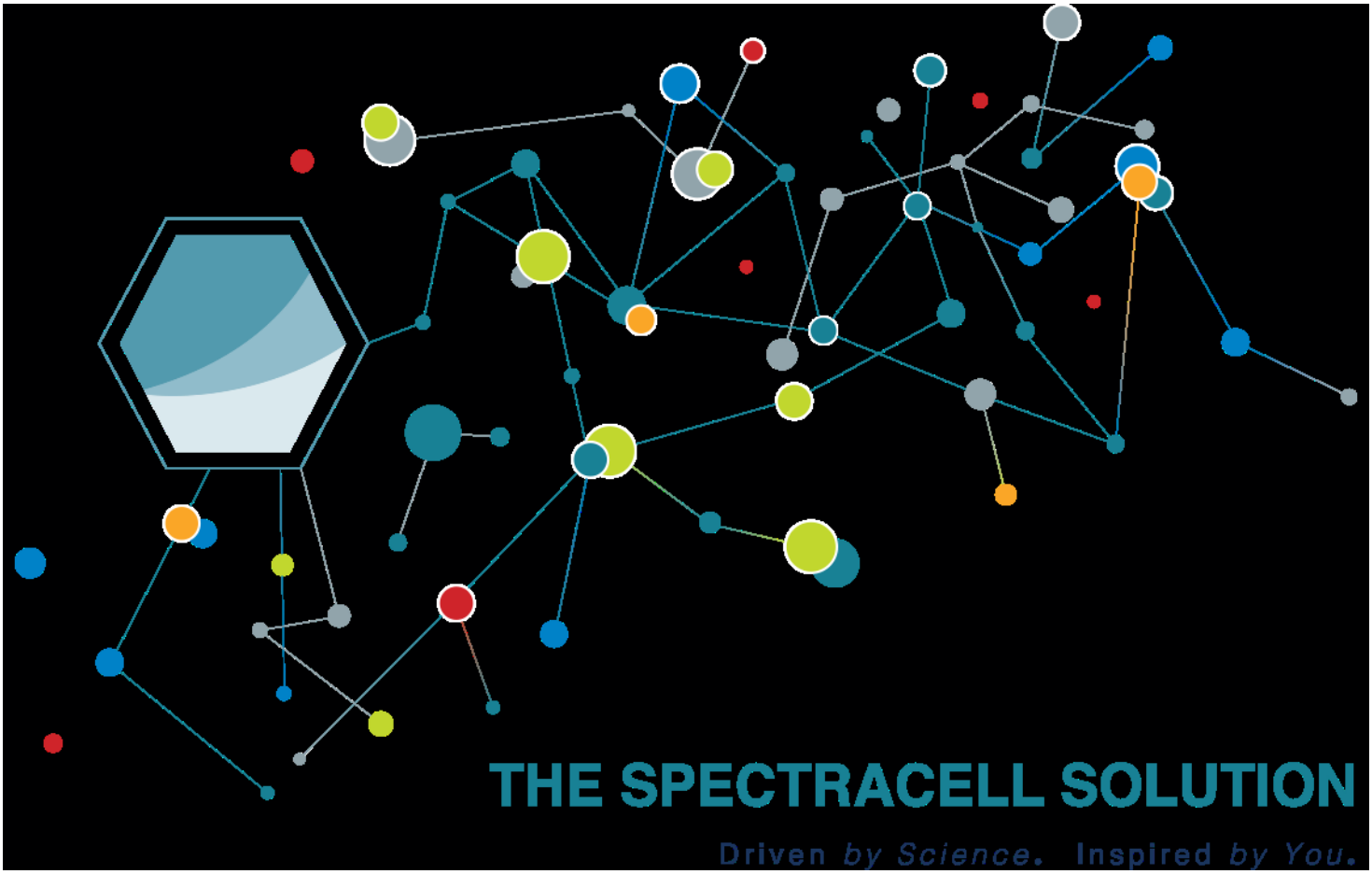

Patient: **Doe, J**

Accession ID: 0000000001

Provider: Ruth

Order Status: Complete

LPP Plus

Micronutrient Panel

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PATIENT

NAME	AGE
Doe, J	**44**
DOB	GENDER
1/01/1976	**Male**
PATIENT ID	
00-00001	

SPECIMEN

ACCESSION ID	DATE COLLECTED
0000001	**05/13/2020**
ORDER ID	DATE RECEIVED
0000-0000001	**05/14/2020**
	DATE REPORTED
	05/26/2020

PROVIDER

ACCOUNT ID	CLIENT NAME
0000001	**Ruth**
ADDRESS	
555 Nowhere Dr. **Nowhere, CA 00000**	

Normal | Borderline | Out of Range

Lipoprotein Particle Numbers

Tests	In Range	Out of Range	Reference Range	Units
VLDL Particles (0 34 68 102 136 170)	19		<85	nmol/L
Total LDL Particles (0 360 720 1080 1440 1800)	572		<900	nmol/L
Non-HDL Particles (0 400 800 1200 1600 2000)	592		<1000	nmol/L
Remnant Lipoprotein (0 60 120 180 240 300)	73		<150	nmol/L
Dense LDL III (0 120 240 360 480 600)	187		<300	nmol/L
Dense LDL IV (0 40 80 120 160 200)	49		<100	nmol/L
Total HDL Particles (14000 11200 8400 5600 2800 0)	8124		>7000	nmol/L
Buoyant HDL 2b (3000 2400 1800 1200 600 0)		**1719**	>1500	nmol/L

Lipid Panel

Tests	In Range	Out of Range	Reference Range	Units
Total Cholesterol (0 80 160 240 320 400)	127		<200	mg/dL
Triglycerides (30 84 138 192 246 300)	41		<150	mg/dL
HDL (100 80 60 40 20 0)		**50**	>40	mg/dL
LDL (40 84 128 172 216 260)	82		40-130	mg/dL
Non-HDL Cholesterol (0 64 128 192 256 320)	77		<160	mg/dL

Vascular Inflammation

Tests	In Range	Out of Range	Reference Range	Units
Insulin (0 5 10 15 20 25)	4.5		<21.0	□,8P/
hs-CRP (0 1 2 4 5 6)		**2.16**	<3.00	mg/L
Lipoprotein(a) (6 17 28 38 49 60)	19.1		<30.0	mg/dL
Apolipoprotein B (40 72 104 136 168 200)	57		40-100	mg/dL
Apolipoprotein A1 (250 200 150 100 50 0)	134		>115	mg/dL
Homocysteine (0 4 9 13 18 22)	8.1		<11	□PRO/

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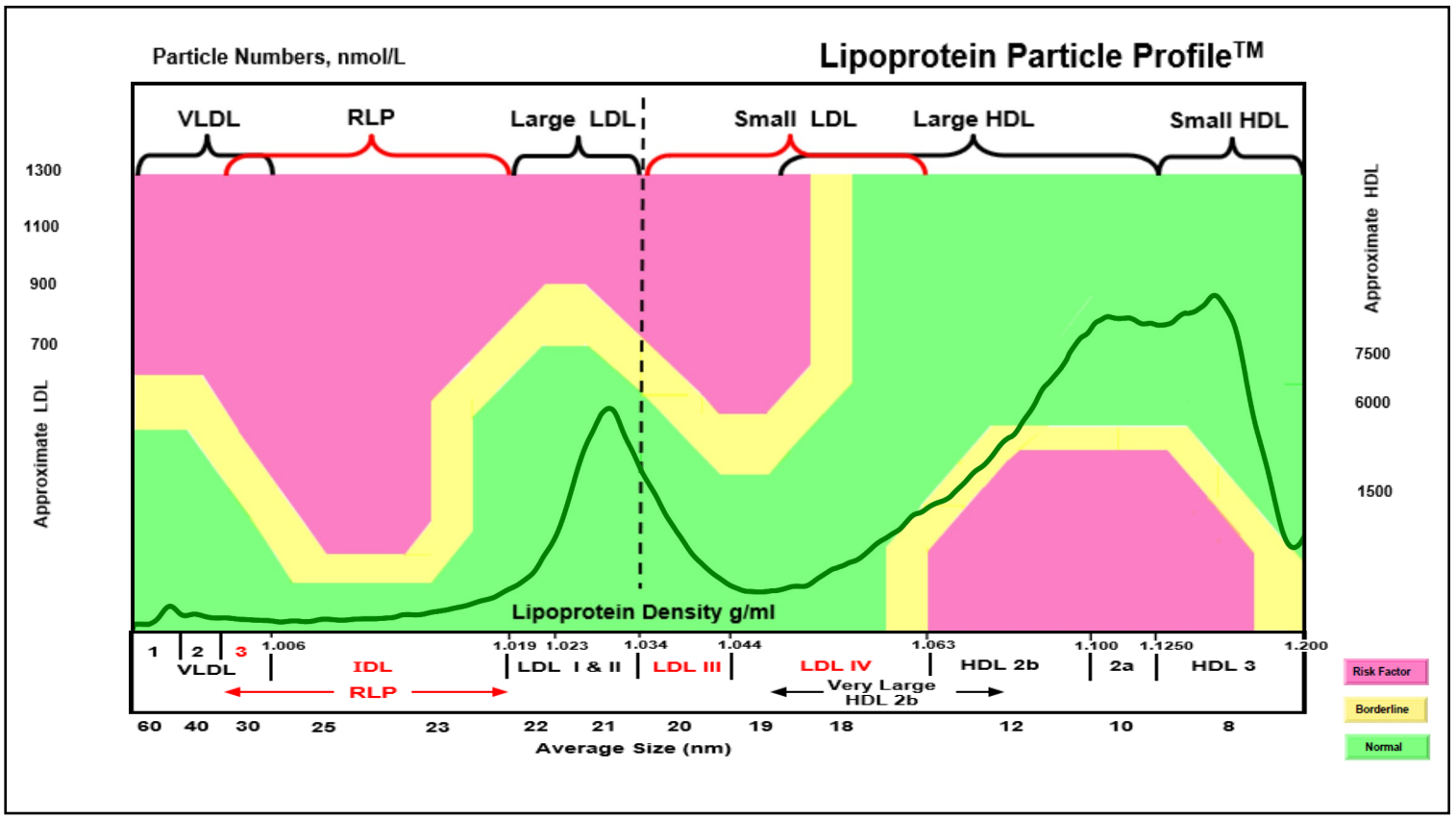
PATIENT: **Doe, J** PROVIDER: **Ruth** DATE REPORTED: **05/26/2020** ACCESSION ID: **2005140051**

Metabolic Syndrome Traits

Tests		In Range	Out of Range	Reference Range	Units
Metabolic Syndrome Traits		0		Zero	

A diagnosis of metabolic syndrome is confirmed if any three of the following traits exist in a patient: (1)high triglycerides [>150mg/dL]*; (2)low HDL [<40mg/dL in men, <50mg/dL in women]*; (3) elevated small dense LDL III and LDL IV [>400 nmol/L]*; (4) high fasting glucose [>100mg/dL]; (5) high blood pressure [>130/85]; (6) high waist circumference [>40 inches in men, >35 inches in women]. *Included in this section of report. Clinician must determine traits (4), (5), (6).



Lipoprotein Particle Profile (Component Summaries)

This information is provided for educational purposes.

Lipoprotein Particle Numbers ± Lipoproteins are ball-shaped proteins in the blood that transport fats (lipids) throughout the body. The fact that lipoproteins ± not the cholesterol that is carried within them ± causes cardiovascular disease by penetrating the endothelial lining of the arteries, becoming oxidized and contributing to arterial plaque, has been well established. Further, the most effective treatment will depend on which lipoproteins are elevated, so measuring lipoprotein particle numbers enables a clinician to GHWHUPLQHDFFXUDWHO\WKHOHYHORIFDUGLRPHWDEROLFULVNDQGKRZEHVWWRWUHDWLW

Remnant Lipoprotein (RLP) ± This highly atherogenic lipoprotein causes platelet aggregation and impairs vascular relaxation. Unlike other LDL particles which have to be oxidized before they are taken into the arterial intima by macrophage cells, RLP can contribute to plaque buildup even when not oxidized. Foam cells (the sticky contributors to arterial plaque) contains high levels of RLP. Treatment with omega 3 fatty acids can be efficacious.

Dense LDL III and LDL IV ± These lipoproteins are small and can thus more easily penetrate and damage the lining of the arteries due to their size, causing plaque and atherosclerosis. They are highly correlated to cardiovascular disease.

HDL2b ± This is a protective lipoprotein that indicates how well cholesterol is being cleared by the liver (reverse cholesterol transport system). HDL is made in the liver as HDL3 and as it travels through the body accumulating cholesterol it becomes the larger and lipid-enriched HDL2b. It positively correlates with heart health.

Lipid Panel ± The lipid panel measures cholesterol, not lipoproteins (which carry cholesterol). Although directly measuring the actual number of lipoproteins (versus the amount of cholesterol inside them) is widely recognized as a superior tool in assessing cardiometabolic health, clinicians and patients tend to be familiar with a standard lipid panel and its historical use. It is important to note that half of all people who have a heart attack will have cholesterol values that fall in the normal range. Thus, the lipid panel is most useful when viewed in the context of other biomarkers, particularly lipoprotein particle numbers. Elevated triglycerides and low HDL-cholesterol are highly correlated to metabolic syndrome and increase the risk of heart disease significantly.

Vascular Inflammation ± Cardiovascular disease is generally considered an inflammatory process and the analytes included here are important determinants of cardiometabolic risk, particularly with respect to vascular inflammation.

Insulin ± Insulin is a hormone made by beta cells ùFHOOVLQWKHSDQFUHDVDQGVHFUHWHGLQUHVSRQVHWRHOHYDWHGEORR
main function is to regulate plasma glucose levels within a narrow range and is correlated to the efficiency with which a person can metabolize carbohydrates. If one becomes de-sensitized to the action of insulin (insulin resistant), more is needed to achieve adequate glucose-lowering effects, thus altering metabolism to favor fat storage over efficient energy production. High fasting insulin
LQGLFDWHVLQVXOLQUHVLVWDQFHDQGSRVVLEOHHSUHGLDEHWHV6WLPXODWRU\KRUPRQHVLHDGUHQDOQHFRUWLVRO

hs-CRP ± High Sensitivity C-reactive Protein (hs-CRP) is an acute phase protein that reflects the presence of inflammation in the body. High CRP, regardless of cause, is strongly correlated to the risk of sudden cardiac death and low-grade chronic systemic inflammation raises the risk of metabolic syndrome, heart disease, diabetes and other degenerative diseases.

Lipoprotein(a) ± This unique lipoprotein is particularly dangerous because it inhibits the formation of plasmin which is an enzyme
WKDWGLVVROYHVEORRGFORWV+LJKOHYHOVRI/SDDUHVWURQJO\OLQNHGWRWKURPERVLVVLJQLILFDQWO\UDLVLQJWKH
DVVRFLDWHGFDUGLDFHYHQWV,WFDQDOVRSHQHWUDWHWKHDUWHULDOOOLQLQJEHFRPHR[LGL]HGDQGEXLOGSODTXHWK
atherosclerosis independent of its thrombotic potential.

Apolipoprotein B ± ApoB100 is a protein produced in the liver that attached to the surface of all low-density lipoproteins (LDL), regardless of type. Every molecule of VLDL, RLP, Lp(a) and LDL has exactly one, and only one apoB100 molecule attached to it and thus, apoB reflects the level of atherogenic lipoproteins in the blood.

Apolipoprotein A1 ± ApoA1 is a protein that is attached to the surface of all high-density lipoproteins (HDL) and is thus reflective of
WKHDPRXQWRISURWHFWLYHOLSRSURWHLQVLQWKHEORRG,WIDFLOLWDWHVWKUHPRYDORIIDWVFKROHVWHUROIURPD
transport back to the liver for eventual excretion. Like HDL, low levels raise risk of heart disease.

Homocysteine ± A metabolic intermediate, this protein is dangerous at high levels because it indicates poor methylation
GHWR[LILFDWLRQDELOLW\+RPRF\VWHLQHZLOODOVRDFWDVDQDUWHULDODEUDVLYHSK\VLFDOO\GPDJLQJWKHQGRWK
YHVVHOV+LJKOHYHOVDUHVWURQJO\OLQNHGWRNLGQH\DQGKHDUWGLVHDVHVWURNHDQGGHPHQWLD

*Welcome to your Micronutrient Profile, **Bryson**!*

Your body is unique and your story is too. Virtually all metabolic and developmental processes that take place in the body require micronutrients and strong evidence suggests that subtle vitamin, mineral, and antioxidant deficiencies can contribute to degenerative processes. These cellular deficiencies may suggest the underlying cause of a myriad of unwanted symptoms and, if corrected, can optimize physical and mental health performance.

The SpectraCell Advantage

Superior insights, earlier interventions, customized treament plans.

Functional

We measure the functional level and capability of nutrients present within your white blood cells, where metabolism takes place and where micronutrients do their job.

Long-term

This test measures intracellular micronutrient function over a period of 4-6 months, extending beyond static serum measurements

Proprietary

Only SpectraCell offers the patented Spectrox∏(reflects antioxidant capacity) and Immunidex (an overall measure of immune function).

What we measure:

We have measured the functional levels of 31 micronutrients, from vitamins and minerals to fatty acids and metabolites, as well as an overall measurement of antioxidant capacity and immune function to provide you with a powerful tool for optimal health, performance, and insight into any health condition. We provide your unique nutrient status in the following areas:

VITAMINS & MINERALS
Discover your body¶s unique vitamin and mineral requirements and the disparities that exist within your makeup.

AMINO ACIDS
Learn how well your amino acids, the building block of protein, are functioning within your cells.

ENERGY, FAT AND METABOLISM
Know how well your body is metabolizing micronutrients for energy production.

ANTIOXIDANT STATUS & IMMUNE FUNCTION
Understand your body¶s ability to manage oxidative stress and your immune response to infections and disease.

PATIENT: **Doe, J** PROVIDER: **Ruth** DATE REPORTED: **05/26/2020** ACCESSION ID: **0000**

Results At-A-Glance

Functional Deficiencies

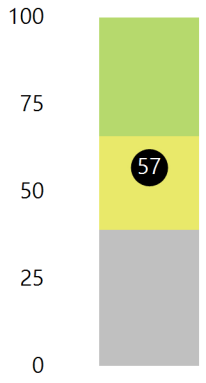
Abnormal	Suggested Supplementation *	Provider Comments
Magnesium	150 mg b.i.d. (300 mg daily) as aspartate, citrate, lysinate, glycinate, or malate	
Vitamin A	5000 IU of Vitamin A and 25,000 IU beta-carotene for 6 months and then retest.	
Vitamin D3	1000 IU daily of Cholecalciferol (Vitamin D3-1-alpha 25-dihydroxyvitamin D)	

* The RDA (Recommended Daily Allowance) was first published in 1968 primarily for use in nutritional labeling of packaged foods. The DRI (Dietary Reference Intake), published in 1997, serves as replacements for the former RDA, although the actual values are generally within an order of magnitude, and are also primarily for use in nutritional labeling and fortification of packaged foods. In most cases, neither the RDA nor the DRI will be adequate to replete a nutrient in people who demonstrate a functional cellular deficiency of said nutrient. An evidence based approach was used to develop clinically relevant repletion recommendations, consisting of data from published studies and clinician expertise. However, the information presented is not intended nor implied to be a substitute for professional medical advice, diagnosis or treatment.

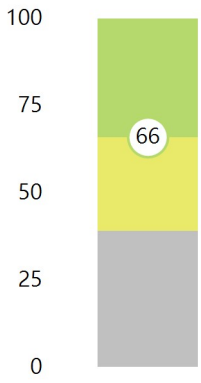
Borderline Deficiencies

Borderline	Provider Comments
Folate	
Glucose-Insulin Interaction	
Glutathione	
Pantothenate	
Serine	
Vitamin B2	
Vitamin K2	

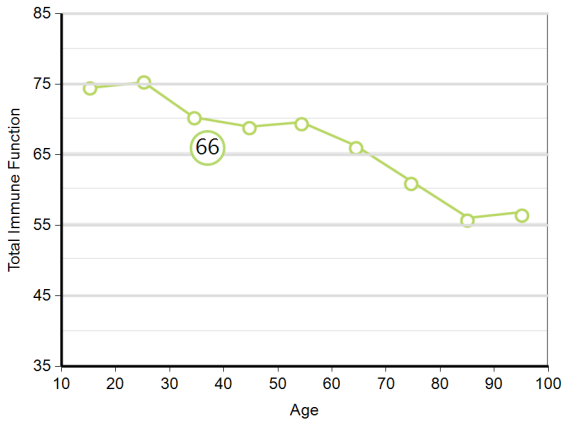
Spectrox(
Total Antioxidant Function



Immunidex
Total Immune Function



Total Immune Function vs Age



Deficient
Values in this range indicate a poor growth response. Cell function is compromised and likely requires nutrient repletion.

Average
Values in this range indicate an average growth response. Cell function is not yet optimal and may require nutrient repletion.

Strong
Values in the range indicate a stronger than average growth response. Cells are functioning well.

Spectrox(

Total Antioxidant Function is a measurement of overall antioxidant function. The patient¶s cells are oxidatively challenged and the cells¶ ability to resist damage is determined.

Immunidex

Total Immune Function is an indication of how well a person¶s T-lymphocytes are functioning by measuring their response to mitogen stimulation (ability to grow). Since lymphocyte function is widely considered a systemic measure of general health, a healthy (stronger) response is desired. A less-than-optimal response may improve with nutrient repletion.

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PATIENT: **Doe, J** PROVIDER: **Ruth** DATE REPORTED: **05/26/2020** ACCESSION ID: **0000**

Micronutrients	Patient Results	Reference Range	Patient Result	Interpretation
B-VITAMINS				
Vitamin B1		>78%	94	
Vitamin B2		>53%	58	Borderline
Vitamin B3		>80%	92	
Vitamin B6		>54%	63	
Vitamin B12		>14%	19	
Folate		>32%	34	Borderline
Pantothenate		>7%	9	Borderline
Biotin		>34%	43	
AMINO ACIDS AND METABOLITES				
Serine		>30%	33	Borderline
Glutamine		>37%	56	
Asparagine		>39%	47	
Choline		>20%	30	
Inositol		>58%	71	
Carnitine		>46%	53	
Oleic Acid		>65%	72	
OTHER VITAMINS & MINERALS				
Vitamin D3		>50%	46	Deficient
Vitamin A		>70%	68	Deficient
Vitamin K2		>30%	34	Borderline
Manganese		>50%	71	
Calcium		>38%	51	
Zinc		>37%	43	
Copper		>42%	54	
Magnesium		>37%	36	Deficient
CARBOHYDRATE METABOLISM				
Fructose Sensitivity		>34%	48	
Glucose-Insulin Interaction		>38	43	Borderline
Chromium		>40%	48	
ANTIOXIDANTS				
Glutathione		>42%	45	Borderline
Cysteine		>41%	52	
Coenzyme Q10		>86%	93	
Selenium		>74%	84	
Vitamin E		>84%	91	
Alpha Lipoic Acid		>81%	90	
Vitamin C		>40%	57	

The reference ranges listed in the above table are valid for male and female patients 12 years of age or older.

Deficient
Values in this area represent a deficiency and may require nutrient repletion or dietary changes

Borderline
Values in this area represent a borderline deficiency and may indicate a need for nutrient repletion or dietary changes

Normal
Values in this area represent a normal result

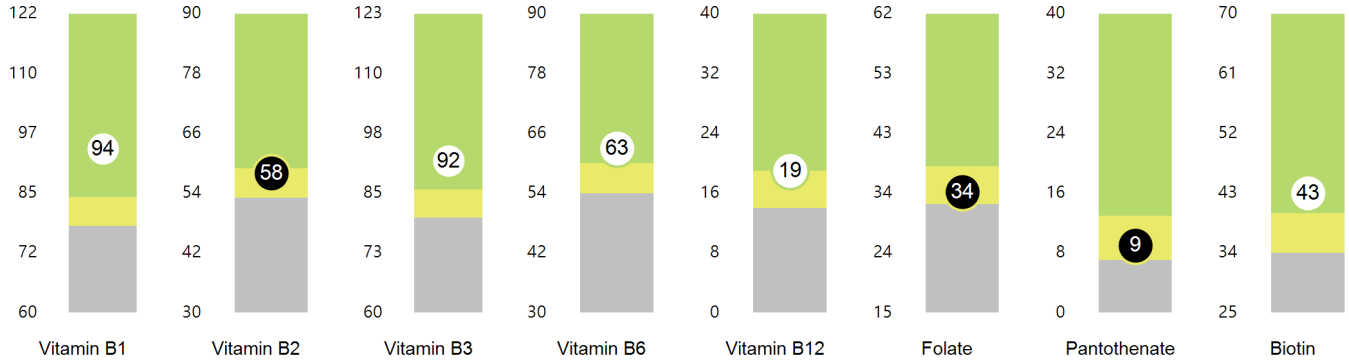
PATIENT: **Doe, J** PROVIDER: **Ruth** DATE REPORTED: **05/26/2020** ACCESSION ID: **0000**

Deficient
Values in this area represent a deficiency and may require nutrient repletion or dietary changes

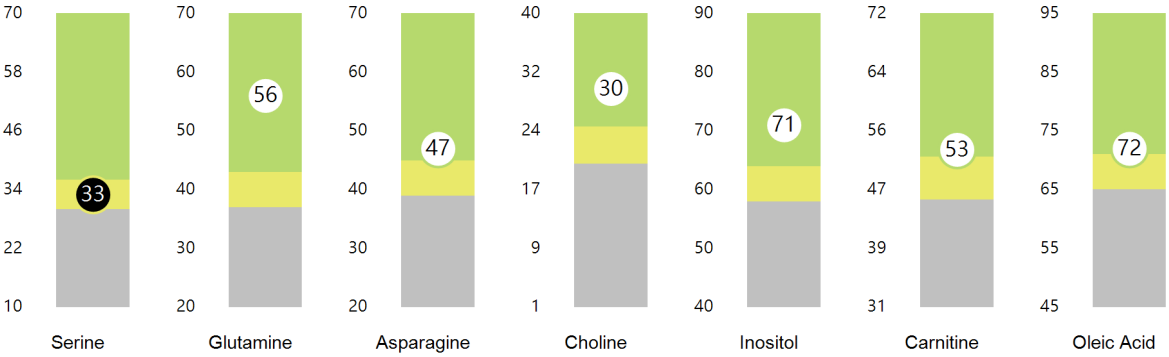
Borderline
Values in this area represent a borderline deficiency and may indicate a need for nutrient repletion or dietary changes

Normal
Values in this area represent a normal result

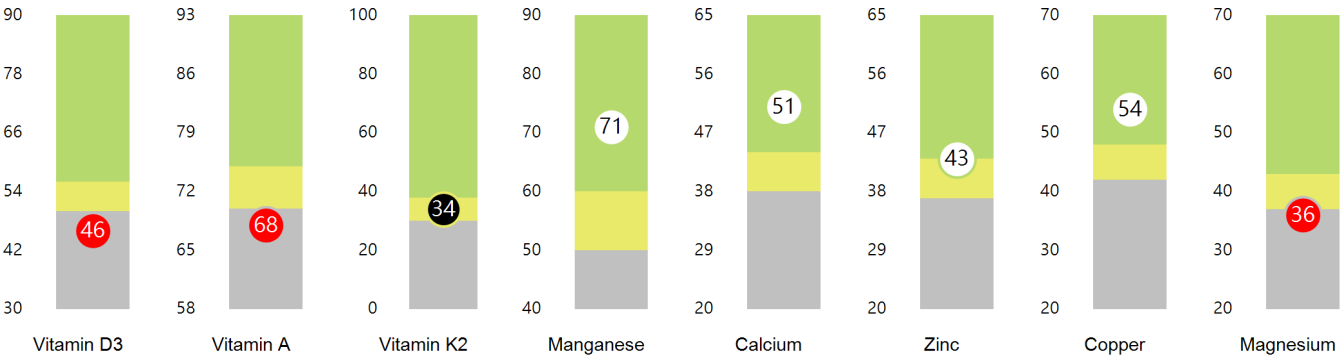
B-Complex Vitamins



Amino Acids & Metabolites



Other Vitamins & Minerals



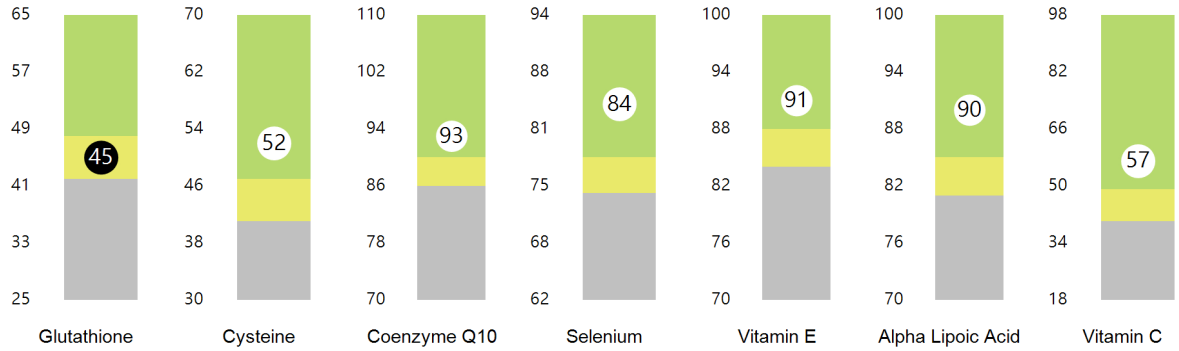
PATIENT: **Doe, J** PROVIDER: **Ruth** DATE REPORTED: **05/26/2020** ACCESSION ID: **0000**

Deficient
Values in this area represent a deficiency and may require nutrient repletion or dietary changes

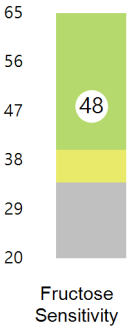
Borderline
Values in this area represent a borderline deficiency and may indicate a need for nutrient repletion or dietary changes

Normal
Values in this area represent a normal result

Individual Antioxidants

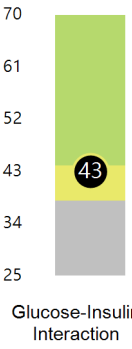


Carbohydrate Metabolism



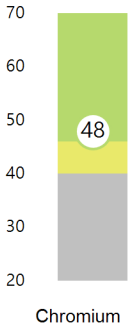
Fructose Sensitivity

This assay measures changes in the patient¶s lymphocyte growth response to a fructose challenge. Significant reduction in cell growth capacity is indicative of poor ability to metabolize fructose. This can be due to nutritional deficiencies of necessary cofactors in the fructose metabolizing pathway (e.g. copper, zinc) or may be due to genetic factors.



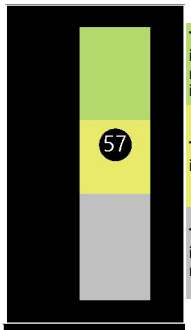
Glucose-Insulin Interaction

The patient¶s cells are challenged with glucose and their ability to grow in the presence or absence of insulin is determined. A significant decrease of cell growth is indicative of reduced ability to metabolize glucose.



Spectrox(- Total Antioxidant Function

Total Antioxidant Function is a measurement of overall antioxidant function. The patient¶s cells are oxidatively challenged and the cells¶ability to resist damage is determined.



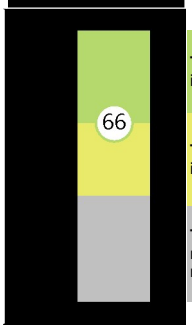
Total Antioxidant Function value above 65%
indicates a desirable status. Since antioxidants are protective nutrients, higher antioxidant function is desirable because it increase cells¶ability to resist oxidative stress.

Total Antioxidant Function value between 40%-65%
indicates an average ability to resist oxidative stress.

Total Antioxidant Function value below 40%
indicates poor antioxidant function resulting in reduced ability to resist oxidative stress.

Immunidex - Total Immune Function

Total Immune Function is an indication of how well a person¶s T-lymphocytes are functioning by measuring their response to mitogen stimulation (ability to grow). Since lymphocyte function is widely considered a systemic measure of general health, a healthy (stronger) response is desired. A less-than-optimal response may improve with nutrient repletion.



Total Immune Function value above 65%
indicates a strong (healthy) cell-mediated immune response.

Total Immune Function value between 40% and 65%
indicates an average response.

Total Immune Function value below 40%
may indicate a weakened cell-mediated immune response.

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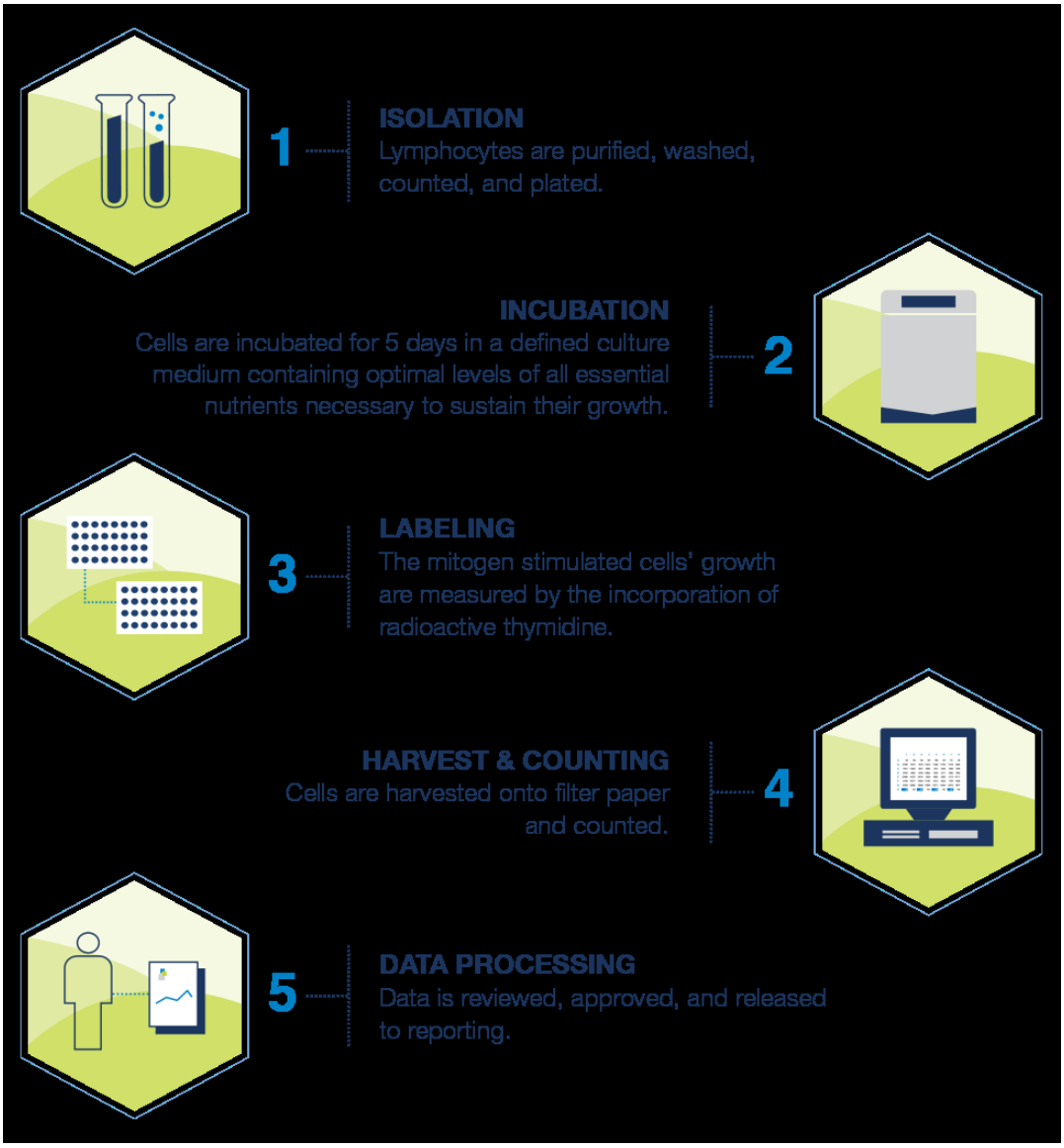
Overview of Test Methodology

Cellular Function = Performance, Not Just Potential

Lymphocyte Proliferation Assay



Routine turnaround time for the Micronutrient assay is 10-14 business days.

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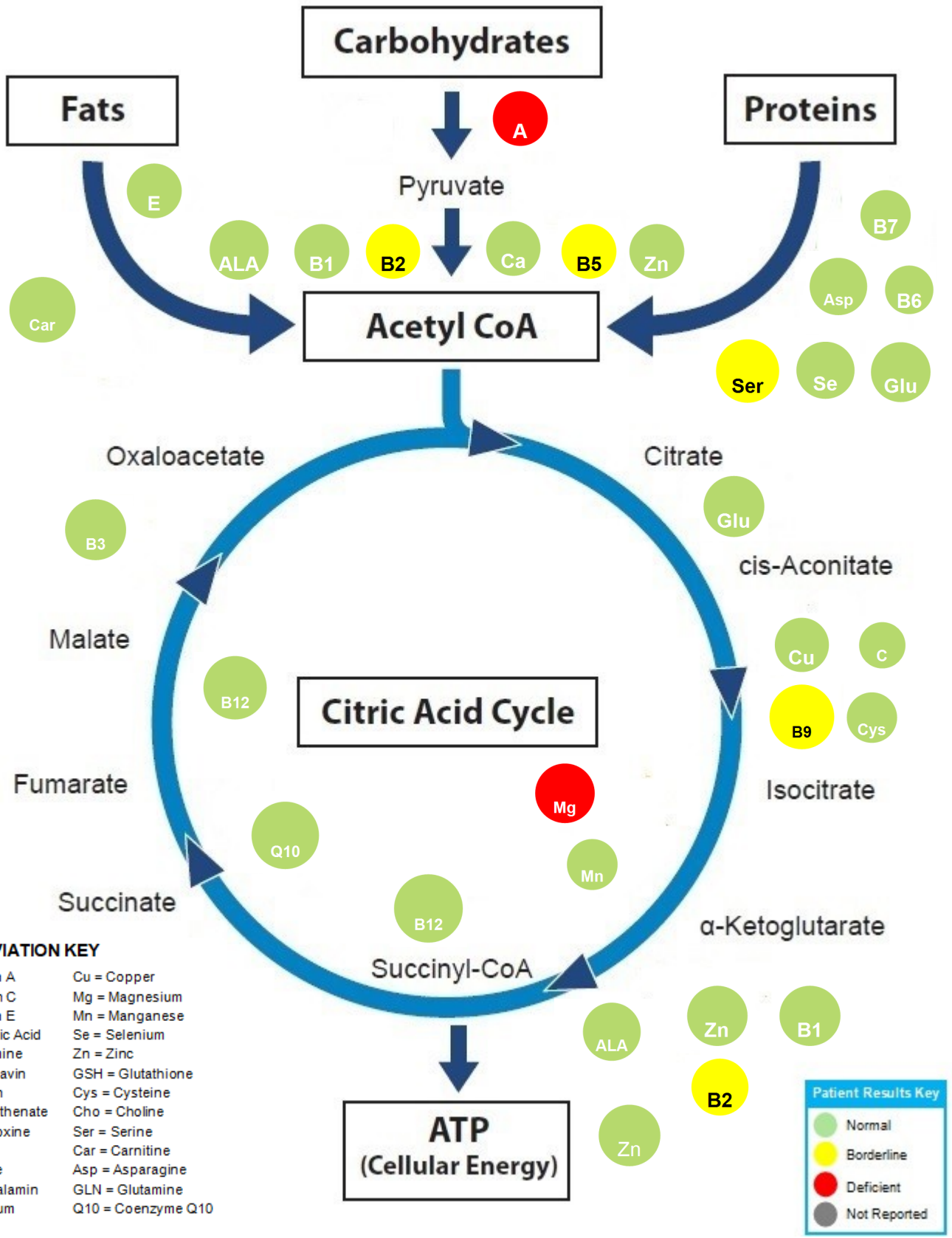
Krebs Cycle

Energy Production

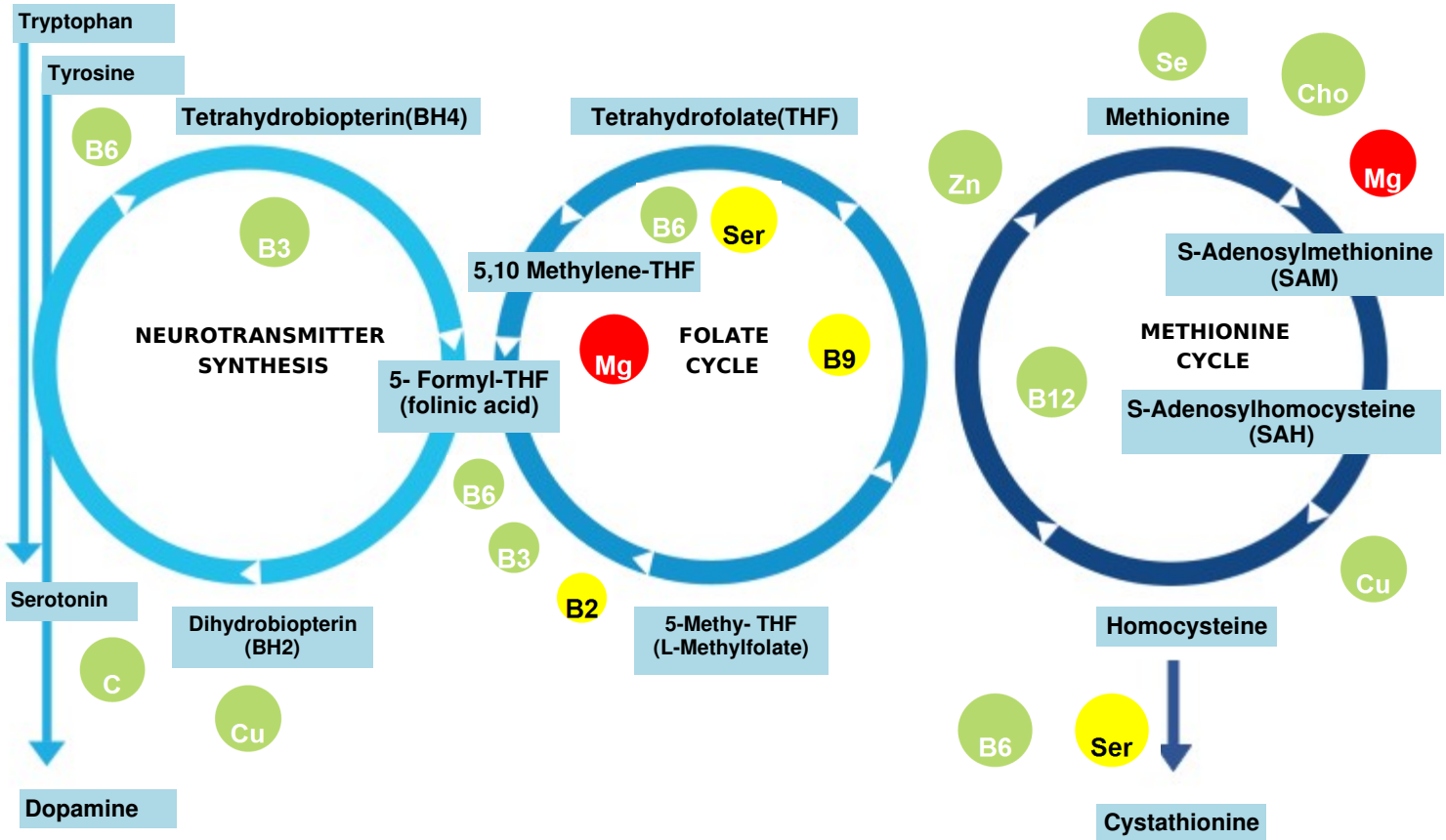


ABBREVIATION KEY

A = Vitamin A	Cu = Copper
C = Vitamin C	Mg = Magnesium
E = Vitamin E	Mn = Manganese
ALA = Lipoic Acid	Se = Selenium
B1 = Thiamine	Zn = Zinc
B2 = Riboflavin	GSH = Glutathione
B3 = Niacin	Cys = Cysteine
B5 = Pantothenate	Cho = Choline
B6 = Pyridoxine	Ser = Serine
B7 = Biotin	Car = Carnitine
B9 = Folate	Asp = Asparagine
B12 = Cobalamin	GLN = Glutamine
Ca = Calcium	Q10 = Coenzyme Q10

Methylation Cycle

Detoxification, Cellular Adaptability, Gene Regulation



ABBREVIATION KEY

A = Vitamin A	Cu = Copper
C = Vitamin C	Mg = Magnesium
E = Vitamin E	Mn = Manganese
ALA = Lipoic Acid	Se = Selenium
B1 = Thiamine	Zn = Zinc
B2 = Riboflavin	GSH = Glutathione
B3 = Niacin	Cys = Cysteine
B5 = Pantothenate	Cho = Choline
B6 = Pyridoxine	Ser = Serine
B7 = Biotin	Car = Carnitine
B9 = Folate	Asp = Asparagine
B12 = Cobalamin	GLN = Glutamine
Ca = Calcium	Q10 = Coenzyme Q10

Patient Results Key

- Normal
- Borderline
- Deficient
- Not Reported

Supplemental Information

Cellular Function = Performance, Not Just Potential

PHYSIOLOGICAL FUNCTION

Magnesium is predominantly found intracellularly, where it is vital for proper cell functions. Magnesium is the second most prevalent intracellular cation (after potassium). Magnesium functions are numerous and essential, including enzyme activation (over 300 types), neuromuscular activity, membrane transport and interactions, energy metabolism (carbohydrates, fats, proteins), and roles in calcium and phosphorus metabolism.

DEFICIENCY SYMPTOMS

Deficiency symptoms are both acute (Trouseau and Chvostek signs, muscle spasms, tetany, cardiac arrythmias, ataxia, vertigo, convulsions, organic brain syndrome) and chronic (thrombophlebitis, hemolytic anemia, bone loss, depressed immune function, poor wound healing, hyperirritability, burxism, hyperlipidemia, fatigue, hypertension).

Those at risk for Magnesium deficiency include: malabsorption, malnourished, alcoholics, diabetics, diuretic therapy, children, elderly, pregnant and lactating women, postmenopausal women with osteoporosis, athletes, digitalis therapy, long-term therapy with antibiotics, chemotherapeutic and immunosuppressive medications. In addition, the following diseases are associated with Magnesium deficiency: cardiovascular disease, cirrhosis, renal disease, parathyroid diseases, thyroid conditions.

FOOD SOURCES

Food	Serving	(mg)
Oat bran	1/2 cup	96
Brown rice	1 cup	86
Mackerel	3 oz.	82
Spinach, cooked	1/2 cup	78
Almonds	1 oz.	77
Swiss chard, cooked	1/2 cup	75

Food	Serving	(mg)
Lima beans	1/2 cup	63
Edamame	1/2 cup	50
Blackstrap molasses	1 tbsp	48
Potato, with skin	1 baked	43
Black eyed peas	1/2 cup	42
Banana	1 whole	34

REPLETION INFORMATION

Large oral intakes of Magnesium (400-1000 mg daily), when spread throughout the day, are not considered harmful, except for some persons with impaired renal function. Higher doses have been used as laxatives and antacids. Excessive Magnesium intake may cause diarrhea, nausea, vomiting, hypotension, bradycardia, and CNS depression. Continued excessive intakes of Magnesium may imbalance calcium and phosphorous metabolism.

Supplemental Information

Cellular Function = Performance, Not Just Potential

PHYSIOLOGICAL FUNCTION

Vitamin A is a family of fat soluble compounds (carotenoids) that play an important role in vision, bone growth, reproduction and cell differentiation. It also helps regulate the immune system, promoting optimal lymphocyte function in defending against bacterial and viral infections. Retinal (Vitamin A) promotes healthy surface linings of the eyes and respiratory, urinary and instestinal tracts. Vitamin A also promotes healthy skin function and integrity. Retinal is the most active form of Vitamin A and is synthesized in the body by conversion of provitamin A, primarily beta carotene, into retinal. Lycopene, lutein and zeaxathin are carotenoids that do not have Vitamin A activity, but have other health promoting properties. Studies are inconclusive in identifying vitamin A's role as an antioxidant.

DEFICIENCY SYMPTOMS

A large number of physiological systems may be affected by Vitamin A deficiency. Poor epithelial regeneration can result in skin hyperkeratinization, problems with the genitourinary reproductive system (reduced fertility) dysfunction within the gastroenterological/biliary system or the pulmonary system. Patients with Celiac disease, Crohn's disease and pancreatic disorders are pmiicularly susceptible to Vitamin A deficiency due to malabsorption. Vitamin A deficiency may result in night blindness and/or epithelial degeneration of the eye. The immune system may also be adversely affected, reducing white blood cell levels and impairing both cell-mediated and humoral defense systems. Vitamin A is also essential for the developing skeletal system and deficiency can result in growth retardation or abnormal bone formation. Vitamin A deficiency is most often associated with strict dietary restrictions and excess alcohol intake.

FOOD SOURCES

Food	Serving	µg RAE*
Beef liver	3 oz.	6582
Cod liver oil	1 tbsp	4080
Sweet potato	1/2 cup	1136
Pumpkin, canned	1/2 cup	953
Carrots	1/2 cup	595

Food	Serving	µg RAE*
Butternut squash	1/2 cup	572
Spinach, cooked	1/2 cup	472
Cantaloupe	1/2 melon	466
Red peppers	1/2 cup	117
Apricot	1 medium	74

*µg RAE = micrograms of Retinol Activity Equivalents

REPLETION INFORMATION

ADEQUATE ZINC IS REQUIRED to synthesize retinal binding protein (RAP) which transports vitamin A. Therefore a deficiency in zinc limits the body's ability to mobilize Vitamin A stores from the liver.

EXCESSIVE VITAMIN A INTAKE IS TOXIC AND MUST BE AVOIDED. Liver abnormalities, reduced bone density (osteoporosis) and central nervous system disorders may result from hypervitaminosis A. Early toxicity signs include peeling/itching skin, brittle nails, yellowish skin, alopecia (hair loss), and bone/joint pain. Provitamin A (beta carotene and mixed carotenoids) are much less toxic and not associated with the commonly noted side effects of excess Vitamin A intake.

Supplemental Information

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PHYSIOLOGICAL FUNCTION

Vitamin D is the principle regulator of calcium homeostasis in the body. It is essential for skeletal development and bone mineralization. Vitamin D is a prohormone with no hormone activity. It is converted to a molecule that has biological activity. The active form of the vitamin is 1,25-dihydroxyvitamin D, usually referred to as vitamin D3. It is synthesized in the skin from 7-dehydrocholesterol via photochemical reactions requiring UV light (sunlight). Inadequate exposure to sunlight contributes to vitamin D deficiency. Vitamin D deficiency in adults can lead to osteoporosis. This results from a compensatory increase in the production of parathyroid hormone resulting in bone resorption. Increasing evidence is accumulating that vitamin D may also contribute to antioxidant function by inhibiting lipid peroxidation. The mechanism of the antioxidant effect is unknown. Vitamin D is also needed for adequate blood levels of insulin. Vitamin D receptors have been identified in the pancreas.

DEFICIENCY SYMPTOMS

Osteoporosis results from an imbalance between bone resorption and bone formation. Decreased vitamin D levels result in decreased production of the active vitamin form, vitamin D3. Vitamin D enhances the efficiency of calcium absorption. Chronic vitamin D deficiency results in decreased calcium absorption and secondary hyperparathyroidism.

Vitamin D3 has been found to have anticarcinogenic activity, inducing apoptosis in many types of cancer cells. It has also been useful in the treatment of psoriasis when applied topically. Vitamin D appears to demonstrate both immune-enhancing and immunosuppressive effects.

FOOD SOURCES

Natural Sources	Serving	(IU)
Salmon, wild	3 1/2 oz.	600-1000
Salmon, farm	3 1/2 oz.	100-250
Mackerel	3 1/2 oz.	250
Tuna	3 1/2 oz.	230
Cod liver oil	1 tsp	400
Shitake mushroom, fresh	3 1/2 oz.	100
Shitake mushroom, dried	3 1/2 oz.	1600

Fortified Sources	Serving	(IU)
Milk	8 oz.	100
Orange juice	8 oz.	100
Yogurt	8 oz.	100
Cheese	3 oz.	100
Butter	3 1/2 oz.	50

*Vitamin D is a fat-soluble vitamin so if a food is fat-free (e.g. skim milk, OJ, low-fat yogurt) absorption may be an issue even if it is fortified.

REPLETION INFORMATION

Supplemental vitamin D is available as vitamin D2 (ergocalciferol) or vitamin D3 (cholecalciferol). Dosages over 3000 IU/day are associated with hypercalcemia, causing multiple debilitating effects. Anorexia, nausea and vomiting have been observed at doses as low as 1250 IU/day. The prolonged ingestion of excessive vitamin D and the accompanying hypercalcemia can result in metastatic calcification of soft tissues, including kidney, blood vessels, heart and lungs.