The Great Plains Laboratory, Inc.

William Shaw, Ph.D., Director | 11813 West 77th Street, Lenexa, KS 66214 | (913) 341-8949 | Fax (913) 341-6207

Requisition #:		***Physician:***	
Patient Name:		***Date of Collection:***	
Patient Age:	40	***Time of Collection:***	07:30 AM
Patient Sex:	F	***Print Date:***	04/18/2019

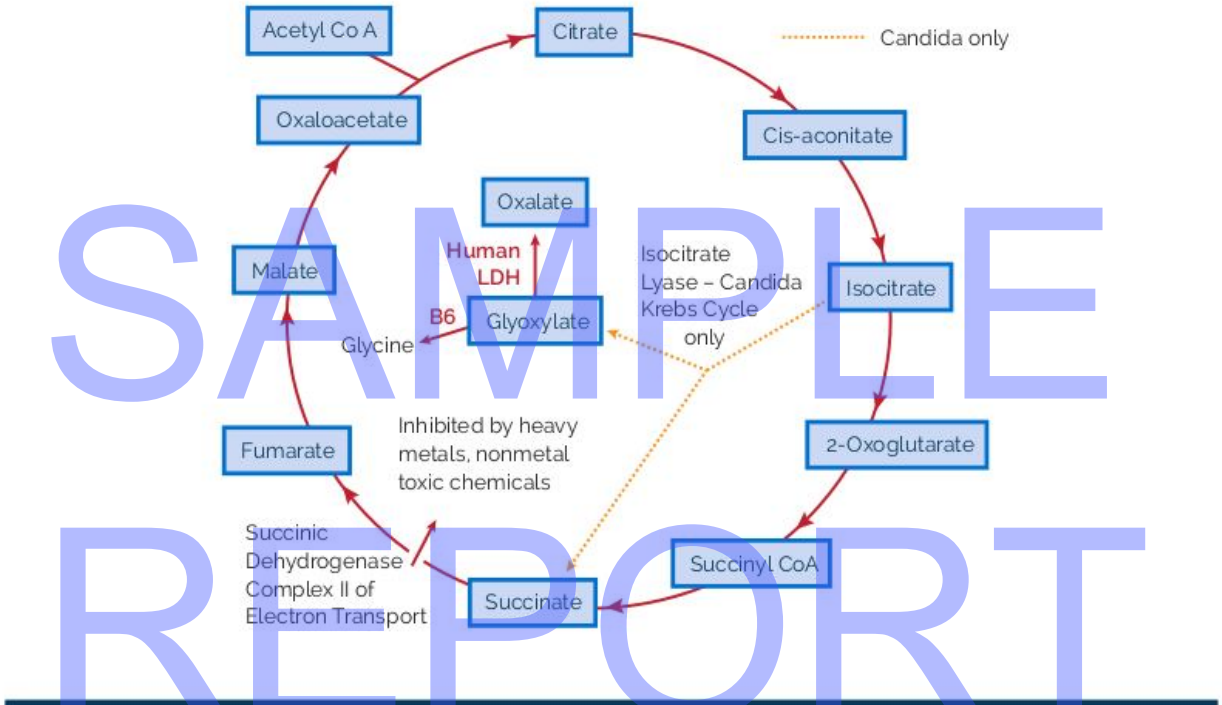
Organic Acids Test - Nutritional and Metabolic Profile

SAMPLE REPORT

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	3.7	3.7
2 5-Hydroxymethyl-2-furoic *(Aspergillus)*	≤ 14	H	31	31
3 3-Oxoglutaric	≤ 0.33	H	3.6	3.6
4 Furan-2,5-dicarboxylic *(Aspergillus)*	≤ 16		15	15
5 Furancarbonylglycine *(Aspergillus)*	≤ 1.9		1.1	1.1
6 Tartaric *(Aspergillus)*	≤ 4.5		3.7	3.7
7 Arabinose	≤ 29	H	167	167
8 Carboxycitric	≤ 29		0.46	0.46
9 Tricarballylic *(Fusarium)*	≤ 0.44	H	0.45	0.45
Bacterial Markers				
10 Hippuric	≤ 613	H	615	615
11 2-Hydroxyphenylacetic	0.06 - 0.66		0.27	0.27
12 4-Hydroxybenzoic	≤ 1.3		0.29	0.29
13 4-Hydroxyhippuric	0.79 - 17		8.8	8.8
14 DHPPA (Beneficial Bacteria)	≤ 0.38	H	0.61	0.61
Clostridia Bacterial Markers				
15 4-Hydroxyphenylacetic *(C. difficile, C. stricklandii, C. lituseburense & others)*	≤ 19		5.1	5.1
16 HPHPA *(C. sporogenes, C. caloritolerans, C. botulinum & others)*	≤ 208		26	26
17 4-Cresol *(C. difficile)*	≤ 75		6.0	6.0
18 3-Indoleacetic *(C. stricklandii, C. lituseburense, C. subterminale & others)*	≤ 11		0.28	0.28

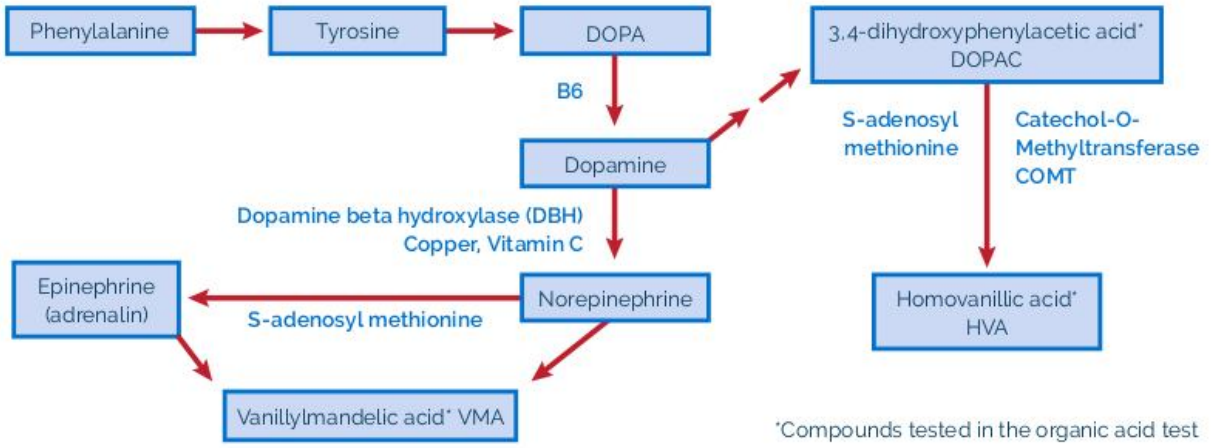
The Great Plains Laboratory, Inc.

Human Krebs Cycle showing Candida Krebs Cycle variant that causes excess Oxalate via Glyoxylate



SAMPLE REPORT

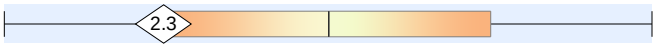
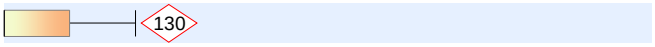
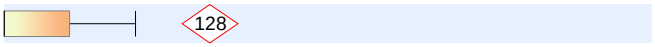
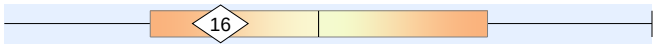
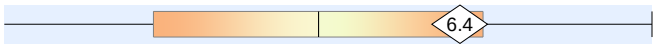
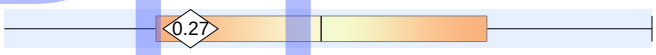
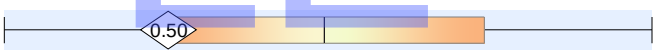
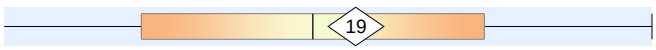
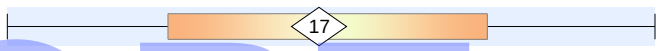
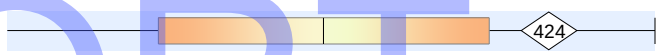
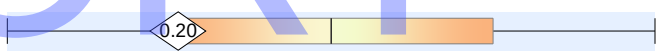
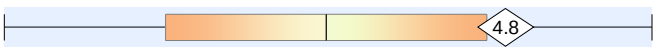
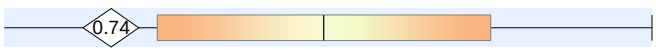
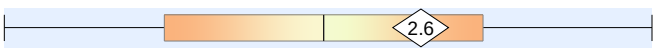
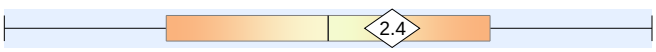
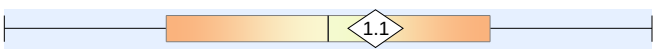
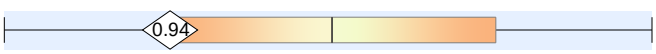
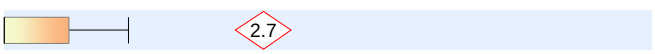
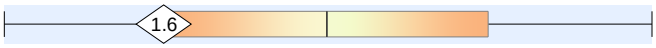
Major pathways in the synthesis and breakdown of **catecholamine neurotransmitters** in the absence of microbial inhibitors



The Great Plains Laboratory, Inc.

Requisition #: *Physician:*

Patient Name: *Date of Collection:* 03/25/2019

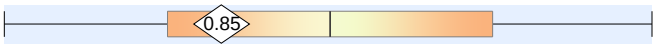
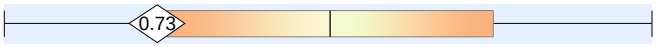
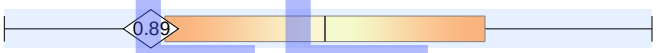
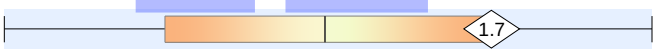
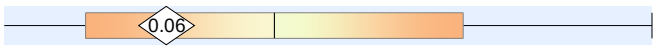
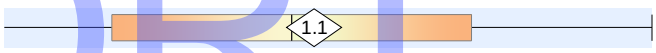
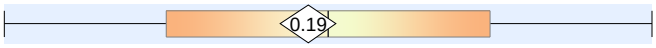
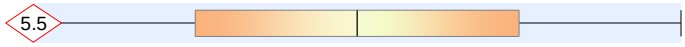
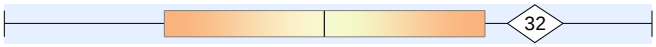
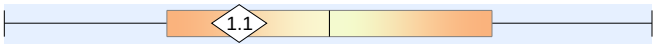
Metabolic Markers in Urine	Reference Range *(mmol/mol creatinine)*		Patient Value	Reference Population - Females Age 13 and Over
Oxalate Metabolites				
19 Glyceric	0.77 - 7.0		2.3	
20 Glycolic	16 - 117	H	130	
21 Oxalic	6.8 - 101	H	128	
Glycolytic Cycle Metabolites				
22 Lactic	≤ 48		16	
23 Pyruvic	≤ 9.1		6.4	
Mitochondrial Markers - Krebs Cycle Metabolites				
24 Succinic	≤ 9.3		3.6	
25 Fumaric	≤ 0.94		0.27	
26 Malic	0.06 - 1.8		0.50	
27 2-Oxoglutaric	≤ 35		19	
28 Aconitic	6.8 - 28		17	
29 Citric	≤ 507		424	
Mitochondrial Markers - Amino Acid Metabolites				
30 3-Methylglutaric	≤ 0.76		0.20	
31 3-Hydroxyglutaric	≤ 6.2		4.8	
32 3-Methylglutaconic	≤ 4.5		0.74	
Neurotransmitter Metabolites				
Phenylalanine and Tyrosine Metabolites				
33 Homovanillic (HVA) *(dopamine)*	0.80 - 3.6		2.6	
34 Vanillylmandelic (VMA) *(norepinephrine, epinephrine)*	0.46 - 3.7		2.4	
35 HVA / VMA Ratio	0.16 - 1.8		1.1	
36 Dihydroxyphenylacetic (DOPAC) *(dopamine)*	0.08 - 3.5		0.94	
37 HVA/ DOPAC Ratio	0.10 - 1.8	H	2.7	
Tryptophan Metabolites				
38 5-Hydroxyindoleacetic (5-HIAA) *(serotonin)*	≤ 4.3		1.2	
39 Quinolinic	0.85 - 3.9		1.6	

SAMPLE REPORT

The Great Plains Laboratory, Inc.

Requisition #: *Physician:* \ *Date of Collection:*

Patient Name: 03/25/2019

Metabolic Markers in Urine	Reference Range *(mmol/mol creatinine)*	Patient Value	Reference Population - Females Age 13 and Over
Neurotransmitter Metabolites			
40 Kynurenic	0.17 - 2.2	0.85	
Pyrimidine Metabolites - Folate Metabolism			
41 Uracil	≤ 9.7	1.9	
42 Thymine	≤ 0.56	0.20	
Ketone and Fatty Acid Oxidation			
43 3-Hydroxybutyric	≤ 3.1	0.73	
44 Acetoacetic	≤ 10	0	
45 Ethylmalonic	0.44 - 2.8	1.8	
46 Methylsuccinic	0.10 - 2.2	1.2	
47 Adipic	0.04 - 3.8	0.89	
48 Suberic	0.18 - 2.2	1.7	
49 Sebacic	≤ 0.24	0.06	
Nutritional Markers			
Vitamin B12			
50 Methylmalonic *	≤ 2.3	1.1	
Vitamin B6			
51 Pyridoxic (B6)	≤ 34	2.7	
Vitamin B5			
52 Pantothenic (B5)	≤ 10	1.2	
Vitamin B2 (Riboflavin)			
53 Glutaric *	0.04 - 0.36	0.19	
Vitamin C			
54 Ascorbic	10 - 200	L 5.5	
Vitamin Q10 (CoQ10)			
55 3-Hydroxy-3-methylglutaric *	0.17 - 39	32	
Glutathione Precursor and Chelating Agent			
56 N-Acetylcysteine (NAC)	≤ 0.28	0.16	
Biotin (Vitamin H)			
57 Methylcitric *	0.19 - 2.7	1.1	

SAMPLE REPORT

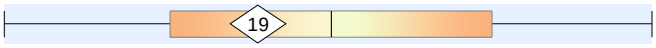
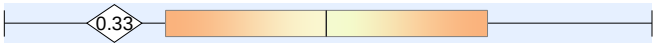
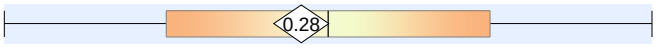
**** A high value for this marker may indicate a deficiency of this vitamin.***

The Great Plains Laboratory, Inc.

Requisition #: *Physician:*

Patient Name: *Date of Collection:* 03/25/2019

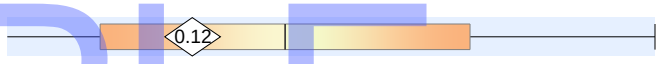
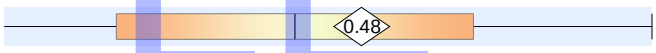
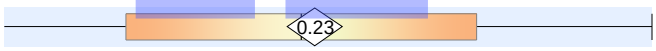
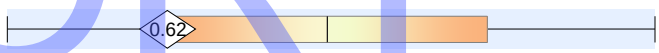
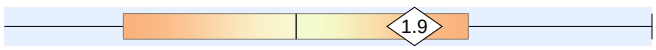
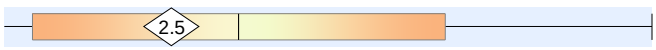
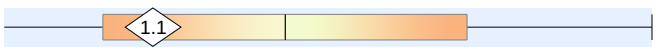
Indicators of Detoxification

Glutathione						
58	Pyroglutamic *	10	- 33		19	
Methylation, Toxic exposure						
59	2-Hydroxybutyric **	0.03	- 1.8		0.33	
Ammonia Excess						
60	Orotic	0.06	- 0.54		0.28	
Aspartame, salicylates, or GI bacteria						
61	2-Hydroxyhippuric		≤ 1.3	H	2.4	

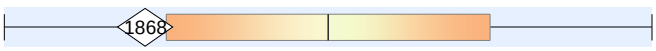
**** A high value for this marker may indicate a Glutathione deficiency.***

***** High values may indicate methylation defects and/or toxic exposures.***

Amino Acid Metabolites

62	2-Hydroxyisovaleric	≤ 0.42		0.12	
63	2-Oxoisovaleric	≤ 2.1		0.05	
64	3-Methyl-2-oxovaleric	≤ 0.87		0.48	
65	2-Hydroxyisocaproic	≤ 0.48		0.23	
66	2-Oxoisocaproic	≤ 0.37		0.11	
67	2-Oxo-4-methiolbutyric	≤ 0.16		0.04	
68	Mandelic	≤ 0.21		0.20	
69	Phenyllactic	≤ 0.20		0.09	
70	Phenylpyruvic	0.20 - 1.9		0.62	
71	Homogentisic	≤ 0.36		0.03	
72	4-Hydroxyphenyllactic	≤ 0.80		0.32	
73	N-Acetylaspartic	≤ 3.0		1.9	
74	Malonic	≤ 9.7		2.5	
75	4-Hydroxybutyric	≤ 4.8		1.1	

Mineral Metabolism

76	Phosphoric	1,000 - 5,000		1,868	

SAMPLE REPORT

The Great Plains Laboratory, Inc.

Requisition #: ***Physician:***

Patient Name: ***Date of Collection:*** 03/25/2019

Indicator of Fluid Intake

77	*Creatinine	310	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.

SAMPLE REPORT

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 ± 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).

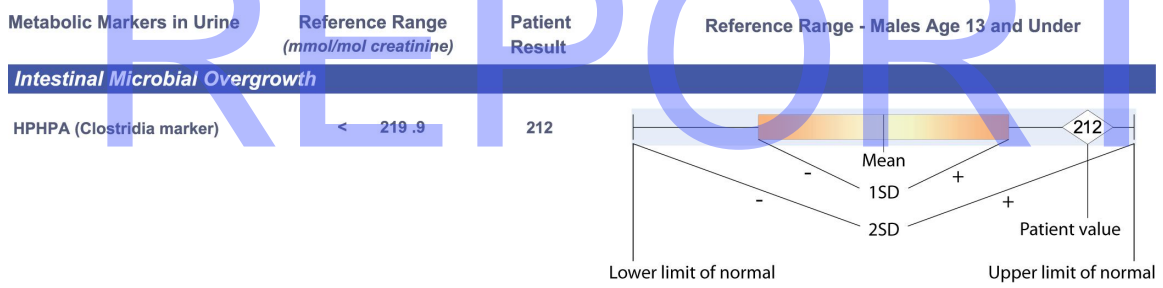
There are two types of graphical representations of patient values found in the new report format of both the standard Organic Acids Test and the Microbial Organic Acids Test.

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.

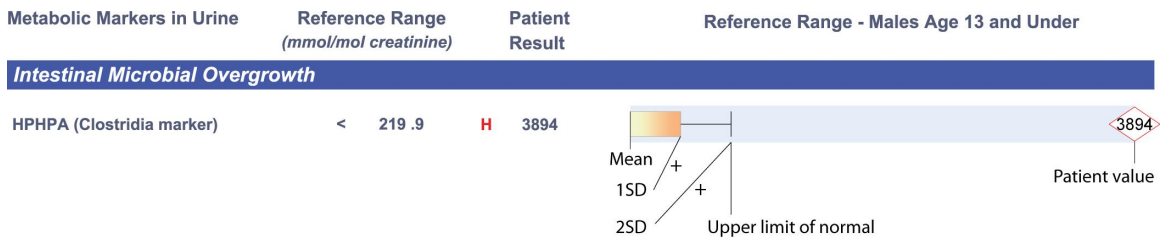
The second graph will occur when the value of the patient exceeds the upper limit of normal. In such cases, the graphical reference range is "shrunk" so that the degree of abnormality can be appreciated at a glance. In this case, the lower limits of normal are not shown, only the upper limit of normal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

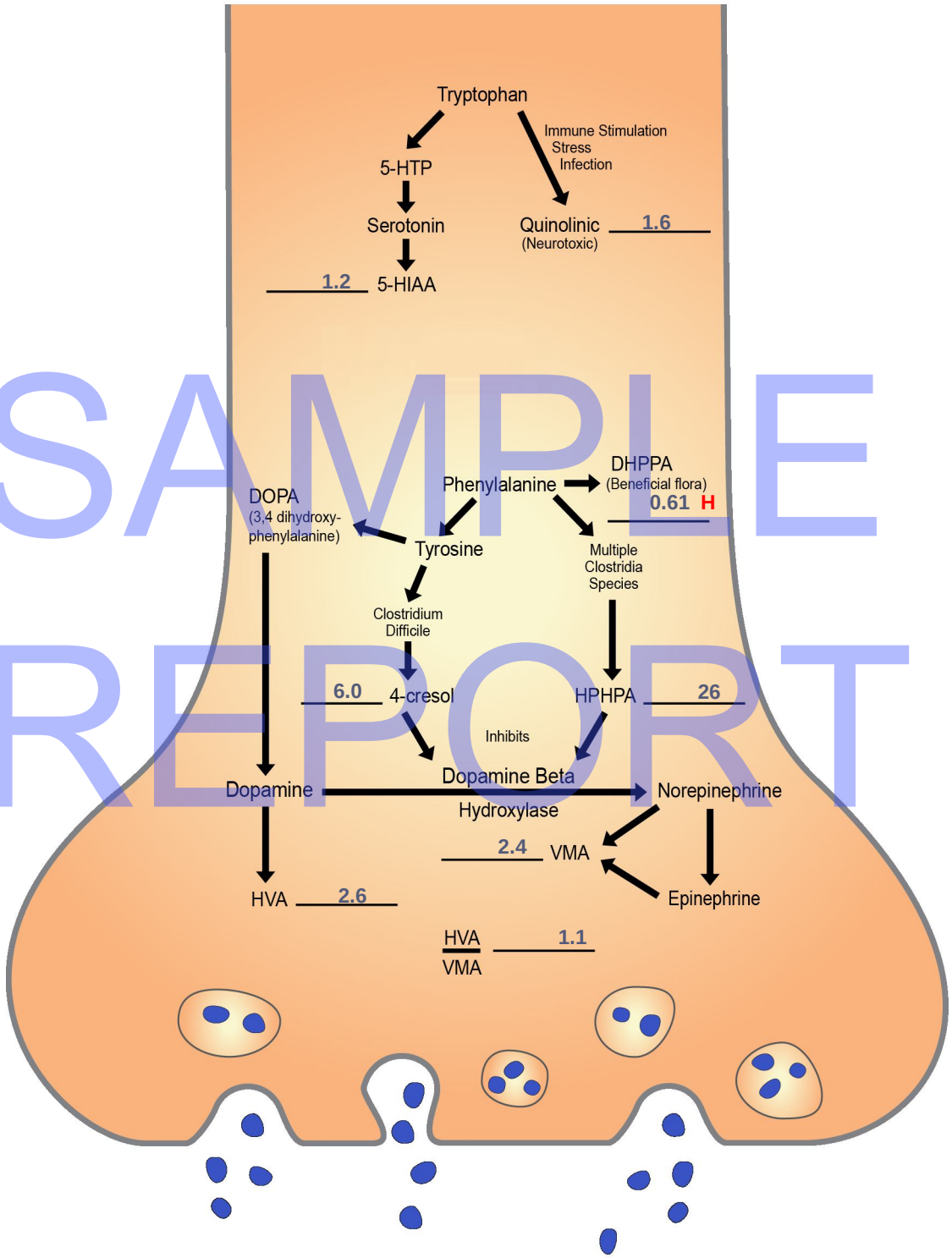
Example of Value Within Reference Range



Example of Elevated Value



Neurotransmitter Metabolism Markers



SAMPLE REPORT

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.

Requisition #: ***Physician:***

Patient Name: ***Date of Collection:***

Interpretation

High yeast/fungal metabolites (1-8) Elevations of one or more metabolites indicate a yeast/fungal overgrowth of the gastrointestinal (GI) tract. Prescription or natural (botanical) anti-fungals, along with supplementation of high potency multi-strain probiotics, may reduce yeast/fungal levels.

High 5-hydroxymethyl-2-furoic acid (2), furan-2,5-dicarboxylic acid (4), or furancarbonylglycine (5). High 5-hydroxymethyl-2-furoic acid, furan-2,5-dicarboxylic acid, and furancarbonylglycine have been reported to be byproducts of fungi such as Aspergillus species. Tartaric acid and oxalic acid have also been reported as fungal byproducts. Values of these compounds in urine decreased after antifungal treatment so high values may indicate fungal colonization of the gastrointestinal tract. Individuals with high values may want to followup with The Great Plains Laboratory urine Mycotoxin test.

***Significantly high tricarballylic acid (propane-1,2,3-tricarboxylic acid*) (9)** could be caused by the intake of corn or corn-based food contaminated with fumonisins, a group of mycotoxins produced primarily by *F. verticillioides*, and other related species. Tricarballylic acid is released from fumonisins during passage through the gastrointestinal tract. Tricarballylic acid is an inhibitor of the enzyme aconitase and therefore interferes with the Krebs cycle. The main symptoms of aconitase deficiency are myopathy and exercise intolerance. It may also act as a magnesium chelator. Tricarballylic acid is also metabolite of a component of a substance in modified corn starch, octenylsuccinic acid, found in a number of infant formulas such as Nutramigen, Vivonex, and Pregestimil. In addition, tricarballylic acid is a byproduct of beet sugar and maple sugar refining and might appear after ingestion of these sugars. Tricarballylic acid is also released from fumonisins upon certain food processing conditions. Clinical syndromes due to the intact mycotoxin are rare and characterized by abdominal pain and diarrhea. A specific role for fumonisins in the development of neural tube defects was suggested after the appearance of a cluster of such defects in Texas associated with consumption of corn from the heavily fumonisin-contaminated 1989 corn crop. More recent studies have shown that fumonisin B1 inhibits folate metabolism in cultured cells. Confirmation of Fusarium species can be done by the urine Mycotoxin test of The Great Plains Laboratory.

SAMPLE REPORT

High hippuric acid (10) may derive from food, GI bacterial activity, or exposure to the solvent toluene. Hippuric acid is a conjugate of glycine and benzoic acid formed in the liver. Most hippuric acid in urine is derived from microbial breakdown of chlorogenic acid to benzoic acid. Chlorogenic acid is a common substance in beverages and in many fruits and vegetables, including apples, pears, tea, coffee, sunflower seeds, carrots, blueberries, cherries, potatoes, tomatoes, eggplant, sweet potatoes, and peaches. Benzoic acid is present in high amounts in cranberry juice and is a food preservative. The workplace is the most common source of toluene exposure, but toluene may be absorbed from outgassing of new carpets and other building materials, or absorbed during recreational abuse of solvents such as glue-sniffing. Because most hippuric acid in urine is from GI sources, this marker is a poor indicator of toluene exposure and is being replaced by other markers in occupational safety testing. Bacterial overgrowth can be treated with natural anti-bacterial agents and/or probiotics (30-50 billion cfu's) that include *Lactobacillus rhamnosus*.

High DHPPA (3,4 dihydroxyphenylpropionic acid) (14) indicates excessive intake of chlorogenic acid, a common substance found in beverages and in many fruits and vegetables, including apples, pears, tea, coffee, sunflower seeds, carrots, blueberries, cherries, potatoes, tomatoes, eggplant, sweet potatoes, and peaches. Harmless or beneficial bacteria such as Lactobacilli, Bifidobacteria, and E. coli mediate the breakdown of chlorogenic acid to 3,4-dihydroxyphenylpropionic acid (DHPPA), and high values may indicate increased amounts of these species in the GI tract. In addition, one *Clostridia* species, *C. orbiscindens*, can convert the flavanoids luteolin and eriodictyol, occurring only in a relatively small food group that includes parsley, thyme, celery, and sweet red pepper to 3,4-dihydroxyphenylpropionic acid. The quantity of *Clostridia orbiscindens* in the GI tract is negligible (approximately 0.1% of the total bacteria) compared to the predominant flora of *Lactobacilli, Bifidobacteria,* and *E. coli*. Consequently, this marker is essentially useless as a general *Clostridia* marker but may be a good indicator of the presence of beneficial

High oxalic (21) with or without elevated glyceric (19) or glycolic acids (20) may be associated with the genetic hyperoxalurias, autism, women with vulvar pain, fibromyalgia, and may also be due to high vitamin C intake. However, kidney stone formation from oxalic acid was not correlated with vitamin C intake in a very large study. Besides being present in varying concentrations in most vegetables and fruits, oxalates, the mineral conjugate base forms of oxalic acid, are also byproducts of molds such as *Aspergillus* and *Penicillium* and probably *Candida*. If yeast or fungal markers are elevated, antifungal therapy may reduce excess oxalates. High oxalates may cause anemia that is difficult to treat, skin ulcers, muscles pains, and heart abnormalities. Elevated oxalic acid is also the result of anti-freeze (ethylene glycol) poisoning. Oxalic acid is a toxic metabolite of trichloroacetic acid and other environmental pollutants. In addition, decomposing vitamin C may form oxalates during transport or storage.

Elevated oxalate values with a concomitant increase in glycolic acid may indicate genetic hyperoxaluria (type I), whereas increased glyceric acid may indicate a genetic hyperoxaluria (type II). Elevated oxalic acid with normal levels of glyceric or glycolic metabolites rules out a genetic cause for high oxalate. However, elevated oxalates may be due to a new genetic disorder, hyperoxaluria type III.

Regardless of its source, high oxalic acid may contribute to kidney stones and may also reduce ionized calcium. Oxalic acid absorption from the GI tract may be reduced by calcium citrate supplementation before meals. Vitamin B6, arginine, vitamin E, chondroitin sulfate, taurine, selenium, omega-3 fatty acids and/or N-acetyl glucosamine supplements may also reduce oxalates and/or their toxicity. Excessive fats in the diet may cause elevated oxalate if fatty acids are poorly absorbed because of bile salt deficiency. Unabsorbed free fatty acids bind calcium to form insoluble soaps, reducing calcium's ability to bind oxalate and increase its absorption. If taurine is low in a plasma amino acid profile, supplementation with taurine (1000 mg/day) may help stimulate bile salt production (taurocholic acid), leading to better fatty acid absorption and diminished oxalate absorption.

High levels of oxalates are common in autism. Malabsorption of fat and intestinal *Candida* overgrowth are probably the major causes for elevated oxalates in this disorder. Even individuals with elevated glyceric or glycolic acids may not have a genetic disease. To rule out genetic diseases in those people with abnormally high markers characteristic of the genetic diseases, do the following steps: (1) Follow the nutritional steps indicated in this interpretation for one month; (2) If *Candida* is present, treat *Candida* for at least one month; (3) Repeat the organic acid test after abstaining from vitamin C supplements for 48 hours; (4) If the biochemical markers characteristic of genetic oxalate disorders are still elevated in the repeat test, consider DNA tests for the most common mutations of oxalate metabolism. DNA testing for type I hyperoxaluria is available from the Mayo Clinic, Rochester, MN as test #89915 "*AGXT* Gene, Full Gene Analysis" and, for the p.Gly170Arg mutation only, as # 83643 "Alanine:Glyoxylate Aminotransferase [*AGXT*] Mutation Analysis [G170R], Blood"). Another option to confirm the genetic disease is a plasma oxalate test, also available from the Mayo Clinic (Phone 507.266.5700). Plasma oxalate values greater than 50 micromol/L are consistent with genetic oxalate diseases and may serve as an alternate confirmation test.

SAMPLE REPORT

Bone tends to be the major repository of excess oxalate in patients with primary hyperoxaluria. Bone oxalate levels are negligible in healthy subjects. Oxalate deposition in the skeleton tends to increase bone resorption and decrease osteoblast activity.

Oxalates may also be deposited in the kidneys, joints, eyes, muscles, blood vessels, brain, and heart and may contribute to muscle pain in fibromyalgia. Oxalate crystal formation in the eyes may be a source of severe eye pain in individuals with autism who may exhibit eye-poking behaviors. High oxalates in the GI tract also may significantly reduce absorption of essential minerals such as calcium, magnesium, zinc, and others. In addition, oxalate deposits in the breast have been associated with breast cancer.

A low oxalate diet may also be particularly useful in the reduction of body oxalates even if dysbiosis of GI flora is the major source of oxalates. Foods especially high in oxalates include spinach, beets, chocolate, soy, peanuts, wheat bran, tea, cashews, pecans, almonds, berries, and many others. A complete list of high oxalate foods is available online at <http://www.greatplainslaboratory.com/home/eng/oxalates.asp>.

People with abnormally high markers characteristic of the genetic diseases should do the following:
1. Avoid spinach, soy, nuts, and berries for one month.
2. If *Candida* is present, treat *Candida* for at least one month.
3. Repeat the organic acid test having abstained from vitamin C supplements for 48 hours.

SAMPLE REPORT

High HVA/DOPAC ratio **(37)** HVA and DOPAC are the major metabolites of dopamine. An increase in the conversion of DOPAC to HVA might be due to excessive supplementation of S-adenosyl methionine (S-ame) and/or supplements such as methyltetrahydrofolate or methylcobalamin that increase endogenous Sam-e.

5-hydroxyindoleacetic acid (5HIAA) (38) levels below the mean may indicate lower production and/or decreased metabolism of the neurotransmitter serotonin. 5-hydroxy-indoleacetic acid is a metabolite of serotonin. Low values have been correlated with symptoms of depression. Low production of 5HIAA can be due to decreased intake or absorption of serotonin's precursor amino acid tryptophan, decreased quantities of cofactors needed for biosynthesis of serotonin such as tetrahydrobiopterin and vitamin B6 coenzyme. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations can cause reduced production of 5HIAA. Such SNPs are available on **The Great Plains DNA methylation pathway test** which can be performed on a cheek swab. Values may be decreased in patients on monoamine oxidase (MAO) inhibitors that are drugs or foods that contain tyramine such such as Chianti wine and vermouth, fermented foods such as cheeses, fish, bean curd, sausage, bologna, pepperoni, sauerkraut, and salami.

Pyridoxic acid (B6) levels below the mean (51) may be associated with less than optimum health conditions (low intake, malabsorption, or dysbiosis). Supplementation with B6 or a multivitamin may be beneficial.*

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

Ascorbic acid (vitamin C) levels below the mean **(54)** may indicate a less than optimum level of the antioxidant vitamin C. Individuals who consume large amounts of vitamin C can still have low values if the sample is taken 12 or more hours after intake. Supplementation with buffered vitamin C taken 2 or 3 times a day is suggested.* Since vitamin C (ascorbic acid) is a cofactor in the inactivation of dopamine-beta-hydroxylase by 4-cresol and HPHPA, vitamin C (ascorbic acid) supplementation and/or foods high in vitamin C should probably be avoided until *Clostridia* treatment has been completed, if *Clostridia* these markers are elevated.

High 2-hydroxyhippuric acid (61) may result from ingestion of aspartame (Nutrasweet®), salicylates (aspirin), dietary salicylates, or from GI bacteria converting tyrosine or phenylalanine to salicylic acid. For more information about salicylates in foods go to <http://www.feingold.org/salicylate.php> . 2-Hydroxyhippuric acid is a conjugate of hydroxybenzoic acid (salicylic acid) and glycine. Very high 2-hydroxyhippuric also inhibits dopamine beta-hydroxylase resulting in elevated HVA, decreased VMA, and elevated HVA/VMA ratio.

Low values for amino acid metabolites **(62-75)** 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.

SAMPLE REPORT

*See the supplementation schedule for dosing information.