

Lab Values and Bloodwork in Pregnancy: Basic Concepts Simplified

Blood abnormalities may be surprisingly difficult to detect in pregnancy. Although pregnancy is a "natural state," it is not a "normal state" – and this altered state affects the entire physiology. The circulatory system and blood chemistry respond to the the placenta and baby, resulting in changes to the “normal ranges” printed on our lab slips. These changes can cloak some health conditions, while mimicking the presence of others. We must carefully interpret all lab work in relation to pregnancy and the week of gestation. The blood is a snapshot of health. Even the minimal tests will provide a great deal of information, to help women and Attendants assess the course of the pregnancy.

At a Glance: The Essentials: Basic Bloodwork

The minimal bloodwork ordered in pregnancy should include at least; Blood type and Rh, the hematocrit, hemoglobin, Red Blood Cells, White Blood Cells and Platelets in addition to blood type and antibody screens. Antibody screens are usually set to detect titres showing immunity to Rubella, Measles, Varicella (chicken pox) HIV, Syphilis and Hepatitis B. Antibody screens are often required by state law, but the requirements vary, and some require no more than Syphilis. You will have to check the requirements for your region. Some women may desire tests for genetic disorders; or they may have religious objections and decline them. Ask her preference and follow her directions. These are the basics; if finances permit, do more! Add a CBC and urinalysis with culture. Blood type and antibody screens don't change (or shouldn't), so we will focus on the rest.

The Numbers

The normal lab values are usually lower for pregnant women except for the White Blood Cell count which is generally elevated in pregnancy. I'm using shorthand numbers. (I'm sure you know these numbers are exponents: That is, the RBC is actually 3.8×10^{12}). Your laboratory may use slightly different numbers, but they should be close to this for females. NOTE: These readings are in US format. Some other countries calculate differently. To convert to the other format, multiply by ten. IE 11.5 becomes 115, 14 becomes 140. The hematocrit may also be called Packed Cell Volume, or EVP Erythrocyte Volume Fraction. It is the percentage of red blood cells by volume.

Non-pregnant range vrs Pregnant range

| | |
|------------------------------|----------------------------|
| ·Hgb 12.0 to 16 | Pregnant Range 11.0 to 14 |
| ·Hct - - 35 to 47 | Pregnant Range 32 to 36 |
| ·RBC 3.8 to 5.20 | Pregnant Range 3.5 to 4.75 |
| ·WBC 3.5 to 11.0 | Pregnant Range 10.5 to 20 |
| ·Platelets 140 to 440 (1000) | Pregnant Range 187 to 300 |

Discussion

What do you do when results are outside these ranges?

In general, do not panic!. Pregnant blood values vary so widely and the normal range varies in individuals. Also laboratory errors are common. Something as simple as a delay from the time the blood is drawn to the time it's tested, can affect the numbers you see on your report. A highly unusual lab report should require a repeat test before any "treatment" is considered. Pregnant women are easily stressed. Lets make sure an unusual lab result is worth worrying about before we unduly alarm the mom!

Changes In Pregnancy

During pregnancy, there's an increase of total cell volume of 18% and the plasma volume increases 40% to 50% over the non-pregnant state. Hemoglobin itself – as measured by the packed cell volume --- changes little, but the amount of plasma rises. This increase in plasma causes a "hemodilution", which creates a sort of artificial anemia called "the physiologic anemia of pregnancy". (As an example, you might envision what happens if you add an extra cup of water to a pitcher of juice mix. There will still be the same amount of juice solids in the pitcher, but the juice will be diluted and thin. The additional water will make it seem as if it contains less juicemix, but you have not decreased the amount of mix at all. Similarly, the hemoglobin falls during pregnancy because of the increased plasma, and not because the blood actually has fewer cells)

To make it even more confusing, the plasma levels fluctuate up and down during pregnancy, dropping the hematocrit as much as 4 points at the time of maximum hemodilution (around 32 weeks). The levels begin to contract again near term and cause hemoconcentration. Many practitioners test for anemia near that point of maximum dilution when hemoglobin and hematocrit numbers aren't inaccurate. This practice risks mistakenly identifying pregnant women as anemic based on their artificially low hemoglobin numbers, and they may be advised to unneeded iron supplements. Excess iron in pregnancy may be harmful, and should be avoided.

During pregnancy, a low hemoglobin or hematocrit count does not automatically indicate **anemia** -- especially if the blood test is performed before the last months. The normal “hemoconcentration” will raise the hemoglobin by two points or more in the next eight weeks till the due date. This natural rise will correct the perceived “anemia” **without treatment** by nutritional supplements or iron. (This fast rise, we may convince us of the effectiveness of our favorite supplements!)

About Hemoglobin (Hgb, Hb) in pregnancy

Non-pregnant range = 12.0 to 16

Pregnant Range 11.0 to 14

Hemoglobin is the oxygen-carrying and iron-binding pigment in red blood cells, and is measured by grams per deciliter (g/dL) Or per liter in the other measurement) We used to think the non-pregnant range of 12.0 to 16 would drop to 11.5 to 14 in pregnancy, but new research shows this number may actually be several points lower. The normal hemodilution in pregnancy may drop the NORMAL hemoglobin values to as low as 10.5 to 11.0 at term. Almost every pregnant woman will show a drop of about 2 points in hemoglobin measurement during pregnancy, and yet will return to just below her beginning number by 40 weeks. We can prevent this drop by giving iron supplements, and this has been common practice for many years in an effort to prevent what we assumed was anemia, But normal hemodilution makes it difficult to accurately detect anemia during pregnancy, and the judgment can't be based upon the hemoglobin/hematocrit count. A woman with a low hemoglobin/hematocrit count in the beginning weeks of pregnancy can accurately be judged anemic, but if the bloodwork is done after 10 weeks the expanding blood volume makes it difficult to get an accurate reading.

Falling hemoglobin – A drop in hemoglobin is a sign of hemodilution due to an expanding blood volume and is a reassuring sign of a healthy functioning placenta and a low risk of pre-eclampsia. Or, it could be a sign of anemia.

Stable hemoglobin – A failure of the hemoglobin to drop is evidence of poor blood volume expansion, and is an early warning sign of pre-eclampsia. A woman with stable hemoglobin should be considered

at risk. This abnormal stabilization can also be due to unnecessary use of iron supplements; a potentially harmful practice.

High hemoglobin – A sign of failure of hemodilution and is generally worrisome, especially in middle trimester. A hemoglobin above 14 at term is highly suggestive of pre-eclampsia (PE), and the woman should be carefully monitored for evidence of the condition. (There is currently no reliable 'treatment' for PE other than birth of the baby, so we must rely on early detection).

Hematocrit (Hct)

Non-pregnant Range - - 35 to 47

Pregnant Range – 32 to 36

We could think of hematocrit as being another way to confirm the amount of hemoglobin. The hematocrit measures the volume of red blood cells by their percentage in a centrifuged sample of blood, and thus closely follows the hemoglobin count. Everything I said about hemoglobin (Hgb) applies to hematocrit (hct) as well. The hct may fluctuate as much as 4 to 6 points during the course of pregnancy; The hemoglobin seems more stable in comparison. An old rule of thumb says to expect the hct to drop 4 points from the start of pregnancy and to rise 3 points by 40 weeks ending at or just below the original hct. Like high hemoglobin, high hematocrit is a marker for potential pre-eclampsia.

Red Blood Cell Count (RBC)

Non-Pregnant Range 3.8 to 5.20

Pregnant Range 3.5 to 4.75

The RBC is the number of Red Blood Cells per cubic m/l of blood, and usually falls only slightly in pregnancy. Because it is a literal "count" of the blood cells it is relatively stable, and can help distinguish true anemia from the "physiologic anemia of pregnancy". Through most of the pregnancy the hgb and hct are inaccurate due to hemodilution and are artificially low, and these low numbers may lead to a mistaken assumption that the woman is anemic. The first weeks of pregnancy and the last weeks are the only time when all three measurements (hgb, hct and RBC) can be considered accurate.

At all stages of pregnancy, the RBC is the most reliable measurement, and can be an important clue to help us detect anemia.

If the woman has a low *hgb/hct and a low RBC* at the start of pregnancy, she is **anemic**. But if the bloodwork is tested *after* the first trimester and the RBC is within the normal range, the woman is probably not anemic *even though* hemodilution can cause her hematocrit to fall as low as 31 or her hemoglobin to 10.5. She simply has normal physiologic hemodilution; she does not have anemia, and she does not need nutritional supplements. If the bloodwork is done at the optimum time of 30 weeks (the point of maximum hemodilution) the normal hemoconcentration over the next 10 weeks can be expected to raise her numbers to at least 11.5hgb and 33hct by term. She is not anemic at 30 weeks and will not be at 40 weeks.

But If the RBC is low *in addition to* the low hgb/hct, then this confirms the woman may have anemia, not just hemodilution. Her low RBC count shows she may lack the iron she needs to make enough red blood cells. She is anemic, and she may need nutritional supplements including iron tablets. (Iron should not be used routinely during pregnancy, but only when a woman is deficient.)

MCV – Mean Corpuscular Volume. The average (mean) volume of an individual Red Blood Cell.

So this is labwork in a nutshell: The hemoglobin measures the hemoglobin protein which carries oxygen and binds with iron. The hematocrit tells us what percent of blood is red blood cells. The RBC tells us the how many red blood cells there are. And the MCV tells us their size.

White Blood Cells

Non-Pregnant Range – 3.5 to 11.0 Pregnant Range 10.5 to 20

The WBC usually indicates an infection when elevated above normal, but the normal range is much higher during pregnancy. It m average as high as 14,000 or even reach 20,000. This is called "leukocytosis of pregnancy" and can confuse the detection of infections.

Eosinophils, neutrophils are types of white blood cells.

Erythrocytes are immature red blood cells.

Platelets

Non-Pregnant Range – 140 to 440 (1000) Pregnant Range 187 to 300

Platelets tell us what they are. They are “plate-shaped” cells also called “thrombocytes”. “Thrombo” is a Greek meaning “clot” and “cyte” means “cell”. And this is exactly what they are; cells which cause blood to clot. Platelets have a wide range of normal, and a wide range even within the same woman during different weeks of her pregnancy. They may be unusually high in lupus type conditions, and abnormally low in Gestational **Thrombocytopenia**, or Immune Thrombocytopenia (ITP), or in the severe pre-eclampsia condition called HELLP. Although platelets below 125 or even below 100 may be sometimes harmless or a normal variant, any depleted state must be carefully evaluated! A low number may mean nothing or it could mean the mother is terribly sick. It's important to retest to see if the platelet count or hct/hgb numbers are steady or whether they are falling. Deficient platelets means reduced clotting capacity and a risk of severe bleeding!

Pre-eclampsia labwork

Hemoconcentration is noted almost always in pre-eclampsia, and a high or rising hct and hgb measurement is often the first sign (although it will fall if HELLP develops). It's widely debated whether the hemoconcentration is the cause of -- or the result of - a preeclamptic syndrome. Women with higher hematocrit are so closely associated with risk of preclampsia that women with a history of PE are advised to avoid iron supplements. ⁱⁱⁱ

A suggested panel to run if you are suspicious of pre-eclampsia includes hematocrit, hemoglobin, peripheral blood smear, BUN, Uric acid, protein, SGOT and AST.

Possible signs of preeclampsia which may be discovered through labwork.

- Albumin level may fall (sign not totally reliable).
- Uric acid may increase
- Blood Urea Nitrogen (BUN), may rise
- creatinine may rise (sign not as reliable)
- Glomerular Filtration Rate (GFR) - decreasing from normal range or baseline
- Liver panel changes and/or rising SGOT (above 72)
- hct/hgb/CBC/platelets – look for a rise in hct/hgb and/or drop in platelets

- Urine Albumin (24 hour)-- rising or >300 but 10% of women with pre-eclampsia and 20% of women with ECLAMPSIA may not develop proteinuria ⁱⁱⁱ
- any evidence of cell destruction – drop in hgb or platelets; bilirubin,

Note: labs vary in their printed "normal ranges" and in their testing methods. You may see numbers slightly different from these. These tests tell little by themselves, and need to be put in context of the woman's symptoms and other bloodwork. Tests should be repeated to show a trend in progression.

Normal Range Female

Albumin (blood) 3.2 to 4.1

Uric acid 3 to 5 (avg 4.1)

GFR -Glomerular Filtration Rate >90

BUN 9 to 17 (this may be normally as low as 5 in pregnancy so any rise is concerning)

Creatinine 0.8 to 1.3

SGOT 3 to 40

AST <70

Platelets - >100,000

Urine 24 hour collection – <300

Signs or changes suspicious of preeclampsia

Albumin

Uric Acid

GFR

BUN

Creatinine

SGOT

AST

BUN and liver panels are most accurate in the fasting state so the blood draw should occur first thing in the morning. The BUN (Blood Urea Nitrogen) detects nitrogen products from the liver through the kidneys and is a way of testing of renal function. A high BUN means there is too much protein for

your kidney to handle (or too few calories, dehydration, poor circulation or renal problem or maybe pre-eclampsia). Realistically little is known about the range of normal in pregnancy. The numbers can range throughout the day and vary with diet, gender, race, body type and race, so It's hard to "diagnose" anything based on only one test. Repeated tests may be necessary to show a trend and a change from the first to the next. When suspicious of PE it is wise to get bloodwork done early, so you have a baseline to compare with future tests.

I doubt if anyone has sufficiently established the normal range in pregnancy for some of the tests like phosphorous and alkaline phosphate etc

HELLP

In one of the severe pre-eclampsia/eclampsia variants, the liver functions deteriorate and hemolysis occurs. The red blood cells become rapidly microcytic and deformed, the hemoglobin and hematocrit drop, fibrinogen (necessary for clot formation) decreases, platelet destruction may occur, bilirubin may rise, and a severe hemorrhagic disorder called Disseminated Intravascular Coagulation (DIC) may develop. HELLP is the acronym to remember and "HELP" is what to seek! Hemolysis, Elevated Livers, Low Platelet. Or a regional variation of the acronym: High BP, Elevated Liver, Low Platelet. However you define the acronym, this is a serious condition which can occur rapidly. And this condition can develop even with only moderately high Blood Pressure.

Urine test (urine dip sticks) for protein – albumin – is unreliable. The only useful test is a 24 hour clean catch or a catheter sample sent to the lab. Albumin levels vary too greatly to be significant as predictors of pre-eclampsia, but repeated catches may show a progression of the process. But remember, proteinuria is a LATE sign of preeclampsia, and is not a conclusive aid to discovery. The presence of large amounts of protein or progressive rise is a sign that renal function is failing, and this often accompanies pre-eclampsia (and other conditions). There are only two reliable signs of pre-eclampsia: a rising blood pressure and characteristic bloodwork changes, and even then there are some women who don't these signs. The old 'triad of symptoms' – proteinuria, edema and a rising BP-- must be retired! A birth practitioner must never dismiss a rising blood pressure just because the woman does not have edema or proteinuria.

Dip Stick Urine Tests

- **Glucose** – glucoseuria is common in pregnancy; it is not a good screen for diabetes.
- **Protein** – A trace to mild amounts are common and usually meaningless. The albuminuria associated with PIH is usually a late sign, and may not appear at all.
- **Ketones** ---- a product of "starvation". Illness, fever, lack of food, too few carbohydrates, too high of protein, dehydration, or diabetes (*if you see both ketones and glucose, the woman probably has Diabetes Mellitus*)
- **Leukocytes** – commonly due to a contaminate. High levels may indicate a urinary tract infection especially if blood is also found
- **blood** – usual source is vaginal, cervical, or rectal. May be caused by renal problem, kidney infection, stones. (of high dose of vitamin C).
- Ph one of the pretty much irrelevant things we do.

(The custom of doing a routine dipstick at each prenatal is not particularly helpful and I predict that in a few years few people will do them)

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