be sufficient to enable FHR acceleration (typically no earlier than 26 to 28 weeks).
Frequency

• There is no high-quality evidence defining the optimal frequency of testing. Testing is performed periodically (usually once weekly, but twice weekly for some high-risk conditions) as long as the indication for testing persists, but maternal or fetal deterioration requires reevaluation despite recent normal test results.

• In most cases a normal NST is predictive of good perinatal outcome for one week (providing the maternal-fetal condition remains stable), except in women with insulin dependent diabetes or with a postdates pregnancy, in which case NSTs are recommended at least twice weekly.
Technique

• during the antenatal period the uterus is relaxed, i.e., the fetus is not exposed to the “stress” of uterine contractions.

• The woman should empty her bladder

• positioned on either a bed or a reclining chair in the left lateral recumbent position.

• The recording should last at least 20 minutes.
Reactive tests

• Criteria — The NST is reactive from 32 weeks to term if there are two or more fetal heart rate (FHR) accelerations reaching a peak of at least 15 beats per minute (bpm) above the baseline rate and lasting at least 15 seconds from onset to return to baseline (15 x 15) in a 20-minute period

• A reactive test provides reliable evidence of normal fetal oxygenation, regardless of the length of observation time needed to demonstrate reactivity

• Before 32 weeks of gestation ⇒ Different criteria have been suggested for gestational ages less than 32 weeks

• Before 32 weeks of gestation, a reactive NST may be defined as two accelerations that rise at least 10 bpm above baseline and have a duration of at least 10 seconds (10 x 10)
• A **negative predictive value** of the test for fetal and neonatal death is **99%** within one week of testing.

• Therefore, a normal tracing meeting the acceleration criteria is sufficient for assurance of fetal well-being and does not warrant any other testing.

• **If the fetal heart acceleratory response does not meet the criteria after 20 minutes of testing, the recording should continue for another 20 minutes** to account for the average period of non-rapid eye movement sleep when fetal movement and subsequently heart rate variability are reduced.

• Note that this criterion applies to the term or near-term fetus.
• Is administration of glucose effective???

• Is the performance of manual stimulation is recommended as a technique to encourage fetal heart rate accelerations in the fetus??

• Studies in which the NST was used as the primary screening tool have demonstrated that up to 40% of fetuses will not meet the acceleration criteria within 40 minutes of testing.
• If the fetus lacks accelerations after 40 minutes of testing, the primary care provider should be informed, and the electronic fetal monitoring should be continued.

• A decision should be made to proceed either to amniotic fluid assessment and or to multiple parameters testing (such as a biophysical profile or contraction stress testing).

• Although the use of vibroacoustic stimulation has demonstrated a decrease in both testing time and number of non-reactive antenatal cardiotocographs, its use is not recommended to stimulate fetal heart accelerations, because the predictive reliability and safety of this modality are still unknown.
• Minimal duration of FHR monitoring →

• The optimal duration of the NST has not been established. Some sources recommend the NST should be continued for at least 20 minutes, even if two qualifying accelerations have been observed before that time

• However, large studies evaluating the predictive value of the NST combined with amniotic fluid volume assessment have not included this requirement

• Variable, late, or prolonged decelerations observed during antepartum testing require further evaluation, which might include extended FHR and uterine activity monitoring, ultrasound assessment of fetal growth and anatomy, BPP, amniotic fluid volume, and/or Doppler velocimetry in the setting of fetal growth restriction.

• Intermittent fetal cardiac arrhythmias can also cause decelerations and may be diagnosed by echocardiography. Management depends on the arrhythmia and patient-specific factors
Nonreactive tests

- A nonreactive NST usually warrants further evaluation. Some options include:
  
  • Repeat the test in 30 minutes
  
  • Perform vibroacoustic stimulation to elicit accelerations
  
  • Perform a back-up test, (either CST or complete BPP)
  
  • If possible, modify factors potentially causing nonreactive results
Vibroacoustic stimulation can decrease the number of nonreactive NSTs and shorten test time without reducing the predictive value of a reactive NST.

A vibroacoustic source, typically an artificial larynx, placed on or just above the maternal abdomen, is used to stimulate fetal movement.

There are no evidence-based standards for performing this procedure. It has been performed as soon as five minutes after initiation of the NST.

The American College of Obstetricians and Gynecologists suggests positioning the device on the maternal abdomen and applying a stimulus for one to two seconds.

If no fetal response occurs, the stimulus may be repeated up to three times for progressively longer durations of up to three seconds.
• Transabdominal light stimulation with a halogen light for 10 seconds appears to stimulate the fetus and may be as effective as vibroacoustic stimulation

• Changing maternal position does not increase reactivity as long as the woman is tested in a position that does not lead to hypotension from uterine compression of the great vessels

• Cocoa and caffeine consumption may affect fetal movement, but the dose, timing, and effect on NST reactivity have not been evaluated

• Maternal hydration (oral or intravenous) may increase the AFI and decrease the baseline FHR, but there is no evidence that it increases fetal movement or heart rate reactivity.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>NormalNST (Previously “Reactive”)</th>
<th>AtypicalNST (Previously “Non-Reactive”)</th>
<th>AbnormalNST (Previously “Non-Reactive”)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>110–160 bpm</td>
<td>100–110 bpm</td>
<td>Bradycardia &lt; 100 bpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 160 bpm &lt; 30 min.</td>
<td>Tachycardia &gt; 160 for &gt; 30 min.</td>
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<tr>
<td></td>
<td></td>
<td>Rising baseline</td>
<td>Erratic baseline</td>
</tr>
<tr>
<td>Variability</td>
<td>6–25 bpm (moderate)</td>
<td>≤ 5 (absent or minimal) for &lt; 40 min.</td>
<td>≤ 5 for ≥ 80 min.</td>
</tr>
<tr>
<td></td>
<td>≤ 5 (absent or minimal) for &lt; 40 min.</td>
<td></td>
<td>≥ 25 bpm &gt; 10 min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sinusoidal</td>
</tr>
<tr>
<td>Decelerations</td>
<td>None or occasional variable &lt; 30 sec.</td>
<td>Variable decelerations 30–60 sec. duration</td>
<td>Variable decelerations ≥ 60 sec. duration</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Late deceleration(s)</td>
</tr>
<tr>
<td>Accelerations</td>
<td>≥ 2 accelerations with acme of ≥ 15 bpm, lasting 15 sec. in ≤ 40 min. of testing</td>
<td>≤ 2 accelerations with acme of ≥ 15 bpm, lasting 15 sec. in 40–80 min.</td>
<td>≤ 2 accelerations with acme of ≥ 15 bpm, lasting 15 sec. in &gt; 80 min.</td>
</tr>
<tr>
<td>Term Fetus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preterm Fetus (&lt; 32 weeks)</td>
<td>≥ 2 accelerations with acme of ≥ 10 bpm, lasting 10 sec. in ≤ 40 min. of testing</td>
<td>≤ 2 accelerations of ≥ 10 bpm, lasting 10 sec. in 40-80 min.</td>
<td>≤ 2 accelerations of ≥ 10 bpm, lasting 10 sec. in &gt; 80 min.</td>
</tr>
<tr>
<td>ACTION</td>
<td>FURTHER ASSESSMENT OPTIONAL, based on total clinical picture</td>
<td>FURTHER ASSESSMENT REQUIRED</td>
<td>URGENT ACTION REQUIRED</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>An overall assessment of the situation and further investigation with U/S or BPP is required. Some situations will require delivery.</td>
</tr>
</tbody>
</table>
• For the purpose of clarity and consistency in interpretation, communication, and management, this guideline classifies non-stress tests as (1) normal, (2) atypical, or (3) abnormal.

• A classification of normal refers to what was previously described as a “reactive” NST, and further testing would be undertaken according to the presence of risk factors and the overall clinical situation.
• The presence of an abnormal non-stress test demands immediate further investigation and possibly delivery →

• initiation of intrauterine resuscitation
• consultation or communication with MFM sub-specialist
• arrangement for further testing
• and/or consideration of delivery
• MANAGEMENT OF PREGNANCIES WITH ABNORMAL TEST RESULTS

• **Transient condition** as cause of abnormal test

  • **Temporary maternal condition**, such as diabetic ketoacidosis or acute bronchospasm → **prompt treatment of the maternal condition**

• maternal medication

• **Chronic condition as cause of abnormal result**

  • Given the high rate of false-positive tests and the high negative predictive value of a normal test, an abnormal test result is generally followed by additional testing with a different test

    • contraction stress test [CST] or biophysical profile [BPP] after a nonreactive nonstress test [NST]) to provide more information about fetal status.
DELIVERY VERSUS FOLLOW-UP

• Gestational age

• Severity of maternal and fetal disease (eg, low threshold for delivery for hydrops fetalis, for diabetes with poor glycemic control versus good glycemic control, or for fetal growth restriction at 3rd percentile with oligohydramnios and abnormal umbilical artery Doppler flow versus 10th percentile with normal amniotic fluid volume and normal umbilical artery Doppler flow).

• Progression of disease (eg, low threshold for delivery when fetal growth falls from the 10th percentile to the 3rd percentile versus stable or slow but progressive growth).

• Other available information (eg, low threshold for delivery when late or variable decelerations, absent variability, or a prolonged deceleration on a nonreactive NST; BPP score 0 versus 4 or 6; absence of accelerations on a positive CST; intrauterine growth restriction with absent or reversed Doppler flow in umbilical artery).