KRESSER INSTITUTE
FOR FUNCTIONAL AND EVOLUTIONARY MEDICINE

Iron-Deficiency Anemia - Part Two

All right, let's dive into some cases. The first is a 39-year-old female. She was under considerable stress finishing graduate school, and that was compounded by an anxiety disorder, chronic idiopathic pelvic and gastrointestinal disorder, and idiopathic neuropathy. She had been to a neurologist, had routine labs plus a spine MRI and nerve conduction test. She had seen an OB/GYN, who diagnosed her with UTI, idiopathic PID, and gave her some antibiotics and birth control. After she stopped the birth control, to which she had a bad reaction, her anxiety escalated, and her past symptoms resurfaced.

Glucose	88	75 - 90	65 - 99
Hemoglobin A1c	6.4	4.8 – 5.4	4.8 - 5.6
Uric Acid	4.4	3.2 - 5.5	2.5 - 7.1
BUN	10	13 – 18	6 - 20
Creatinine	0.65	0.85 – 1.1	0.57 - 1
BUN/Creatinine Ratio	15	9 – 23	8 - 20
Sodium	142	134 – 140	134 - 144
Potassium	4.2	4.0 – 4.5	3.5 - 5.2
Chloride	100	100 – 106	97 - 108
C02	29	25 – 30	18 - 29
Calcium	9.1	9.2 – 10.1	8.7 - 10.2
Phosphorus	3.7	3.5 – 4.0	2.5 - 4.5
Magnesium	2.0	2.0 – 2.6	1.6 - 2.3
Protein, total	6.5	6.9 – 7.4	6.0 - 8.5
Albumin	4.4	4.0 – 5.0	3.5 - 5.5
Globulin	2.1	2.4 – 2.8	1.5 - 4.5
A/G ratio	2.1	1.5 – 2.0	1.1 - 2.5
Bilirubin, total	0.2	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	69	42 – 107	39 - 117
LDH	176	140 - 180	119 - 226
AST	14	10 - 30	0 - 40
ALT	13	10 - 22	0 - 32
GGT	16	0 - 28	0 - 60
TIBC	427	250 – 350	250 - 450
UIBC	401	150 - 375	131 - 425
Iron	26	85 – 135	27 - 159
Iron saturation	6	15 – 45	15 - 55
Ferritin	6	15 - 120	15 - 150
Vitamin B-12	602	450 – 2000	211 - 946
Vitamin D, 25-hydroxy	50	35 - 60	30.0 - 100.0
Cholesterol, total	174	150 - 250	100 - 199
Triglycerides	94	50 – 100	0 - 149
HDL	70	55 – 85	> 39
LDL	85	0 - 175	0 - 99
T. Chol / HDL Ratio	2.5	< 3	0 - 4.4
Triglycerides / HDL Ratio	1.34	< 2	< 3.8
CRP-hs	2.5	< 1.0	0.00 - 3.00
Homocysteine	6.6	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	2.570	0.5 – 2.5	0.45 - 4.50
T4, total	6.4	6.0 – 12	4.5 - 12
T3 Uptake	25	28 - 35	24 - 39
T3, Total	117	100 – 180	71 - 180
Copper	122		72 - 166
Zinc	81		56 - 134
Zinc / Copper Ratio	0.66	> 0.85	
Serum Methylmalonic Acid (MMA)	183	0 - 325	0 - 378
WBC	6.3	5.0 – 8.0	3.4 - 10.8
RBC	4.35	4.4 – 4.9	3.77 - 5.28
Hemoglobin	11.0	13.5 - 14.5	11.1 - 15.9
Hematocrit	34.4	37 - 44	34 - 46.6
MCV	79	85 – 92	79 - 97
MCH	25.3	27.7 – 32.0	26.6 - 33.0
MCHC	32	32 – 35	31.5 - 35.7
RDW	14.2	11.5 – 15.0	12.3 - 15.4
Platelets	347	150 – 415	150 - 379
Neutrophils	68	40 – 60	
Lymphocytes	24	25 – 40	
Monocytes	6	4.0 – 7.0	
Eosinophils	2	0.0 – 3.0	
Basophils	0	0.0 – 3.0	

Unbelievably, in all of that workup, no one had run a full iron panel or even, apparently, a CBC because they had completely missed the iron-deficiency anemia. We see here her hemoglobin was 11. That is below the lab range. Her red blood cells are functionally low. Hematocrit and MCV are functionally low, although MCV is almost out of the lab range, and MCH is lab-low. Then, we see in her iron panel that iron, iron saturation, and ferritin are all lab-low with an iron saturation of 6, which is extremely low—you'll usually get an alert for an iron saturation that low—and a ferritin of 6, which is really low. Her TIBC and UIBC are functionally high, so this is a pretty textbook case here. Not all of the markers are out of the lab range, but they are all moving in the direction that you would expect except for RDW, which is high-normal. It is 14.2 in a range of 12.3 to 15.4. It's actually pretty normal, but you don't always see RDW out of range, and you don't always see all of the markers out of range. Like I said, it's rarely a textbook presentation, but this is about as close as you get.

Comprehensive Stool Analysis / Parasitology x3

BACTERIOLOGY CULTURE

Expected/Beneficial flora	Commensal (Imbalanced) flora	Dysbiotic flora
3+ Bacteroides fragilis group	2+ Alpha hemolytic strep	
2+ Bifidobacterium spp.	1+ Enterobacter cloacae complex	
3+ Escherichia coli	3+ Gamma hemolytic strep	
1+ Lactobacillus spp.		
1+ Enterococcus spp.		
3+ Clostridium spp.		
NG = No Growth		

BACTERIA INFORMATION

Expected /Beneficial bacteria make up a significant portion of the total microflora in a healthy & balanced GI tract. These beneficial bacteria have many health-protecting effects in the GI tract including manufacturing vitamins, fermenting fibers, digesting proteins and carbohydrates, and propagating anti-tumor and anti-inflammatory factors.
Clostridia are prevalent flora in a healthy intestine. Clostridium spp. should be considered in the context of balance with other expected/beneficial flora. Absence of clostridia or over abundance relative to other expected/beneficial flora indicates bacterial imbalance. If *C. difficile* associated disease is suspected, a Comprehensive Clostridium culture or toxigenic *C. difficile* DNA test is recommended.
Commensal (Imbalanced) bacteria are usually neither pathogenic nor beneficial to the host GI tract. Imbalances can occur when there are insufficient levels of beneficial bacteria and increased levels of commensal bacteria. Certain commensal bacteria are reported as dysbiotic at higher levels.
Dysbiotic bacteria consist of known pathogenic bacteria and those that have the potential to cause disease in the GI tract. They can be present due to a number of factors including: consumption of contaminated water or food, exposure to chemicals that are toxic to beneficial bacteria; the use of antibiotics, oral contraceptives or other medications; poor fiber intake and high stress levels.

YEAST CULTURE

Normal flora	Dysbiotic flora
No yeast isolated	

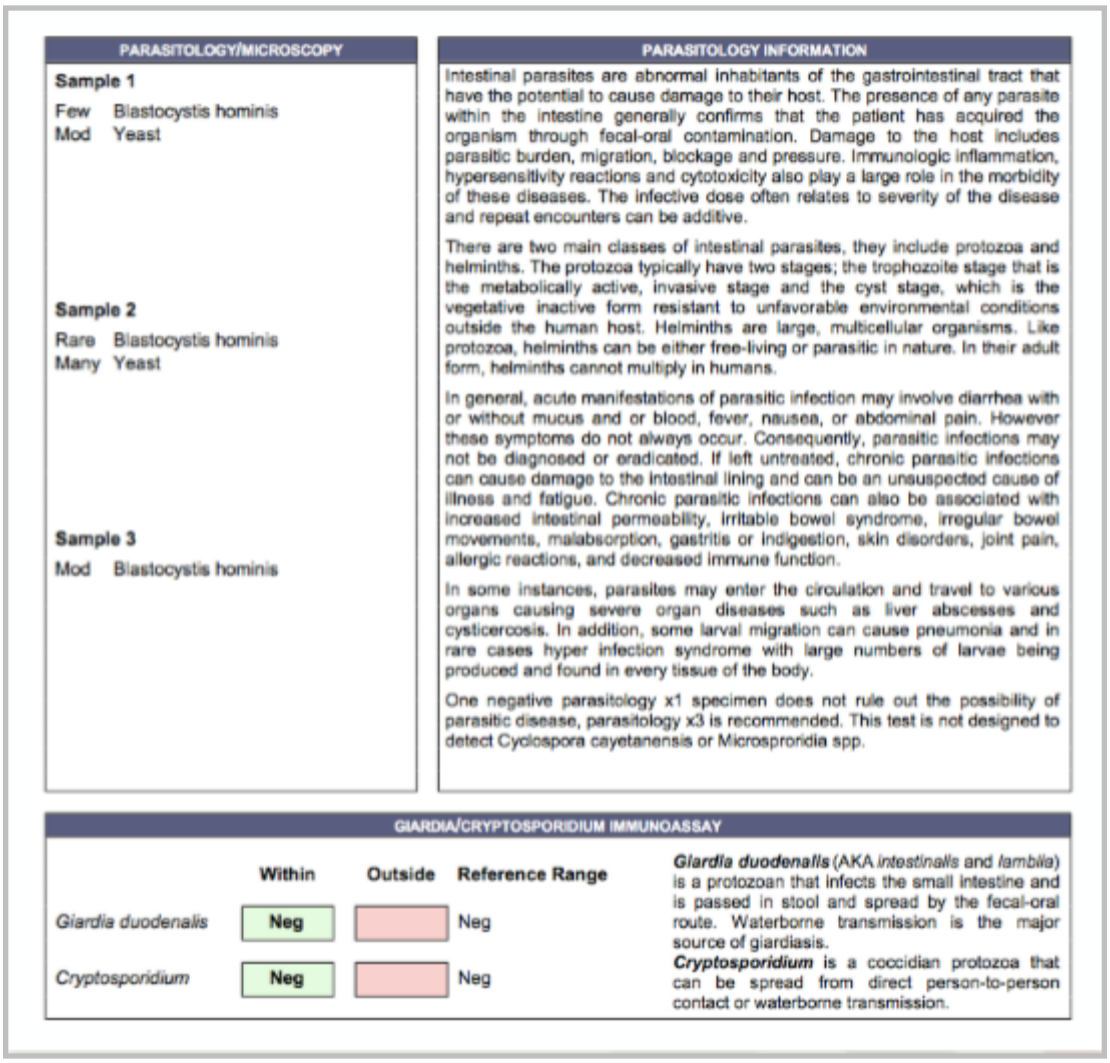
MICROSCOPIC YEAST

Result:	Expected:
Many	None - Rare

The microscopic finding of yeast in the stool is helpful in identifying whether there is proliferation of yeast. Rare yeast may be normal; however, yeast observed in higher amounts (few, moderate, or many) is abnormal.

YEAST INFORMATION

Yeast normally can be found in small quantities in the skin, mouth, intestine and mucocutaneous junctions. Overgrowth of yeast can infect virtually every organ system, leading to an extensive array of clinical manifestations. Fungal diarrhea is associated with broad-spectrum antibiotics or alterations of the patient's immune status. Symptoms may include abdominal pain, cramping and irritation. When investigating the presence of yeast, disparity may exist between culturing and microscopic examination. Yeast are not uniformly dispersed throughout the stool, this may lead to undetectable or low levels of yeast identified by microscopy, despite a cultured amount of yeast. Conversely, microscopic examination may reveal a significant amount of yeast present, but no yeast cultured. Yeast does not always survive transit through the intestines rendering it unviable.



PARASITOLOGY/MICROSCOPY

Sample 1

Few Blastocystis hominis
Mod Yeast

Sample 2

Rare Blastocystis hominis
Many Yeast

Sample 3

Mod Blastocystis hominis

PARASITOLOGY INFORMATION

Intestinal parasites are abnormal inhabitants of the gastrointestinal tract that have the potential to cause damage to their host. The presence of any parasite within the intestine generally confirms that the patient has acquired the organism through fecal-oral contamination. Damage to the host includes parasitic burden, migration, blockage and pressure. Immunologic inflammation, hypersensitivity reactions and cytotoxicity also play a large role in the morbidity of these diseases. The infective dose often relates to severity of the disease and repeat encounters can be additive.

There are two main classes of intestinal parasites, they include protozoa and helminths. The protozoa typically have two stages; the trophozoite stage that is the metabolically active, invasive stage and the cyst stage, which is the vegetative inactive form resistant to unfavorable environmental conditions outside the human host. Helminths are large, multicellular organisms. Like protozoa, helminths can be either free-living or parasitic in nature. In their adult form, helminths cannot multiply in humans.

In general, acute manifestations of parasitic infection may involve diarrhea with or without mucus and or blood, fever, nausea, or abdominal pain. However these symptoms do not always occur. Consequently, parasitic infections may not be diagnosed or eradicated. If left untreated, chronic parasitic infections can cause damage to the intestinal lining and can be an unsuspected cause of illness and fatigue. Chronic parasitic infections can also be associated with increased intestinal permeability, irritable bowel syndrome, irregular bowel movements, malabsorption, gastritis or indigestion, skin disorders, joint pain, allergic reactions, and decreased immune function.

In some instances, parasites may enter the circulation and travel to various organs causing severe organ diseases such as liver abscesses and cysticercosis. In addition, some larval migration can cause pneumonia and in rare cases hyper infection syndrome with large numbers of larvae being produced and found in every tissue of the body.

One negative parasitology x1 specimen does not rule out the possibility of parasitic disease, parasitology x3 is recommended. This test is not designed to detect Cyclospora cayetanensis or Microsporidia spp.

GIARDIA/CRYPTOSPORIDIUM IMMUNOASSAY

	Within	Outside	Reference Range
Giardia duodenalis	Neg		Neg
Cryptosporidium	Neg		Neg

Giardia duodenalis (AKA *intestinalis* and *lambila*) is a protozoan that infects the small intestine and is passed in stool and spread by the fecal-oral route. Waterborne transmission is the major source of giardiasis.
Cryptosporidium is a coccidian protozoa that can be spread from direct person-to-person contact or waterborne transmission.

Stool tests for her revealed fungal overgrowth and dysbiosis, as well as Blastocystis hominis, so GI malabsorption is definitely playing a role here.

B-Complex Vitamin Markers
(B1, B2, B3, B5, B6, Biotin)

15. a-Ketoisovalerate	<DL*			<= 0.49
16. a-Ketoisocaproate	0.05			<= 0.52
17. a-Keto-ß-methylvalerate	<DL*			<= 1.10
18. Xanthurenate	0.06			<= 0.46
19. ß-Hydroxyisovalerate	3.4			<= 11.5

Methylation Cofactor Markers
(B12, Folate)

20. Methylmalonate	1.9	H		<= 2.3
21. Formiminoglutamate	0.3			<= 2.2

Cell Regulation Markers

Neurotransmitter Metabolism Markers
(Tyrosine, Tryptophan, B6, antioxidants)

22. Vanilmandelate	2.9		1.6 – 3.9	1.2-5.3
23. Homovanillate	2.8		1.9 – 5.7	1.4-7.6
24. 5-Hydroxyindoleacetate	3.6		2.1 – 5.6	1.6-9.8
25. Kynurenate	0.3			<= 1.5
26. Quinolinate	1.6			<= 5.8
27. Picolinate	3.9			2.8-13.5

Oxidative Damage and Antioxidant Markers
(Vitamin C and other antioxidants)

28. p-Hydroxyphenyllactate	0.24			<= 0.66
29. 8-Hydroxy-2-deoxyguanosine	0.7			<= 7.6

Compounds of Bacterial or Yeast/Fungal Origin

Bacterial - general

36. Benzoate	<DL*			<= 9.3
37. Hippurate	97			<= 1070
38. Phenylacetate	0.06			<= 0.18
39. Phenylpropionate	<DL*			<= 0.06
40. p-Hydroxybenzoate	0.2			<= 1.8
41. p-Hydroxyphenylacetate	11			<= 34
42. Indican	30			<= 90
43. Tricarballylate	0.12			<= 1.41

L. acidophilus / general bacterial

44. D-Lactate	3.5	H		<= 4.3

Clostridial species

45. 3,4-Dihydroxyphenylpropionate	<DL*			<= 0.05

Yeast / Fungal

46. D-Arabinitol	40	H		<= 73

Creatinine = 244 mg/dL

Organic acids testing showed high methylmalonic acid above the 1.5 cutoff, which suggested B12 deficiency. Her D-lactate was high, which suggested dysbiosis and SIBO. D-arabinitol was high, confirming fungal overgrowth. Note that although her B12 is low, her MCV, MCH, and MCHC are also low. This indicates that her iron deficiency is a more significant cause of anemia than B12 deficiency.

Remember, in iron-deficiency anemia, you'd expect MCV, MCH, and MCHC to be low, whereas in B12 or folate-deficiency anemia, you'd expect those markers to be high. What can actually happen in some cases where you have concurrent B12 or folate deficiency and iron-deficiency anemia is that MCV, MCH, and MCHC will be normal because you have the B12 and folate deficiency pushing them up and the iron deficiency pushing them down, and that sort of cancels each other out, and they end up being normal. You will see that, and it can be a little bit deceptive, but it doesn't mean they don't have anemia.

In her case, GI malabsorption of iron, B12, and possibly folate deficiency, although her formiminoglutamic acid is normal here, are contributing to anemia, and they are also contributing to her anxiety and neuropathy. Her TSH was also high-normal at 2.5. Hypothyroidism, as we discussed on the previous slide, is another possible cause of anemia, but in my experience, that rarely happens when the hypothyroidism is functional or mild like it is in her case.

Finally, you may have noticed on her blood work slide that her zinc-to-copper ratio is low, suggesting that inflammation is present. All of these things are probably contributing, and we would address these underlying causes, and we would retest, but we would also treat her for the iron-deficiency anemia right away because it is pretty severe in her case, and it's almost certainly contributing significantly to her symptoms. Sometimes in functional medicine, as we've discussed, you need to take a root and a branch approach where you address the root of the problem, but you also address the branch to give the patient immediate relief and help them recover.

Marker	Value	Functional Range	Lab Range
Glucose	97	75 – 90	65 - 99
Hemoglobin A1c	5.1	4.4 – 5.4	4.8 - 5.6
Uric Acid	4.0	3.2 - 5.5	2.5 - 7.1
BUN	6	13 – 18	6 - 20
Creatinine	0.63	0.85 – 1.1	0.57 - 1
BUN/Creatinine Ratio	10	9 – 23	8 - 20
Sodium	137	135 – 140	134 - 144
Potassium	4.3	4.0 – 4.5	3.5 - 5.2
Chloride	103	100 – 106	97 - 108
C02	22	25 – 30	18 - 29
Calcium	9.8	9.2 – 10.1	8.7 - 10.2
Phosphorus	3.4	3.5 – 4.0	2.5 - 5.3
Magnesium	1.9	2.0 – 2.6	1.6 - 2.6
Protein, total	7.1	6.9 – 7.4	6.0 - 8.5
Albumin	4.0	4.0 – 5.0	3.5 - 5.5
Globulin	3.1	2.4 – 2.8	1.5 - 4.5
A/G ratio	1.3	1.5 – 2.0	1.1 - 2.5
Bilirubin, total	<0.2	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	53	42 – 107	39 - 117
LDH	150	140 - 180	119 - 226
AST	21	10 - 30	0 - 40
ALT	26	10 - 22	0 - 32
GGT	13	0 - 28	0 - 60
TIBC	431	250 – 350	250 - 450
UIBC	376	150 - 375	150 - 375
Iron	55	85 – 135	35 - 155
Iron saturation	13	15 – 45	15 - 55
Ferritin	25	15 - 120	15 - 150
Cholesterol, total	185	150 – 250	100 - 199
Triglycerides	143	50 – 100	0 - 89
HDL	79	55 – 85	> 39
LDL	77	0 – 175	0 - 109
T. Chol / HDL Ratio	2.3	< 3	0 - 4.4
Triglycerides / HDL Ratio	1.81	< 2	
TSH	0.014	0.5 – 2.5	0.450 - 4.500
T4, total	12.6	6.0 – 12	4.5 - 12.0
T3 Uptake	20	28 - 35	24 - 39
T3, Total	241	100 – 180	71 - 180
Vitamin D, 25-hydroxy	50.3	35 - 60	30.0 - 100.0

Marker	Value	Functional Range	Lab Range
WBC	5.7	5.0 – 8.0	3.4 - 10.8
RBC	4.89	4.4 – 4.9	3.77 - 5.28
Hemoglobin	14.0	13.5 - 14.5	11.1 - 15.9
Hematocrit	40.8	37 - 44	34.0 - 46.6
MCV	83	85 – 92	79 - 97
MCH	28.6	27.7 – 32.0	26.6 - 33.0
MCHC	34.3	32 – 35	31.5 - 35.7
RDW	14.9	11.5 – 15.0	12.3 - 15.4
Platelets	379	150 – 415	150 - 379
Neutrophils	41	40 – 60	
Lymphocytes	46	25 – 40	
Monocytes	11	4.0 – 7.0	
Eosinophils	1	0.0 – 3.0	
Basophils	1	0.0 – 3.0	
Additional Tests:			
T3, Free	4.5	2.5 - 4.0	2.3 - 5
T4, Free	1.28	1 - 1.5	0.93 - 1.6
CRP-hs	4.77	< 1.0	0.00 - 3.00
Homocysteine	5.7	< 7.0	0.0 - 15.0
Vitamin B-12	517	450 – 2000	211 - 946
Copper	192		72 - 166
Zinc	76		56 - 134
Zinc / Copper Ratio	0.40	> 0.85	
Serum Methylmalonic Acid (MMA)	95	0 - 325	0 - 378

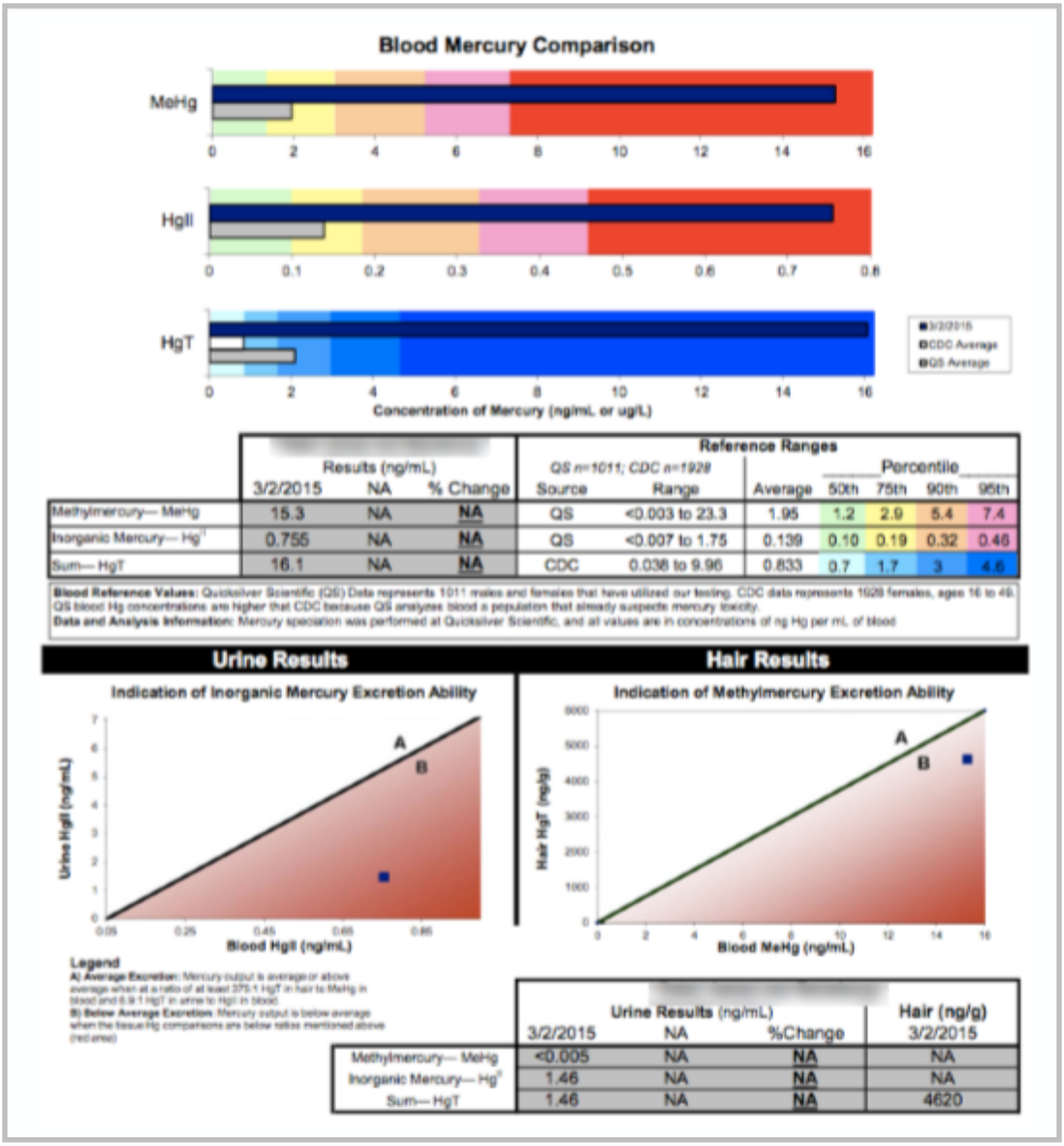
The next patient is a 20-year-old female with a 4 x 1 cm tumor, or goiter, on the thyroid. The size was kind of borderline for surgery, and we talked about her case in the thyroid hyperfunction unit. Her main complaints beyond that were GI issues, food sensitivities, dark circles under her eyes, and weight gain. Her iron saturation was lab-low. Her UIBC was lab-high. Her serum iron and TIBC were outside of the functional range. They were in the direction of iron deficiency, and her ferritin was borderline low at 25. Her red blood cells, hemoglobin, and hematocrit were normal, but her MCV is below the functional range.

This is a case where the patient does not have anemia yet but is on the way to having it. Remember that anemia is the last stage of iron deficiency, and red blood cells, hemoglobin, and hematocrit are the last markers to drop. If you're doing routine testing such as this, you'll often catch people who are in the earlier stages or on the way, and you'll be better able to help them.

Note that she also has markers of inflammation. She has high CRP at 4.77 and high serum copper, which as you know is more likely a marker for inflammation than it is of copper toxicity or excess. She has a low zinc-to-copper ratio. Then, we also know that she has an autoimmune process going on with the thyroid stuff, and autoimmune thyroid and hypothyroidism can lead to anemia.

TEST	RESULT			
Array 3 – Wheat/Gluten Proteome Reactivity & Autoimmunity	**IN RANGE (Normal)**	**EQUIVOCAL***	**OUT OF RANGE**	**REFERENCE** (ELISA Index)
Wheat IgG	0.89			0.3-1.5
Wheat IgA	0.64			0.1-1.2
Wheat Germ Agglutinin IgG	0.81			0.4-1.3
Wheat Germ Agglutinin IgA		1.05		0.2-1.1
Native & Deamidated Gliadin 33 IgG	0.74			0.2-1.2
Native & Deamidated Gliadin 33 IgA	0.60			0.1-1.1
Alpha Gliadin 17-mer IgG	0.69			0.1-1.5
Alpha Gliadin 17-mer IgA		1.06		0.1-1.1
Gamma Gliadin 15-mer IgG	0.67			0.5-1.5
Gamma Gliadin 15-mer IgA	0.29			0.1-1.0
Omega Gliadin 17-mer IgG	0.55			0.3-1.2
Omega Gliadin 17-mer IgA	0.47			0.1-1.2
Glutenin 21-mer IgG			1.57	0.1-1.5
Glutenin 21-mer IgA	0.55			0.1-1.3
Gluteomorphin + Prodynorphin IgG			1.82	0.3-1.2
Gluteomorphin + Prodynorphin IgA		0.92		0.1-1.2
Gliadin-Transglutaminase Complex IgG		1.18		0.3-1.4
Gliadin-Transglutaminase Complex IgA	0.48			0.2-1.5
Transglutaminase-2 IgG	0.90			0.3-1.6
Transglutaminase-2 IgA	1.05			0.1-1.6
Transglutaminase-3 IgG	0.77			0.2-1.6
Transglutaminase-3 IgA	0.77			0.1-1.5
Transglutaminase-6 IgG	0.57			0.2-1.5
Transglutaminase-6 IgA	0.54			0.1-1.5

This patient also had gluten intolerance and was not following a gluten-free diet, and that was likely contributing to malabsorption.



	Results (ng/mL)			Reference Ranges			Percentile			
	3/2/2015	NA	% Change	Source	Range	Average	50th	75th	90th	95th
Methylmercury— MeHg	15.3	NA	NA	QS	<0.003 to 23.3	1.95	1.2	2.9	5.4	7.4
Inorganic Mercury— Hg^{+}	0.755	NA	NA	QS	<0.007 to 1.75	0.139	0.10	0.19	0.32	0.46
Sum— HgT	16.1	NA	NA	CDC	0.036 to 9.96	0.833	0.7	1.7	3	4.6

Blood Reference Values: Quicksilver Scientific (QS) Data represents 1011 males and females that have utilized our testing. CDC data represents 1928 females, ages 16 to 49. QS blood Hg concentrations are higher that CDC because QS analyzes blood a population that already suspects mercury toxicity.
Data and Analysis Information: Mercury speciation was performed at Quicksilver Scientific, and all values are in concentrations of ng Hg per mL of blood

Urine Results

Indication of Inorganic Mercury Excretion Ability

Hair Results

Indication of Methylmercury Excretion Ability

Legend
A) Average Excretion: Mercury output is average or above average when at a ratio of at least 375:1 HgT in hair to MeHg in blood and 6.9:1 HgT in urine to HgII in blood.
B) Below Average Excretion: Mercury output is below average when the tissue:Hg comparisons are below ratios mentioned above (red area)

	Urine Results (ng/mL)			Hair (ng/g)
	3/2/2015	NA	%Change	3/2/2015
Methylmercury— MeHg	<0.005	NA	NA	NA
Inorganic Mercury— Hg^{+}	1.46	NA	NA	NA
Sum— HgT	1.46	NA	NA	4620

She had significant mercury toxicity, as you can see here. Both inorganic and organic mercury levels were high, and her detox capacity for both was impaired, but particularly for inorganic mercury. Remember that poisoning from toxins such as heavy metals can contribute to anemia. In her case, we have a combination of inflammation, autoimmunity, toxins, and GI malabsorption.

The next patient is a 35-year-old female with the chief complaint of infertility. She also had Hashimoto's and significant fatigue. She was a vegetarian for 15 years and had switched to Paleo four months before coming to see me.

Marker	Value	Functional Range	Lab Range
Glucose	86	75 - 90	65 - 99
BUN	15	13 – 18	6 - 20
Creatinine	0.60	0.85 – 1.1	0.57 - 1
BUN/Creatinine Ratio	25	9 – 23	8 - 20
Sodium	138	135 – 140	134 - 144
Potassium	4.4	4.0 – 4.5	3.5 - 5.2
Chloride	102	100 – 106	97 - 108
C02	21	25 – 30	18 - 29
Calcium	9.8	9.2 – 10.1	8.7 - 10.2
Protein, total	6.9	6.9 – 7.4	6.0 - 8.5
Albumin	4.6	4.0 – 5.0	3.5 - 5.5
Globulin	2.3	2.4 – 2.8	1.5 - 4.5
A/G ratio	2.0	1.5 – 2.0	1.1 - 2.5
Bilirubin, total	0.5	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	42	42 – 107	39 - 117
AST	22	10 - 30	0 - 40
ALT	11	10 - 22	0 - 32
TSH	0.099	0.5 – 2.5	0.45 - 4.50
T3, Free	4.2	2.5 - 4.0	2 - 4.4
T4, Free	1.21	1 - 1.5	0.82 - 1.77
Thyroid – TPO Ab	311		0 - 34
Thyroid – TGA	1120.5		0 - 0.9
WBC	6.0	5.0 – 8.0	3.4 - 10.8
RBC	5.93	4.4 – 4.9	3.77 - 5.28
Hemoglobin	12.2	13.5 - 14.5	11.1 - 15.9
Hematocrit	37.6	37 - 44	34 - 46.6
MCV	63	85 – 92	79 - 97
MCH	20.6	27.7 – 32.0	26.6 - 33.0
MCHC	32.4	32 – 35	31.5 - 35.7
RDW	15.0	11.5 – 15.0	12.3 - 15.4
Platelets	285	150 – 415	150 - 379
Neutrophils	58	40 – 60	
Lymphocytes	28	25 – 40	
Monocytes	10	4.0 – 7.0	
Eosinophils	3	0.0 – 3.0	
Basophils	1	0.0 – 3.0	
Cyclic AMP, Plasma	19.1		12 - 22

Note her extremely high thyroglobulin antibodies. These are among the highest that I've ever seen. She also has very high TPO antibodies, and her TSH was effectively zero. She was on a combination of Armour and Synthroid. I'm not entirely sure why. It's an unusual combination. Her free T3 is predictably borderline high because of this.

She brought lab work in from another provider, which didn't have an iron panel, as is unfortunately typical. Just with the CBC that was run, we can determine that she likely has iron-deficiency anemia. Her hemoglobin is functionally low at 12.2, but her MCV is lab-low at 63, and her MCH is lab-low at 20.6. Those are both quite low. Remember that MCV, MCH, and MCHC can be used to distinguish between iron-deficiency anemia and B12 and folate deficiency anemia.

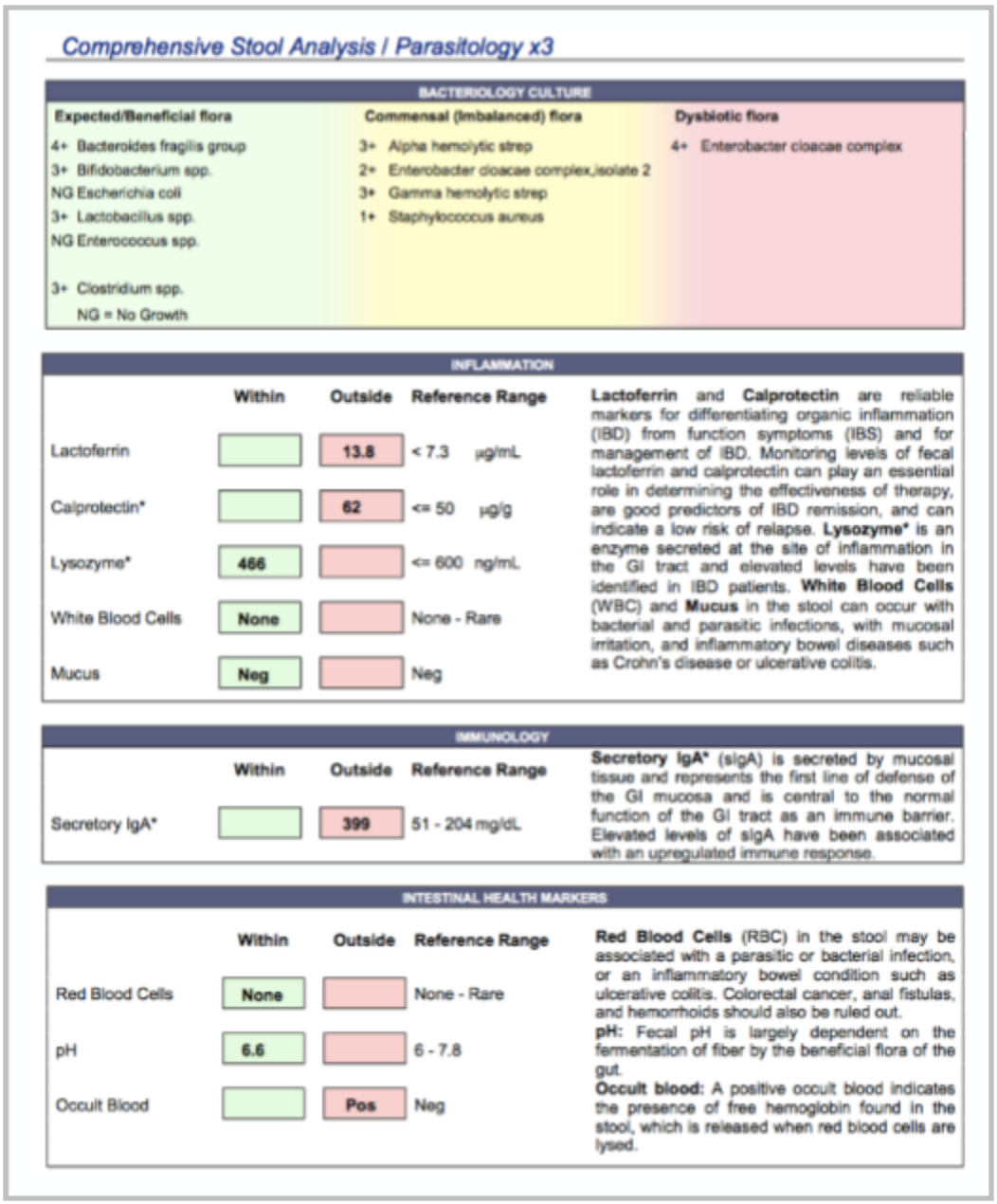
Check out her red blood cell count. In this case, it is actually lab-high at 5.93. That is unusual, but it's not unheard of. It can sometimes be caused by dehydration. In that case, you might expect BUN to be high, but it's not for her. It's actually low-normal for her. It can also be caused by hemoglobinopathies and thalassemias, which reduce oxygen deliverability, and the body increases red blood cell production to compensate. Hemoglobinopathies are most common in people of African and Southeast Asian descent, and this patient was Vietnamese. I referred her to a hematologist for workup, and I suggest you do this when you see an unusual presentation that is difficult to explain, but you should first retest to confirm that those markers are actually consistently in that pattern before you refer out in most cases.

Marker	Value	Functional Range	Lab Range
Glucose	88	75 - 90	65 - 99
Hemoglobin A1c	5.2	4.4 – 5.4	4.8 - 5.6
Uric Acid	4.7	3.7 – 6.0	3.7 - 8.6
BUN	16	13 – 18	6 - 20
Creatinine	0.90	0.85 – 1.1	0.76 - 1.27
BUN/Creatinine Ratio	18	8 – 19	8 - 19
Sodium	142	135 – 140	134 - 144
Potassium	4.4	4.0 – 4.5	3.5 - 5.2
Chloride	100	100 – 106	97 - 108
C02	24	25 – 30	18 - 29
Calcium	8.6	9.2 – 10.1	8.7 - 10.2
Phosphorus	3.7	3.5 – 4.0	2.5 - 4.5
Magnesium	2.1	2.0 – 2.6	1.6 - 2.6
Protein, total	5.6	6.9 – 7.4	6.0 - 8.5
Albumin	3.9	4.0 – 5.0	3.5 - 5.5
Globulin	1.7	2.4 – 2.8	1.5 - 4.5
A/G ratio	2.3	1.5 – 2.0	1.1 - 2.5
Bilirubin, total	0.2	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	48	42 – 107	39 - 117
LDH	154	140 - 180	121 - 224
AST	23	10 - 30	0 - 40
ALT	22	10 - 29	0 - 44
GGT	13	0 - 40	0 - 65
TIBC	322	250 – 350	250 - 450
UIBC	293	150 - 375	150 - 375
Iron	29	85 – 135	40 - 155
Iron saturation	9	15 – 45	15 - 55
Ferritin	58	30 - 150	30 - 400
Cholesterol, total	176	150 - 240	100 - 199
Triglycerides	48	50 – 100	0 - 149
HDL	69	55 – 85	> 39
LDL	97	0 – 175	0 - 99
T. Chol / HDL Ratio	2.6	< 3	0 - 5.0
Triglycerides / HDL Ratio	0.70	< 2	< 3.8
TSH	2.070	0.5 – 2.5	0.450 - 4.500
T4, total	8.2	6.0 – 12	4.5 - 12
T3 Uptake	26	30 - 38	24 - 39
T3, Total	76	100 – 180	71 - 180
Vitamin D, 25-hydroxy	31.1	35 - 60	30.0 - 100.0

Marker	Value	Functional Range	Lab Range
WBC	6.5	5.0 – 8.0	3.4 - 10.8
RBC	4.77	4.4 – 4.9	4.14 - 5.8
Hemoglobin	13.8	14 - 15	12.6 - 17.7
Hematocrit	41.4	40 - 48	37.5 - 51.0
MCV	87	85 – 92	79 - 97
MCH	28.9	27.7 – 32.0	26.6 - 33.0
MCHC	33.3	32 – 35	31.5 - 35.7
RDW	16.1	11.5 – 15.0	12.3 - 15.4
Platelets	189	150 – 415	150 - 379
Neutrophils	65	40 – 60	
Lymphocytes	15	25 – 40	
Monocytes	11	4.0 – 7.0	
Eosinophils	8	0.0 – 3.0	
Basophils	1	0.0 – 3.0	
Additional Tests:			
T3, Free	2.2	2.5 - 4.0	2 - 4.4
T4, Free	1.12	1 - 1.5	0.82 - 1.77
Thyroid – TPO Ab	8		0 - 34
Thyroid – TGA	<1.0		0 - 0.9
CRP-hs	8.37	< 1.0	0.00 - 3.00
Homocysteine	7.6	< 7.0	0.0 - 15.0
Vitamin B-12	338	450 – 2000	211 - 946
Copper	108		72 - 166
Zinc	96		56 - 134
Zinc / Copper Ratio	0.89	> 0.85	
Serum Methylmalonic Acid (MMA)	150	0 - 325	0 - 378

The next case is a 29-year-old male with constipation, skin issues, unexplained weight loss, fatigue, and loss of libido. Serum iron was lab-low at 29. Iron saturation was lab-low at 9. TIBC, UIBC, and ferritin were completely normal. Red blood cell indices were mostly normal except for functionally low hemoglobin at 13.8. His RDW, red blood cell distribution width, was lab-high at 16.1. CRP was quite high at 8.3, and B12 was borderline low at 338.

This is a good example of an important thing to be aware of. Ferritin here is normal, and we know that inflammation increases ferritin, and iron deficiency decreases it. If a patient has both inflammation and iron deficiency, ferritin can be normal, as it is here. In this case, the CRP, soluble transferrin receptor, and A1-acid glycoprotein can be useful markers for determining whether iron deficiency, inflammation, or both are present, and in this case, it turned out to be both.



Comprehensive Stool Analysis / Parasitology x3

BACTERIOLOGY CULTURE

Expected/Beneficial flora	Commensal (Imbalanced) flora	Dysbiotic flora
4+ Bacteroides fragilis group	3+ Alpha hemolytic strep	4+ Enterobacter cloacae complex
3+ Bifidobacterium spp.	2+ Enterobacter cloacae complex,isolate 2	
NG Escherichia coli	3+ Gamma hemolytic strep	
3+ Lactobacillus spp.	1+ Staphylococcus aureus	
NG Enterococcus spp.		
3+ Clostridium spp.		

NG = No Growth

INFLAMMATION

	Within	Outside	Reference Range
Lactoferrin		13.8	< 7.3 µg/mL
Calprotectin*		62	<= 50 µg/g
Lysozyme*	466		<= 600 ng/mL
White Blood Cells	None		None - Rare
Mucus	Neg		Neg

Lactoferrin and **Calprotectin** are reliable markers for differentiating organic inflammation (IBD) from function symptoms (IBS) and for management of IBD. Monitoring levels of fecal lactoferrin and calprotectin can play an essential role in determining the effectiveness of therapy, are good predictors of IBD remission, and can indicate a low risk of relapse. **Lysozyme*** is an enzyme secreted at the site of inflammation in the GI tract and elevated levels have been identified in IBD patients. **White Blood Cells** (WBC) and **Mucus** in the stool can occur with bacterial and parasitic infections, with mucosal irritation, and inflammatory bowel diseases such as Crohn's disease or ulcerative colitis.

IMMUNOLOGY

	Within	Outside	Reference Range
Secretory IgA*		399	51 - 204 mg/dL

Secretory IgA* (sIgA) is secreted by mucosal tissue and represents the first line of defense of the GI mucosa and is central to the normal function of the GI tract as an immune barrier. Elevated levels of sIgA have been associated with an upregulated immune response.

INTESTINAL HEALTH MARKERS

	Within	Outside	Reference Range
Red Blood Cells	None		None - Rare
pH	6.6		6 - 7.8
Occult Blood		Pos	Neg

Red Blood Cells (RBC) in the stool may be associated with a parasitic or bacterial infection, or an inflammatory bowel condition such as ulcerative colitis. Colorectal cancer, anal fistulas, and hemorrhoids should also be ruled out.
pH: Fecal pH is largely dependent on the fermentation of fiber by the beneficial flora of the gut.
Occult blood: A positive occult blood indicates the presence of free hemoglobin found in the stool, which is released when red blood cells are lysed.

Stool panel revealed insufficiency and pathogenic dysbiosis, gut inflammation, and blood in his stool. Remember that the primary cause of iron-deficiency anemia in males is gastrointestinal bleeding. I referred him out for colonoscopy, and he was diagnosed with inflammatory bowel disease.