MOSAIC DIAGNOSTICS

OAT ORGANIC ACIDS TEST

Requisition #:	9900001			*Practitioner:*	REGENERUS LABS
Patient Name:	Sample Report CMI30			*Date of Collection:*	12/01/2022
Date of Birth:	04/10/2005	*Patient Age:*	17	*Time of Collection:*	Not Given
Patient Sex:	M			*Print Date:*	03/21/2023
				Report Date:	12/01/2021

Organic Acids Test - Nutritional and Metabolic Profile

Metabolic Markers in Urine	Reference Range (mmol/mol creatinine)		Patient Value	Reference Population - Males Age 13 and Over
Intestinal Microbial Overgrowth				
Yeast and Fungal Markers				
1 Citramalic	0.11 - 2.0		0.39	0.39
2 5-Hydroxymethyl-2-furoic *(Aspergillus)*	≤ 18		1.3	1.3
3 3-Oxoglutaric	≤ 0.11		0.03	0.03
4 Furan-2,5-dicarboxylic *(Aspergillus)*	≤ 13		0.94	0.94
5 Furancarbonylglycine *(Aspergillus)*	≤ 2.3		0.10	0.10
6 Tartaric *(Aspergillus)*	≤ 5.3	H	25	25
7 Arabinose	≤ 20		16	16
8 Carboxycitric	≤ 20		0.02	0.02
9 Tricarballylic *(Fusarium)*	≤ 0.58		0.05	0.05
Bacterial Markers				
10 Hippuric	≤ 241		118	118
11 2-Hydroxyphenylacetic	0.03 - 0.47		0.22	0.22
12 4-Hydroxybenzoic	≤ 0.73		0.40	0.40
13 4-Hydroxyhippuric	≤ 14		7.2	7.2
14 DHPPA (Beneficial Bacteria)	≤ 0.23		0.10	0.10
Clostridia Bacterial Markers				
15 4-Hydroxyphenylacetic *(C. difficile, C. stricklandii, C. lituseburense & others)*	≤ 18		5.4	5.4
16 HPHPA *(C. sporogenes, C. caloritolerans, C. botulinum & others)*	≤ 102		45	45
17 4-Cresol *(C. difficile)*	≤ 39		1.4	1.4
18 3-Indoleacetic *(C. stricklandii, C. lituseburense, C. subterminale & others)*	≤ 6.8		0.21	0.21

Testing performed by The Great Plains Laboratory, LLC., Overland Park, 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.

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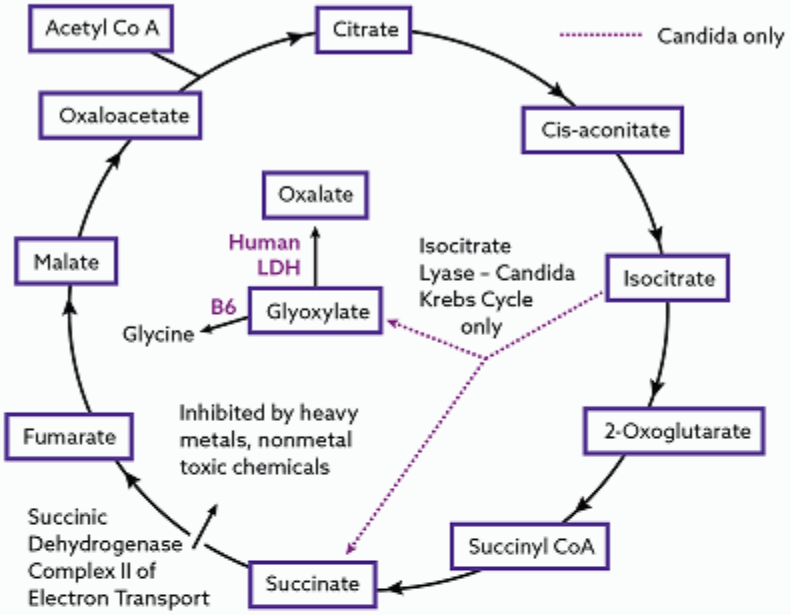
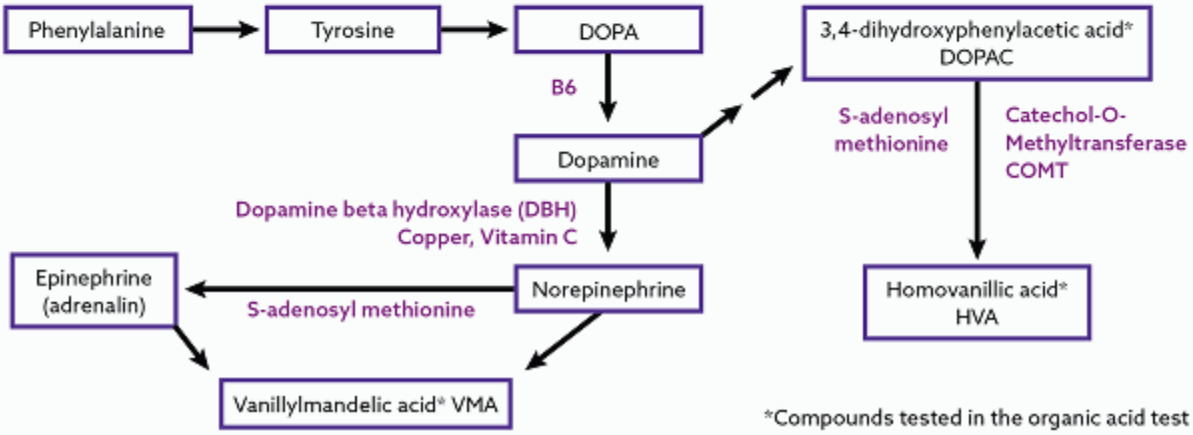
Patient Name:	Sample Report CMI30	***Date of Collection:***	12/01/2022

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



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



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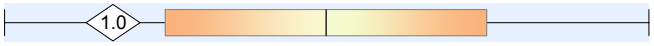
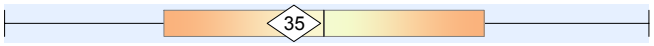
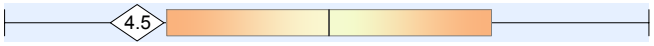
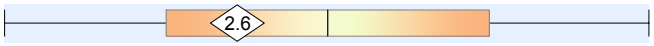
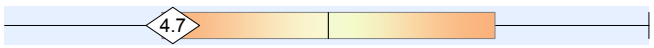
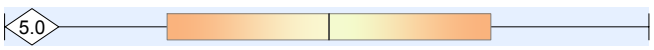
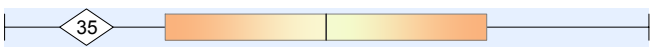
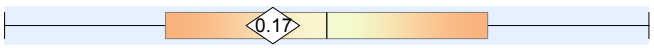
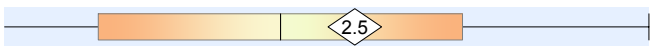
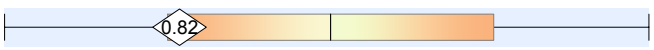
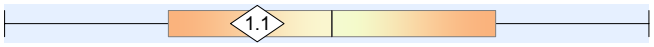
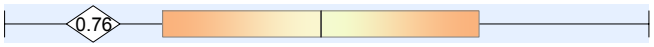
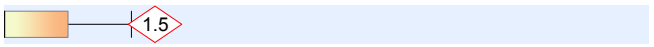
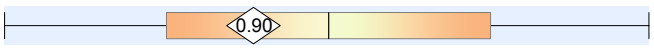
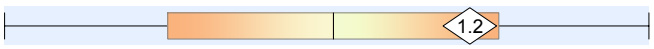
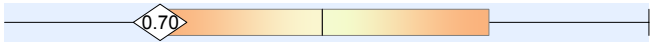
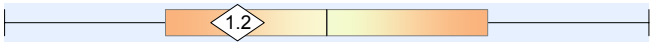
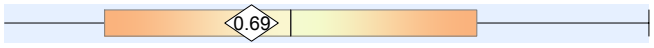
Requisition #:	9900001	***Practitioner:***	REGENERUS LABS
Patient Name:	Sample Report CMI30	***Date of Collection:***	12/01/2022

Metabolic Markers in Urine	Reference Range *(mmol/mol creatinine)*	Patient Value	Reference Population - Males Age 13 and Over
Oxalate Metabolites			
19 Glyceric	0.21 - 4.9	1.0	
20 Glycolic	18 - 81	48	
21 Oxalic	8.9 - 67	35	
Glycolytic Cycle Metabolites			
22 Lactic	0.74 - 19	4.5	
23 Pyruvic	0.28 - 6.7	2.6	
Mitochondrial Markers - Krebs Cycle Metabolites			
24 Succinic	≤ 5.3	0.42	
25 Fumaric	≤ 0.49	0.05	
26 Malic	≤ 1.1	0.13	
27 2-Oxoglutaric	≤ 18	4.7	
28 Aconitic	4.1 - 23	5.0	
29 Citric	2.2 - 260	35	
Mitochondrial Markers - Amino Acid Metabolites			
30 3-Methylglutaric	0.02 - 0.38	0.17	
31 3-Hydroxyglutaric	≤ 4.6	2.5	
32 3-Methylglutaconic	0.38 - 2.0	0.82	
Neurotransmitter Metabolites			
Phenylalanine and Tyrosine Metabolites			
33 Homovanillic (HVA) *(dopamine)*	0.39 - 2.2	1.1	
34 Vanillylmandelic (VMA) *(norepinephrine, epinephrine)*	0.53 - 2.2	0.76	
35 HVA / VMA Ratio	0.32 - 1.4	H 1.5	
36 Dihydroxyphenylacetic (DOPAC) *(dopamine)*	0.27 - 1.9	0.90	
37 HVA/ DOPAC Ratio	0.17 - 1.6	1.2	
Tryptophan Metabolites			
38 5-Hydroxyindoleacetic (5-HIAA) *(serotonin)*	≤ 2.9	0.70	
39 Quinolinic	0.52 - 2.4	1.2	
40 Kynurenic	≤ 1.8	0.69	

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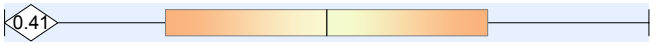
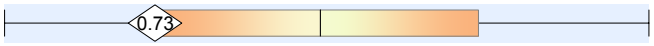
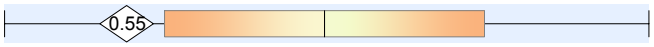
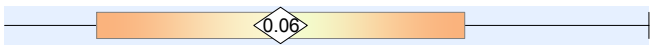
Patient Name:	Sample Report CMI30	***Date of Collection:***	12/01/2022

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

Pyrimidine Metabolites - Folate Metabolism

41	Uracil	≤ 6.9	2.5	
42	Thymine	≤ 0.36	0.13	

Ketone and Fatty Acid Oxidation

43	3-Hydroxybutyric	≤ 1.9	0.57	
44	Acetoacetic	≤ 10	0.41	
45	Ethylmalonic	0.13 - 2.7	0.73	
46	Methylsuccinic	≤ 2.3	0.62	
47	Adipic	≤ 2.9	0.55	
48	Suberic	≤ 1.9	1.2	
49	Sebacic	≤ 0.14	0.06	

Nutritional Markers

Vitamin B12

50	Methylmalonic ✱	≤ 2.3	0.46	

Vitamin B6

51	Pyridoxic (B6)	≤ 26	1.1	

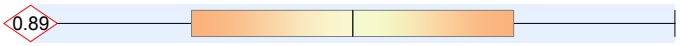
Vitamin B5

52	Pantothenic (B5)	≤ 5.4	0.99	

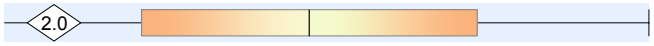
Vitamin B2 (Riboflavin)

53	Glutaric ✱	≤ 0.43	0.11	

Vitamin C

54	Ascorbic	10 - 200	L 0.89	

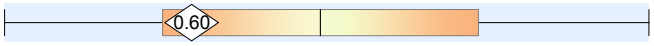
Vitamin Q10 (CoQ10)

55	3-Hydroxy-3-methylglutaric ✱	≤ 26	2.0	

Glutathione Precursor and Chelating Agent

56	N-Acetylcysteine (NAC)	≤ 0.13	H 0.24	

Biotin (Vitamin H)

57	Methylcitric ✱	0.15 - 1.7	0.60	

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

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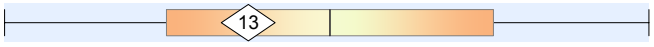
Patient Name:	Sample Report CMI30	***Date of Collection:***	12/01/2022

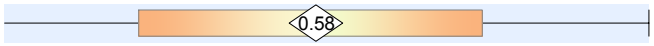
Metabolic Markers in Urine	Reference Range *(mmol/mol creatinine)*	Patient Value	Reference Population - Males Age 13 and Over

Indicators of Detoxification

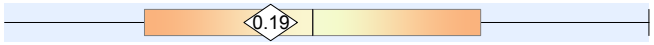
Glutathione

58	Pyroglutamic ✱	5.7 - 25		13	

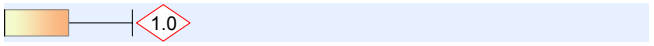
Methylation, Toxic exposure

59	2-Hydroxybutyric ✱✱	≤ 1.2		0.58	

Ammonia Excess

60	Orotic	≤ 0.46		0.19	

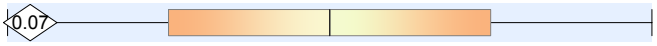
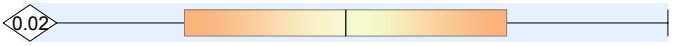
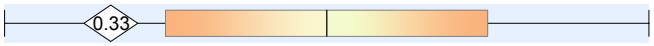
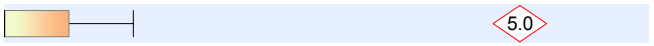
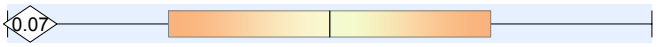
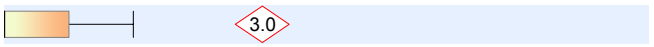
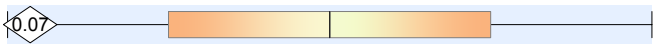
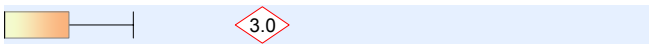
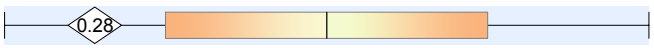
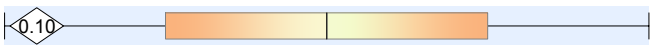
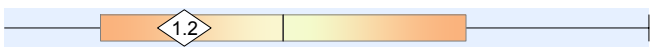
Aspartame, salicylates, or GI bacteria

61	2-Hydroxyhippuric	≤ 0.86	H	1.0	

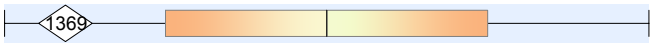
✱ ***A high value for this marker may indicate a Glutathione deficiency.***

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

Amino Acid Metabolites

62	2-Hydroxyisovaleric	≤ 2.0		0.07	
63	2-Oxoisovaleric	≤ 2.0		0.02	
64	3-Methyl-2-oxovaleric	≤ 2.0		0.33	
65	2-Hydroxyisocaproic	≤ 2.0	H	5.0	
66	2-Oxoisocaproic	≤ 2.0		0.07	
67	2-Oxo-4-methiolbutyric	≤ 2.0	H	3.0	
68	Mandelic	≤ 2.0		0.07	
69	Phenyllactic	≤ 2.0	H	3.0	
70	Phenylpyruvic	≤ 2.0		0.28	
71	Homogentisic	≤ 2.0		0.01	
72	4-Hydroxyphenyllactic	≤ 2.0		0.10	
73	N-Acetylaspartic	≤ 38		1.6	
74	Malonic	≤ 9.9		3.4	
75	4-Hydroxybutyric	≤ 4.3		1.2	

Mineral Metabolism

76	Phosphoric	1,000 - 4,900		1,369	

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Indicator of Fluid Intake

77	***Creatinine**	**100**	**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 ± 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.

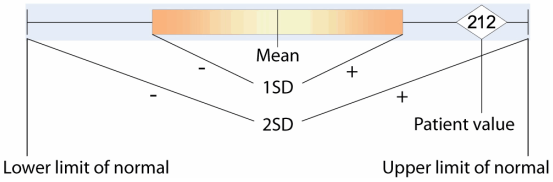
The first graph will occur when the value of the patient is within the reference (normal) range, defined as the mean plus or minus two standard deviations.

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.

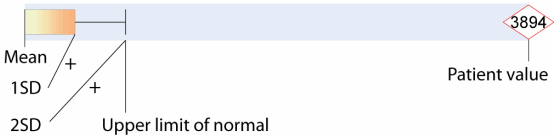
Example of Value Within Reference Range

Metabolic Markers in Urine	Reference Range *(mmol/mol creatinine)*	Patient Result	Reference Range - Males Age 13 and Under
Intestinal Microbial Overgrowth			
HPHPA (Clostridia marker)	< 219 .9	212	



Example of Elevated Value

Metabolic Markers in Urine	Reference Range *(mmol/mol creatinine)*		Patient Result	Reference Range - Males Age 13 and Under
Intestinal Microbial Overgrowth				
HPHPA (Clostridia marker)	< 219 .9	H	3894	



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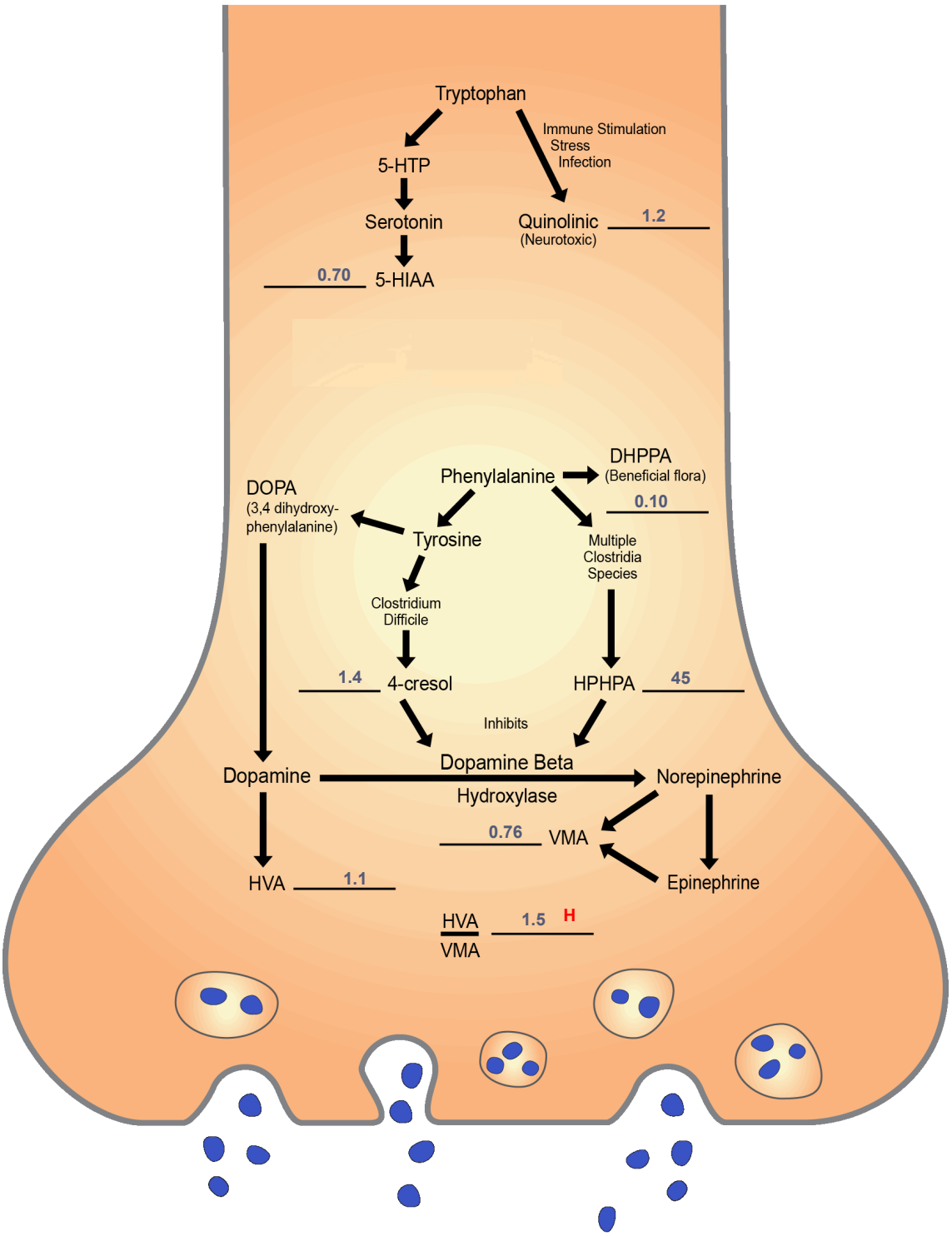
Neurotransmitter Metabolism Markers



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 (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.

Low or low normal citric acid (29) may be due to impaired function of the Krebs cycle, low dietary intake of citrate-containing foods such as citrus fruits and juices, potassium deficiency, acidosis (especially renal tubular acidosis), chronic kidney failure, diabetes, hypoparathyroidism, or excessive muscle activity. Low values may indicate increased risk of oxalate kidney stone formation, especially if oxalic acid is elevated also. Supplement with calcium or magnesium citrate if oxalic acid is elevated.

Homovanillic acid (HVA) levels (33) below the mean indicate low production and/or decreased metabolism of the neurotransmitter dopamine. Homovanillic acid is a metabolite of the neurotransmitter dopamine. Low production of HVA can be due to decreased intake or absorption of dopamine's precursor amino acids such as phenylalanine and/or tyrosine, decreased quantities of cofactors needed for biosynthesis of dopamine such as tetrahydrobiopterin and vitamin B6 coenzyme or decreased amounts of cofactors such as S-adenosylmethionine (Sam-e) needed to convert dopamine to HVA. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations can cause reduced production of HVA due to enzymes with decreased function. HVA values below the mean but which are much higher than VMA values are usually due to impairment of dopamine beta hydroxylase due to excessive Clostridia metabolites, the mold metabolite fusaric acid, pharmaceuticals such as disulfiram, or food additives like aspartame or deficiencies of cofactors such as vitamin C or copper. Values may also be decreased in patients on monoamine oxidase (MAO) inhibitors. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations in MAO or COMT genes can cause reduced production of HVA. Such SNPs are available on **The Great Plains DNA methylation pathway test** which can be performed on a cheek swab.

Vanillylmandelic acid (VMA) levels (34) below the mean indicate low production and/or decreased metabolism of the neurotransmitters norepinephrine and epinephrine. Vanillylmandelic acid is a metabolite of the neurotransmitters norepinephrine and epinephrine. Low production of VMA can be due to decreased intake or absorption of norepinephrine's and epinephrine's precursor amino acids such as phenylalanine and/or tyrosine, decreased quantities of cofactors needed for biosynthesis of norepinephrine and epinephrine such as tetrahydrobiopterin and vitamin B6 coenzyme or decreased amounts of cofactors such as S-adenosylmethionine (Sam-e) needed to convert norepinephrine and epinephrine to VMA. In addition, a number of genetic variations such as single nucleotide polymorphisms (SNPs) or mutations in MAO or COMT genes can cause reduced production of VMA. Such SNPs are available on **The Great Plains DNA methylation pathway test** which can be performed on a cheek swab. VMA values below the mean but which are much lower than HVA values are usually due to impairment of dopamine beta hydroxylase due to Clostridia metabolites, the mold metabolite fusaric acid, pharmaceuticals such as disulfiram, or food additives like aspartame or deficiencies of cofactors such as vitamin C or copper. Values may be decreased in patients on monoamine oxidase (MAO) inhibitors. Another cause for a low VMA value is a genetic variation (single nucleotide polymorphism or SNP) of the DBH enzyme. Patients with low VMA due to Clostridia metabolites or genetic DBH deficiency should not be supplemented with phenylalanine, tyrosine, or L-DOPA.

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High HVA/VMA ratio (35) the HVA/VMA ratio reflects the balance between dopamine and norepinephrine/epinephrine production by catecholamine producing neurons in the central nervous system, sympathetic nervous system, and adrenal gland. The most common reason for an elevation of the HVA/VMA ratio is a decreased conversion of dopamine to norepinephrine. The enzyme responsible for this conversion, dopamine beta-hydroxylase (DBH), is copper and vitamin C dependent so an elevated ratio could be due to deficiencies of these cofactors**. The most common reason** for this elevated ratio is inhibition of this enzyme by Clostridia byproducts including HPHPA, 4-cresol, or 4-hydroxyphenylacetic acid. Other causes of an increased ratio include inhibition of DBH by the mold metabolite fusaric acid, pharmaceuticals such as disulfiram, or food additives like aspartame. Another cause for an elevated ratio is a genetic variation (single nucleotide polymorphism or SNP) of the DBH enzyme. Alternatively, the activity of the DBH enzyme can be measured on blood serum. Individuals with low DBH activity can be treated with the drug Droxidopa™, which provides adequate norepinephrine by an alternate biochemical pathway. High ratios are common in a large number of neuropsychiatric diseases regardless of the reason for DBH deficiency.

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.

High N-acetylcysteine (***NAC) (56)*** is most often due to supplementation. N-acetylcysteine is a powerful antioxidant and a constituent of glutathione. Both directly bind to toxic metabolites. Although NAC may be beneficial under certain conditions, supplementation may stimulate candidiasis.

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.

High 2-hydroxyisovaleric acid and/or 2-hydroxyisocaproic acid (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 thiamine.* Individuals high in all MSUD metabolites and have values that exceed 20 times the upper limit may benefit from very high doses (5-20 mg/kg/day) of thiamine.

High 2-oxo-4-methiolbutyric acid (67) may be due to an error in methionine metabolism.

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High phenyllactic acid (69) Phenyllactic acid is a metabolite of phenylalanine. Slight elevations of phenyllactic acid may be due to gastrointestinal overgrowth of *Clostridium sordelli, C.stricklandii, C. mangenoti, C. ghoni, and C. bifermentans. C. sordelli* is usually considered nonpathogenic but has been implicated in catastrophic infectious gynecologic illness among women of child bearing age. The other species have rarely or never been reported to be pathogenic.

Values of 200 mmol/mol creatinine may indicate the individual is heterozygous (carrier state) or homozygous for the genetic disease phenylketonuria (PKU). Additional metabolites that can become elevated in PKU include mandelic acid, phenylpyruvic, and 2-hydroxyphenylacidic acids. The diagnosis of PKU is more likely if the individual has an elevation in more than one of these metabolites.

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