

- Specimen collection and Processing:
- Collection of blood: Blood is the most frequent body fluid used for analytical purposes.
- There are three general procedures available for obtaining blood.
- venipuncture, skin puncture, arterial puncture.

Specimen types



- Biological specimens include:
 - Whole blood, serum, plasma, urine, saliva, body fluids (spinal, synovial, amniotic, pleural, pericardial, ascetic fluid), and various types of solid tissue, including specific cell types
- Majority of clinical chemistry tests are done on blood : serum , whole blood, or plasma.

- For hematological studies, biochemistry and microbiology unclotted whole blood or anticoagulated blood is needed.
- Plasma is obtained from the anticoagulated blood. It is needed in coagulation studies.
- Serum is collected from coagulated blood. It is required for biochemistry, serology and blood bank.
- Arterial blood is essentially uniform in composition throughout the body.
- The composition of venous blood varies and is dependent on metabolic activity of the perfused organ or tissues. It differs in pH, carbon dioxide concentration and packed cell volume.
- The concentration of glucose, lactic acid, chloride and ammonia may also differ.

Specimen types



- Random specimen
 - collected any time
- Fasting specimen
 - collected after no food has been eaten for more than 6 hours and usually in the morning
- timed specimens
 - collected at a particular time after an event such as eating or taking a medication.

Blood



- Blood for analysis may be obtained from veins, arteries or capillaries.
- Venous blood is usually the specimen of choice and **venipuncture** is the method for obtaining this specimen
- **Skin puncture** is frequently used to obtain what is mostly **capillary blood**
- **Arterial puncture** is used mainly for blood **gas analysis**

Venipuncture



- Venous blood is usually collected with evacuated blood tubes
 - Evacuated blood tubes are less expensive, more convenient
 - Different types: vary by the **type of additive** present
 - The **color of the stopper** used identifies the additive present

Coding of stopper color



<u>COLOR</u>	<u>Use</u>	<u>Additive</u>
Gray	plasma or whole blood with glycolysis inhibition	oxalate(Na,K) fluoride(Na), Iodoacetate(Na)
<u>Yellow</u>	Sterile interior of tube	None .
<u>Green</u>	plasma or whole blood	Heparin (Na, Li, NH_4^+)
<u>Red</u>	Serum	None .
<u>Blue</u>	plasma or whole blood	citrate (Na) .
<u>Lavender</u>	plasma or whole blood	EDTA (Na_2 , K_2)

Colors of Tubes



YELLOW - Blood Culture



RED - Serum (glass tube)



BLUE - Citrate



RED / GRAY - SST™ Gel Separator Tube



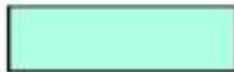
GOLD - SST™ Gel Separator Tube



RED - Serum (plastic tube)



GREEN - Heparin



LT. GREEN. - PST™ Gel Separator Tube with Heparin



LAVENDER - EDTA



GRAY - Potassium Oxalate / Fluoride



Urine



- Urine is frequently requested specimen for assessment of **renal function and metabolic conditions**
- The required type of urine depends upon the analyte to be measured
 - Eg, a timed 24 hour urine is required for **clearance test**
- If analysis is to be delayed, the urine specimen can be retained at 2°C or 4°C for up to a week or at -20 °C if longer delay is needed

Other body fluids



Handling Requirements for Other Body Fluids and Samples⁶

Type	Collection and Handling Requirements
Amniotic fluid	Avoid light during routine testing; transport in ice may be necessary
Ascitic, pericardial, or pleural fluid	Sterile plain tube for culture. Liquid EDTA tube for cell counts and cell differentials.
CSF	Sterile tubes: the first for chemical and immunologic studies; the second for microbiological examination; and the third for microscopic and cytological studies.
Feces	Voided sample rather than examination glove residue; refrigeration prior to analysis; avoid contamination with urine or toilet bowl cleaners
Synovial fluid	Sterile plain tube for microbiological examination; heparinized or liquid EDTA tube for cell count and differential
Urine	Refrigeration of 24-hr specimen during collection; HCl to pH 3 is common for many analytes; NaOH to pH 8 for porphyrins, urobilinogen, and uric acid

Anticoagulants for blood

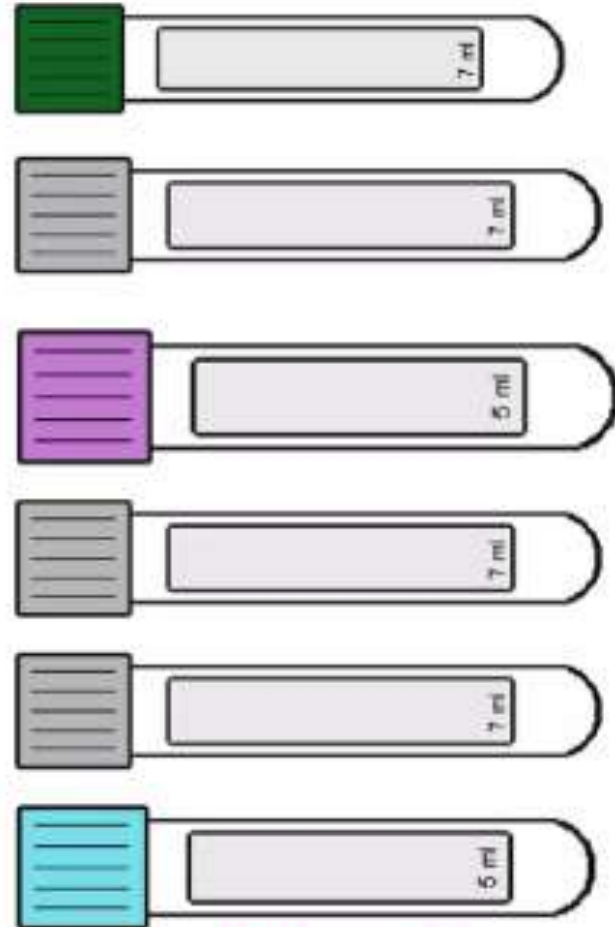


- Anticoagulant: chemical substances added to fresh blood to **prevent clotting**
- Used when whole blood or plasma is desired for testing
- The right type of anticoagulant in correct amounts should be used

Common Anticoagulants



- Heparin
- Sodium fluoride
- EDTA
- Oxalates
- Iodoacetate
- Citrate, Na



- Potassium oxalate: It is used at a concentration of 2mg/ml of blood. It is the most commonly used anticoagulant, but should not be used for electrolyte estimation.
- Ammonium oxalate: It is used at a concentration of 2mg/ml of blood. It causes swelling of RBC and therefore not used for PVC,ESR or blood smears.
- Balanced oxalate, double oxalate or Winthrobe's Mixture: Ammonium oxalate 1.2g and potassium oxalate 0.8g in 100ml of distilled water.
- EDTA: This is usually used as disodium salt of the acid or dipotassium acid. These are used in the concentration of 1-2mg/ml of blood.
- Trisodium citrate: This is the most commonly used solution as 3.8%.

Heparin

- Available as Na, K, Li, and NH_4^+ salts.
- Acts as **antithrombin**, preventing the transformation of prothrombin into thrombin and thus the formation of fibrin into fibrinogen.
- Most widely used anticoagulant for chemical analyses.
- It causes the least interference with tests.
- Disadvantage: high cost and temporary action.

Sodium fluoride

- Is usually considered as a **preservative** for blood glucose, it also acts as a weak anticoagulant.
- Exerts preservative action by **inhibiting glycolytic** enzymes
- Potent inhibitor to urease as well.

Urine collection

- Untimed urine sample (random) (single sample)
- Timed urine sample (24 H sample)
- First Morning Specimen
- Midstream Clean Catch Specimen
- Catheter Collection Specimen
- Pediatric Specimen

Urine collection

1- Random Specimen

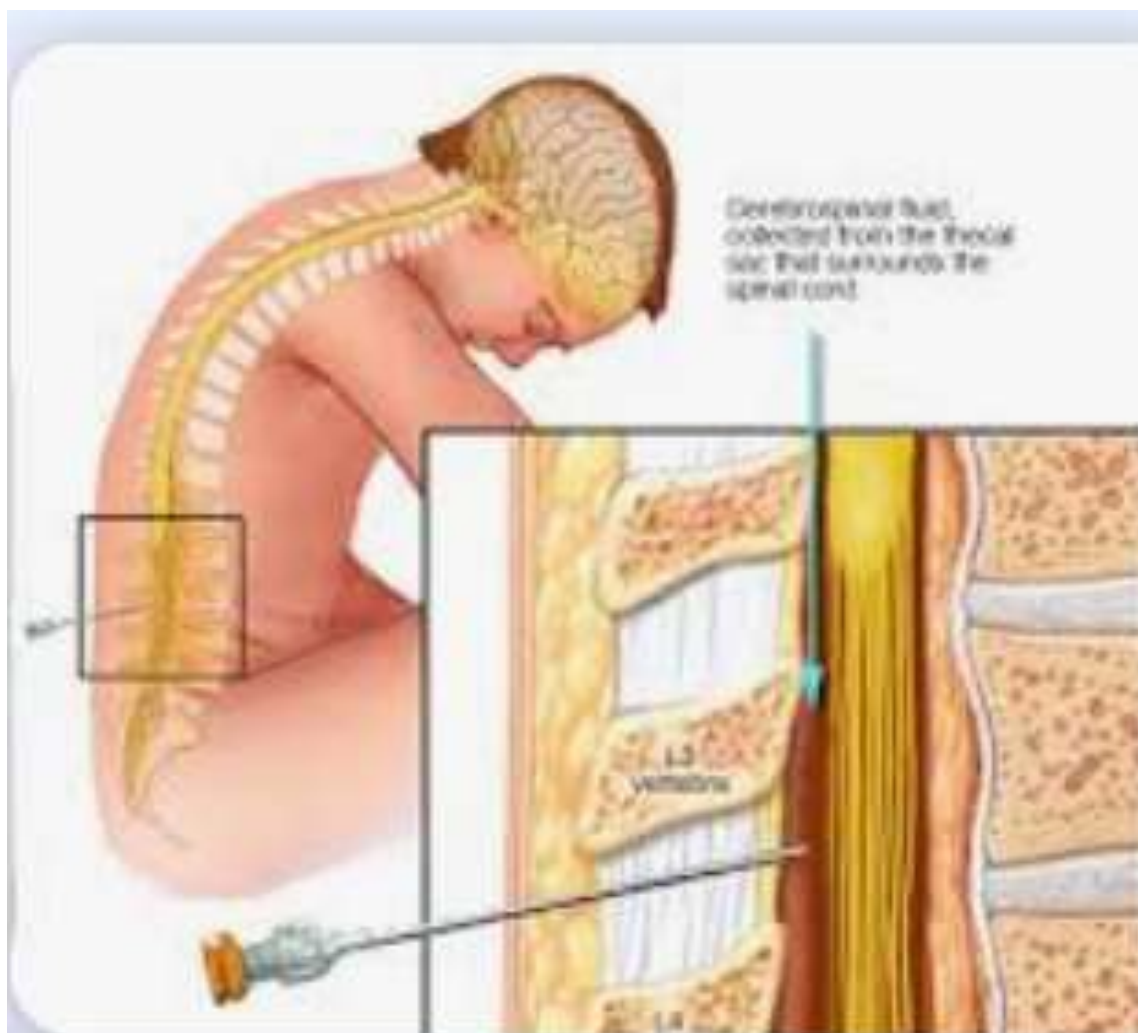
- This is the specimen most commonly sent to the laboratory for analysis, primarily because it is the easiest to obtain and is readily available.
- This specimen is usually submitted for urinalysis and microscopic analysis, although it is not the specimen of choice for either of these tests.
- Random specimens can sometimes give an inaccurate view of a patient's health if the specimen is too diluted and analytic values are artificially lowered.

Urine collection

2- Timed Collection Specimen

- Among the most commonly performed tests requiring timed specimens are those measuring creatinine, urine urea nitrogen, glucose, sodium, potassium and other analytes that are affected by diurnal variations.
- A timed specimen is collected to measure the concentration of these substances in urine over a specified length of time.

- Preservatives for urine: commonly used preservatives are acetic acid, thymol, HCl, chloroform, toluene, light petroleum and formalin.
- Several changes like bacterial action, precipitation of phosphates and crystallization of uric acid can take place without adding preservatives.
- **CEREBOSPINAL FLUID:**
- Collection and handling of CSF: It is usually obtained by lumbar puncture using a LP needle.
- During the procedure, a needle is inserted usually between the 3rd and 4th lumbar vertebrae and the CSF fluid is collected for testing.
- The needle measures 10-12cm in length and is made up of platinum or German alloy. It has a needle and a stylet.



 MedicoInfo

Cerebrospinal Fluid (CSF ...

- This test is done to measure pressures within the CSF and to collect a sample of the fluid for further testing.
- CSF analysis can be used to diagnose certain neurologic disorders. These may include infections (such as meningitis) and brain or spinal cord damage. A spinal tap may also be done to establish the diagnosis of normal pressure hydrocephalus or bleeding into the spinal fluid from an aneurysm.
- Normal values typically range as follows:
 - Pressure: 70 to 180 mm H₂O
 - Appearance: clear, colorless
 - CSF total protein: 15 to 60 mg/100 mL (0.15 to 0.6 g/L)
 - Gamma globulin: 3% to 12% of the total protein
 - CSF glucose: 50 to 80 mg/100 mL or 2.77 to 4.44 mmol/L (or greater than two thirds of blood sugar level)
 - CSF cell count: 0 to 5 white blood cells (all mononuclear), and no red blood cells
 - Chloride: 110 to 125 mEq/L

- If the CSF looks cloudy, it could mean there is an infection or a buildup of white blood cells or protein.
- If the CSF looks bloody or red, it may be a sign of bleeding or spinal cord obstruction. If it is brown, orange, or yellow, it may be a sign of increased CSF protein or previous bleeding (more than 3 days ago). There may be blood in the sample that came from the spinal tap itself. This makes it harder to interpret the test results.
- CSF PRESSURE
- Increased CSF pressure may be due to increased intracranial pressure (pressure within the skull).
- Decreased CSF pressure may be due to spinal block, dehydration, or CSF leakage.
- CSF PROTEIN
- Increased CSF protein may be due to blood in the CSF, diabetes, polyneuritis, tumor, injury, or any inflammatory or infectious condition.
- Decreased protein is a sign of rapid CSF production or systemic loss of protein.

- CSF GLUCOSE

- Increased CSF glucose is a sign of high blood sugar.
- Decreased CSF glucose may be due to hypoglycemia (low blood sugar), bacterial or fungal infection (such as meningitis), tuberculosis, or certain other types of meningitis.

- BLOOD CELLS IN CSF

- Increased white blood cells in the CSF may be a sign of meningitis, acute infection, beginning of a long-term (chronic) illness, tumor, abscess, or demyelinating disease (such as multiple sclerosis).
- Red blood cells in the CSF sample may be a sign of bleeding into the spinal fluid or the result of a traumatic lumbar puncture.

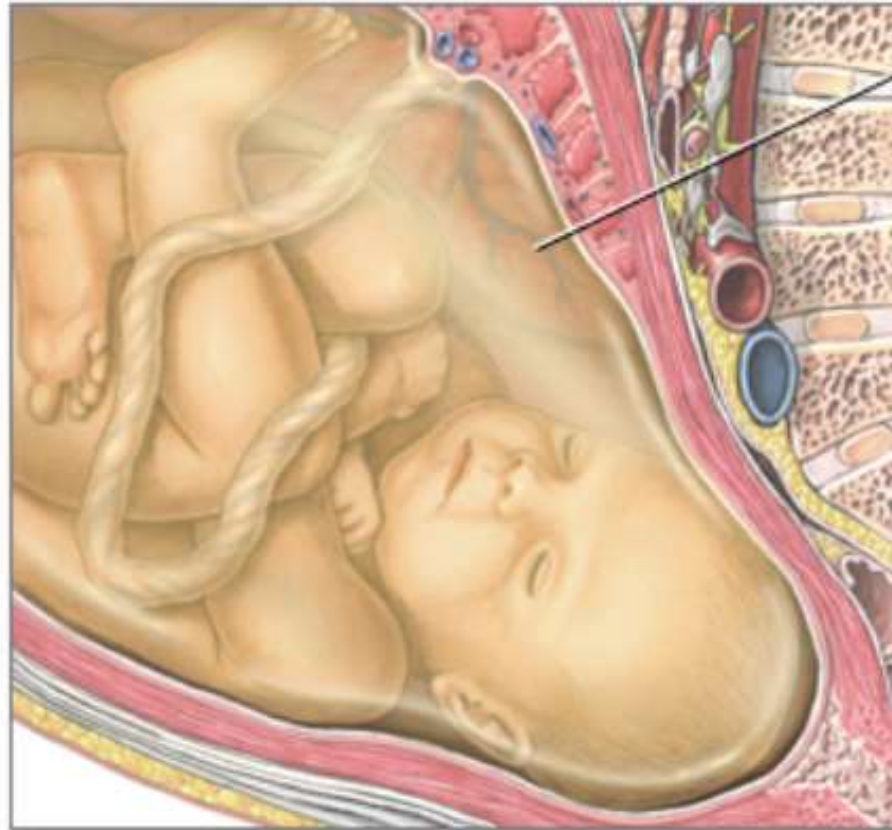
- OTHER CSF RESULTS

- Increased CSF gamma globulin levels may be due to diseases such as multiple sclerosis, neurosyphilis, or Guillain-Barré syndrome.

- Additional conditions under which the test may be performed:
- Chronic inflammatory polyneuropathy
- Dementia due to metabolic causes
- Encephalitis
- Epilepsy
- Febrile seizure (children)
- Generalized tonic-clonic seizure
- Hydrocephalus
- Normal pressure hydrocephalus (NPH)
- Pituitary tumor
- Reye syndrome

Amniotic fluid

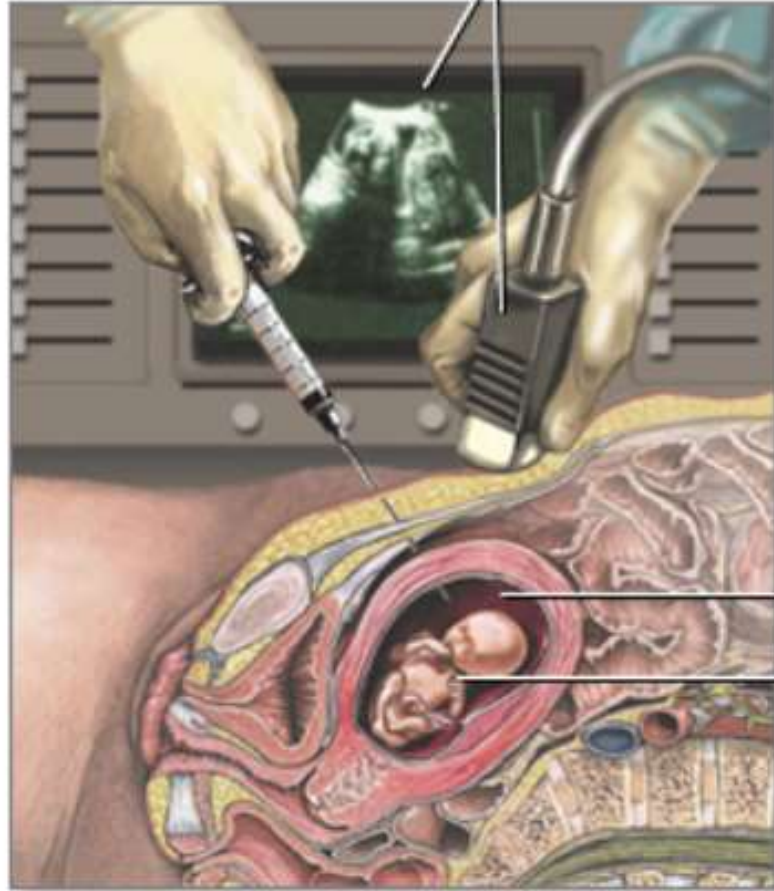
Amniotic fluid is a clear, slightly yellowish liquid that surrounds the unborn baby (fetus) during pregnancy. It is contained in the amniotic sac.



Amniotic fluid is the clear, yellowish fluid that surrounds and protects the fetus in the uterus



Ultrasound equipment



In amniocentesis, a hollow needle is inserted through the mother's abdomen into the uterus, and amniotic fluid is drawn for analysis

Amniotic fluid

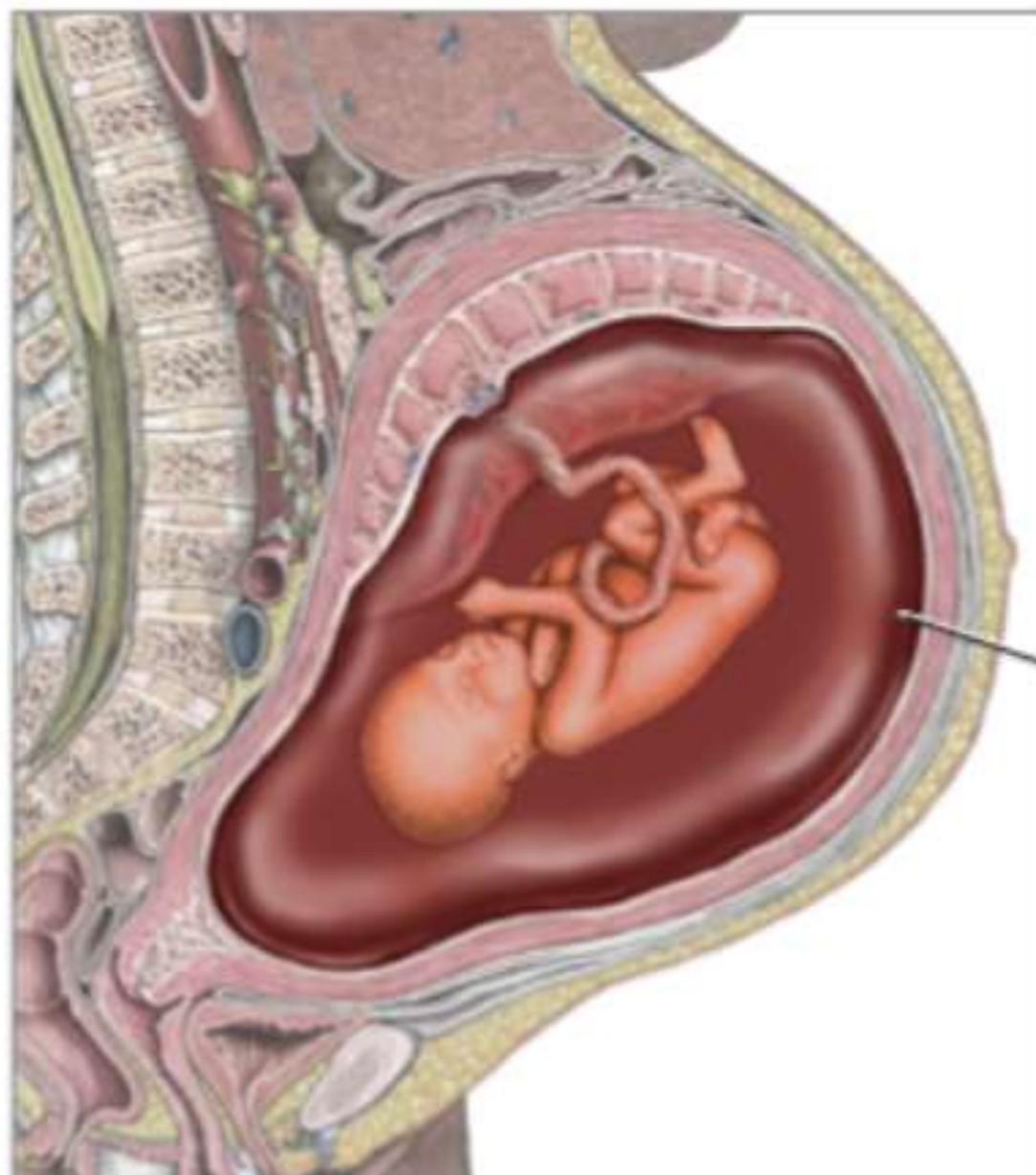
Fetus



Amniocentesis is used to determine the health of an unborn baby. Amniotic fluid contains cells that are normally shed from the fetus. Samples of these cells are obtained by withdrawing some amniotic fluid. The chromosome analysis of these cells can be performed to determine abnormalities. In addition, the cells may be cultured and analyzed for enzymes, or for other materials that may indicate genetically transmitted diseases. Other studies can be done directly on the amniotic fluid including measurement of alpha-fetoprotein.

- While in the womb, the baby floats in the amniotic fluid. The amount of amniotic fluid is greatest at about 34 weeks into the pregnancy (34 weeks gestation), when it averages 800 mL. About 600 mL of amniotic fluid surrounds the baby at full term (40 weeks gestation).
- The amniotic fluid constantly moves (circulates) as the baby swallows and "inhales" the fluid, and then releases it.
- The amniotic fluid helps:
 - The developing baby to move in the womb, which allows for proper bone growth
 - The lungs to develop properly
 - Prevent pressure on the umbilical cord
 - Keep a constant temperature around the baby, protecting from heat loss
 - Protect the baby from outside injury by cushioning sudden blows or movements

- Too much amniotic fluid is called polyhydramnios. This condition can occur with multiple pregnancies (twins or triplets), congenital anomalies (problems that exist when the baby is born), or gestational diabetes.
- Too little amniotic fluid is known as oligohydramnios. This condition may occur with late pregnancies, ruptured membranes, placental dysfunction, or fetal abnormalities.
- Abnormal amounts of amniotic fluid may cause the health care provider to watch the pregnancy more carefully. Removing a sample of the fluid through amniocentesis can provide information about the sex, health, and development of the fetus.



Polyhydramnios
is excessive
amniotic fluid
surrounding
the fetus