Physician Copy

GENOVA DIAGNOSTICS EUROPE

46-50 Coombe Road
New Malden
Surrey KT3 4QF

63 Zillicoa Street
Asheville, NC 28801 USA

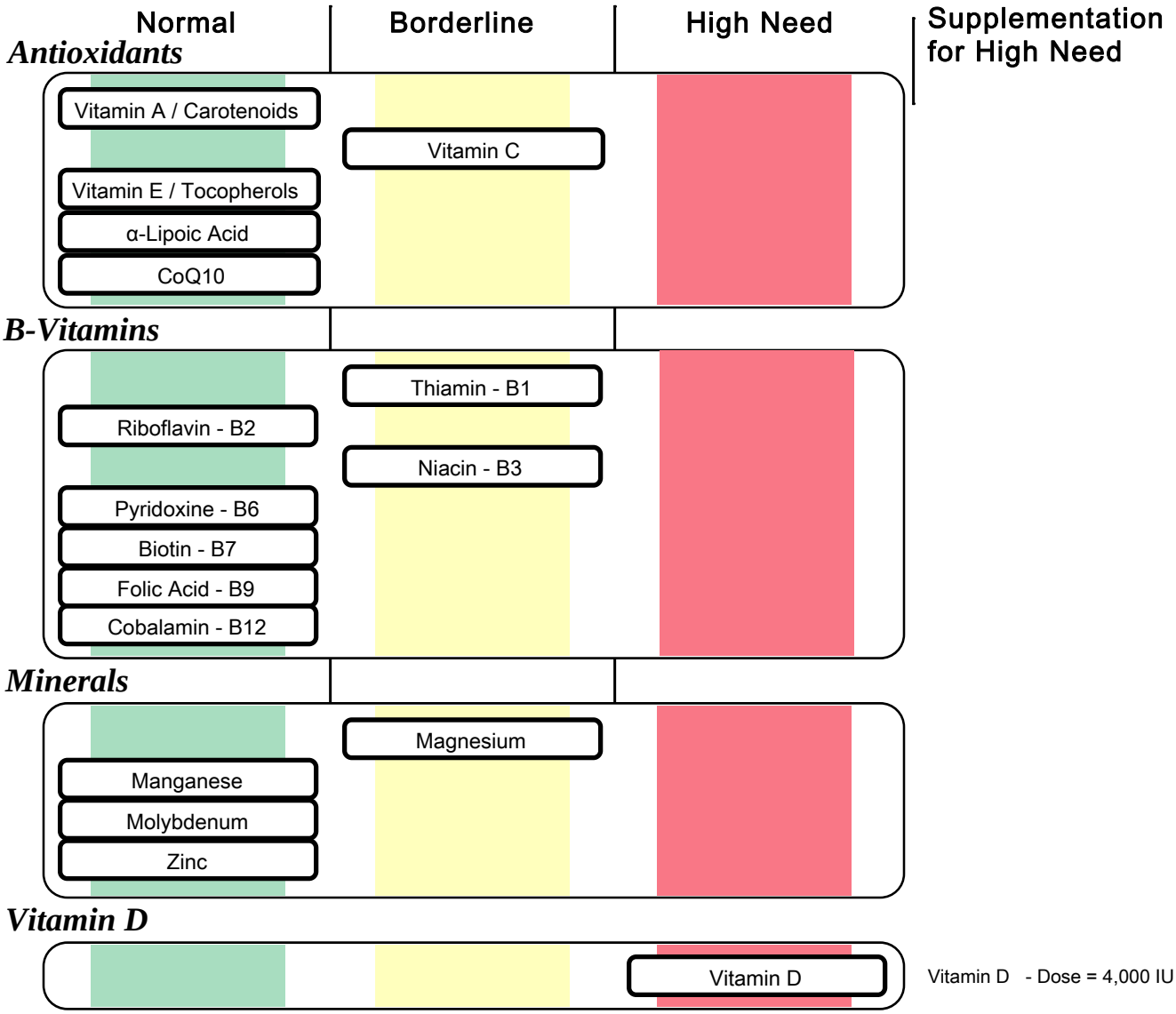
Patient:
DOB:
Sex:
MRN:

Order Number:

Completed:
Received:
Collected:

NutrEval®

NutrEval Results Overview



SUGGESTED SUPPLEMENT SCHEDULE

Supplements	Daily Recommended Intake (DRI)	Patient's Daily Recommendations	Provider Daily Recommendations
Antioxidants			
Vitamin A / Carotenoids	3,000 IU	3,000 IU	
Vitamin C	90 mg	500 mg	
Vitamin E / Tocopherols	22 IU	100 IU	
α-Lipoic Acid		50 mg	
CoQ10		30 mg	
B-Vitamins			
Thiamin - B1	1.2 mg	25 mg	
Riboflavin - B2	1.3 mg	10 mg	
Niacin - B3	16 mg	30 mg	
Pyridoxine - B6	1.3 mg	10 mg	
Biotin - B7	30 mcg	100 mcg	
Folic Acid - B9	400 mcg	400 mcg	
Cobalamin - B12	2.4 mcg	100 mcg	
Minerals			
Magnesium	420 mg	600 mg	
Manganese	2.3 mg	3.0 mg	
Molybdenum	45 mcg	75 mcg	
Zinc	11 mg	10 mg	
Essential Fatty Acids			
Omega-3 Oils	500 mg	1,000 mg	
Digestive Support			
Probiotics		25 billion CFU	
Pancreatic Enzymes		0 IU	
Other Vitamins			
Vitamin D	600 IU	4,000 IU	

Amino Acid	mg/day	Amino Acid	mg/day
Arginine	0	Methionine	81
Asparagine	0	Phenylalanine	0
Cysteine	0	Serine	0
Glutamine	0	Taurine	0
Glycine	0	Threonine	0
Histidine	0	Tryptophan	0
Isoleucine	0	Tyrosine	151
Leucine	147	Valine	0
Lysine	908		

Recommendations for age and gender-specific supplementation are set by comparing levels of nutrient functional need to optimal levels as described in the peer-reviewed literature. They are provided as guidance for short-term support of nutritional deficiencies only.

The Suggested Supplemental Schedule is provided at the request of the ordering practitioner. Any application of it as a therapeutic intervention is to be determined by the ordering practitioner.

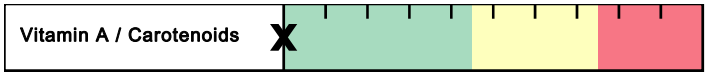
Key Normal | Borderline | High Need

NutrEval FMV amino acids — Interpretation At-A-Glance

Nutritional Needs

Antioxidants

Vitamin A / Carotenoids



- Beta-carotene & other carotenoids are converted to vitamin A (retinol), involved in vision, antioxidant & immune function, gene expression & cell growth.
- Vitamin A deficiency may occur with chronic alcoholism, zinc deficiency, hypothyroidism, or oral contraceptives containing estrogen & progestin.
- Deficiency may result in night blindness, impaired immunity, healing & tissue regeneration, increased risk of infection, leukoplakia or keratosis.
- Food sources include cod liver oil, fortified cereals & milk, eggs, sweet potato, pumpkin, carrot, cantaloupe, mango, spinach, broccoli, kale & butternut squash.

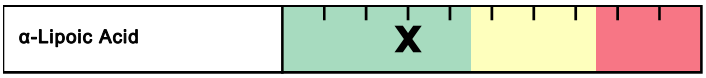
Vitamin C

- Vitamin C is an antioxidant (also used in the regeneration of other antioxidants). It is involved in cholesterol metabolism, the production & function of WBCs and antibodies, and the synthesis of collagen, norepinephrine and carnitine.
- Deficiency may occur with oral contraceptives, aspirin, diuretics or NSAIDs.
- Deficiency can result in scurvy, swollen gingiva, periodontal destruction, loose teeth, sore mouth, soft tissue ulcerations, or increased risk of infection.
- Food sources include oranges, grapefruit, strawberries, tomato, sweet red pepper, broccoli and potato.

Vitamin E / Tocopherols

- Alpha-tocopherol (body's main form of vitamin E) functions as an antioxidant, regulates cell signaling, influences immune function and inhibits coagulation.
- Deficiency may occur with malabsorption, cholestyramine, colestipol, isoniazid, orlistat, olestra and certain anti-convulsants (e.g., phenobarbital, phenytoin).
- Deficiency may result in peripheral neuropathy, ataxia, muscle weakness, retinopathy, and increased risk of CVD, prostate cancer and cataracts.
- Food sources include oils (olive, soy, corn, canola, safflower, sunflower), eggs, nuts, seeds, spinach, carrots, avocado, dark leafy greens and wheat germ.

α-Lipoic Acid



- α-Lipoic acid plays an important role in energy production, antioxidant activity (including the regeneration of vitamin C and glutathione), insulin signaling, cell signaling and the catabolism of α-keto acids and amino acids.
- High biotin intake can compete with lipoic acid for cell membrane entry.
- Optimal levels of α-lipoic acid may improve glucose utilization and protect against diabetic neuropathy, vascular disease and age-related cognitive decline.
- Main food sources include organ meats, spinach and broccoli. Lesser sources include tomato, peas, Brussels sprouts and brewer's yeast.

CoQ10

- CoQ10 is a powerful antioxidant that is synthesized in the body and contained in cell membranes. CoQ10 is also essential for energy production & pH regulation.
- CoQ10 deficiency may occur with HMG-CoA reductase inhibitors (statins), several anti-diabetic medication classes (biguanides, sulfonylureas) or beta-blockers.
- Low levels may aggravate oxidative stress, diabetes, cancer, congestive heart failure, cardiac arrhythmias, gingivitis and neurologic diseases.
- Main food sources include meat, poultry, fish, soybean, canola oil, nuts and whole grains. Moderate sources include fruits, vegetables, eggs and dairy.

Glutathione

- Glutathione (GSH) is composed of cysteine, glutamine & glycine. GSH is a source of sulfate and plays a key role in antioxidant activity and detoxification of toxins.
- GSH requirement is increased with high-fat diets, cigarette smoke, cystinuria, chronic alcoholism, chronic acetaminophen use, infection, inflammation and toxic exposure.
- Deficiency may result in oxidative stress & damage, impaired detoxification, altered immunity, macular degeneration and increased risk of chronic illness.
- Food sources of GSH precursors include meats, poultry, fish, soy, corn, nuts, seeds, wheat germ, milk and cheese.

Plant-based Antioxidants

- Oxidative stress is the imbalance between the production of free radicals and the body's ability to readily detoxify these reactive species and/or repair the resulting damage with anti-oxidants.
- Oxidative stress can be endogenous (energy production and inflammation) or exogenous (exercise, exposure to environmental toxins).
- Oxidative stress has been implicated clinically in the development of neurodegenerative diseases, cardiovascular diseases and chronic fatigue syndrome.
- Antioxidants may be found in whole food sources (e.g., brightly colored fruits & vegetables, green tea, turmeric) as well as nutraceuticals (e.g., resveratrol, EGCG, lutein, lycopene, ginkgo, milk thistle, etc.).

Key

- Function
- Causes of Deficiency
- Complications of Deficiency
- Food Sources

NutrEval FMV amino acids

Interpretation At-A-Glance

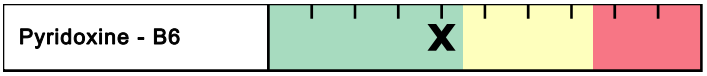
Nutritional Needs

B-Vitamins

- B1 is a required cofactor for enzymes involved in energy production from food, and for the synthesis of ATP, GTP, DNA, RNA and NADPH.
- Low B1 can result from chronic alcoholism, diuretics, digoxin, oral contraceptives and HRT, or large amounts of tea & coffee (contain anti-B1 factors).
- B1 deficiency may lead to dry beriberi (e.g., neuropathy, muscle weakness), wet beriberi (e.g., cardiac problems, edema), encephalopathy or dementia.
- Food sources include lentils, whole grains, wheat germ, Brazil nuts, peas, organ meats, brewer's yeast, blackstrap molasses, spinach, milk & eggs.

- B2 is a key component of enzymes involved in antioxidant function, energy production, detoxification, methionine metabolism and vitamin activation.
- Low B2 may result from chronic alcoholism, some anti-psychotic medications, oral contraceptives, tricyclic antidepressants, quinacrine or adriamycin.
- B2 deficiency may result in oxidative stress, mitochondrial dysfunction, low uric acid, low B3 or B6, high homocysteine, anemia or oral & throat inflammation.
- Food sources include milk, cheese, eggs, whole grains, beef, chicken, wheat germ, fish, broccoli, asparagus, spinach, mushrooms and almonds.

- B3 is used to form NAD and NADP, involved in energy production from food, fatty acid & cholesterol synthesis, cell signaling, DNA repair & cell differentiation.
- Low B3 may result from deficiencies of tryptophan (B3 precursor), B6, B2 or Fe (cofactors in B3 production), or from long-term isoniazid or oral contraceptive use.
- B3 deficiency may result in pellagra (dermatitis, diarrhea, dementia), neurologic symptoms (e.g., depression, memory loss), bright red tongue or fatigue.
- Food sources include poultry, beef, organ meats, fish, whole grains, peanuts, seeds, lentils, brewer's yeast and lima beans.



- B6 (as P5P) is a cofactor for enzymes involved in glycogenolysis & gluconeogenesis, and synthesis of neurotransmitters, heme, B3, RBCs and nucleic acids.
- Low B6 may result from chronic alcoholism, long-term diuretics, estrogens (oral contraceptives and HRT), anti-TB meds, penicillamine, L-DOPA or digoxin.
- B6 deficiency may result in neurologic symptoms (e.g., irritability, depression, seizures), oral inflammation, impaired immunity or increased homocysteine.
- Food sources include poultry, beef, beef liver, fish, whole grains, wheat germ, soybean, lentils, nuts & seeds, potato, spinach and carrots.

- Biotin is a cofactor for enzymes involved in functions such as fatty acid synthesis, mitochondrial FA oxidation, gluconeogenesis and DNA replication & transcription.
- Deficiency may result from certain inborn errors, chronic intake of raw egg whites, long-term TPN, anticonvulsants, high-dose B5, sulfa drugs & other antibiotics.
- Low levels may result in neurologic symptoms (e.g., paresthesias, depression), hair loss, scaly rash on face or genitals or impaired immunity.
- Food sources include yeast, whole grains, wheat germ, eggs, cheese, liver, meats, fish, wheat, nuts & seeds, avocado, raspberries, sweet potato and cauliflower.

- Folic acid plays a key role in coenzymes involved in DNA and SAMe synthesis, methylation, nucleic acids & amino acid metabolism and RBC production.
- Low folate may result from alcoholism, high-dose NSAIDs, diabetic meds, H2 blockers, some diuretics and anti-convulsants, SSRIs, methotrexate, trimethoprim, pyrimethamine, triamterene, sulfasalazine or cholestyramine.
- Folate deficiency can result in anemia, fatigue, low methionine, increased homocysteine, impaired immunity, heart disease, birth defects and CA risk.
- Food sources include fortified grains, green vegetables, beans & legumes.

- B12 plays important roles in energy production from fats & proteins, methylation, synthesis of hemoglobin & RBCs, and maintenance of nerve cells, DNA & RNA.
- Low B12 may result from alcoholism, malabsorption, hypochlorhydria (e.g., from atrophic gastritis, H. pylori infection, pernicious anemia, H2 blockers, PPIs), vegan diets, diabetic meds, cholestyramine, chloramphenicol, neomycin or colchicine.
- B12 deficiency can lead to anemia, fatigue, neurologic symptoms (e.g., paresthesias, memory loss, depression, dementia), methylation defects or chromosome breaks.
- Food sources include shellfish, red meat poultry, fish, eggs, milk and cheese.

NutrEval FMV amino acids Interpretation At-A-Glance

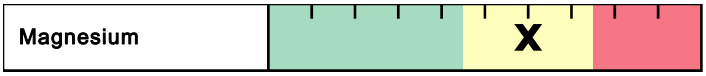
Nutritional Needs

Minerals

Manganese

- Manganese plays an important role in antioxidant function, gluconeogenesis, the urea cycle, cartilage & bone formation, energy production and digestion.
- Impaired absorption of Mn may occur with excess intake of Fe, Ca, Cu, folic acid, or phosphorous compounds, or use of long-term TPN, Mg-containing antacids or laxatives.
- Deficiency may result in impaired bone/connective tissue growth, glucose & lipid dysregulation, infertility, oxidative stress, inflammation or hyperammonemia.
- Food sources include whole grains, legumes, dried fruits, nuts, dark green leafy vegetables, liver, kidney and tea.

Magnesium



- Magnesium is involved in >300 metabolic reactions. Key areas include energy production, bone & ATP formation, muscle & nerve conduction and cell signaling.
- Deficiency may occur with malabsorption, alcoholism, hyperparathyroidism, renal disorders (wasting), diabetes, diuretics, digoxin or high doses of zinc.
- Low Mg may result in muscle weakness/spasm, constipation, depression, hypertension, arrhythmias, hypocalcemia, hypokalemia or personality changes.
- Food sources include dark leafy greens, oatmeal, buckwheat, unpolished grains, chocolate, milk, nuts & seeds, lima beans and molasses.

Molybdenum

- Molybdenum is a cofactor for enzymes that convert sulfites to sulfate, and nucleotides to uric acid, and that help metabolize aldehydes & other toxins.
- Low Mo levels may result from long-term TPN that does not include Mo.
- Mo deficiency may result in increased sulfite, decreased plasma uric acid (and antioxidant function), deficient sulfate, impaired sulfation (detoxification), neurologic disorders or brain damage (if severe deficiency).
- Food sources include buckwheat, beans, grains, nuts, beans, lentils, meats and vegetables (although Mo content of plants depends on soil content).

Zinc

- Zinc plays a vital role in immunity, protein metabolism, heme synthesis, growth & development, reproduction, digestion and antioxidant function.
- Low levels may occur with malabsorption, alcoholism, chronic diarrhea, diabetes, excess Cu or Fe, diuretics, ACE inhibitors, H2 blockers or digoxin.
- Deficiency can result in hair loss and skin rashes, also impairments in growth & healing, immunity, sexual function, taste & smell and digestion.
- Food sources include oysters, organ meats, soybean, wheat germ, seeds, nuts, red meat, chicken, herring, milk, yeast, leafy and root vegetables.

Essential Fatty Acids

Need for Essential Fatty Acids

- Omega-3 (O3) and Omega-6 (O6) fatty acids are polyunsaturated fatty acids that cannot be synthesized by the human body. They are classified as essential nutrients and must be obtained from dietary sources.
- The standard American diet is much higher in O6 than O3 fatty acids. Deficiency of EFAs may result from poor dietary intake and/or poor conversion from food sources.
- EFA deficiency is associated with decreased growth & development of infants and children, dry skin/rash, poor wound healing, and increased risk of infection, cardiovascular and inflammatory diseases.
- Dietary sources of the O6 Linoleic Acid (LA) include vegetable oils, nuts, seeds and some vegetables. Dietary sources of the O3 a-Linolenic Acid (ALA) include flaxseeds, walnuts, and their oils. Fish (mackerel, salmon, sardines) are the major dietary sources of the O3 fatty acids EPA and DHA.

Digestive Support

Need for Probiotics

- Probiotics have many functions. These include: production of some B vitamins and vitamin K; enhance digestion & absorption; decrease severity of diarrheal illness; modulate of immune function & intestinal permeability.
- Alterations of gastrointestinal microflora may result from C-section delivery, antibiotic use, improved sanitation, decreased consumption of fermented foods and use of certain drugs.
- Some of the diseases associated with microflora imbalances include: IBS, IBD, fibromyalgia, chronic fatigue syndrome, obesity, atopic illness, colic and cancer.
- Food sources rich in probiotics are yogurt, kefir and fermented foods.

Need for Pancreatic Enzymes

- Pancreatic enzymes are secreted by the exocrine glands of the pancreas and include protease/peptidase, lipase and amylase.
- Pancreatic exocrine insufficiency may be primary or secondary in nature. Any indication of insufficiency warrants further evaluation for underlying cause (i.e., celiac disease, small intestine villous atrophy, small bowel bacterial overgrowth).
- A high functional need for digestive enzymes suggests that there is an impairment related to digestive capacity.
- Determining the strength of the pancreatic enzyme support depends on the degree of functional impairment. Supplement potency is based on the lipase units present in both prescriptive and non-prescriptive agents.

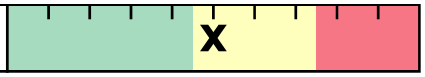
Interpretation At-A-Glance

Functional Imbalances

Mitochondrial Dysfunction

- Mitochondria are a primary site of generation of reactive oxygen species. Oxidative damage is considered an important factor in decline of physiologic function that occurs with aging and stress.
- Mitochondrial defects have been identified in cardiovascular disease, fatigue syndromes, neurologic disorders such as Parkinson's and Alzheimer's disease, as well as a variety of genetic conditions. Common nutritional deficiencies can impair mitochondrial efficiency.

Toxic Exposure

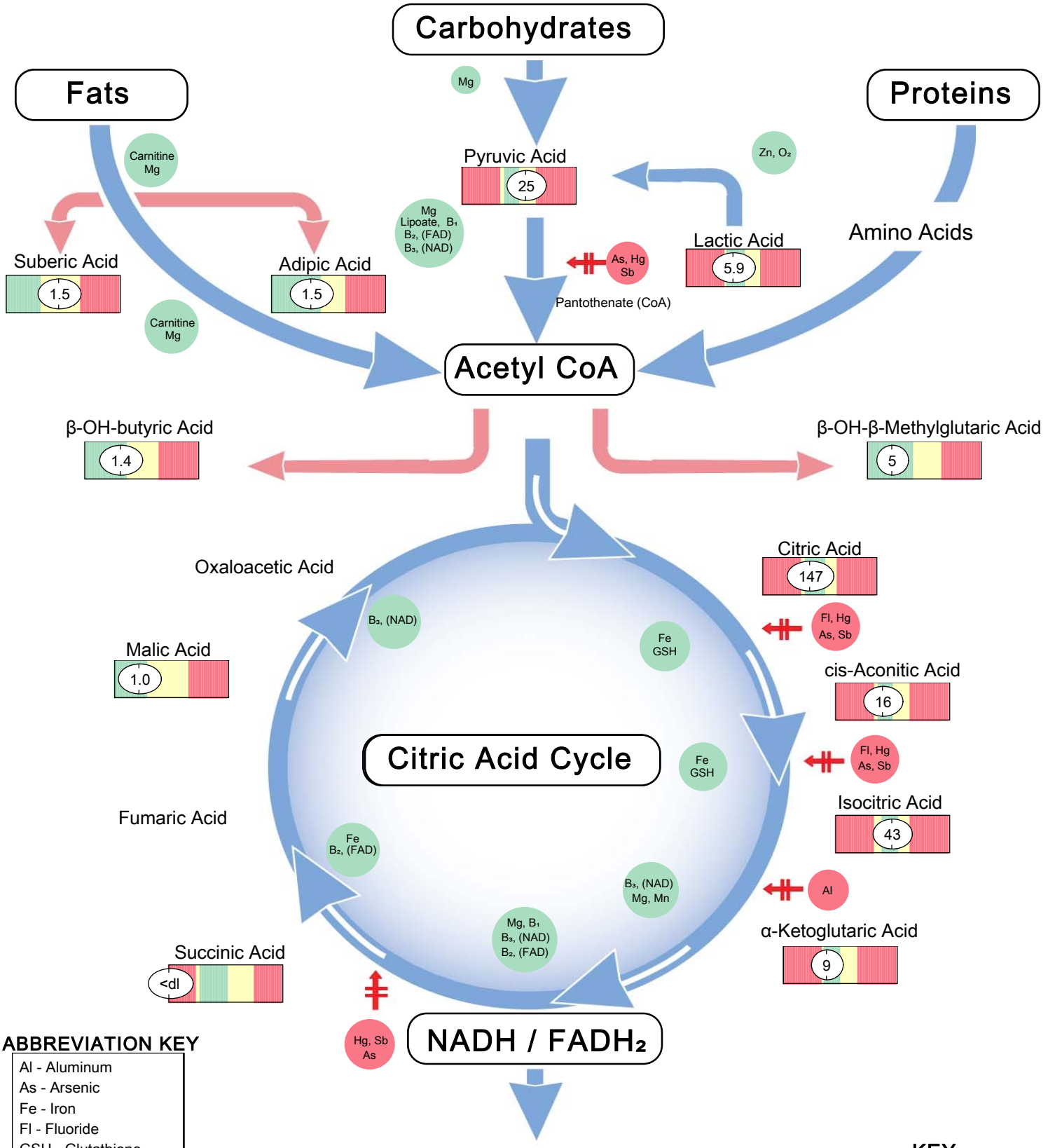


- Methyl tert-Butyl Ether (MTBE) is a common gasoline additive used to increase octane ratings, and has been found to contaminate ground water supplies where gasoline is stored. Inhalation of MTBE may cause nose and throat irritation, as well as headaches, nausea, dizziness and mental confusion. Animal studies suggest that drinking MTBE may cause gastrointestinal irritation, liver and kidney damage and nervous system effects.
- Styrene is classified by the US EPA as a "potential human carcinogen," and is found widely distributed in commercial products such as rubber, plastic, insulation, fiberglass, pipes, food containers and carpet backing.
- Levels of these toxic substances should be examined within the context of the body's functional capacity for methylation and need for glutathione.

Need for Methylation

- Methylation is an enzymatic process that is critical for both synthesis and inactivation. DNA, estrogen and neurotransmitter metabolism are all dependent on appropriate methylation activity.
- B vitamins and other nutrients (methionine, magnesium, selenium) functionally support catechol-O-methyltransferase (COMT), the enzyme responsible for methylation.

At-A-Glance



ABBREVIATION KEY

Al	Aluminum
As	Arsenic
Fe	Iron
Fl	Fluoride
GSH	Glutathione
Hg	Mercury
Mg	Magnesium
Mn	Manganese
Sb	Antimony
Zn	Zinc

KEY

Green = cofactor

Red = inhibitor

All biomarkers reported in mmol/mol creatinine unless otherwise noted.

Metabolic Analysis Markers (Urine)

Malabsorption and Dysbiosis Markers

Malabsorption Markers		Reference Range
Indoleacetic Acid (IAA)	0.7	<= 4.2
Phenylacetic Acid (PAA)	0.11	<= 0.12
Bacterial Dysbiosis Markers		
Dihydroxyphenylpropionic Acid (DHPPA)	1.0	<= 5.3
3-Hydroxyphenylacetic Acid	2.9	<= 8.1
4-Hydroxyphenylacetic Acid	20	<= 29
Benzoic Acid	0.15	<= 0.05
Hippuric Acid	<dl	<= 603
Yeast / Fungal Dysbiosis Markers		
Arabinose	53	<= 96
Citramalic Acid	6.2	<= 5.8
Tartaric Acid	<dl	<= 15

Cellular Energy & Mitochondrial Metabolites

Carbohydrate Metabolism		Reference Range
Lactic Acid	5.9	1.9-19.8
Pyruvic Acid	25	7-32
β-OH-Butyric Acid (BHBA)	1.4	<= 2.8
Energy Metabolism		
Citric Acid	147	40-520
Cis-Aconitic Acid	16	10-36
Isocitric Acid	43	22-65
α-Ketoglutaric Acid (AKG)	9	4-52
Succinic Acid	<dl	0.4-4.6
Malic Acid	1.0	<= 3.0
β-OH-β-Methylglutaric Acid (HMG)	5	<= 15
Fatty Acid Metabolism		
Adipic Acid	1.5	<= 2.8
Suberic Acid	1.5	<= 2.1

Creatinine Concentration

		Reference Range
Creatinine ◆	8.0	3.1-19.5 mmol/L

Neurotransmitter Metabolites

		Reference Range
Vanilmandelic Acid	1.9	0.4-3.6
Homovanillic Acid	2.4	1.2-5.3
5-OH-indoleacetic Acid	7.6	3.8-12.1
3-Methyl-4-OH-phenylglycol	0.15	0.02-0.22
Kynurenic Acid	5.5	<= 7.1
Quinolinic Acid	2.0	<= 9.1
Kynurenic / Quinolinic Ratio	2.75	>= 0.44

Vitamin Markers

		Reference Range
α-Ketoadipic Acid	0.4	<= 1.7
α-Ketoisovaleric Acid	0.48	<= 0.97
α-Ketoisocaproic Acid	0.63	<= 0.89
α-Keto-β-Methylvaleric Acid	1.1	<= 2.1
Formiminoglutamic Acid (FIGlu)	0.5	<= 1.5
Glutaric Acid	0.29	<= 0.51
Isovalerylglycine	1.1	<= 3.7
Methylmalonic Acid	0.9	<= 1.9
Xanthurenic Acid	0.42	<= 0.96
3-Hydroxypropionic Acid	8	5-22
3-Hydroxyisovaleric Acid	10	<= 29

Toxin & Detoxification Markers

		Reference Range
α-Ketophenylacetic Acid (from Styrene)	0.20	<= 0.46
α-Hydroxyisobutyric Acid (from MTBE)	6.0	<= 6.7
Orotic Acid	0.41	0.33-1.01
Pyroglutamic Acid	21	16-34

Tyrosine Metabolism

		Reference Range
Homogentisic Acid	7	<= 19
2-Hydroxyphenylacetic Acid	0.33	<= 0.76

Metabolic Analysis Reference Ranges are Age Specific

The performance characteristics of all assays have been verified by Genova Diagnostics, Inc. Unless otherwise noted with ◆, the assay has not been cleared by the U.S. Food and Drug Administration.

Amino Acids (Urine FMV)

All biomarkers reported in micromol/g creatinine unless otherwise noted.

Nutritionally Essential Amino Acids

Amino Acid		Reference Range
Arginine	14	3-43
Histidine	321	102-763
Isoleucine	8	3-25
Leucine	14	6-61
Lysine	33	15-231
Methionine	4	2-16
Phenylalanine	24	7-92
Taurine	219	39-568
Threonine	70	9-97
Tryptophan	21	8-58
Valine	19	5-43

Nonessential Protein Amino Acids

Amino Acid		Reference Range
Alanine	160	26-275
Asparagine	54	12-115
Aspartic Acid	<dl	<= 9
Cysteine (FMV urine)	40	9-60
Cystine (FMV Urine)	39	10-116
γ-Aminobutyric Acid	2	<= 3
Glutamic Acid	12	2-16
Glutamine	175	85-518
Proline	4	1-9
Tyrosine	34	19-135

Creatinine Concentration

		Reference Range
Creatinine ◆	8.1	3.1-19.5 mmol/L

Amino Acid reference ranges are age specific.

The performance characteristics of all assays have been verified by Genova Diagnostics, Inc. Unless otherwise noted with ◆, the assays have not been cleared by the U.S. Food and Drug Administration.

Methodology: LC/MS/MS, Enzymatic and Alkaline Picrate

Intermediary Metabolites

B Vitamin Markers		Reference Range
α-Aminoadipic	11	6-56
α-Amino-N-butyric Acid	3	2-21
β-Aminoisobutyric Acid	10	4-194
Cystathionine	9	4-48
3-Methylhistidine	93	47-232

Urea Cycle Markers

Citrulline	2.1	0.7-3.4
Ornithine	8	3-17
Urea ◆	141	150-380 mmol/g creatinine

Glycine/Serine Metabolites

Glycine	166	47-435
Serine	97	24-140
Ethanolamine	172	40-226
Phosphoethanolamine	2	1-9
Phosphoserine	6	2-13
Sarcosine	0.9	<= 1.0

Dietary Peptide Related Markers

		Reference Range
Anserine (dipeptide)	0.8	0.7-76.1
Carnosine (dipeptide)	7	1-32
1-Methylhistidine	19	18-887
β-Alanine	1	<= 18

Essential and Metabolic Fatty Acids Markers (RBCs)

Omega 3 Fatty Acids

Analyte	(cold water fish, flax, walnut)	Reference Range
α-Linolenic (ALA) 18:3 n3	0.40	>= 0.09 wt %
Eicosapentaenoic (EPA) 20:5 n3	0.63	>= 0.16 wt %
Docosapentaenoic (DPA) 22:5 n3	1.71	>= 1.14 wt %
Docosahexaenoic (DHA) 22:6 n3	2.2	>= 2.1 wt %
% Omega 3s	4.9	>= 3.8

Omega 9 Fatty Acids

Analyte	(olive oil)	Reference Range
Oleic 18:1 n9	14	10-13 wt %
Nervonic 24:1 n9	3.8	2.1-3.5 wt %
% Omega 9s	18.5	13.3-16.6

Saturated Fatty Acids

Analyte	(meat, dairy, coconuts, palm oils)	Reference Range
Palmitic C16:0	19	18-23 wt %
Stearic C18:0	17	14-17 wt %
Arachidic C20:0	0.27	0.22-0.35 wt %
Behenic C22:0	0.79	0.92-1.68 wt %
Tricosanoic C23:0	0.16	0.12-0.18 wt %
Lignoceric C24:0	2.4	2.1-3.8 wt %
Pentadecanoic C15:0	0.08	0.07-0.15 wt %
Margaric C17:0	0.21	0.22-0.37 wt %
% Saturated Fats	39.8	39.8-43.6

Omega 6 Fatty Acids

Analyte	(vegetable oil, grains, most meats, dairy)	Reference Range
Linoleic (LA) 18:2 n6	15.5	10.5-16.9 wt %
γ-Linolenic (GLA) 18:3 n6	0.15	0.03-0.13 wt %
Dihomo-γ-linolenic (DGLA) 20:3 n6	0.97	>= 1.19 wt %
Arachidonic (AA) 20:4 n6	16	15-21 wt %
Docosatetraenoic (DTA) 22:4 n6	2.24	1.50-4.20 wt %
Eicosadienoic 20:2 n6	0.30	<= 0.26 wt %
% Omega 6s	35.4	30.5-39.7

Monounsaturated Fats

Omega 7 Fats		Reference Range
Palmitoleic 16:1 n7	0.27	<= 0.64 wt %
Vaccenic 18:1 n7	0.88	<= 1.13 wt %
Trans Fat		
Elaidic 18:1 n9t	0.24	<= 0.59 wt %

Delta - 6 Desaturase Activity

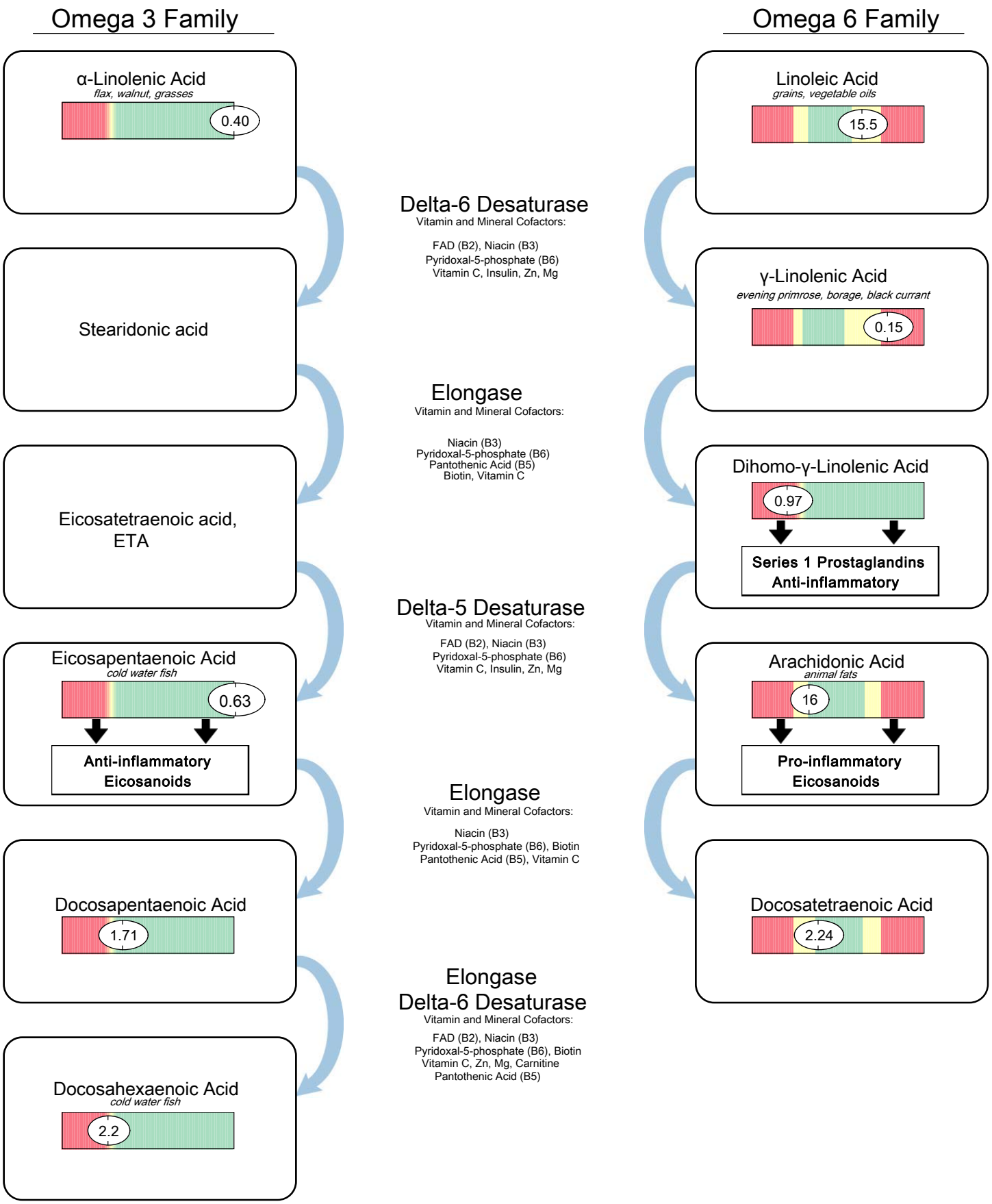
	Upregulated Functional Impaired	
Linoleic / DGLA 18:2 n6 / 20:3 n6	16.0	6.0-12.3

Cardiovascular Risk

Analyte		Reference Range
Omega 6s / Omega 3s	7.2	3.4-10.7
AA / EPA 20:4 n6 / 20:5 n3	26	12-125
Omega 3 Index	2.8	>= 4.0

The Essential Fatty Acid reference ranges are based on an adult population.

Acid Metabolism



This test was developed and its performance characteristics determined by Genova Diagnostics, Inc. It has not been cleared by the U.S. Food and Drug Administration.

Oxidative Stress Markers

Oxidative Stress Markers

		Reference Range
Glutathione (whole blood)	904	>=669 micromol/L
Lipid Peroxides (urine)	4.7	<=10.0 micromol/g Creat.
8-OHdG (urine)	9	<=16 mcg/g Creat.
Coenzyme Q10, Ubiquinone (serum)	1.09	0.46-1.72 mcg/mL

The Oxidative Stress reference ranges are based on an adult population.

The performance characteristics of the Oxidative Stress Markers have been verified by Genova Diagnostics, Inc. They have not been cleared by the U.S. Food and Drug Administration.

Vitamin D (Serum)

	Inside Range	Outside Range	Reference Range
25 - OH Vitamin D ◆		<12	50-100 ng/mL

Deficiency = < 20 ng/mL (< 50 nmol/L)
Insufficiency = 20-49 ng/mL (50-124 nmol/L)
Optimal = 50-100 ng/mL (125-250 nmol/L)
Excessive = > 100 ng/mL (> 250 nmol/L)

Elemental Markers

Nutrient Elements

Element	Reference Range	Reference Range
Copper *(plasma)*	97.6	75.3-192.0 mcg/dL
Magnesium *(RBC)*	47.9	30.1-56.5 mcg/g
Manganese *(whole blood)*	6.3	3.0-16.5 mcg/L
Potassium *(RBC)*	2,944	2,220-3,626 mcg/g
Selenium *(whole blood)*	115	109-330 mcg/L
Zinc *(plasma)*	84.0	64.3-159.4 mcg/dL

Toxic Elements*

Element	Reference Range	Reference Range
Lead	2.11	<= 2.81 mcg/dL
Mercury	0.42	<= 4.35 mcg/L
Arsenic	<DL	<= 13.7 mcg/L
Cadmium	0.21	<= 1.22 mcg/L
Tin	<DL	<= 0.39 mcg/L

* All toxic Elements are measured in whole blood.

The Elemental reference ranges are based on an adult population.

The performance characteristics of the Elemental Markers have been verified by Genova Diagnostics, Inc. They have not been cleared by the U.S. Food and Drug Administration.

Elemental testing performed by Genova Diagnostics, Inc. 3425 Corporate Way, Duluth, GA 30096 - Robert M. David, PhD, Lab Director - CLIA Lic. #11D0255349 - Medicare Lic. #34-8475

Commentary

The CoQ10 analysis is now performed from the serum sample. The reference range has not changed.

The assay for elemental analysis has been updated and some reference ranges have been changed accordingly.

Homocysteine (Plasma)

GENOVA DIAGNOSTICS EUROPE

46-50 Coombe Road
New Malden
Surrey KT3 4QF

63 Zillicoa Street
Asheville, NC 28801 USA

Patient:
DOB:
Sex:
MRN:

Order Number:
Completed:
Received:
Collected:

Homocysteine

	Inside Range	Outside Range	Reference Range
Homocysteine		13.10	5.20-11.40 umol/L

Commentary

The reference range for homocysteine is based on the sex-specific 5th to 95th percentile values for men and women (20 to 39 years of age) in the NHANES nutritionally replete cohort. Annals of Internal Medicince 1999; 131 (331-338).

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

The **homocysteine** level is ABOVE the REFERENCE range. Homocysteinemia has received abundant regard as a key independent risk factor for cardiovascular disease which is responsive to nutritional intervention. Elevated homocysteine levels result in micro-abrasive effects on the vascular endothelium, thus providing loci for other plaque-generating events to occur. Smoking and hypertension increase cardiovascular risks associated with high homocysteine.

Commentary

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Benzoic acid is a common food component, especially in fruits and in particular berries/cranberries. It is also a common food additive/preservative. Benzoic acid is also formed by gut microflora metabolism of phenylalanine and dietary polyphenols. Elevated levels may thus reflect dietary intake (for example strawberries), imbalanced gut flora or a high intake of polyphenols or phenylalanine. Older studies note a relationship between decreased cognitive function and increased BA in the urine.

Citramalic Acid is elevated. With a chemical structure very similar to that of malic acid, citramalate may cause metabolic interference with malate. This is of concern because malic acid has extra-mitochondrial functions, as with the "malate shuttle" for carrying reducing equivalents (protons) into the mitochondria. While the metabolic interference aspect is uncertain, the presence of citramalate in the urine indicates intestinal dysbiosis. Not formed in human tissues, citramalate may be formed by anaerobic bacteria such as clostridia, as well as by yeast/fungi. A stool analysis with bacteriology or microbiology is suggested.

Succinic acid participates in the citric acid cycle, acting to donate electrons to the mitochondrial electron transport and leading to formation of fumaric acid. Common in foods such as cantaloupe, it is also a food additive, providing flow-altering effects and a tart flavor. It appears that lacto-ovo vegetarians may show decreased levels in the urine and chronic fatigue patients may also show low levels, although studies on this topic are mixed. Low levels may also be an indicator of B12 or folate deficiency.

Amino Acid Markers (FMV)

Commentary

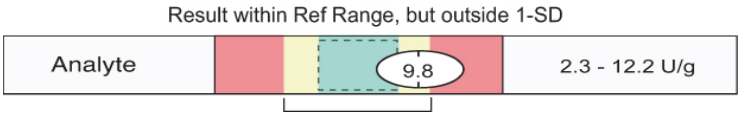
<dl = Unable to calculate results due to less than detectable levels of analyte.
Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

Essential & Metabolic Fatty Acids Markers (RBCs)

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

The **Reference Range** is a statistical interval representing 95% or 2 Standard Deviations (2 S.D.) of the reference population. One Standard Deviation (1 S.D.) is a statistical interval representing 68% of the reference population. Values between 1 and 2 S.D. are not necessarily abnormal. Clinical correlation is suggested. (See example below)



Fatty Acids and Your Health

Doctors and nutritionists used to think that all fat was merely a way for the body to store calories for later use as energy, since, as we all know too well, if we eat excess food, our body converts those calories to fat. Only in the last century have we discovered that some fats are absolutely essential to health. Our bodies cannot make these fats, and so we must get them from our food, or our health will suffer. These Essential Fatty Acids (EFAs) have many functions in the body: they are the precursors for local "hormones"; they regulate all inflammation as well as all smooth muscle contraction and relaxation. These local hormones are given names like prostaglandins, leukotrienes and thromboxanes. EFAs are also essential components for all cell membranes. Their importance for health cannot be overemphasized since the brain, nerves, eyes, connective tissue, skin, blood vessels, and every cell in the body depend on a proper balance of essential fatty acids for optimal function. It is the fats found in red blood cell membranes, known as phospholipids, that this test measures.

Essential fatty acids are classified into fat "families": omega 3 fats and omega 6 fats. Non-essential fat "families" include omega-9 fats, saturated fats, omega-7 fats, and trans-fats. Optimal health depends on the proper balance of all fats - both essential and non-essential fats - in the diet. Proper balance means adequate amounts of each individual fat, without having too much, and maintaining proper balance between the various "families" of fats. Fat health also means avoiding potentially harmful fats such as trans fats found in shortening, margarine, fried foods and dairy. A proper balance of fatty acids will lead to mental health and proper nerve function, a healthy heart and circulatory system, reduced inflammation in general, proper gastrointestinal and lung function, a more balanced immune system, and even healthy skin, hair and nails. Fatty acid balance is also critical for the health of all pregnant women and their babies since the developing brain and nervous system of the baby requires large amounts of EFAs that must come from the mother. Fatty acid imbalances have been seen in many disease processes including heart disease, hypertension, insulin resistance and diabetes, asthma, painful menstruation, pre-menstrual syndrome (PMS), depression, attention deficit hyperactivity disorder (ADHD), senility, obsessive-compulsive disorder, and post-partum depression.

This Essential and Metabolic Fatty Acid Analysis allows your health care practitioner to examine the fats found in your red blood cell membranes. These fats represent the types of fats your body has available to make cell membranes and the local "hormones" that control inflammation and smooth muscle contraction throughout the body. Following your health care practitioner's advice on diet and fatty acid supplementation is likely to restore your fatty acids to a state of healthy balance.

Results of Your Individual Essential and Metabolic Fatty Acid Analysis

Docosahexaenoic acid (DHA) is within the reference range, but below the functional physiologic range. DHA is the

Commentary

longest and most polyunsaturated fatty acid in the body and is critical for proper membrane fluidity and for the proper function of all cells, especially nerve and brain. Low DHA (and low ALA, and the ratio of AA to EPA) has been correlated with the severity of depression in depressed patients. Low DHA has also been associated with increased tendency to aggression, violence, depression and suicide.

Adequate DHA is critical for pregnant or breast-feeding women and their babies. Brain and nerve cells in the developing fetus require huge amounts of DHA (and AA). The brain at birth weighs ~350g and by 12 months old weighs ~1000g. 60% of the brain┼s weight is fat, the most important being DHA and AA. Because these fats are essential, they must come from the mother. Women with lower DHA levels have a much higher incidence of gestational diabetes, hypertension and pre-eclampsia during pregnancy and a much higher incidence of post-partum depression and post-partum obsessive/compulsive disorder after birth. Breast fed babies show much faster neurological development, presumably due to the presence of DHA and AA in breast milk. Until very recently, baby formula did not contain DHA or AA. Moderate maternal DHA supplementation has been shown to increase breast milk DHA levels dramatically.

DHA is found in cold water fish (salmon, mackerel, sardines, etc.) and in fish oil and cod liver oil supplements. A vegetarian, algae-derived DHA is available as a supplement.

Linoleic acid (LA) is within the reference range, but above the functional physiologic range. LA is the main fatty acid in all vegetable oils (corn, peanut, soy, sunflower, safflower, canola, etc.). High LA levels are frequently seen in people consuming a high fat diet, especially with over-consumption of vegetable oils. High LA consumption has been associated with increased risk of breast, colon and prostate cancers; and with increased risk of cognitive impairment. LA is known to be a cellular mitogen; adequate amounts facilitate cell repair and division, but excess amounts may lead to abnormal cell division.

Reducing the consumption of vegetable oils and using olive oil (high in omega-9 oleic acid) as the main dietary oil is the best means of lowering LA levels.

Dihomo Gamma Linolenic Acid (DGLA) is below the reference range. DGLA is the main precursor fat for the production of highly anti-inflammatory eicosanoids, especially the series 1 prostaglandins. Low DGLA is often associated with inflammatory conditions such as heart disease, arthritis, inflammatory bowel disorders, eczema, and psoriasis. Since DGLA-derived eicosanoids also promote smooth muscle relaxation, low DGLA levels may contribute to increased smooth muscle contraction, and subsequently to conditions like hypertension, asthma, painful menstruation, and irritable bowel syndrome.

Low DGLA can result from impaired conversion of linoleic acid into gamma-linolenic acid (and subsequently into DGLA) or from an increased conversion of DGLA into arachidonic acid or both. Delta-6 desaturase is the enzyme responsible for converting LA into GLA and may be impaired with age, alcohol use, genetic defect, or nutrient deficiency. An elevated linoleic/DGLA ratio or an elevated eicosadienoic/DGLA ratio (see p.3 of this report) would strongly suggest impaired delta-6 desaturase activity. Supplementation with GLA-containing oils like evening primrose, borage or black currant seed oils bypasses delta-6 desaturase.

A low DGLA/arachidonic acid ratio (see p.3 of this report) would indicate a likely increased activity of delta-5 desaturase. Insulin activates delta-5 desaturase. A high carbohydrate (sugars and starch) diet increases insulin secretion and action in the body. Consumption of a higher protein and higher fiber and complex carbohydrate diet reduces insulin action in the body. Eicosapentaenoic acid (EPA) supplementation, found in fish and fish oils, has also been shown to reduce delta-5 desaturase activity, reducing the conversion of DGLA into AA.

Commentary

Oleic acid is above the reference range. Oleic acid is important in maintaining cell membrane fluidity. High oleic acid may result from the consumption of olive oil, high-oleic safflower, or high-oleic sunflower oil. Moderately high levels may be indicative of increased olive oil consumption and are likely to be of no clinical concern.

The linoleic/DGLA ratio is high which may indicate impaired delta-6 desaturase enzyme activity. Impaired delta-6 activity would be confirmed if the eicosadienoic/DGLA ratio were also high since eicosadienoic acid represents the elongation of linoleic acid before it has undergone desaturation. However, a high linoleic/DGLA ratio, alone, is sufficient to suggest impaired delta-6 activity. Typical remedies include supplementing with vitamins B2, B3, B6, C, and the minerals zinc and magnesium. The enzyme may be bypassed by supplementing oils containing pre-formed GLA oils such as evening primrose, borage, or black currant seed oil.

Oxidative Stress Markers

Commentary

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

The performance characteristics of this assay have been verified by Genova Diagnostics, Inc. This assay for Vitamin D has been cleared by the U.S. Food and Drug Administration.

Deficient or Insufficient levels:

Vitamin D is a hormone produced in the skin during exposure to sunlight or consumed in the diet, and converted to its active form, calcitriol, in the liver and kidneys. Vitamin D helps regulate serum calcium and phosphorus levels by increasing intestinal absorption of calcium and stimulating tubular reabsorption of calcium. Vitamin D also affects numerous other functions in the body.

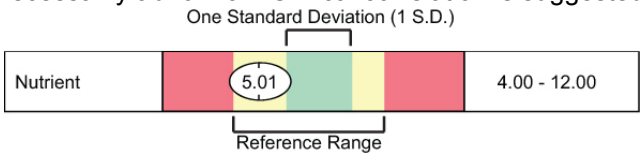
Calcitriol deficiency can result in rickets or osteomalacia due to under-mineralization of the growing skeleton or demineralization of the adult skeleton, respectively. Hypovitaminosis D also increases the risk of infection, cancer, autoimmune disease, hypertension, arteriosclerosis, diabetes and/or insulin resistance, musculoskeletal pain, epilepsy, and migraine.

Elemental Markers

Commentary

Testing Methodology: ICP-MS

The **Reference Range** is a statistical interval representing 95% or 2 Standard Deviations (2 S.D.) of the reference population. One Standard Deviation (1 S.D.) is a statistical interval representing 68% of the reference population. Values between 1 and 2 S.D. are not necessarily abnormal. Clinical correlation is suggested. (See example below)



The reference range for Lead is set at NHANES 95th percentile.
https://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Volume1_Jan2017.pdf

The reference range for Cadmium is set at NHANES 95th percentile.
https://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Volume1_Jan2017.pdf

The reference range for Mercury is set at NHANES 95th percentile.
https://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Volume1_Jan2017.pdf

Patient Copy

GENOVA DIAGNOSTICS EUROPE

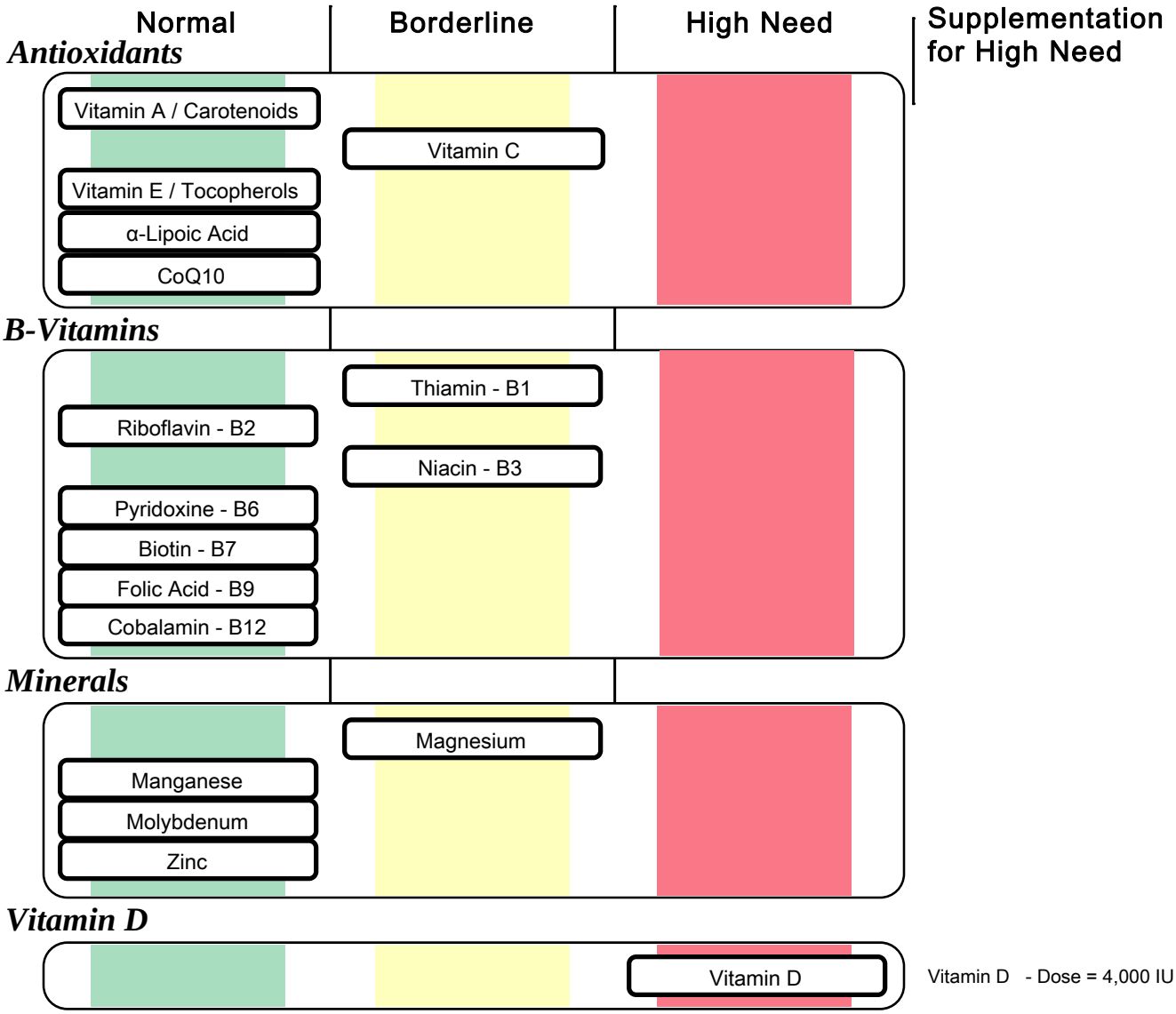
46-50 Coombe Road
New Malden
Surrey KT3 4QF

63 Zillicoa Street
Asheville, NC 28801 USA

Patient:
DOB:
Sex:
MRN:

Order Number:
Completed:
Received:
Collected:

NutrEval Results Overview



SUGGESTED SUPPLEMENT SCHEDULE

Supplements	Daily Recommended Intake (DRI)	Patient's Daily Recommendations	Provider Daily Recommendations
Antioxidants			
Vitamin A / Carotenoids	3,000 IU	3,000 IU	
Vitamin C	90 mg	500 mg	
Vitamin E / Tocopherols	22 IU	100 IU	
α-Lipoic Acid		50 mg	
CoQ10		30 mg	
B-Vitamins			
Thiamin - B1	1.2 mg	25 mg	
Riboflavin - B2	1.3 mg	10 mg	
Niacin - B3	16 mg	30 mg	
Pyridoxine - B6	1.3 mg	10 mg	
Biotin - B7	30 mcg	100 mcg	
Folic Acid - B9	400 mcg	400 mcg	
Cobalamin - B12	2.4 mcg	100 mcg	
Minerals			
Magnesium	420 mg	600 mg	
Manganese	2.3 mg	3.0 mg	
Molybdenum	45 mcg	75 mcg	
Zinc	11 mg	10 mg	
Essential Fatty Acids			
Omega-3 Oils	500 mg	1,000 mg	
Digestive Support			
Probiotics		25 billion CFU	
Pancreatic Enzymes		0 IU	
Other Vitamins			
Vitamin D	600 IU	4,000 IU	

Amino Acid	mg/day	Amino Acid	mg/day
Arginine	0	Methionine	81
Asparagine	0	Phenylalanine	0
Cysteine	0	Serine	0
Glutamine	0	Taurine	0
Glycine	0	Threonine	0
Histidine	0	Tryptophan	0
Isoleucine	0	Tyrosine	151
Leucine	147	Valine	0
Lysine	908		

Recommendations for age and gender-specific supplementation are set by comparing levels of nutrient functional need to optimal levels as described in the peer-reviewed literature. They are provided as guidance for short-term support of nutritional deficiencies only.

The Suggested Supplemental Schedule is provided at the request of the ordering practitioner. Any application of it as a therapeutic intervention is to be determined by the ordering practitioner.

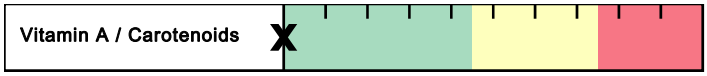
Key Normal | Borderline | High Need

Interpretation At-A-Glance

Nutritional Needs

Antioxidants

Vitamin A / Carotenoids



- Beta-carotene & other carotenoids are converted to vitamin A (retinol), involved in vision, antioxidant & immune function, gene expression & cell growth.
- Vitamin A deficiency may occur with chronic alcoholism, zinc deficiency, hypothyroidism, or oral contraceptives containing estrogen & progestin.
- Deficiency may result in night blindness, impaired immunity, healing & tissue regeneration, increased risk of infection, leukoplakia or keratosis.
- Food sources include cod liver oil, fortified cereals & milk, eggs, sweet potato, pumpkin, carrot, cantaloupe, mango, spinach, broccoli, kale & butternut squash.

Vitamin C

- Vitamin C is an antioxidant (also used in the regeneration of other antioxidants). It is involved in cholesterol metabolism, the production & function of WBCs and antibodies, and the synthesis of collagen, norepinephrine and carnitine.
- Deficiency may occur with oral contraceptives, aspirin, diuretics or NSAIDs.
- Deficiency can result in scurvy, swollen gingiva, periodontal destruction, loose teeth, sore mouth, soft tissue ulcerations, or increased risk of infection.
- Food sources include oranges, grapefruit, strawberries, tomato, sweet red pepper, broccoli and potato.

Vitamin E / Tocopherols

- Alpha-tocopherol (body's main form of vitamin E) functions as an antioxidant, regulates cell signaling, influences immune function and inhibits coagulation.
- Deficiency may occur with malabsorption, cholestyramine, colestipol, isoniazid, orlistat, olestra and certain anti-convulsants (e.g., phenobarbital, phenytoin).
- Deficiency may result in peripheral neuropathy, ataxia, muscle weakness, retinopathy, and increased risk of CVD, prostate cancer and cataracts.
- Food sources include oils (olive, soy, corn, canola, safflower, sunflower), eggs, nuts, seeds, spinach, carrots, avocado, dark leafy greens and wheat germ.

α-Lipoic Acid

- α-Lipoic acid plays an important role in energy production, antioxidant activity (including the regeneration of vitamin C and glutathione), insulin signaling, cell signaling and the catabolism of α-keto acids and amino acids.
- High biotin intake can compete with lipoic acid for cell membrane entry.
- Optimal levels of α-lipoic acid may improve glucose utilization and protect against diabetic neuropathy, vascular disease and age-related cognitive decline.
- Main food sources include organ meats, spinach and broccoli. Lesser sources include tomato, peas, Brussels sprouts and brewer's yeast.

CoQ10

- CoQ10 is a powerful antioxidant that is synthesized in the body and contained in cell membranes. CoQ10 is also essential for energy production & pH regulation.
- CoQ10 deficiency may occur with HMG-CoA reductase inhibitors (statins), several anti-diabetic medication classes (biguanides, sulfonylureas) or beta-blockers.
- Low levels may aggravate oxidative stress, diabetes, cancer, congestive heart failure, cardiac arrhythmias, gingivitis and neurologic diseases.
- Main food sources include meat, poultry, fish, soybean, canola oil, nuts and whole grains. Moderate sources include fruits, vegetables, eggs and dairy.

Glutathione

- Glutathione (GSH) is composed of cysteine, glutamine & glycine. GSH is a source of sulfate and plays a key role in antioxidant activity and detoxification of toxins.
- GSH requirement is increased with high-fat diets, cigarette smoke, cystinuria, chronic alcoholism, chronic acetaminophen use, infection, inflammation and toxic exposure.
- Deficiency may result in oxidative stress & damage, impaired detoxification, altered immunity, macular degeneration and increased risk of chronic illness.
- Food sources of GSH precursors include meats, poultry, fish, soy, corn, nuts, seeds, wheat germ, milk and cheese.

Plant-based Antioxidants

- Oxidative stress is the imbalance between the production of free radicals and the body's ability to readily detoxify these reactive species and/or repair the resulting damage with anti-oxidants.
- Oxidative stress can be endogenous (energy production and inflammation) or exogenous (exercise, exposure to environmental toxins).
- Oxidative stress has been implicated clinically in the development of neurodegenerative diseases, cardiovascular diseases and chronic fatigue syndrome.
- Antioxidants may be found in whole food sources (e.g., brightly colored fruits & vegetables, green tea, turmeric) as well as nutraceuticals (e.g., resveratrol, EGCG, lutein, lycopene, ginkgo, milk thistle, etc.).

Key

- Function
- Causes of Deficiency
- Complications of Deficiency
- Food Sources

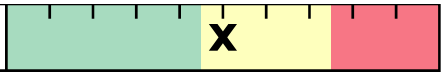
NutrEval FMV amino acids

Interpretation At-A-Glance

Nutritional Needs

B-Vitamins

Thiamin - B1



- B1 is a required cofactor for enzymes involved in energy production from food, and for the synthesis of ATP, GTP, DNA, RNA and NADPH.
- Low B1 can result from chronic alcoholism, diuretics, digoxin, oral contraceptives and HRT, or large amounts of tea & coffee (contain anti-B1 factors).
- B1 deficiency may lead to dry beriberi (e.g., neuropathy, muscle weakness), wet beriberi (e.g., cardiac problems, edema), encephalopathy or dementia.
- Food sources include lentils, whole grains, wheat germ, Brazil nuts, peas, organ meats, brewer's yeast, blackstrap molasses, spinach, milk & eggs.

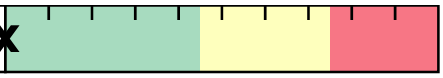
Pyridoxine - B6

- B6 (as P5P) is a cofactor for enzymes involved in glycogenolysis & gluconeogenesis, and synthesis of neurotransmitters, heme, B3, RBCs and nucleic acids.
- Low B6 may result from chronic alcoholism, long-term diuretics, estrogens (oral contraceptives and HRT), anti-TB meds, penicillamine, L-DOPA or digoxin.
- B6 deficiency may result in neurologic symptoms (e.g., irritability, depression, seizures), oral inflammation, impaired immunity or increased homocysteine.
- Food sources include poultry, beef, beef liver, fish, whole grains, wheat germ, soybean, lentils, nuts & seeds, potato, spinach and carrots.

Riboflavin - B2

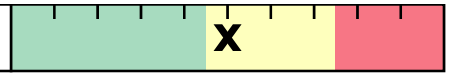
- B2 is a key component of enzymes involved in antioxidant function, energy production, detoxification, methionine metabolism and vitamin activation.
- Low B2 may result from chronic alcoholism, some anti-psychotic medications, oral contraceptives, tricyclic antidepressants, quinacrine or adriamycin.
- B2 deficiency may result in oxidative stress, mitochondrial dysfunction, low uric acid, low B3 or B6, high homocysteine, anemia or oral & throat inflammation.
- Food sources include milk, cheese, eggs, whole grains, beef, chicken, wheat germ, fish, broccoli, asparagus, spinach, mushrooms and almonds.

Biotin - B7



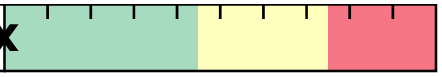
- Biotin is a cofactor for enzymes involved in functions such as fatty acid synthesis, mitochondrial FA oxidation, gluconeogenesis and DNA replication & transcription.
- Deficiency may result from certain inborn errors, chronic intake of raw egg whites, long-term TPN, anticonvulsants, high-dose B5, sulfa drugs & other antibiotics.
- Low levels may result in neurologic symptoms (e.g., paresthesias, depression), hair loss, scaly rash on face or genitals or impaired immunity.
- Food sources include yeast, whole grains, wheat germ, eggs, cheese, liver, meats, fish, wheat, nuts & seeds, avocado, raspberries, sweet potato and cauliflower.

Niacin - B3



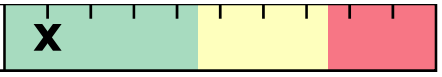
- B3 is used to form NAD and NADP, involved in energy production from food, fatty acid & cholesterol synthesis, cell signaling, DNA repair & cell differentiation.
- Low B3 may result from deficiencies of tryptophan (B3 precursor), B6, B2 or Fe (cofactors in B3 production), or from long-term isoniazid or oral contraceptive use.
- B3 deficiency may result in pellagra (dermatitis, diarrhea, dementia), neurologic symptoms (e.g., depression, memory loss), bright red tongue or fatigue.
- Food sources include poultry, beef, organ meats, fish, whole grains, peanuts, seeds, lentils, brewer's yeast and lima beans.

Folic Acid - B9



- Folic acid plays a key role in coenzymes involved in DNA and SAMe synthesis, methylation, nucleic acids & amino acid metabolism and RBC production.
- Low folate may result from alcoholism, high-dose NSAIDs, diabetic meds, H2 blockers, some diuretics and anti-convulsants, SSRIs, methotrexate, trimethoprim, pyrimethamine, triamterene, sulfasalazine or cholestyramine.
- Folate deficiency can result in anemia, fatigue, low methionine, increased homocysteine, impaired immunity, heart disease, birth defects and CA risk.
- Food sources include fortified grains, green vegetables, beans & legumes.

Cobalamin - B12



- B12 plays important roles in energy production from fats & proteins, methylation, synthesis of hemoglobin & RBCs, and maintenance of nerve cells, DNA & RNA.
- Low B12 may result from alcoholism, malabsorption, hypochlorhydria (e.g., from atrophic gastritis, H. pylori infection, pernicious anemia, H2 blockers, PPIs), vegan diets, diabetic meds, cholestyramine, chloramphenicol, neomycin or colchicine.
- B12 deficiency can lead to anemia, fatigue, neurologic symptoms (e.g., paresthesias, memory loss, depression, dementia), methylation defects or chromosome breaks.
- Food sources include shellfish, red meat poultry, fish, eggs, milk and cheese.

NutrEval FMV amino acids — Interpretation At-A-Glance

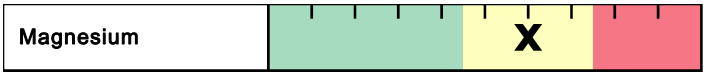
Nutritional Needs

Minerals

Manganese

- Manganese plays an important role in antioxidant function, gluconeogenesis, the urea cycle, cartilage & bone formation, energy production and digestion.
- Impaired absorption of Mn may occur with excess intake of Fe, Ca, Cu, folic acid, or phosphorous compounds, or use of long-term TPN, Mg-containing antacids or laxatives.
- Deficiency may result in impaired bone/connective tissue growth, glucose & lipid dysregulation, infertility, oxidative stress, inflammation or hyperammonemia.
- Food sources include whole grains, legumes, dried fruits, nuts, dark green leafy vegetables, liver, kidney and tea.

Magnesium



- Magnesium is involved in >300 metabolic reactions. Key areas include energy production, bone & ATP formation, muscle & nerve conduction and cell signaling.
- Deficiency may occur with malabsorption, alcoholism, hyperparathyroidism, renal disorders (wasting), diabetes, diuretics, digoxin or high doses of zinc.
- Low Mg may result in muscle weakness/spasm, constipation, depression, hypertension, arrhythmias, hypocalcemia, hypokalemia or personality changes.
- Food sources include dark leafy greens, oatmeal, buckwheat, unpolished grains, chocolate, milk, nuts & seeds, lima beans and molasses.

Molybdenum

- Molybdenum is a cofactor for enzymes that convert sulfites to sulfate, and nucleotides to uric acid, and that help metabolize aldehydes & other toxins.
- Low Mo levels may result from long-term TPN that does not include Mo.
- Mo deficiency may result in increased sulfite, decreased plasma uric acid (and antioxidant function), deficient sulfate, impaired sulfation (detoxification), neurologic disorders or brain damage (if severe deficiency).
- Food sources include buckwheat, beans, grains, nuts, beans, lentils, meats and vegetables (although Mo content of plants depends on soil content).

Zinc

- Zinc plays a vital role in immunity, protein metabolism, heme synthesis, growth & development, reproduction, digestion and antioxidant function.
- Low levels may occur with malabsorption, alcoholism, chronic diarrhea, diabetes, excess Cu or Fe, diuretics, ACE inhibitors, H2 blockers or digoxin.
- Deficiency can result in hair loss and skin rashes, also impairments in growth & healing, immunity, sexual function, taste & smell and digestion.
- Food sources include oysters, organ meats, soybean, wheat germ, seeds, nuts, red meat, chicken, herring, milk, yeast, leafy and root vegetables.

Essential Fatty Acids

Need for Essential Fatty Acids

- Omega-3 (O3) and Omega-6 (O6) fatty acids are polyunsaturated fatty acids that cannot be synthesized by the human body. They are classified as essential nutrients and must be obtained from dietary sources.
- The standard American diet is much higher in O6 than O3 fatty acids. Deficiency of EFAs may result from poor dietary intake and/or poor conversion from food sources.
- EFA deficiency is associated with decreased growth & development of infants and children, dry skin/rash, poor wound healing, and increased risk of infection, cardiovascular and inflammatory diseases.
- Dietary sources of the O6 Linoleic Acid (LA) include vegetable oils, nuts, seeds and some vegetables. Dietary sources of the O3 a-Linolenic Acid (ALA) include flaxseeds, walnuts, and their oils. Fish (mackerel, salmon, sardines) are the major dietary sources of the O3 fatty acids EPA and DHA.

Digestive Support

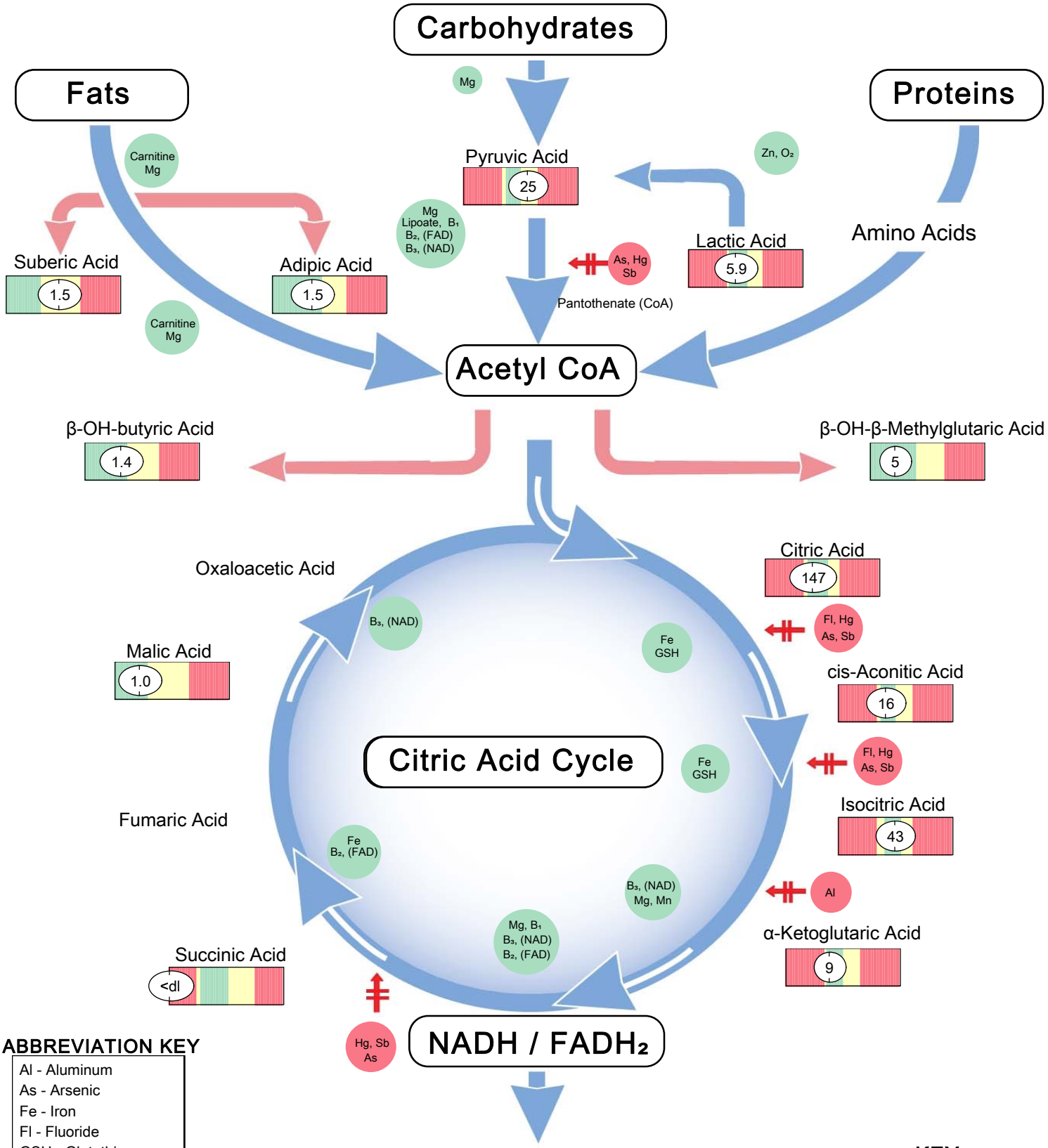
Need for Probiotics

- Probiotics have many functions. These include: production of some B vitamins and vitamin K; enhance digestion & absorption; decrease severity of diarrheal illness; modulate of immune function & intestinal permeability.
- Alterations of gastrointestinal microflora may result from C-section delivery, antibiotic use, improved sanitation, decreased consumption of fermented foods and use of certain drugs.
- Some of the diseases associated with microflora imbalances include: IBS, IBD, fibromyalgia, chronic fatigue syndrome, obesity, atopic illness, colic and cancer.
- Food sources rich in probiotics are yogurt, kefir and fermented foods.

Need for Pancreatic Enzymes

- Pancreatic enzymes are secreted by the exocrine glands of the pancreas and include protease/peptidase, lipase and amylase.
- Pancreatic exocrine insufficiency may be primary or secondary in nature. Any indication of insufficiency warrants further evaluation for underlying cause (i.e., celiac disease, small intestine villous atrophy, small bowel bacterial overgrowth).
- A high functional need for digestive enzymes suggests that there is an impairment related to digestive capacity.
- Determining the strength of the pancreatic enzyme support depends on the degree of functional impairment. Supplement potency is based on the lipase units present in both prescriptive and non-prescriptive agents.

At-A-Glance



ABBREVIATION KEY

Al	Aluminum
As	Arsenic
Fe	Iron
Fl	Fluoride
GSH	Glutathione
Hg	Mercury
Mg	Magnesium
Mn	Manganese
Sb	Antimony
Zn	Zinc

KEY

Green = cofactor

Red = inhibitor

Metabolic Analysis Markers (Urine)

All biomarkers reported in mmol/mol creatinine unless otherwise noted.

Malabsorption and Dysbiosis Markers

Malabsorption Markers

		Reference Range
Indoleacetic Acid (IAA)	0.7	<= 4.2
Phenylacetic Acid (PAA)	0.11	<= 0.12

Bacterial Dysbiosis Markers

		Reference Range
Dihydroxyphenylpropionic Acid (DHPPA)	1.0	<= 5.3
3-Hydroxyphenylacetic Acid	2.9	<= 8.1
4-Hydroxyphenylacetic Acid	20	<= 29
Benzoic Acid	0.15	<= 0.05
Hippuric Acid	<dl	<= 603

Yeast / Fungal Dysbiosis Markers

		Reference Range
Arabinose	53	<= 96
Citramalic Acid	6.2	<= 5.8
Tartaric Acid	<dl	<= 15

Cellular Energy & Mitochondrial Metabolites

Carbohydrate Metabolism

		Reference Range
Lactic Acid	5.9	1.9-19.8
Pyruvic Acid	25	7-32
β-OH-Butyric Acid (BHBA)	1.4	<= 2.8

Energy Metabolism

		Reference Range
Citric Acid	147	40-520
Cis-Aconitic Acid	16	10-36
Isocitric Acid	43	22-65
α-Ketoglutaric Acid (AKG)	9	4-52
Succinic Acid	<dl	0.4-4.6
Malic Acid	1.0	<= 3.0
β-OH-β-Methylglutaric Acid (HMG)	5	<= 15

Fatty Acid Metabolism

		Reference Range
Adipic Acid	1.5	<= 2.8
Suberic Acid	1.5	<= 2.1

Creatinine Concentration

		Reference Range
Creatinine ◆	8.0	3.1-19.5 mmol/L

Neurotransmitter Metabolites

		Reference Range
Vanilmandelic Acid	1.9	0.4-3.6
Homovanillic Acid	2.4	1.2-5.3
5-OH-indoleacetic Acid	7.6	3.8-12.1
3-Methyl-4-OH-phenylglycol	0.15	0.02-0.22
Kynurenic Acid	5.5	<= 7.1
Quinolinic Acid	2.0	<= 9.1
Kynurenic / Quinolinic Ratio	2.75	>= 0.44

Vitamin Markers

		Reference Range
α-Ketoadipic Acid	0.4	<= 1.7
α-Ketoisovaleric Acid	0.48	<= 0.97
α-Ketoisocaproic Acid	0.63	<= 0.89
α-Keto-β-Methylvaleric Acid	1.1	<= 2.1
Formiminoglutamic Acid (FIGlu)	0.5	<= 1.5
Glutaric Acid	0.29	<= 0.51
Isovalerylglycine	1.1	<= 3.7
Methylmalonic Acid	0.9	<= 1.9
Xanthurenic Acid	0.42	<= 0.96
3-Hydroxypropionic Acid	8	5-22
3-Hydroxyisovaleric Acid	10	<= 29

Toxin & Detoxification Markers

		Reference Range
α-Ketophenylacetic Acid (from Styrene)	0.20	<= 0.46
α-Hydroxyisobutyric Acid (from MTBE)	6.0	<= 6.7
Orotic Acid	0.41	0.33-1.01
Pyroglutamic Acid	21	16-34

Tyrosine Metabolism

		Reference Range
Homogentisic Acid	7	<= 19
2-Hydroxyphenylacetic Acid	0.33	<= 0.76

Metabolic Analysis Reference Ranges are Age Specific

The performance characteristics of all assays have been verified by Genova Diagnostics, Inc. Unless otherwise noted with ◆, the assay has not been cleared by the U.S. Food and Drug Administration.

Amino Acids (Urine FMV)

All biomarkers reported in micromol/g creatinine unless otherwise noted.

Nutritionally Essential Amino Acids

Amino Acid		Reference Range
Arginine	14	3-43
Histidine	321	102-763
Isoleucine	8	3-25
Leucine	14	6-61
Lysine	33	15-231
Methionine	4	2-16
Phenylalanine	24	7-92
Taurine	219	39-568
Threonine	70	9-97
Tryptophan	21	8-58
Valine	19	5-43

Nonessential Protein Amino Acids

Amino Acid		Reference Range
Alanine	160	26-275
Asparagine	54	12-115
Aspartic Acid	<dl	<= 9
Cysteine (FMV urine)	40	9-60
Cystine (FMV Urine)	39	10-116
γ-Aminobutyric Acid	2	<= 3
Glutamic Acid	12	2-16
Glutamine	175	85-518
Proline	4	1-9
Tyrosine	34	19-135

Creatinine Concentration

		Reference Range
Creatinine ◆	8.1	3.1-19.5 mmol/L

Amino Acid reference ranges are age specific.

The performance characteristics of all assays have been verified by Genova Diagnostics, Inc. Unless otherwise noted with ◆, the assays have not been cleared by the U.S. Food and Drug Administration.

Methodology: LC/MS/MS, Enzymatic and Alkaline Picrate

Intermediary Metabolites

B Vitamin Markers		Reference Range
α-Aminoadipic	11	6-56
α-Amino-N-butyric Acid	3	2-21
β-Aminoisobutyric Acid	10	4-194
Cystathionine	9	4-48
3-Methylhistidine	93	47-232

Urea Cycle Markers

Citrulline	2.1	0.7-3.4
Ornithine	8	3-17
Urea ◆	141	150-380 mmol/g creatinine

Glycine/Serine Metabolites

Glycine	166	47-435
Serine	97	24-140
Ethanolamine	172	40-226
Phosphoethanolamine	2	1-9
Phosphoserine	6	2-13
Sarcosine	0.9	<= 1.0

Dietary Peptide Related Markers

		Reference Range
Anserine (dipeptide)	0.8	0.7-76.1
Carnosine (dipeptide)	7	1-32
1-Methylhistidine	19	18-887
β-Alanine	1	<= 18

Essential and Metabolic Fatty Acids Markers (RBCs)

Omega 3 Fatty Acids

Analyte (cold water fish, flax, walnut)		Reference Range
α-Linolenic (ALA) 18:3 n3	0.40	>= 0.09 wt %
Eicosapentaenoic (EPA) 20:5 n3	0.63	>= 0.16 wt %
Docosapentaenoic (DPA) 22:5 n3	1.71	>= 1.14 wt %
Docosahexaenoic (DHA) 22:6 n3	2.2	>= 2.1 wt %
% Omega 3s	4.9	>= 3.8

Omega 9 Fatty Acids

Analyte (olive oil)		Reference Range
Oleic 18:1 n9	14	10-13 wt %
Nervonic 24:1 n9	3.8	2.1-3.5 wt %
% Omega 9s	18.5	13.3-16.6

Saturated Fatty Acids

Analyte (meat, dairy, coconuts, palm oils)		Reference Range
Palmitic C16:0	19	18-23 wt %
Stearic C18:0	17	14-17 wt %
Arachidic C20:0	0.27	0.22-0.35 wt %
Behenic C22:0	0.79	0.92-1.68 wt %
Tricosanoic C23:0	0.16	0.12-0.18 wt %
Lignoceric C24:0	2.4	2.1-3.8 wt %
Pentadecanoic C15:0	0.08	0.07-0.15 wt %
Margaric C17:0	0.21	0.22-0.37 wt %
% Saturated Fats	39.8	39.8-43.6

Omega 6 Fatty Acids

Analyte (vegetable oil, grains, most meats, dairy)		Reference Range
Linoleic (LA) 18:2 n6	15.5	10.5-16.9 wt %
γ-Linolenic (GLA) 18:3 n6	0.15	0.03-0.13 wt %
Dihomo-γ-linolenic (DGLA) 20:3 n6	0.97	>= 1.19 wt %
Arachidonic (AA) 20:4 n6	16	15-21 wt %
Docosatetraenoic (DTA) 22:4 n6	2.24	1.50-4.20 wt %
Eicosadienoic 20:2 n6	0.30	<= 0.26 wt %
% Omega 6s	35.4	30.5-39.7

Monounsaturated Fats

Omega 7 Fats		Reference Range
Palmitoleic 16:1 n7	0.27	<= 0.64 wt %
Vaccenic 18:1 n7	0.88	<= 1.13 wt %
Trans Fat		
Elaidic 18:1 n9t	0.24	<= 0.59 wt %

Delta - 6 Desaturase Activity

	Upregulated Functional Impaired	
Linoleic / DGLA 18:2 n6 / 20:3 n6	16.0	6.0-12.3

Cardiovascular Risk

Analyte		Reference Range
Omega 6s / Omega 3s	7.2	3.4-10.7
AA / EPA 20:4 n6 / 20:5 n3	26	12-125
Omega 3 Index	2.8	>= 4.0

The Essential Fatty Acid reference ranges are based on an adult population.

Acid Metabolism

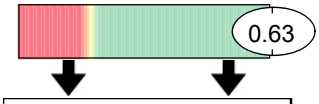
Omega 3 Family

α-Linolenic Acid
flax, walnut, grasses

Stearidonic acid

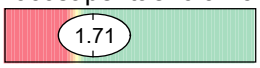
Eicosatetraenoic acid, ETA

Eicosapentaenoic Acid
cold water fish

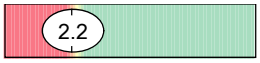


Anti-inflammatory Eicosanoids

Docosapentaenoic Acid



Docosahexaenoic Acid
cold water fish



Delta-6 Desaturase
Vitamin and Mineral Cofactors:
FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6)
Vitamin C, Insulin, Zn, Mg

Elongase
Vitamin and Mineral Cofactors:
Niacin (B3)
Pyridoxal-5-phosphate (B6)
Pantothenic Acid (B5)
Biotin, Vitamin C

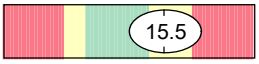
Delta-5 Desaturase
Vitamin and Mineral Cofactors:
FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6)
Vitamin C, Insulin, Zn, Mg

Elongase
Vitamin and Mineral Cofactors:
Niacin (B3)
Pyridoxal-5-phosphate (B6), Biotin
Pantothenic Acid (B5), Vitamin C

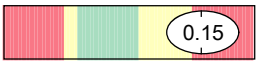
Elongase
Delta-6 Desaturase
Vitamin and Mineral Cofactors:
FAD (B2), Niacin (B3)
Pyridoxal-5-phosphate (B6), Biotin
Vitamin C, Zn, Mg, Carnitine
Pantothenic Acid (B5)

Omega 6 Family

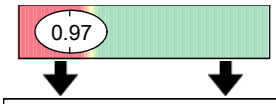
Linoleic Acid
grains, vegetable oils



γ-Linolenic Acid
evening primrose, borage, black currant

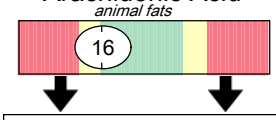


Dihomo-γ-Linolenic Acid



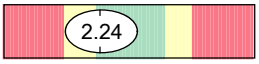
Series 1 Prostaglandins Anti-inflammatory

Arachidonic Acid
animal fats



Pro-inflammatory Eicosanoids

Docosatetraenoic Acid



This test was developed and its performance characteristics determined by Genova Diagnostics, Inc. It has not been cleared by the U.S. Food and Drug Administration.

Oxidative Stress Markers

Oxidative Stress Markers

		Reference Range
Glutathione (whole blood)	904	>=669 micromol/L
Lipid Peroxides (urine)	4.7	<=10.0 micromol/g Creat.
8-OHdG (urine)	9	<=16 mcg/g Creat.
Coenzyme Q10, Ubiquinone (serum)	1.09	0.46-1.72 mcg/mL

The Oxidative Stress reference ranges are based on an adult population.

The performance characteristics of the Oxidative Stress Markers have been verified by Genova Diagnostics, Inc. They have not been cleared by the U.S. Food and Drug Administration.

Vitamin D (Serum)

	Inside Range	Outside Range	Reference Range
25 - OH Vitamin D ◆		<12	50-100 ng/mL

Deficiency = < 20 ng/mL (< 50 nmol/L)
Insufficiency = 20-49 ng/mL (50-124 nmol/L)
Optimal = 50-100 ng/mL (125-250 nmol/L)
Excessive = > 100 ng/mL (> 250 nmol/L)

Elemental Markers

Nutrient Elements

Element	Reference Range	Reference Range
Copper *(plasma)*	97.6	75.3-192.0 mcg/dL
Magnesium *(RBC)*	47.9	30.1-56.5 mcg/g
Manganese *(whole blood)*	6.3	3.0-16.5 mcg/L
Potassium *(RBC)*	2,944	2,220-3,626 mcg/g
Selenium *(whole blood)*	115	109-330 mcg/L
Zinc *(plasma)*	84.0	64.3-159.4 mcg/dL

Toxic Elements*

Element	Reference Range	Reference Range
Lead	2.11	<= 2.81 mcg/dL
Mercury	0.42	<= 4.35 mcg/L
Arsenic	<DL	<= 13.7 mcg/L
Cadmium	0.21	<= 1.22 mcg/L
Tin	<DL	<= 0.39 mcg/L

* All toxic Elements are measured in whole blood.

The Elemental reference ranges are based on an adult population.

The performance characteristics of the Elemental Markers have been verified by Genova Diagnostics, Inc. They have not been cleared by the U.S. Food and Drug Administration.

Elemental testing performed by Genova Diagnostics, Inc. 3425 Corporate Way, Duluth, GA 30096 - Robert M. David, PhD, Lab Director - CLIA Lic. #11D0255349 - Medicare Lic. #34-8475

Commentary

The CoQ10 analysis is now performed from the serum sample. The reference range has not changed.

The assay for elemental analysis has been updated and some reference ranges have been changed accordingly.

Homocysteine (Plasma)

GENOVA DIAGNOSTICS EUROPE

46-50 Coombe Road
New Malden
Surrey KT3 4QF

63 Zillicoa Street
Asheville, NC 28801 USA

Patient:
DOB:
Sex:
MRN:

Order Number:

Completed:
Received:
Collected:

Homocysteine

	Inside Range	Outside Range	Reference Range
Homocysteine		13.10	5.20-11.40 umol/L

Commentary

The reference range for homocysteine is based on the sex-specific 5th to 95th percentile values for men and women (20 to 39 years of age) in the NHANES nutritionally replete cohort. Annals of Internal Medicince 1999; 131 (331-338).

Commentary is provided to the practitioner for educational purposes, and should not be interpreted as diagnostic or treatment recommendations. Diagnosis and treatment decisions are the responsibility of the practitioner.

The **homocysteine** level is ABOVE the REFERENCE range. Homocysteinemia has received abundant regard as a key independent risk factor for cardiovascular disease which is responsive to nutritional intervention. Elevated homocysteine levels result in micro-abrasive effects on the vascular endothelium, thus providing loci for other plaque-generating events to occur. Smoking and hypertension increase cardiovascular risks associated with high homocysteine.