



Requisition #:

Physician:

Patient Name:

Date of Collection:

Patient Age: 55

Time of Collection:

Patient Sex: F

Print Date:



Organic Acids Test - Nutritional and Metabolic Profile

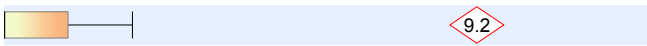
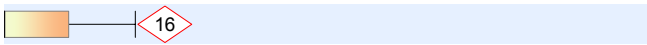



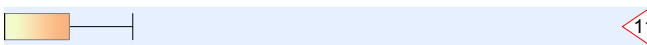
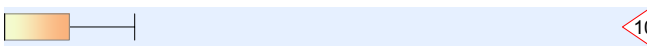
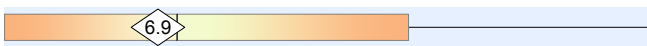
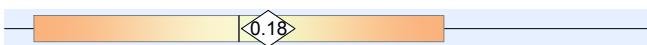
Metabolic Markers in Urine

Reference Range
(mmol/mol creatinine)Patient
Value


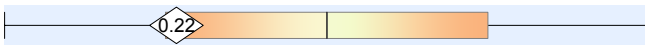
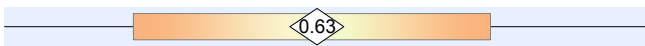
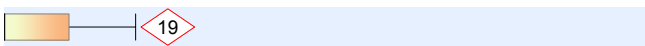

Reference Population - Females Age 13 and Over

Intestinal Microbial Overgrowth

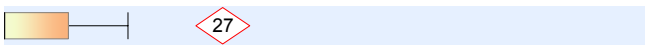
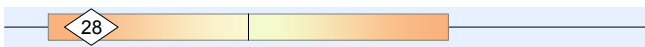

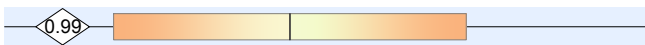
Yeast and Fungal Markers

| | | | | | |
|---|--------------------------|--------|---|------|--|
| 1 | Citramalic | ≤ 3.6 | H | 9.2 |  |
| 2 | 5-Hydroxymethyl-2-furoic | ≤ 14 | H | 16 |  |
| 3 | 3-Oxoglutaric | ≤ 0.33 | | 0.19 |  |
| 4 | Furan-2,5-dicarboxylic | ≤ 16 | | 2.4 |  |
| 5 | Furancarbonylglycine | ≤ 1.9 | | 1.0 |  |
| 6 | Tartaric | ≤ 4.5 | H | 119 |  |
| 7 | Arabinose | ≤ 29 | H | 109 |  |
| 8 | Carboxycitric | ≤ 29 | | 6.9 |  |
| 9 | Tricarballic | ≤ 0.44 | | 0.18 |  |

Bacterial Markers

| | | | | | |
|----|-----------------------------|-------------|---|------|--|
| 10 | Hippuric | ≤ 613 | | 235 |  |
| 11 | 2-Hydroxyphenylacetic | 0.06 - 0.66 | | 0.22 |  |
| 12 | 4-Hydroxybenzoic | ≤ 1.3 | | 0.63 |  |
| 13 | 4-Hydroxyhippuric | 0.79 - 17 | H | 19 |  |
| 14 | DHPPA (Beneficial Bacteria) | ≤ 0.38 | | 0.34 |  |

Clostridia Bacterial Markers

| | | | | | |
|----|--|-------|---|------|--|
| 15 | 4-Hydroxyphenylacetic (<i>C. difficile</i> , <i>C. stricklandii</i> , <i>C. lituseburens</i> & others) | ≤ 19 | H | 27 |  |
| 16 | HPHPA (<i>C. sporogenes</i> , <i>C. caloritolerans</i> , <i>C. botulinum</i> & others) | ≤ 208 | | 28 |  |
| 17 | 4-Cresol (<i>C. difficile</i>) | ≤ 75 | | 23 |  |
| 18 | 3-Indoleacetic (<i>C. stricklandii</i> , <i>C. lituseburens</i> , <i>C. subterminale</i> & others) | ≤ 11 | | 0.99 |  |

Testing performed by The Great Plains Laboratory, Inc., Lenexa, Kansas. The Great Plains Laboratory has developed and determined the performance characteristics of this test. This test has not been evaluated by the U.S. FDA; the FDA does not currently regulate such testing.

The Great Plains Laboratory, Inc.

Requisition #:

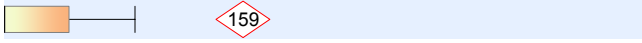
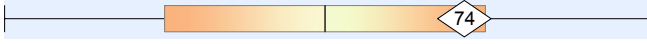
Physician:

Patient Name:

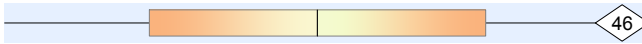
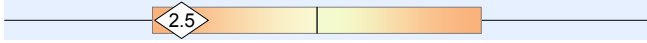
Date of Collection:

| Metabolic Markers in Urine | Reference Range (mmol/mol creatinine) | Patient Value | Reference Population - Females Age 13 and Over |
|----------------------------|--|------------------|--|
|----------------------------|--|------------------|--|


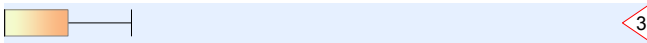
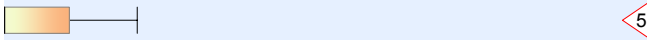
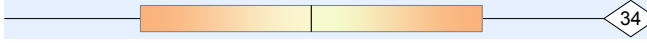
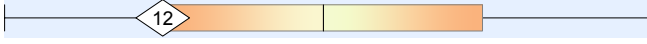
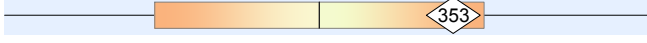
Oxalate Metabolites

| | | | | | |
|----|----------|------------|---|-----|--|
| 19 | Glyceric | 0.77 - 7.0 | H | 14 |  |
| 20 | Glycolic | 16 - 117 | H | 159 |  |
| 21 | Oxalic | 6.8 - 101 | | 74 |  |

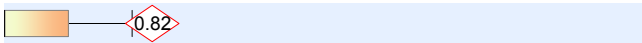

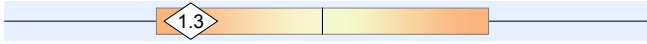
Glycolytic Cycle Metabolites

| | | | | | |
|----|---------|-------|--|-----|--|
| 22 | Lactic | ≤ 48 | | 46 |  |
| 23 | Pyruvic | ≤ 9.1 | | 2.5 |  |

Mitochondrial Markers - Krebs Cycle Metabolites

| | | | | | |
|----|---------------|------------|---|-----|--|
| 24 | Succinic | ≤ 9.3 | | 5.6 |  |
| 25 | Fumaric | ≤ 0.94 | H | 3.7 |  |
| 26 | Malic | 0.06 - 1.8 | H | 5.5 |  |
| 27 | 2-Oxoglutaric | ≤ 35 | | 34 |  |
| 28 | Aconitic | 6.8 - 28 | | 12 |  |
| 29 | Citric | ≤ 507 | | 353 |  |

Mitochondrial Markers - Amino Acid Metabolites

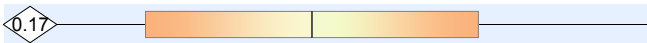
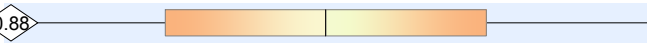
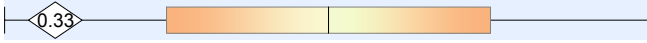
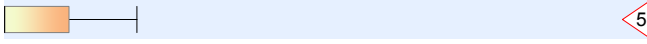
| | | | | | |
|----|--------------------|--------|---|------|--|
| 30 | 3-Methylglutaric | ≤ 0.76 | H | 0.82 |  |
| 31 | 3-Hydroxyglutaric | ≤ 6.2 | H | 10 |  |
| 32 | 3-Methylglutaconic | ≤ 4.5 | | 1.3 |  |

Neurotransmitter Metabolites

Phenylalanine and Tyrosine Metabolites

| | | | | | |
|----|---|------------|---|------|--|
| 33 | Homovanillic (HVA) (dopamine) | 0.80 - 3.6 | | 1.0 |  |
| 34 | Vanillylmandelic (VMA) (norepinephrine, epinephrine) | 0.46 - 3.7 | L | 0.43 |  |
| 35 | HVA / VMA Ratio | 0.16 - 1.8 | H | 2.4 |  |

Tryptophan Metabolites

| | | | | | |
|----|---|------------|---|------|--|
| 36 | 5-Hydroxyindoleacetic (5-HIAA) (serotonin) | ≤ 4.3 | | 0.17 |  |
| 37 | Quinolinic | 0.85 - 3.9 | | 0.88 |  |
| 38 | Kynurenic | 0.17 - 2.2 | | 0.33 |  |
| 39 | Quinolinic / 5-HIAA Ratio | 0.42 - 2.0 | H | 5.2 |  |

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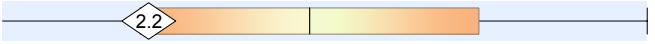
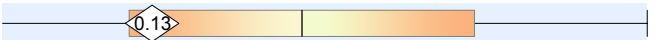
Physician:

Patient Name:

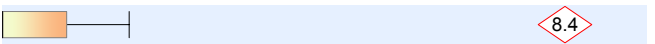
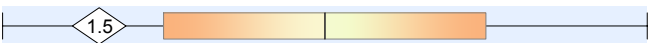
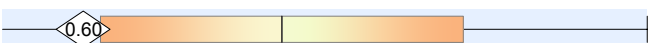
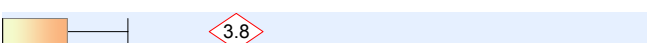
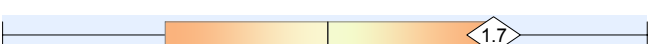
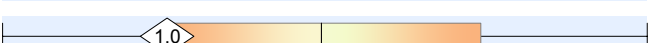
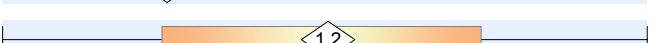
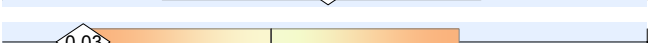
Date of Collection:

| Metabolic Markers in Urine | Reference Range (mmol/mol creatinine) | Patient Value | Reference Population - Females Age 13 and Over |
|----------------------------|--|---------------|--|
|----------------------------|--|---------------|--|

Pyrimidine Metabolites - Folate Metabolism

| | | | | |
|----|---------|--------|------|--|
| 40 | Uracil | ≤ 9.7 | 2.2 |  |
| 41 | Thymine | ≤ 0.56 | 0.13 |  |

Ketone and Fatty Acid Oxidation

| | | | | |
|----|------------------|------------|--------------|---|
| 42 | 3-Hydroxybutyric | ≤ 3.1 | H 8.4 |  |
| 43 | Acetoacetic | ≤ 10 | 1.5 |  |
| 44 | 4-Hydroxybutyric | ≤ 4.8 | 0.60 |  |
| 45 | Ethylmalonic | 0.44 - 2.8 | H 3.8 |  |
| 46 | Methylsuccinic | 0.10 - 2.2 | 1.7 |  |
| 47 | Adipic | 0.04 - 3.8 | 1.0 |  |
| 48 | Suberic | 0.18 - 2.2 | 1.2 |  |
| 49 | Sebacic | ≤ 0.24 | 0.03 |  |

Nutritional Markers

Vitamin B12

| | | | | |
|----|-----------------|-------|------|--|
| 50 | Methylmalonic * | ≤ 2.3 | 0.83 |  |
|----|-----------------|-------|------|--|

Vitamin B6

| | | | | |
|----|----------------|------|-----|--|
| 51 | Pyridoxic (B6) | ≤ 34 | 1.1 |  |
|----|----------------|------|-----|--|

Vitamin B5

| | | | | |
|----|------------------|------|-----|--|
| 52 | Pantothenic (B5) | ≤ 10 | 3.2 |  |
|----|------------------|------|-----|--|

Vitamin B2 (Riboflavin)

| | | | | |
|----|------------|-------------|---------------|--|
| 53 | Glutaric * | 0.04 - 0.36 | H 0.37 |  |
|----|------------|-------------|---------------|--|

Vitamin C

| | | | | |
|----|----------|----------|---------------|--|
| 54 | Ascorbic | 10 - 200 | L 0.56 |  |
|----|----------|----------|---------------|--|

Vitamin Q10 (CoQ10)

| | | | | |
|----|------------------------------|-----------|-------------|--|
| 55 | 3-Hydroxy-3-methylglutaric * | 0.17 - 39 | H 42 |  |
|----|------------------------------|-----------|-------------|--|

Glutathione Precursor and Chelating Agent

| | | | | |
|----|------------------------|--------|------|--|
| 56 | N-Acetylcysteine (NAC) | ≤ 0.28 | 0.08 |  |
|----|------------------------|--------|------|--|

Biotin (Vitamin H)

| | | | | |
|----|----------------|------------|------|--|
| 57 | Methylcitric * | 0.19 - 2.7 | 0.96 |  |
|----|----------------|------------|------|--|

* A high value for this marker may indicate a deficiency of this vitamin.

The Great Plains Laboratory, Inc.

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Physician:

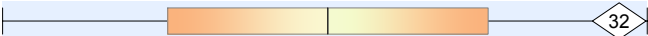
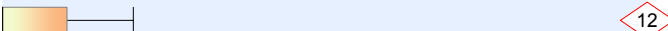
Patient Name:

Date of Collection:

| Metabolic Markers in Urine | Reference Range (mmol/mol creatinine) | Patient Value | Reference Population - Females Age 13 and Over |
|----------------------------|--|------------------|--|
|----------------------------|--|------------------|--|

Indicators of Detoxification

Glutathione

| | | | | |
|----|--------------------|------------|------|--|
| 58 | Pyroglutamic * | 10 - 33 | 32 |  |
| 59 | 2-Hydroxybutyric * | 0.03 - 1.8 | H 12 |  |

Ammonia Excess

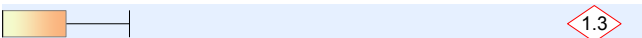
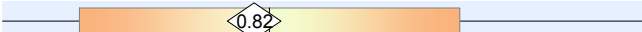
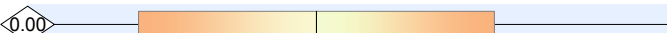
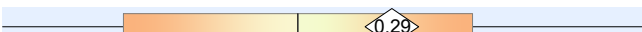
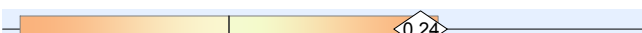
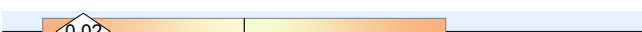
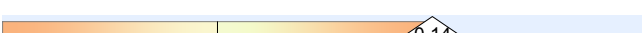
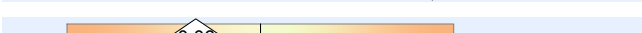
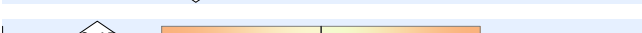
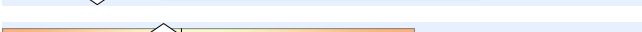
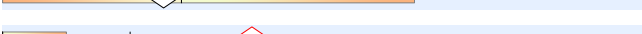

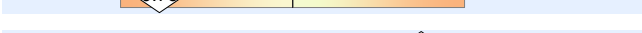
| | | | | |
|----|--------|-------------|------|--|
| 60 | Orotic | 0.06 - 0.54 | 0.19 |  |
|----|--------|-------------|------|--|

Aspartame, salicylates, or GI bacteria

| | | | | |
|----|-------------------|-------|------|--|
| 61 | 2-Hydroxyhippuric | ≤ 1.3 | 0.94 |  |
|----|-------------------|-------|------|--|

* A high value for this marker may indicate a Glutathione deficiency.

Amino Acid Metabolites

| | | | | |
|----|------------------------|------------|-------|--|
| 62 | 2-Hydroxyisovaleric | ≤ 0.42 | H 1.3 |  |
| 63 | 2-Oxoisovaleric | ≤ 2.1 | 0.82 |  |
| 64 | 3-Methyl-2-oxovaleric | ≤ 0.87 | 0 |  |
| 65 | 2-Hydroxyisocaproic | ≤ 0.48 | 0.29 |  |
| 66 | 2-Oxoisocaproic | ≤ 0.37 | 0.24 |  |
| 67 | 2-Oxo-4-methiolbutyric | ≤ 0.16 | 0.02 |  |
| 68 | Mandelic | ≤ 0.21 | 0.14 |  |
| 69 | Phenyllactic | ≤ 0.20 | 0.06 |  |
| 70 | Phenylpyruvic | 0.20 - 1.9 | 0.45 |  |
| 71 | Homogentisic | ≤ 0.36 | 0.09 |  |
| 72 | 4-Hydroxyphenyllactic | ≤ 0.80 | H 1.2 |  |
| 73 | N-Acetylaspartic | ≤ 3.0 | 0.73 |  |
| 74 | Malonic | ≤ 9.7 | 6.3 |  |

Mineral Metabolism

| | | | | |
|----|------------|---------------|-------|--|
| 75 | Phosphoric | 1 000 - 5 000 | 1 261 |  |
|----|------------|---------------|-------|--|

The Great Plains Laboratory, Inc.

Requisition #:

Physician:

Patient Name:

Date of Collection:

Indicator of Fluid Intake

76 *Creatinine

108 mg/dL

*The creatinine test is performed to adjust metabolic marker results for differences in fluid intake. Urinary creatinine has limited diagnostic value due to variability as a result of recent fluid intake. Samples are rejected if creatinine is below 20 mg/dL unless the client requests results knowing of our rejection criteria.

Explanation of Report Format

The reference ranges for organic acids were established using samples collected from typical individuals of all ages with no known physiological or psychological disorders. The ranges were determined by calculating the mean and standard deviation (SD) and are defined as $\pm 2SD$ of the mean. Reference ranges are age and gender specific, consisting of Male Adult (≥ 13 years), Female Adult (≥ 13 years), Male Child (<13 years), and Female Child (<13 years).

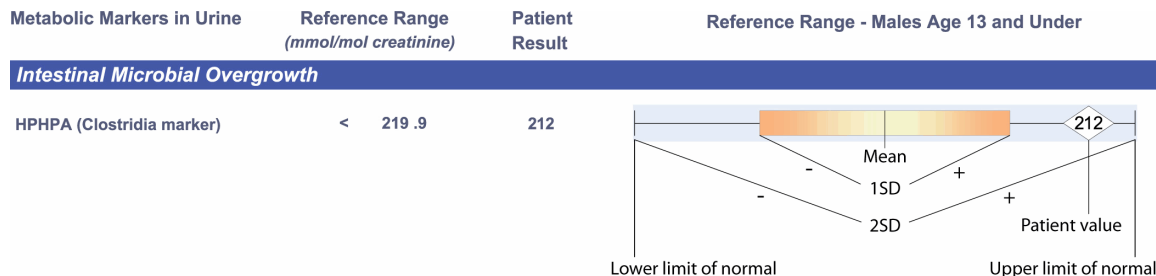
There are two types of graphical representations of patient values found in the new report format of both the standard Organic Acids Test and the Microbial Organic Acids Test.

The first graph will occur when the value of the patient is within the reference (normal) range, defined as the mean plus or minus two standard deviations.

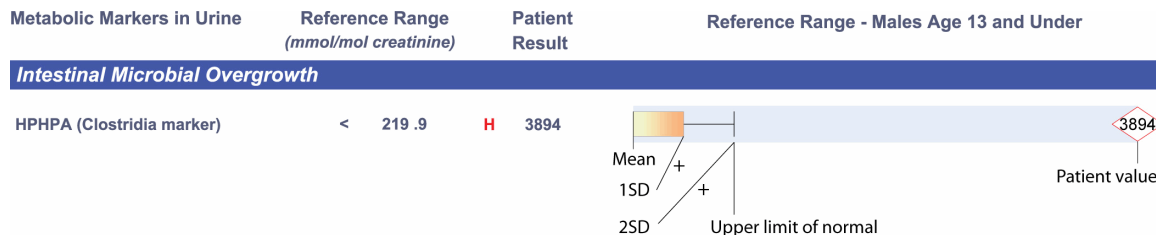
The second graph will occur when the value of the patient exceeds the upper limit of normal. In such cases, the graphical reference range is "shrunk" so that the degree of abnormality can be appreciated at a glance. In this case, the lower limits of normal are not shown, only the upper limit of normal is shown.

In both cases, the value of the patient is given to the left of the graph and is repeated on the graph inside a diamond. If the value is within the normal range, the diamond will be outlined in black. If the value is high or low, the diamond will be outlined in red.

Example of Value Within Reference Range



Example of Elevated Value



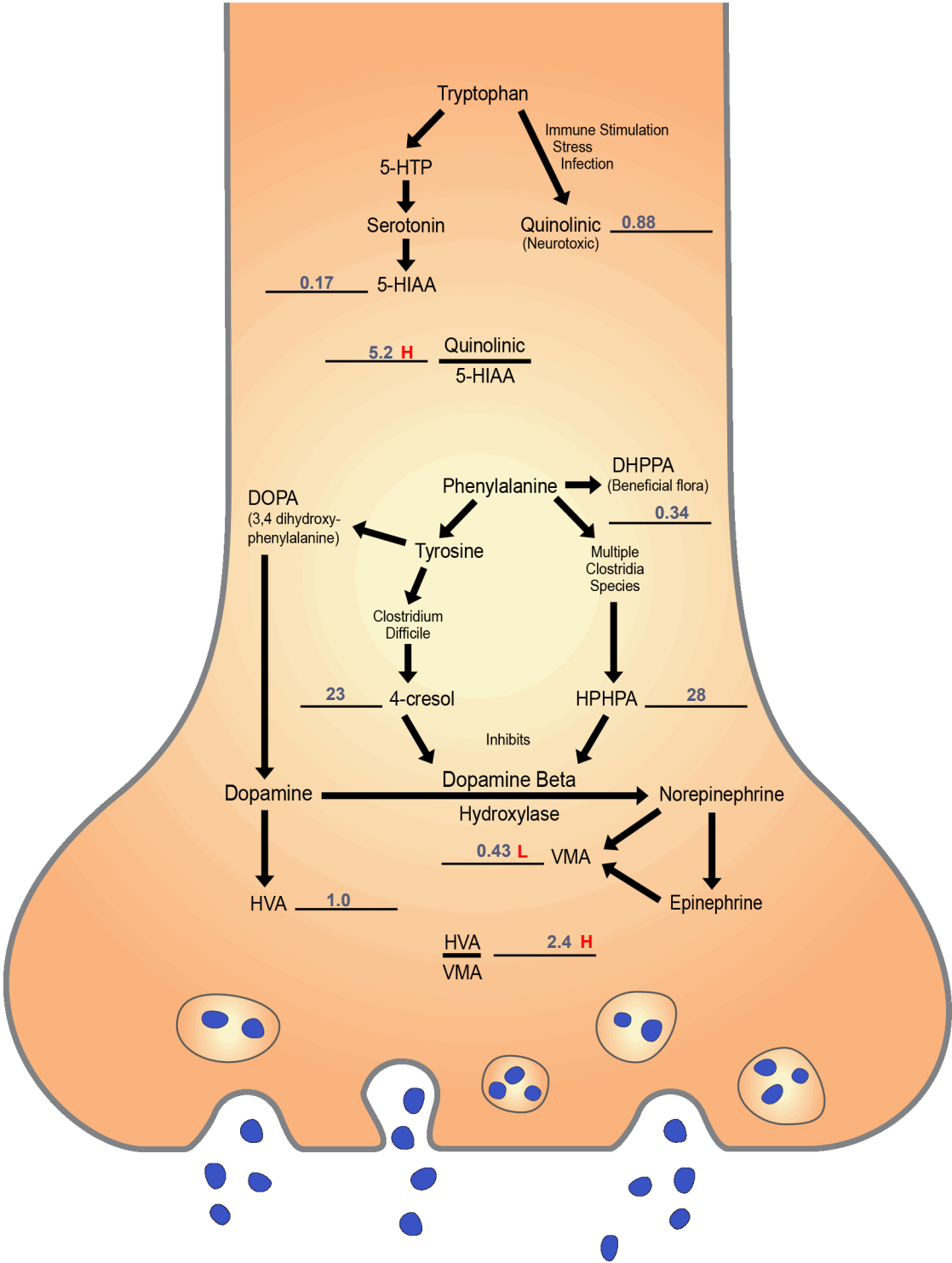
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Neurotransmitter Metabolism Markers



The diagram contains the patient's test results for neurotransmitter metabolites and shows their relationship with key biochemical pathways within the axon terminal of nerve cells. The effect of microbial byproducts on the blockage of the conversion of dopamine to norepinephrine is also indicated.

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Interpretation

High yeast/fungal metabolites (Markers 1,2,3,4,5,6,7,8) indicate a yeast/fungal overgrowth of the gastrointestinal tract. Prescription or natural (botanical) anti-fungals, along with supplementation of high potency multi-strain probiotics (20-50 billion cfu's), may reduce yeast/fungal levels.

High 4-hydroxybenzoic acid and/or 4-hydroxyhippuric acid (Markers 12,13) may be due to bacterial overgrowth of the GI tract, intake of fruits such as blueberries rich in polyphenols (anthocyanins, flavonols, and hydroxycinnamates), or may be from paraben additive exposure. Parabens are 4-hydroxybenzoic acid alkyl esters with antimicrobial properties. 4-Hydroxybenzoic acid may be excreted as its glycine conjugate 4-hydroxyhippuric acid. High levels of these paraben metabolites in urine (>10 mmol/mol creatinine) may result from excessive exposure to parabens. Parabens are common preservatives allowed in foods, drugs, cosmetics and toiletries, but they also have a long history of use in a variety of pharmaceutical products for injection, inhalation, oral, topical, rectal or vaginal administration. Some individuals experience skin reactions as most parabens are readily and completely absorbed through the skin and the GI tract. Parabens have been considered safe because of their low toxicity profile and their long history of safe use; however, recent studies challenge this view. In 1998, Routledge *et.al.*, (Toxicol.Appl.Pharmacol. **153**,12-19), reported parabens having estrogenic activity *in vitro*. A number of *in vivo* studies have further elucidated potential endocrine disruption by parabens affecting reproduction or promote tumor growth. Parabens have been found at high levels in breast cancer biopsies, although a definitive relationship with breast cancer has not been demonstrated. Parabens may contribute to mitochondrial failure by uncoupling oxidative phosphorylation and depleting cellular ATP. 4-Hydroxyhippuric acid has been found to be an inhibitor of Ca²⁺-ATPase in end-stage renal failure. Eliminate all sources of parabens. To accelerate paraben excretion, use sauna therapy, the Hubbard detoxification protocol employing niacin supplementation, or glutathione supplementation (oral, intravenous, transdermal, or precursors such as N-acetyl cysteine [NAC]).

High 4-hydroxyphenylacetic acid (Marker 15) is associated with small intestinal bacteria overgrowth due to its production by the following Clostridia bacteria: *C. difficile*, *C. stricklandii*, *C. lituseburens*, *C. subterminale*, *C. putrefaciens*, and *C. propionicum*. *C. difficile* can be distinguished from the other species by its production of 4-cresol which none of the other species produce. No information on the pathogenicity of the other species producing 4-hydroxyphenylacetic acid is available. It is likely that the phenol 4-hydroxyphenylacetic is an inhibitor of dopamine-beta-hydroxylase and that patients with high values may have elevated dopamine and HVA/VMA ratios. Elevated values are common in celiac disease and cystic fibrosis and have been reported as elevated in jejuna web, transient lactose intolerance, Giardia infection, ileal resection, ileocolic intussusception, septicemia, and projectile vomiting. Treatment with probiotics or antibiotics may be clinically useful.

Extremely elevated levels of at least 100 mmol/mol creatinine are associated with tyrosinemia, which can be due to immature development of enzymes in infants or to genetic deficiencies.

High glyceric or glycolic acid with low/normal oxalic acid (Markers 19,20,21) may result from a different metabolic pathway and have no known health consequences or genetic implications.

High fumaric acid (Marker 25) may be due to impaired Krebs cycle function, defect of the enzyme fumarase or a defect in mitochondrial function. Recommendations for supporting mitochondrial function include supplementation with coenzyme Q-10 (300-600 mg), NAD (25-50mg), L-carnitine or acetyl-L-carnitine (1000-2000 mg), riboflavin (40-80 mg), nicotinamide (40-80 mg), biotin (4-8 mg), and vitamin E (200-400 IU's) per day. All of these supplements are known to benefit mitochondrial dysfunction.

High malic acid (Marker 26) indicates a greater requirement for nutrients such as niacin (25-50mg) and coenzyme Q-10 (300-600mg). If malic acid is simultaneously elevated with citric, fumaric and alpha-ketoglutaric acids, a possible Cytochrome C Oxidase deficiency would strongly indicate mitochondrial energy pathway dysfunction.

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High 3-methylglutaric and/or high 3-methylglutaconic acids (Markers 30,32) may be due to reduced capacity to metabolize the amino acid leucine. This abnormality is found in the genetic disease methylglutaconic aciduria and in mitochondrial disorders in which there are severe deficiencies of the respiratory complexes (Complex I, NADH ubiquinone oxidoreductase and complex IV, cytochrome c oxidase.). Small elevations may be due to impairment of mitochondrial function and may respond to the recommended supplements below. Typical results found in genetic defects are above 10 mmol/mol creatinine. A few non-genetic conditions including pregnancy and kidney failure may also produce elevation of these organic acids in urine. Confirmation of the genetic disease requires enzymes and/or DNA testing. Multiple genetic defects can cause the biochemical abnormality. Confirmation of mitochondrial disorder usually requires tissue biopsy for mitochondria testing. Symptoms differ within different types of genetic disorders, but in severe cases may include speech delay, delayed development of both mental and motor skills (psychomotor delay), metabolic acidosis, abnormal muscle tone (dystonia), and spasms and weakness affecting the arms and legs (spastic quadriparesis). Recommendations include supplementation with coenzyme Q-10 (300-600 mg), NAD 25-50mg, L-carnitine and acetyl-L-carnitine (1000-2000 mg), riboflavin (40-80 mg), nicotinamide (40-80 mg), biotin (4-8 mg), and vitamin E (200-400 IU's) per day.

High 3-hydroxyglutaric (Marker 31) is a metabolite associated with the genetic disease glutaric aciduria type I, which is due to a deficiency of glutaryl CoA dehydrogenase, an enzyme involved in the breakdown of lysine, hydroxylysine, and tryptophan. Other elevated organic acids may include glutaric and glutaconic acids. This disease has been associated with clinical symptoms ranging from near normal to encephalopathy, cerebral palsy, and other neurological abnormalities. Some individuals with glutaric acidemia have developed bleeding in the brain or eyes that may be mistaken for the effects of child abuse. This abnormality should be confirmed by additional testing of enzyme deficiencies and/or DNA at a pediatric medical genetics center (Morton et al., Am J. Med. Genetics **41**: 89-95, 1991). Elevated values may also be found in hepatic carnitine palmitoyltransferase I deficiency, short-chain acyl dehydrogenase deficiency (SCAD), or ketosis. Mitochondrial dysfunction induced by glutaric acid metabolites causes astrocytes to adopt a proliferative phenotype, which may underlie neuronal loss, white matter abnormalities and macrocephalia. Values in glutaric aciduria type I range from 60-3000 mmol/mol creatinine. Values higher than normal but less than 60 mmol/mol creatinine may be due to mild glutaric acidemia type I or to the other causes indicated above. Treatment of this disorder includes special diets low in lysine and supplementation with carnitine or acetyl-L-carnitine (1000-2000 mg/day).

HVA levels below the mean (Marker 33) may indicate lower production of the neurotransmitter dopamine, perhaps due to low dietary intake of the amino acid precursors phenylalanine or tyrosine. Homovanillic acid is a metabolite of the neurotransmitter dopamine. Supplementation with phenylalanine or tyrosine may be beneficial. Enzyme cofactors magnesium, B6 (pyridoxine) or bipterin may also be deficient; neurotransmitter levels may increase with supplementation with these cofactors if these are deficient.

VMA levels below the mean (Marker 34) may indicate lower production of the neurotransmitter norepinephrine or the hormone adrenaline, perhaps due to low dietary intake of the amino acid precursors phenylalanine or tyrosine. Vanylmandelic acid (VMA) is a metabolite of norepinephrine or adrenaline. Low VMA may also result from blocked conversion of dopamine to norepinephrine by *Clostridia* metabolites. Supplementation with phenylalanine or tyrosine may be beneficial. Enzyme cofactors magnesium, B6 (pyridoxine) or bipterin may also be deficient and respond to supplementation.

High HVA/VMA ratio (Marker 35) The most common reason for an elevation of the HVA/VMA ratio is the decreased conversion of dopamine to norepinephrine and epinephrine. The enzyme responsible for this conversion, dopamine beta-hydroxylase, is copper and vitamin C dependent, so an elevated ratio could be due to deficiencies of these cofactors. Another common factor is inhibition of this enzyme by *Clostridia* byproducts. A high HPPHA, 4-Cresol, or other elevations of metabolites would be consistent with the latter explanation.

5-hydroxyindoleacetic acid (5-HIAA) levels below the mean (Marker 36) may indicate lower production of the neurotransmitter serotonin. 5-hydroxy-indoleacetic acid is a metabolite of serotonin. Low values have been correlated with symptoms of depression. Supplementation with the precursor 5-HTP (5-hydroxytryptophan) at 50-300 mg/day may be beneficial. Supplementation with tryptophan itself may form the neurotoxic metabolite quinolinic acid, however, 5-HTP is not metabolized to quinolinic acid. Excessive tryptophan supplementation has been associated with eosinophilia myalgia syndrome.

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High quinolinic acid / 5-HIAA ratio (Marker 39) indicates an imbalance of these organic acids and may be a sign of neural excitotoxicity. Quinolinic acid is an excitotoxic stimulant of certain brain cells that have NMDA-type receptors. Overstimulated nerve cells may die. Brain toxicity due to quinolinic acid has been implicated in Alzheimer's disease, autism, Huntington's disease, stroke, dementia of old age, depression, HIV-associated dementia, and schizophrenia. However, quinolinic acid is derived from the amino acid tryptophan and is an important intermediate that the body uses to make the essential nutritional cofactor nicotinamide adenine dinucleotide (NAD), which can also be derived from niacin (B3).

An elevated ratio is not specific for a particular medical condition and is commonly associated with excessive inflammation due to recurrent infections. If quinolinic acid is not elevated, low 5-HIAA from serotonin may be the source of the imbalance. Supplementation with 5-HTP may increase serotonin levels, but 5-HTP is not metabolized to quinolinic acid. Immune overstimulation, excess adrenal production of cortisol due to stress, or high exposure to phthalates may also increase the quinolinic acid/5-HIAA acid ratio.

The drug deprenyl or the dietary supplements carnitine, melatonin, capsaicin, turmeric (curcumin) and garlic may reduce brain damage caused by quinolinic acid. Niacin (nicotinic acid) and niacinamide may also reduce quinolinic acid production by decreasing tryptophan shunting to the quinolinic acid pathway. Inositol hexaniacinate as an adult dose of 500-1000 mg does not cause niacin flush.

High 3-hydroxybutyric and/or acetoacetic acids (Markers 42, 43) indicate increased metabolic utilization of fatty acids. These ketones are associated with diabetes mellitus, fasting, dieting (ketogenic or SCD diet), or illness such as nausea or flu, among many other causes. Regardless of cause, supplementation with L-carnitine or acetyl-L-carnitine (500-1000mg per day) may be beneficial.

High ethylmalonic, methylsuccinic, adipic, suberic, or sebacic acids (Markers 45,46,47,48,49) may be due to fatty acid oxidation disorders, carnitine deficiency, fasting, or to increased intake of the medium-chain triglycerides found in coconut oil, MCT oil, and some infant formulas. The fatty acid oxidation defects are associated with hypoglycemia, apnea episodes, lethargy, and coma. [An acyl carnitine profile (Duke University Biochemical Genetics Laboratory, <http://medgenetics.pediatrics.duke.edu>) can rule out fatty acid oxidation defects.] Regardless of cause, supplementation with L-carnitine or acetyl-L-carnitine (500-1000 mg per day) may be beneficial.

Pyridoxic acid (B6) levels below the mean (Marker 51) may be associated with less than optimum health conditions (low intake, malabsorption, or dysbiosis). Supplementation with B6 (20 - 50 mg/day) or a multivitamin may be beneficial.

Pantothenic acid (B5) levels below the mean (Marker 52) may be associated with less than optimum health conditions. Supplementation with B5 (250 mg/day) or a multivitamin may be beneficial.

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High glutaric acid (Marker 53) can result from glutaric acidemias, fatty acid oxidation defects, riboflavin deficiency, ingestion of medium-chain triglycerides, metabolic effects of valproic acid (Depakene), and celiac disease. The genetic disorders are usually diagnosed in children but have occasionally been detected in adults. The probability of a genetic disease is higher when values exceed 10 mmol/mol creatinine but such diseases may also be present with lower urine values. DNA tests have been developed for the confirmation of both types of genetic disorders but may not be commercially available. This compound may be elevated in about 10% of children with autism. Regardless of the cause, supplementation with riboflavin (20-100 mg/day) and coenzyme Q-10 (50-100 mg/day) may be beneficial.

Glutaric acidemia type I is associated with elevations of 3-hydroxyglutaric and glutaconic acid. Normal values of 3-hydroxyglutaric acid greatly reduce but do not completely eliminate the possibility of glutaric acidemia type I. This disease has been associated with clinical symptoms ranging from near normal to encephalopathy, cerebral palsy, and other neurological abnormalities. Some individuals with glutaric acidemia type I have developed bleeding in the brain or eyes that may be mistaken for the effects of child abuse. Treatment of this disorder includes special diets low in lysine and carnitine supplementation.

Glutaric acidemia type II, also called acyl-CoA dehydrogenase deficiency, caused by a genetic defect in one of the mitochondrial electron transport proteins, is associated with dysmorphic features, seizures, hypoglycemia, and developmental delay. Glutaric acidemia II is commonly associated with elevations of 2-hydroxyglutaric acid as well as isovalerylglycine, hexanoylglycine, isobutyrylglycine, ethylmalonic acid, methylsuccinic acid, and adipic, suberic, and sebacic acids.

Ascorbic acid (vitamin C) levels below the mean (Marker 54) may indicate a less than optimum level of the antioxidant vitamin C. Suggested supplementation is 1000 mg/day of buffered vitamin C, divided into 2-3 doses.

High 3-hydroxy-3-methylglutaric acid (Marker 55) is seen in the genetic disease 3-hydroxy 3-methylglutaric aciduria. Typical values observed in the genetic disease are 200-11,000mmol/mol creatinine. The cause of less significant increases in this urinary metabolite is unknown. 3-Hydroxy-3-methylglutaric aciduria may cause vomiting, lethargy, hypotonia, and apnea, sometimes evolving to coma. Laboratory tests reveal metabolic acidosis with severe hypoketotic hypoglycemia on fasting or during acute illness, hyperammonemia, and abnormal liver function. Preliminary diagnosis is based on a pattern of organic acids in urine which includes 3-hydroxy-3-methylglutaric, 3-hydroxyisovaleric, 3-methylglutaconic, 3-methylglutaric, and 3-methylcrotonic acids. Because yeast also produces this compound and yeast metabolites are frequently elevated along with this compound; slight increases may be yeast-related. Reduced activity of 3-hydroxy 3-methylglutaryl Co A reductase, a critical enzyme at the beginning of the cholesterol synthesis pathway, may also elevate this compound. Check cholesterol values when this compound is elevated up to 300 mmol/mol creatinine. Slight elevations may result from coenzyme Q10 deficiency. Supplementation with coenzyme Q10 at 50 - 120 mg/day may be beneficial.

High 2-hydroxybutyric acid (Marker 59) This organic acid is elevated when there is increased production of sulfur amino acids derived from homocysteine. The reasons for an increase can be due to the following reasons (which are not mutually exclusive):

1. There is increased need for glutathione to detoxify a host of toxic chemicals, resulting in increased shunting of homocysteine into the production of cysteine for glutathione. This is the most common reason.
2. There are genetic variants of the DNA such that methylation of homocysteine by betaine homocysteine methyl transferase or methionine synthase is impaired.
3. There are nutritional deficiencies of betaine, methylcobalamin, or methyltetrahydrofolate that reduce the enzyme activities of the enzymes in #2 above.
4. There is a genetic variant in cystathionine beta synthase (CBS) enzyme such that there is excessive shunting of homocysteine into cysteine production that results in excessive 2-hydroxybutyric acid formation.

High 2-hydroxyisovaleric acid and/or 2-hydroxyisocaproic acid (Markers 62,65) may be due to the genetic disease MSUD (maple syrup urine disease) or dihydrolipoyl dehydrogenase deficiency. Individuals with slight to moderate elevations may benefit from supplementing with high doses (5-20 mg/kg/day) of thiamine.

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High 4-hydroxyphenyllactic acid (Marker 72) is associated with tyrosinemia, which can be due to immature development of enzymes in infants or to genetic deficiencies. Even a mild case would have levels at least of 100 mmol/mol creatinine. Values between the upper limit of normal and 100 mmol creatinine may be due to the heterozygous genetic carrier state, or mild disease or unknown physiological conditions.

Low values for amino acid metabolites (Markers 62-74) indicate the absence of genetic disorders of amino acid metabolism. These markers are deamination (ammonia removed) byproducts that are very elevated only when a key enzyme has low activity; slight elevations may indicate a genetic variation or heterozygous condition which may be mitigated with diet or supplementation. Low values are not associated with inadequate protein intake and have not been proven to indicate specific amino acid deficiencies.

High quality nutritional supplements can be purchased through your practitioner or at New Beginnings Nutritionals, www.NBNUS.com <<http://www.NBNUS.com>>, or call 877-575-2467.

The nutritional recommendations in this test are not approved by the US FDA. Supplement recommendations are not intended to treat, cure, or prevent any disease and do not take the place of medical advice or treatment from a healthcare professional.