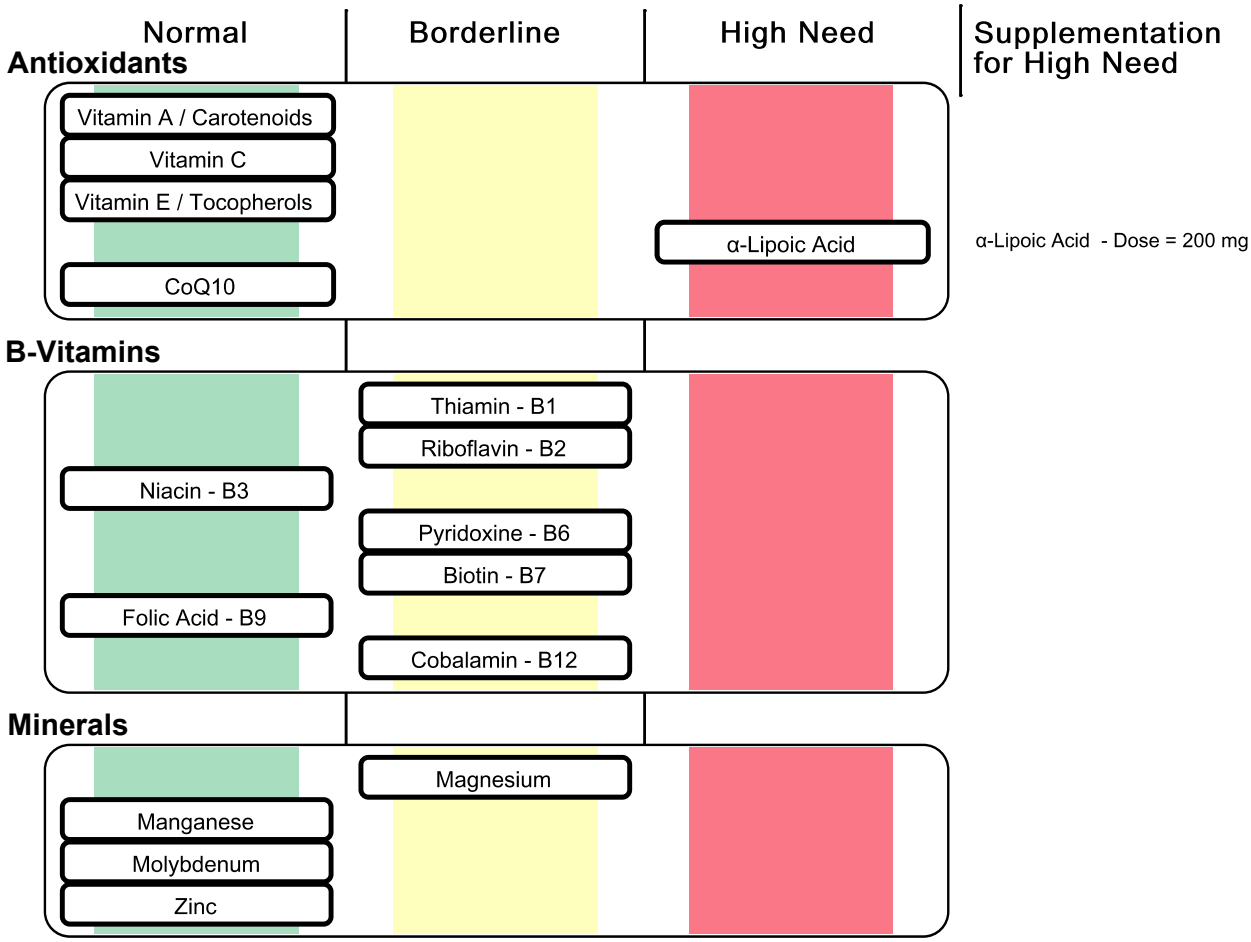
GENOVA DIAGNOSTICS
63 Zillicoa Street
Asheville, NC 28801

Metabolomix+

Patient: **SAMPLE PATIENT**
DOB:
Sex:
MRN:

3200 Metabolomix+ - FMV Urine

Metabolomix+ Results Overview



SUGGESTED SUPPLEMENT SCHEDULE

Supplements	Daily Recommended Intake (DRI)	Patient's Daily Recommendations	Provider Daily Recommendations
Vitamin A / Carotenoids	2,333 IU	3,000 IU	
Vitamin C	75 mg	250 mg	
Vitamin E / Tocopherols	22 IU	100 IU	
α-Lipoic Acid		200 mg	
CoQ10		30 mg	
B-Vitamins			
Thiamin - B1	1.1 mg	25 mg	
Riboflavin - B2	1.1 mg	25 mg	
Niacin - B3	14 mg	20 mg	
Pyridoxine - B6	1.3 mg	25 mg	
Biotin - B7	30 mcg	200 mcg	
Folic Acid - B9	400 mcg	400 mcg	
Cobalamin - B12	2.4 mcg	500 mcg	
Minerals			
Magnesium	320 mg	600 mg	
Manganese	1.8 mg	3.0 mg	
Molybdenum	45 mcg	75 mcg	
Zinc	8 mg	10 mg	
Digestive Support			
Probiotics		10 billion CFU	
Pancreatic Enzymes		0 IU	
Other Vitamins			
Vitamin D	600 IU		

Amino Acid	mg/day	Amino Acid	mg/day
Arginine	0	Methionine	404
Asparagine	187	Phenylalanine	0
Cysteine	108	Serine	0
Glutamine	89	Taurine	837
Glycine	1,277	Threonine	0
Histidine	671	Tryptophan	0
Isoleucine	0	Tyrosine	35
Leucine	0	Valine	0
Lysine	494		

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.

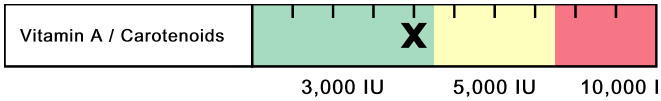
Key

Normal | Borderline | High Need

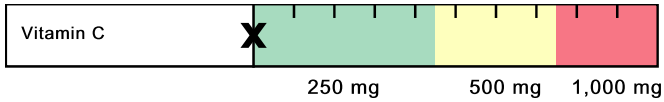
Metabolomix+ Interpretation At-A-Glance

Nutritional Needs

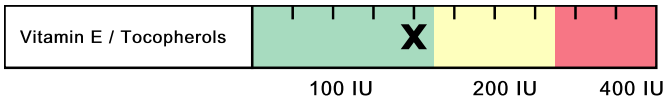
Antioxidants



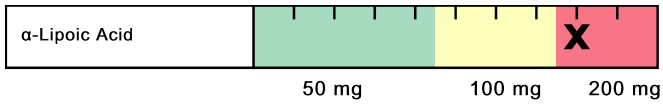
- Beta-carotene & other carotenoids are converted to vitamin A (retinol), involved in vision, antioxidant & immune function, gene expression & cell growth.
- Vitamin A deficiency may occur with chronic alcoholism, zinc deficiency, hypothyroidism, or oral contraceptives containing estrogen & progestin.
- 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 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.

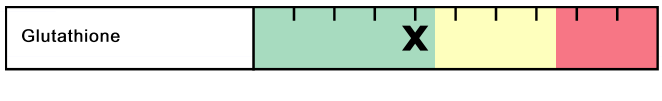


- Alpha-tocopherol (body's main form of vitamin E) functions as an antioxidant, regulates cell signaling, influences immune function and inhibits coagulation.
- Deficiency may occur with malabsorption, cholestyramine, colestipol, isoniazid, orlistat, olestra and certain anti-convulsants (e.g., phenobarbital, 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.

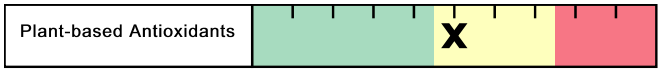


- Lipoic acid plays an important role in energy production, antioxidant activity (including the regeneration of vitamin C and glutathione), insulin signaling, cell signaling and the catabolism of α-keto acids and amino acids.
- High biotin intake can compete with lipoic acid for cell membrane entry.
- Optimal levels of 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 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 (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.



- 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 nutriceuticals (e.g., resveratrol, EGCG, lutein, lycopene, ginkgo, milk thistle, etc.).

Key

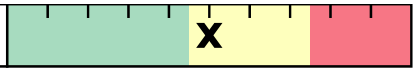
- Function
- Causes of Deficiency
- Complications of Deficiency
- Food Sources

Metabolomix+ Interpretation At-A-Glance

Nutritional Needs

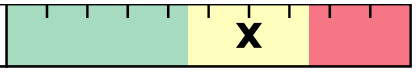
B-Vitamins

Thiamin - B1



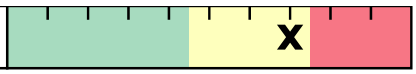
- B1 is a required cofactor for enzymes involved in energy production from food, and for the synthesis of ATP, GTP, DNA, RNA and NADPH.
- Low B1 can result from chronic alcoholism, diuretics, digoxin, oral contraceptives and HRT, or large amounts of tea & coffee (contain anti-B1 factors).
- B1 deficiency 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



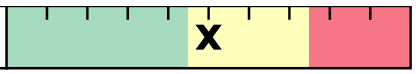
- B6 (as P5P) is a cofactor for enzymes involved in glycogenolysis & gluconeogenesis, and synthesis of neurotransmitters, heme, B3, RBCs and nucleic acids.
- Low B6 may result from chronic alcoholism, long-term diuretics, estrogens (oral contraceptives and HRT), anti-TB meds, penicillamine, L-DOPA or 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



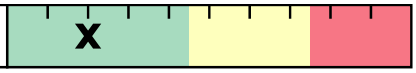
- B2 is a key component of enzymes involved in antioxidant function, energy production, detoxification, methionine metabolism and vitamin activation.
- Low B2 may result from chronic alcoholism, some anti-psychotic medications, oral contraceptives, tricyclic antidepressants, quinacrine or adriamycin.
- 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



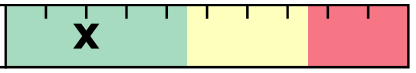
- Biotin is a cofactor for enzymes involved in functions such as fatty acid (FA) synthesis, mitochondrial FA oxidation, gluconeogenesis, and DNA replication & transcription.
- Deficiency may result from certain inborn errors, chronic intake of raw egg whites, long-term TPN use, anticonvulsants, high-dose 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



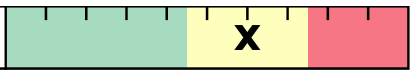
- B3 is used to form NAD and NADP, involved in energy production from food, fatty acid & cholesterol synthesis, cell signaling, DNA repair & cell differentiation.
- Low B3 may result from deficiencies of tryptophan (B3 precursor), B6, B2 or Fe (cofactors in B3 production), or from long-term isoniazid 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.

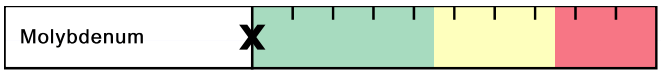
Metabolomix+ Interpretation At-A-Glance

Nutritional Needs

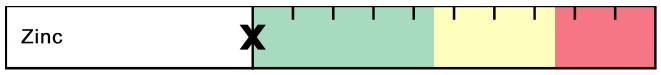
Minerals

- 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 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.

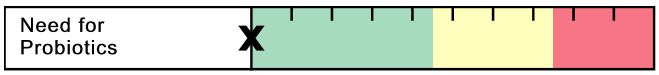


- Molybdenum is a cofactor for enzymes that convert sulfites to sulfate, and nucleotides to uric acid, and that help metabolize aldehydes & other toxins.
- Low Mo levels may result from long-term TPN that does not include Mo.
- Mo deficiency may result in increased sulfite, decreased plasma uric acid (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).

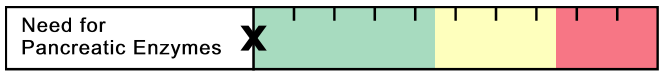


- Zinc plays a vital role in immunity, protein metabolism, heme synthesis, growth & development, reproduction, digestion and antioxidant function.
- Low levels may occur with malabsorption, alcoholism, chronic diarrhea, diabetes, excess Cu or Fe, diuretics, ACE inhibitors, H2 blockers or digoxin.
- Deficiency 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.

Digestive Support



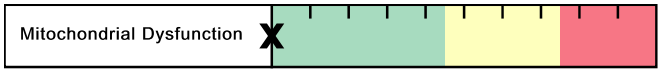
- Probiotics have many functions. These include: production of some B vitamins and vitamin K; enhancement of digestion & absorption; decreasing severity of diarrheal illness; modulation of immune function & intestinal permeability.
- Alterations of gastrointestinal microflora may result from C-section 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.



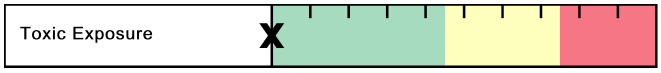
- Pancreatic enzymes are secreted by the exocrine glands of the pancreas and include protease/peptidase, lipase and amylase.
- Pancreatic exocrine insufficiency may be primary or secondary in nature. Any indication of insufficiency warrants further evaluation for underlying cause (i.e., celiac disease, 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.

Metabolomix+ Interpretation At-A-Glance

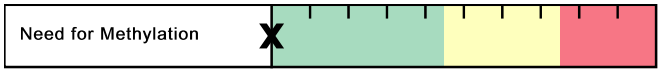
Functional Imbalances



- 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.

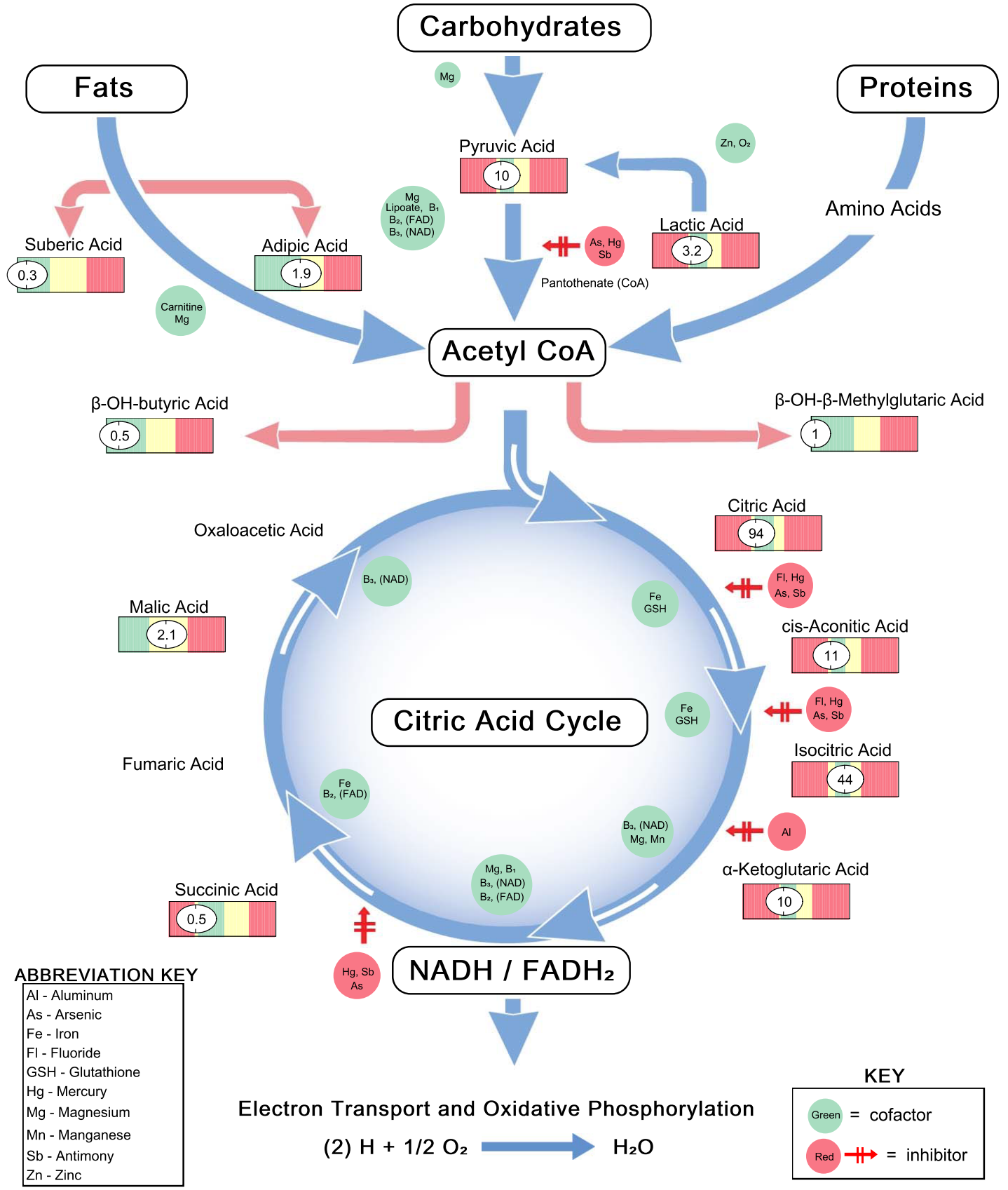


- Methyl tert-Butyl Ether (MTBE) is a common gasoline additive used to increase octane ratings, and has been found to contaminate ground water supplies where gasoline is stored. Inhalation of MTBE may cause nose and throat irritation, as well as headaches, nausea, dizziness and mental confusion. Animal 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.



- 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.

Krebs Cycle 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- FMV Urine

Methodology: GCMS, LC/MS/MS, Alkaline Picrate

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

Malabsorption and Dysbiosis Markers

Malabsorption Markers

		Reference Range
Indoleacetic Acid (IAA)	0.6	<= 4.2
Phenylacetic Acid (PAA)	0.04	<= 0.12

Bacterial Dysbiosis Markers

		Reference Range
Dihydroxyphenylpropionic Acid (DHPPA)	0.3	<= 5.3
3-Hydroxyphenylacetic Acid	0.4	<= 8.1
4-Hydroxyphenylacetic Acid	2	<= 29
Benzoic Acid	0.05	<= 0.05
Hippuric Acid	1	<= 603

Yeast / Fungal Dysbiosis Markers

		Reference Range
Arabinose	1	<= 96
Citramalic Acid	0.4	<= 5.8
Tartaric Acid	1	<= 15

Cellular Energy & Mitochondrial Metabolites

Carbohydrate Metabolism

		Reference Range
Lactic Acid	3.2	1.9-19.8
Pyruvic Acid	10	7-32
β-OH-Butyric Acid (BHBA)	0.5	<= 2.8

Energy Metabolism

		Reference Range
Citric Acid	94	40-520
Cis-Aconitic Acid	11	10-36
Isocitric Acid	44	22-65
α-Ketoglutaric Acid (AKG)	10	4-52
Succinic Acid	0.5	0.4-4.6
Malic Acid	2.1	<= 3.0
β-OH-β-Methylglutaric Acid (HMG)	1	<= 15

Fatty Acid Metabolism

		Reference Range
Adipic Acid	1.9	<= 2.8
Suberic Acid	0.3	<= 2.1

Creatinine Concentration

		Reference Range
Creatinine ◆	8.8	3.1-19.5 mmol/L

Neurotransmitter Metabolites

		Reference Range
Vanilmandelic Acid	1.4	0.4-3.6
Homovanillic Acid	1.6	1.2-5.3
5-OH-indoleacetic Acid	4.5	3.8-12.1
3-Methyl-4-OH-phenylglycol	0.15	0.02-0.22
Kynurenic Acid	0.3	<= 7.1
Quinolinic Acid	0.3	<= 9.1
Kynurenic / Quinolinic Ratio	1.00	>= 0.44

Vitamin Markers

		Reference Range
α-Ketoadipic Acid	0.4	<= 1.7
α-Ketoisovaleric Acid	0.24	<= 0.97
α-Ketoisocaproic Acid	0.87	<= 0.89
α-Keto-β-Methylvaleric Acid	0.4	<= 2.1
Formiminoglutamic Acid (FIGlu)	0.7	<= 1.5
Glutaric Acid	0.43	<= 0.51
Isovalerylglycine	0.4	<= 3.7
Methylmalonic Acid	0.5	<= 1.9
Xanthurenic Acid	0.28	<= 0.96
3-Hydroxypropionic Acid	16	5-22
3-Hydroxyisovaleric Acid	2	<= 29

Toxin & Detoxification Markers

		Reference Range
α-Ketophenylacetic Acid (from Styrene)	0.38	<= 0.46
α-Hydroxyisobutyric Acid (from MTBE)	0.5	<= 6.7
Orotic Acid	0.36	0.33-1.01
Pyroglutamic Acid	26	16-34

Tyrosine Metabolism

		Reference Range
Homogentisic Acid	2	<= 19
2-Hydroxyphenylacetic Acid	0.37	<= 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 Analysis Markers - FMV Urine

Methodology: LC/MS/MS, Alkaline Picrate

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

Nutritionally Essential Amino Acids

Amino Acid	Reference Range
Arginine	3-43
Histidine	124-894
Isoleucine	3-28
Leucine	4-46
Lysine	11-175
Methionine	2-18
Phenylalanine	8-71
Taurine	21-424
Threonine	17-135
Tryptophan	5-53
Valine	7-49

Nonessential Protein Amino Acids

Amino Acid	Reference Range
Alanine	63-356
Asparagine	25-166
Aspartic Acid	<= 14
Cysteine (FMV urine)	8-74
Cystine (FMV Urine)	10-104
γ-Aminobutyric Acid	<= 5
Glutamic Acid	4-27
Glutamine	110-632
Proline	1-13
Tyrosine	11-135

Creatinine Concentration

	Reference Range
Creatinine ◆	3.1-19.5 mmol/L

Amino Acid reference ranges are age specific.

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Intermediary Metabolites

B Vitamin Markers	Reference Range
α-Aminoadipic	2-47
α-Amino-N-butyric Acid	2-25
β-Aminoisobutyric Acid	11-160
Cystathionine	2-68
3-Methylhistidine	44-281

Urea Cycle Markers	Reference Range
Citrulline	0.6-3.9
Ornithine	2-21
Urea ◆	168-465 mmol/g creatinine

Glycine/Serine Metabolites	Reference Range
Glycine	95-683
Serine	40-163
Ethanolamine	50-235
Phosphoethanolamine	1-13
Phosphoserine	3-13
Sarcosine	<= 1.1

Dietary Peptide Related Markers

	Reference Range
Anserine (dipeptide)	0.4-105.1
Carnosine (dipeptide)	1-28
1-Methylhistidine	38-988
β-Alanine	<= 22

Oxidative Stress Markers - FMV Urine

Methodology: thiobarbituric acid reactive substances (TBARS), Alkaline Picrate, Hexokinase/G-6-PDH, LC/MS/MS

Oxidative Stress Markers

		Reference Range
Lipid Peroxides (urine)	8.3	<=10.0 micromol/g Creat.
8-OHdG (urine)	5	<=15 mcg/g Creat.

Lab Comments

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