

Blood Chemistry Basics, Part 2

Okay. So, onto the next slides, We're going to present markers that we use in an initial functional blood chemistry panel. We're going to break these down into chunks. You'll be able to order my custom panel for your patients, and we'll also be showing you how to do that in the training.

This panel continues to be fine-tuned and updated as we continue to better understand supporting markers of clinical patterns of disease and imbalance.

Marker	Value	Functional Range	Lab Range
Glucose	107	75 - 85	65 - 99
Hemoglobin A1c	5.7	4.6 - 5.3	4.8 - 5.6
Uric Acid	2.8	3.2 - 5.5	3 - 7.2
BUN	24	13 - 18	8 - 27
Creatinine	0.82	0.7 - 1.0	0.57 - 1.00
BUN/Creatinine Ratio	29	9 - 23	9 - 23
eGFR if Non-African American	75		> 59
eGFR if African American	86		> 59
Sodium	140	135 - 140	134 - 144
Potassium	4.6	4.0 - 4.5	3.5 - 5.2
Chloride	101	100 - 106	96 - 106
CO ₂	28	25 - 30	20 - 29
Calcium	10.7	9.2 - 10.1	8.7 - 10.3
Parathyroid Hormone, Intact	47	15 - 60	15 - 65
Phosphorus	3.3	3.0 - 4.0	3.0 - 4.3
Magnesium	2.7	2.0 - 2.6	1.6 - 2.3
Protein, total	6.8	6.9 - 7.4	6.0 - 8.5
Albumin	4.9	4.0 - 5.0	3.8 - 4.8
Globulin	1.9	2.4 - 2.8	1.5 - 4.5
A/G ratio	2.6	1.5 - 2.0	1.2 - 2.2
Bilirubin, total	0.3	0.1 - 1.2	0.0 - 1.2
Alkaline Phosphatase	119	42 - 107	39 - 117
LDH	187	140 - 180	119 - 226
AST	33	0 - 23	0 - 40
ALT	33	0 - 20	0 - 32
GGT	21	0 - 21	0 - 60
TIBC	339	275 - 425	250 - 450
UIBC	240	175 - 350	118 - 369
Iron	99	40 - 135	27 - 139
Iron saturation	29	17 - 45	15 - 55
Ferritin	61	30 - 100	15 - 150
Vitamin B-12	>2000	450 - 2000	232 - 1245
Folate, Serum	>20	> 8.0	> 3.0
Calcitriol (1,25 di-OH Vitamin D)	102	19.9 - 79.3	19.9 - 79.3
Vitamin D, 25-hydroxy	76.8	35 - 60	30.0 - 100.0
Cholesterol, total	244	150 - 230	100 - 199
Triglycerides	52	50 - 100	0 - 149
HDL	118	55 - 85	> 39
LDL	117	0 - 140	0 - 99
T. Chol / HDL Ratio	2.1	< 3	0 - 4.4
Triglycerides / HDL Ratio	0.44	< 2	< 3.8

Marker	Value	Functional Range	Lab Range
CRP-hs	0.27	< 1.0	0.00 - 3.00
Homocysteine	5.0	< 7.0	0.0 - 14.5
TSH	12.500	0.5 – 2.0	0.45 - 4.500
T4, total	5.7	6.0 – 12	4.5 - 12.0
T3 Uptake	26	28 - 35	24 - 39
T3, Total	81	100 – 180	71 - 180
T3, Free	2.7	2.5 - 4.0	2 - 4.4
T4, Free	1.03	1 - 1.5	0.82 - 1.77
Reverse T3	13.1	9 - 21	9.2 - 24.1
Thyroid – TPO Ab	<9		0 - 34
Thyroid – TGA	<1.0		0 - 0.9
Insulin	8.8	3 - 7	2.6 - 24.9
Copper	99	83 - 141	80 - 158
Zinc	139	90 - 120	44 - 115
Zinc / Copper Ratio	1.40	0.85 - 1.2	
Serum Methylmalonic Acid (MMA)	67	< 300	0 - 378
WBC	4.9	5.0 – 8.0	3.4 - 10.8
RBC	4.58	4.4 – 4.9	3.77 - 5.28
Hemoglobin	14.0	13.5 - 14.5	11.1 - 15.9
Hematocrit	41.8	37 - 44	34 - 46.6
MCV	91	85 – 92	79 - 97
MCH	30.6	27.7 – 32.0	26.6 - 33.0
MCHC	33.5	32 – 35	31.5 - 35.7
RDW	12.1	11.5 – 15.0	11.7 - 15.4
Platelets	222	150 – 379	150 - 450
Neutrophils	59	40 – 60	
Lymphocytes	24	25 – 40	
Monocytes	13	4.0 – 7.0	
Eosinophils	3	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

The initial panel that you run as a functional blood chemistry screening tool is always a middle ground between being as thorough as you can be and also being cost efficient. If a patient comes in—to some extent, it would be ideal if you could just run every possible marker that you think they might ever need and have all that information up front. If cost is of no concern for the patient, then this may be an option, and some clinicians do that. But we are trying to find that balance between getting a comprehensive amount of information that can help us structure and layer an effective

treatment plan, but also being cost efficient and staying focused is the way to go with this initial case review blood panel.

So, we start with recommending markers that we feel are most important and are most likely to reveal underlying patterns that need to be addressed or need to be followed up with additional testing. Now some of this, of course, is personal preference, and you probably will and should evolve your own custom panel over time as you do more of this work, and accommodate the panel to your specialty or area of focus. There is really definitely room for variation, but I do think there are some basic markers that we should all be looking at because there are certain systems of the body that we know contribute to most of the modern inflammatory diseases that exist. For example, blood sugar regulation is very important for cardiovascular disease risk, metabolic disease, and just about every modern disease that we know. We want to look at nutrient status, things such as magnesium, iron, B12, and vitamin D. We want to look at immune function. We also want to look at metabolic function and thyroid. So there are some important markers that I think pretty much everyone should include, and then from there, there is plenty of room for customization.

Comprehensive **metabolic** panel

Glucose	Magnesium
Sodium	Total protein
Potassium	Albumin
Chloride	Globulin
Carbon dioxide	Albumin/Globulin ratio
Blood urea nitrogen (BUN)	Total bilirubin
Creatinine	Alkaline phosphatase
BUN/Creatinine ratio	AST
eGFR	ALT
Calcium	

Okay. So, let's talk about a little bit more about the case review blood panel, again, broken into chunks, and these are often chunks that are used by lab panels that you can order, distinct panels or individual panels at the labs. The first is the comprehensive metabolic panel, or CMP. I'm sure you're familiar with this. It typically includes between 14 to 20 markers depending on the lab. It includes things such as glucose, sodium, potassium chloride, carbon dioxide, blood urea nitrogen, creatinine, BUN-to-creatinine ratio, glomerular filtration rate (EGFR), calcium, and magnesium. These are some things that we actually have added to the CMP. They are not always part of the

CMP; magnesium, for instance, isn't. Then we have total protein, albumin globulin, albumin-to-globulin ratio that we calculate, total bilirubin, and alkaline phosphatase. Most CMPs don't include those by default, so you'll be adding them directly. And then also the amino transferases, AST and ALT.

Additional metabolic markers

Hemoglobin A1c

Uric acid

Lactate dehydrogenase (LDH)

Gamma-glutamyl transferase (GGT)

Phosphorus

Fasting insulin

We add some additional markers to the CMP, including hemoglobin A1c, which is a three-month average of blood sugar; uric acid, which is a chemical created when the body breaks down purines. It tends to be abnormal in blood sugar disorders, gout, and some other inflammatory conditions. Lactate dehydrogenase, or LDH, which is a marker of tissue breakdown and also in insulin resistance. GGT, which is used to determine the cause of high alkaline phosphatase, liver disease, and bile duct obstructions. It also can be very helpful in iron overload conditions. Phosphorus, which is a marker for kidney, liver, and bone disease. And we also include fasting insulin to help round out the blood sugar markers and test for insulin resistance and pancreatic function. Don't worry. We're definitely going to dive into detail on all of these markers and the groups of markers as we go through the unit, but this is just an example so you can see what markers are included on the panel.

Iron panel + ferritin

Serum iron

Total iron binding capacity (TIBC)

Unsaturated iron binding capacity (UIBC)

Iron saturation (%)

Ferritin

Next is the iron panel and ferritin. This is often neglected in conventional medicine, and it just baffles us. I cannot understand why an iron panel plus ferritin is not a part of a standard blood workup. There are over two billion people in the world who suffer from iron deficiency, and iron overload is even a much more common condition than is typically recognized. Iron is an absolutely crucial nutrient. It's essential for life, [and yet] it can be deadly when it is elevated. It just absolutely needs to be part of an initial workup. Ferritin, in addition to being the long-term storage form of iron, is an acute-phase reactant, which can be elevated in the inflammatory process and response, so it's a marker of inflammation as well.

Other important nutrients

Serum B12

Serum methylmalonic acid (MMA)

Serum copper

Serum zinc

Vitamin D (25-hydroxy)

Folate

Homocysteine

In addition to iron, we also want to measure several other important nutrients. B12 deficiency is not uncommon, even in omnivores, due to low stomach acid, digestive issues, and autoimmune conditions such as pernicious anemia. Serum B12, unfortunately, isn't always accurate, and it can miss a lot of people who are deficient, so we add serum methylmalonic acid to this panel. We also have urine methylmalonic acid in the organics comprehensive urine panel, if you end up using that. It's another good marker for B12. Serum folate or folic acid or B9 is another important nutrient for a variety of things like tissue growth and production of red blood cells and supporting methylation. Homocysteine is added as an indirect marker of methylation status, and it's also a marker of inflammation and is associated with cardiovascular disease risk. Serum copper and serum zinc: An altered serum copper-zinc ratio is associated with immune and inflammatory issues, more so than it is with dietary or supplemental intake of copper and zinc, as we'll discuss. Then we have 25-OH(D), or Vitamin D, which is one of the most common deficiencies that we'll see, but we're also going to discuss how I think a lot of people [are] being misdiagnosed with vitamin D deficiency, and vitamin D toxicity is becoming an increasing concern with people now on long-term vitamin D supplementation.

Standard **lipid panel**

Total cholesterol

LDL cholesterol

VLDL cholesterol

HDL cholesterol

Triglycerides

TC/HDL ratio

LDL/HDL ratio

Next is a standard lipid panel. This provides information on lipid metabolism. All the obvious markers here are total LDL, HDL cholesterol, triglycerides, total cholesterol-to-HDL ratio. More advanced testing is often necessary in someone with abnormal lipid values. We're not going to go into great detail on this in the program, but we'll touch on it a bit later in the unit.

You can get a surprisingly useful amount of info just from this standard lipid panel. For example, it turns out that the total cholesterol-to-HDL ratio correlates very well with LDL particle number, which is probably one of the more important lipid markers. Don't totally ignore this. It's still an important part of a basic blood panel.

Basic thyroid panel

Thyroid stimulating hormone (TSH)

Total thyroxine (T4)

Total triiodothyronine (T3)

T3 uptake

Free triiodothyronine (fT3)

Free thyroxine (fT4)

Thyroglobulin antibodies (TGA)

Thyroid peroxidase antibodies (TPO)

Reverse T3 (rT3)

We also do a comprehensive thyroid panel. This is another situation where more advanced testing is often required. We've gone back and forth between leaving this as a basic panel that excludes free T3, T4, and thyroid antibodies on the initial panel, [but] while it does add extra cost, we do find that it does catch a good deal of thyroid disorders that may have been missed on a basic or standard panel, including autoimmune thyroid disease. Because of this, we are ordering a full panel for all of our initial consults, and if finances are a concern, you could just order the TSH and free T3 and free T4, and then decide to add in the antibody levels after the fact if you think that's appropriate.

Complete **blood count** (CBC)

WBC	Lymphocytes (%)
RBC	Monocytes (%)
Hemoglobin	Eosinophils (%)
Hematocrit	Neutrophils (absolute)
MCV	Lymphocytes (absolute)
MCH	Monocytes (absolute)
MCHC	Eosinophils (absolute)
RDW	Immature granulocytes (%)
Platelets	Immature granulocytes (absolute)
Neutrophils (%)	

Finally, we have complete blood count. This is used for a variety of purposes. At the most basic level, it evaluates two types of cells in the blood: red blood cells and white blood cells. Red blood cells transport oxygen through the body, and white blood cells defend against infections and cancer, and they're involved in allergies and inflammation. The CBC helps identify conditions like anemia, infection, inflammation, autoimmunity, bleeding disorders, and cancer. Platelet count and differential are often added. We do this in our panel. This gives you additional information that can be useful. The differential identifies and counts the number of white blood cells that are present.