KRESSER INSTITUTE
FOR FUNCTIONAL AND EVOLUTIONARY MEDICINE

Iron Deficiency - Part Three

Reticulocyte hemoglobin content

Reticulocyte hemoglobin content, or CHr, is a new, sensitive marker of iron deficiency. CHr measures the amount of hemoglobin in reticulocytes. Reticulocytes are the youngest erythrocytes released from the bone marrow into circulating blood. They mature for one to three days within the bone marrow and then circulate for one to two days before becoming mature red blood cells. CHr provides an indirect measure of the functional iron available for new red blood cell production over the previous three to four days. And some evidence suggests that it's the most sensitive marker of iron deficiency and the first to go out of range, especially in children. It's not yet widely available in the U.S., but some Quest Diagnostics locations have it, and it can also be ordered through **Spectra Labs**, which is a specialized lab in New Jersey. Unfortunately, LabCorp does not run it at the moment.

Reference ranges for iron markers

Marker	Men	Pre-menopausal women	Post-menopausal women
Serum iron	40–155 ug/dL	40–155 ug/dL	40–155 ug/dL
Serum ferritin	30–400 ng/mL	15–150 ng/mL	15–150 ng/mL
Transferrin saturation	15–55%	15–55%	15–55%
TIBC	250–450 ug/dL	250–450 ug/dL	250–450 ug/dL
UIBC	150–375 ug/dL	150–375 ug/dL	150–375 ug/dL
sTfR	12.2–27.3 nmol/L	12.2–27.3 nmol/L	12.2–27.3 nmol/L
CHr	24.5–31.8 pg	24.5–31.8 pg	24.5–31.8 pg

As with most nutrients, the reference range for iron varies according to age and gender. Note that the reference range will vary from lab to lab. The ranges that I put here on this slide are from LabCorp, but Kaiser ranges tend to be broader, for example. And this is, of course, one of the ridiculous things about lab ranges. They're based on many different factors, but rarely on what's optimal for health. And we'll have a handout for you that contains the laboratory reference ranges for these markers as well as the functional ranges, which we're going to cover on the next slide.

Functional ranges for iron markers

Marker	Men	Pre-menopausal women	Post-menopausal women
Serum iron	40–135 ug/dL	40–135 ug/dL	40–135 ug/dL
Serum ferritin	30–200 ng/mL	30-100 ng/mL	30-100 ng/mL
Transferrin saturation	17–45%	17-45%	17-45%
TIBC	275–425 ug/dL	275-425 ug/dL	275-425 ug/dL
UIBC	175–350 ug/dL	175-350 ug/dL	175-350 ug/dL
sTfR	14.5-25 nmol/L	13-25 nmol/L	14.5-25 nmol/L
CHr	24.5–31.8 pg	24.5–31.8 pg	24.5–31.8 pg

I've listed the functional ranges for iron markers on this slide. These are based on recommendations from the Iron Disorders Institute as well as my extensive reading of the scientific literature. The bottom end of the range for serum ferritin would be 30 for men and postmenopausal and premenopausal women. For transferrin saturation, the bottom end of the range would be 17 percent instead of 15 percent. That's the major difference with the lab reference range on the low end in terms of iron deficiency. And then for TIBC, the upper end of the range would be 425. For UIBC, the upper end would be 350. For soluble transferrin receptor, the upper end would be 25, and then for CHr, you would just use the standard lab reference range. There's really no data for functional range for that marker. And because it's so highly sensitive for iron deficiency, I think we can just use the reference range in that case.

Marker	Value	Functional Range	Lab Range
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	275 – 425	250 - 450
UIBC	401	175 - 350	131 - 425
Iron	26	40 – 135	27 - 159
Iron saturation	6	17 – 45	15 - 55
Ferritin	6	30 - 100	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	

All right. Let's dive into some lab results and case studies. This patient here had a long history of anxiety and panic attacks and has tried coming off Zoloft several times but felt withdrawal symptoms in each case and had to restart and was also taking oral contraceptives for pelvic pain. She was a 28-year-old female. Her ferritin, iron saturation, and serum iron are all below the lab range. TIBC and UIBC are outside of the functional range. I'm not covering anemia in this presentation, as I mentioned, but as you can see, her hemoglobin and MCH are out of the lab reference range. Red blood cells, hematocrit, and MCV are functionally low, so this is an iron-deficient anemia condition.

She has a number of issues that can predispose her to iron-deficiency anemia. She has Blastocystis hominis parasite, fungal overgrowth in her gut, and insufficiency dysbiosis. She also has severe SIBO with both hydrogen and methane overproduction, which would be indicative of malabsorption; high total cortisol levels; and a disrupted diurnal 24-hour free cortisol rhythm. She has several markers of inflammation, including elevated C-reactive protein, at least outside of the optimal range, as you can see here, it's 2.5; and a high copper-to-zinc ratio. Copper and zinc, just briefly, are not really best considered measures of dietary intake or even nutritional status of copper and zinc in the blood. They are really better considered markers of inflammation, so when

you see high levels of copper relative to zinc, that's a marker of inflammation just like CRP or ferritin. We'll cover that in a different presentation in ADAPT.

Note that her TSH is high-normal out of the functional range. Iron deficiency has been shown to impair thyroid function in numerous ways. It reduces T4 to T3 conversion. It reduces thyroid hormone synthesis, and it reduces thyroid peroxidase activity.

Anxiety and panic attacks are certainly a possible symptom of iron-deficiency anemia because the brain needs oxygen to function properly, and in anemia, oxygen delivery is impaired.

Marker	Value	Functional Range	Lab Range
Glucose	78	75 - 90	65 - 99
Hemoglobin A1c	5.6	4.4 – 5.4	4.8 - 5.6
Uric Acid	4.5	3.2 - 5.5	2.5 - 7.1
BUN	12	13 – 18	6 - 20
Creatinine	0.74	0.85 – 1.1	0.57 - 1.00
BUN/Creatinine Ratio	16	9 – 23	9 - 23
Sodium	138	135 – 140	134 - 144
Potassium	3.8	4.0 – 4.5	3.5 - 5.2
Chloride	98	100 – 106	97 - 108
C02	21	25 – 30	18 - 29
Calcium	9.1	9.2 – 10.1	8.7 - 10.2
Phosphorus	4.5	3.5 – 4.0	2.5 - 4.5
Magnesium	1.9	2.0 – 2.6	1.6 - 2.6
Protein, total	7.6	6.9 – 7.4	6.0 - 8.5
Albumin	4.3	4.0 – 5.0	3.5 - 5.5
Globulin	3.3	2.4 – 2.8	1.5 - 4.5
A/G ratio	1.3	1.5 – 2.0	1.1 - 2.5
Bilirubin, total	0.3	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	141	42 – 107	39 - 117
LDH	196	140 - 180	119 - 226
AST	16	10 - 30	0 - 40
ALT	27	10 - 22	0 - 32
GGT	98	0 - 28	0 - 60
TIBC	436	275 – 425	250 - 450
UIBC	416	175 - 350	150 - 375
Iron	20	40 – 135	35 - 155
Iron saturation	5	17 – 45	15 - 55
Ferritin	6	30 - 100	15 - 150
Vitamin B-12	389	450 – 2000	211 - 946
Vitamin D, 25-hydroxy	32.9	35 - 60	30.0 - 100.0
Cholesterol, total	145	150 - 250	100 - 199
Triglycerides	127	50 – 100	0 - 149
HDL	47	55 – 85	> 39
LDL	73	0 - 175	0 - 99
T. Chol / HDL Ratio	3.1	< 3	0 - 4.4
Triglycerides / HDL Ratio	2.70	< 2	< 3.8
CRP-hs	5.93	< 1.0	0.00 - 3.00
Homocysteine	11.2	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	2.660	0.5 – 2.5	0.45 - 4.500
T4, total	7.0	6.0 – 12	4.5 - 12.0
T3 Uptake	27	28 - 35	24 - 39
T3, Total	126	100 – 180	71 - 180
Copper	134		72 - 166
Zinc	79		56 - 134
Zinc / Copper Ratio	0.59	> 0.85	
Serum Methylmalonic Acid (MMA)	107	0 - 325	0 - 378
WBC	8.1	5.0 – 8.0	3.4 - 10.8
RBC	5.11	4.4 – 4.9	3.77 - 5.28
Hemoglobin	11.2	13.5 - 14.5	11.1 - 15.9
Hematocrit	37.2	37 - 44	34 - 46.6
MCV	73	85 – 92	79 - 97
MCH	21.9	27.7 – 32.0	26.6 - 33.0
MCHC	30.1	32 – 35	31.5 - 35.7
RDW	17.6	11.5 – 15.0	12.3 - 15.4
Platelets	376	150 – 415	150 - 379
Neutrophils	46	40 – 60	
Lymphocytes	38	25 – 40	
Monocytes	9	4.0 – 7.0	
Eosinophils	6	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

The next patient is a 22-year-old female with ulcerative colitis who had a complete colectomy prior to coming to see us and had a j-pouch with persistent bleeding. Did a stool test shortly before our visit and was positive for H. pylori but had not had any treatment for that. Prior to surgery, she tried the specific carbohydrate diet and followed that strictly for two-and-a-half years but, unfortunately, got worse on the SCD and was never able to go into remission. She even tried several of the prescription medications, steroids, and other immunosuppressant drugs but developed osteoporosis while on them and, again, still did not enter remission.

As you can see, all of her iron markers except TIBC are out of the lab reference range. Hemoglobin is two-tenths of a point from being low. MCV, MCH, and MCHC are all low. RDW is high. This is significant iron-deficiency anemia from both blood loss and malabsorption, which she had had for years. Also note the high levels of alkaline phosphatase, GGT, and CRP; functional high levels of LDH, ALT, homocysteine, copper-to-zinc ratio, and absolute eosinophils. These are all indicators of inflammation. She also has multiple nutrient deficiencies, including B12, magnesium, vitamin D, and borderline high thyroid-stimulating hormone. This is a really difficult case and a sad case for such a young woman.

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 - 24
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 - 2.3
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	275 – 425	250 - 450
UIBC	293	175 - 350	150 - 375
Iron	29	40 – 135	40 - 155
Iron saturation	9	17 – 45	15 - 55
Ferritin	58	30 - 100	30 - 400
Vitamin B-12	338	450 – 2000	211 - 946
Vitamin D, 25-hydroxy	31.1	35 - 60	30.0 - 100.0
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
CRP-hs	8.37	< 1.0	0.00 - 3.00
Homocysteine	7.6	< 7.0	0.0 - 15.0

This is a 28-year-old male. It's less common to see iron deficiency in males, but it still does happen. About three years ago, his father had gastric cancer and had his stomach removed. This patient became quite sick, which was stress related. He lost weight, got down to 105 pounds, and was extremely constipated. He couldn't have a bowel movement without an enema for almost six

months. He was doing coffee enemas almost daily. His diet became so restrictive. He could eat a very small number of foods. Then he was on a GAPS type of diet for about two years until he came to see me. He had frequent fatigue, no sex drive, and knee and joint pain.

His serum iron and iron saturation were low, but ferritin TIBC and UIBC were normal. RDW was high. Hemoglobin was functionally low, but hematocrit, MCV, MCH, and MCHC were all normal. Note the low nutrient status. Calcium, total protein, vitamin D, and B12 were all low. This is likely due to malabsorption, as you'll see on the next slide. This case illustrates an important principle, which is that sometimes you'll see a textbook presentation where all of the markers are in the expected range given the patient's circumstances, but oftentimes that won't be the case. Ferritin is a long-term storage form of iron, but as we discussed, it's also an acute-phase reactant, which can be elevated in the inflammatory response. So, if a patient has inflammation, which he does—look at his C-reactive protein level; it's 8.37, which is quite high—that can increase ferritin as well. Even in the face of significant iron deficiency, which he has, we can see a normal ferritin. This is why it is so important to do the entire iron panel and not just ferritin, as many clinicians do. I would say most clinicians don't do any iron markers at all, but if they do, they only run ferritin, and you can clearly see the problem with that with this particular case.

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.

He had several significant findings, not surprisingly given his constipation, on the stool test. He had insufficiency of some species of beneficial bacteria. He had a 4+ for Enterobacter cloacae. He had elevated levels of lactoferrin and calprotectin, which are indicative of inflammation in the gut. At these moderately elevated levels, they are not likely to be indicators of inflammatory bowel

disease. When lactoferrin and calprotectin are significantly elevated, that is what they do signal, Crohn's or ulcerative colitis, but at these mild or moderate elevations, they are more likely to signal fungal overgrowth, dysbiosis, parasite, or something like that.

You can see his secretory IgA levels are high. That indicates activation of the immune response in the gut. Then he has positive for occult blood, which could suggest blood loss and malabsorption due to intestinal bleeding.

Marker	Value	Functional Range	Lab Range
BUN	13	13 – 18	8 - 22
Creatinine	0.89	0.85 – 1.1	0.44 - 1.27
BUN/Creatinine Ratio	15	9 – 23	9 - 23
Sodium	138	135 – 140	135 - 145
Potassium	4.6	4.0 – 4.5	3.3 - 5
Chloride	106	100 – 106	95 - 110
C02	28	25 – 30	24 - 32
Protein, total	6.9	6.9 – 7.4	6.3 - 8.3
Albumin	4.1	4.0 – 5.0	3.4 - 4.8
Bilirubin, total	0.4	0.1 – 1.2	0.3 - 1.3
Alkaline Phosphatase	26	42 – 107	35 - 115
AST	18	10 - 30	15 - 43
ALT	20	10 - 22	5 - 54
TIBC	341	275 – 425	280 - 400
Iron	79	40 – 135	42 - 135
Iron saturation	23.2	17 – 45	15 - 50
Ferritin	8	30 - 100	10 - 291
Vitamin B-12	317	450 – 2000	213 - 816
Vitamin D, 25-hydroxy	19.8	35 - 60	30.0 - 100.0
Cholesterol, total	198	150 - 250	0 - 200
Triglycerides	27	50 – 100	35 - 160
HDL	128	55 – 85	> 34
LDL	65	0 - 175	< 130
T. Chol / HDL Ratio	1.5	< 3	< 4.0
Triglycerides / HDL Ratio	0.21	< 2	< 3.8

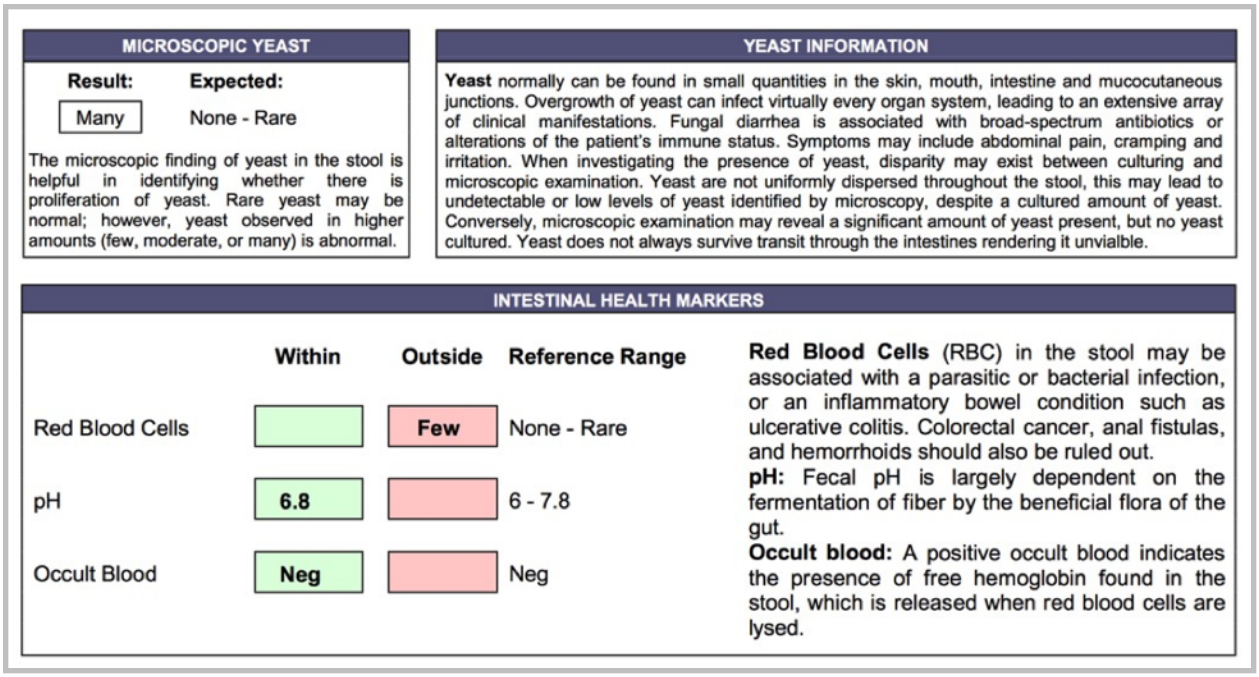
Marker	Value	Functional Range	Lab Range
TSH	6.32	0.5 – 2.5	0.35 - 3.30
T4, Free	1.04	1 - 1.5	0.56 - 1.64
WBC	4.8	5.0 – 8.0	4.5 - 11
RBC	4.66	4.4 – 4.9	3.7 - 5.5
Hemoglobin	13.6	13.5 - 14.5	12 - 16
Hematocrit	41.2	37 - 44	34 - 46.0
MCV	88.5	85 – 92	80 - 100
MCH	29.3	27.7 – 32.0	27.0 - 33.0
MCHC	33.1	32 – 35	32.0 - 36.0
RDW	15.1	11.5 – 15.0	0.0 - 14.7
Platelets	222	150 – 415	130 - 400
Neutrophils	50.7	40 – 60	
Lymphocytes	36.1	25 – 40	
Monocytes	8.1	4.0 – 7.0	
Eosinophils	4.5	0.0 – 3.0	
Basophils	0.6	0.0 – 3.0	

This is a 47-year-old female with fibromyalgia, Hashimoto's, and a history of anemia with no explanation. She didn't have complete blood work when she initially came to see me and chose not to get the full case review panel that we ordered, but you can see on this slide what we did have for this patient. Note that in the iron panel only ferritin was low. As I mentioned earlier in the presentation, ferritin is the first marker often to go out of range, but other markers are out of whack. You can see a high TSH, indicating hypothyroidism. Low vitamin D. Triglycerides are very low. HDL is high, which can actually be a sign of inflammation and autoimmunity in some cases. Alkaline phosphatase is low, which sometimes occurs with hypothyroidism. Other times, a zinc deficiency can be the cause of that. Other testing reveals SIBO, dysbiosis, high free cortisol, and low metabolized cortisol, which is another common finding in hypothyroidism because thyroid hormone is required to metabolize cortisol, and impaired methylation. After treating the SIBO and dysbiosis in this patient, her iron levels started to recover.

Marker	Value	Functional Range	Lab Range
Glucose	87	75 - 90	65 - 99
Hemoglobin A1c	5.6	4.4 – 5.4	4.8 - 5.6
Uric Acid	4.4	3.2 - 5.5	2.5 - 7.1
BUN	14	13 – 18	6 - 24
Creatinine	0.90	0.85 – 1.1	0.57 - 1
BUN/Creatinine Ratio	16	9 – 23	9 - 23
Sodium	140	135 – 140	134 - 144
Potassium	4.4	4.0 – 4.5	3.5 - 5.2
Chloride	101	100 – 106	97 - 108
C02	26	25 – 30	18 - 29
Calcium	9.4	9.2 – 10.1	8.7 - 10.2
Phosphorus	3.3	3.5 – 4.0	2.5 - 4.5
Magnesium	1.8	2.0 – 2.6	1.6 - 2.3
Protein, total	7.0	6.9 – 7.4	6.0 - 8.5
Albumin	4.6	4.0 – 5.0	3.5 - 5.5
Globulin	2.4	2.4 – 2.8	1.5 - 4.5
A/G ratio	1.9	1.5 – 2.0	1.1 - 2.5
Bilirubin, total	0.4	0.1 – 1.2	0.0 - 1.2
Alkaline Phosphatase	52	42 – 107	39 - 117
LDH	168	140 - 180	119 - 226
AST	17	10 - 30	0 - 40
ALT	14	10 - 22	0 - 32
GGT	28	0 - 28	0 - 60
TIBC	447	275 – 425	250 - 450
UIBC	381	175 - 350	131 - 425
Iron	66	40 – 135	27 - 159
Iron saturation	15	17 – 45	15 - 55
Ferritin	12	30 - 100	15 - 150
Vitamin B-12	626	450 – 2000	211 - 946
Vitamin D, 25-hydroxy	53.6	35 - 60	30.0 - 100.0
Cholesterol, total	187	150 - 250	100 - 199
Triglycerides	68	50 – 100	0 - 149
HDL	91	55 – 85	> 39
LDL	82	0 - 175	0 - 99
T. Chol / HDL Ratio	2.1	< 3	0 - 4.4
Triglycerides / HDL Ratio	0.75	< 2	< 3.8
CRP-hs	0.05	< 1.0	0.00 - 3.00
Homocysteine	8.4	< 7.0	0.0 - 15.0

Marker	Value	Functional Range	Lab Range
TSH	2.260	0.5 – 2.5	0.45 - 4.50
T4, total	7.8	6.0 – 12	4.5 - 12
T3 Uptake	30	28 - 35	24 - 39
T3, Total	94	100 – 180	71 - 180
Copper	131		72 - 166
Zinc	140		56 - 134
Zinc / Copper Ratio	1.07	> 0.85	
Serum Methylmalonic Acid (MMA)	156	0 - 325	0 - 378
WBC	6.1	5.0 – 8.0	3.4 - 10.8
RBC	4.32	4.4 – 4.9	3.77 - 5.28
Hemoglobin	12.3	13.5 - 14.5	11.1 - 15.9
Hematocrit	38.1	37 - 44	34 - 46.6
MCV	88	85 – 92	79 - 97
MCH	28.5	27.7 – 32.0	26.6 - 33.0
MCHC	32.3	32 – 35	31.5 - 35.7
RDW	14.4	11.5 – 15.0	12.3 - 15.4
Platelets	269	150 – 415	150 - 379
Neutrophils	63	40 – 60	
Lymphocytes	27	25 – 40	
Monocytes	6	4.0 – 7.0	
Eosinophils	3	0.0 – 3.0	
Basophils	1	0.0 – 3.0	

The next patient is a 45-year-old female with persistent GI issues for as long as she could remember. She was perimenopausal with hot flashes, brain fog, mood swings, poor sleep, and significant fatigue. She was recently diagnosed with arthritis and psoriasis, and her mother had psoriatic arthritis. As you can see, we're catching the early first stage of iron-deficiency anemia here. Her ferritin is low at 12. Her transferrin saturation is outside of the functional range and almost out of the lab range. Her TIBC and UIBC are also elevated in the functional range, which, again, these are inverse markers, so that suggests low levels of iron. Then her red blood cells and hemoglobin are functionally low as well.



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 unvialble.

INTESTINAL HEALTH MARKERS

	Within	Outside	Reference Range
Red Blood Cells		Few	None - Rare
pH	6.8		6 - 7.8
Occult Blood	Neg		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.

This patient had significant fungal overgrowth, as you can see here, and she had red blood cells in her stool, which is an indicator of inflammation in the gut, and that can be causing mild blood loss.