METAOMICS

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Urine Metabolomix Profile

Your Personalized Wellness Fingerprint

Metabolomix Profile

Yeast & Dysbiosis | Bacterial Overgrowth | Clostridia Markers | Oxalate Pathway

Krebs Cycle | Neurotransmitters | Fatty Acids | Nutritional & Amino Acids

This report: Urine Metabolites & Nutritional Analysis

ISO 15189:2022 | NABL Accredited | LC-MS/MS

[redacted]

Lab ID [redacted] • Age: 34 years • Female • Collection: 15-Jun-2026 • FM Diagnostics

PATIENT INFORMATION

Name:[redacted]	**Lab ID:**[redacted]	**Collection: 15-Jun-2026**	**Reported: 26-Jun-2026**
Age: 34 years	**Gender: Female**	**Received: 22-Jun-2026**	**Methodology: LC-MS/MS**
Sample: Urine	**Facility: FM Diagnostics**	**Ref. Dr**[redacted]	**Directly Measured Analytes: 140** *(+ 21 derived functional ratio indices, Section 7A)*

Clinical Significance: This Metabolomix Profile provides a comprehensive functional assessment across multiple biological domains — including plasma amino acids, hormones, fatty acids, urine metabolites, neurotransmitters, trace elements, and toxic elements — using LC-MS/MS quantitative analysis. Abnormal findings reflect functional imbalances that may contribute to underlying health issues and guide targeted nutritional and clinical interventions.

FUNCTIONAL IMBALANCE OVERVIEW

Scoring Method — Pathway-Weighted Concordance Score (PWCS v2): Each domain is scored from 0 to 9.9 using an asymptotic saturation model (τ = 6.0). Tier weights: Core = 2.0 | Supportive = 0.8 | Exploratory = 0.3. Deviation multipliers: ≤25% = 0.4 | 25–200% = 1.0 | 200–500% = 1.5 | 500–1000% = 2.0 | >1000% = 2.5. Concordance bonuses (capped at 2.0): awarded when multiple markers confirm the same pathway disruption. Shared markers across domains receive a 50% discount to prevent double-counting. Risk tiers: 0–2.9 = Minimal | 3.0–5.4 = Moderate | 5.5–7.4 = High | 7.5–9.9 = Elevated

■ COMPOSITE BURDEN	**CRITICAL MULTISYSTEM** | **Domains ≥7.5 (Elevated):** 6 | **Avg score:** 7.16/10 | Domains ≥7.5 (Elevated): 6 | Avg: 7.16/9.9 | PWCS v2 | τ=6.0 | shared-marker discount applied

GUT DYSBIOSIS / MICROBIOME

9.36/10 — ELEVATED

▲ Tartaric acid (3.17× ULN) ▲ Arabinose (2.41× ULN) ▲ DHPPA (3.68× ULN) ▲ p-Cresyl sulfate (1.33× ULN) ▲ 4-Hydroxyhippuric acid (1.54× ULN) ▲ Phenylacetic acid (1.48× ULN)

● Within range: HPHPA, Hippuric acid, 4-Hydroxybenzoic acid, 3-Indoleacetic acid, Benzoic acid

PWCS v2 | testable=19 | markers=16.14 shared_disc=1.60 bonus=2.00 penalty=0.00 raw=16.54

MITOCHONDRIAL DYSFUNCTION / KREBS CYCLE

7.95/10 — ELEVATED

▲ Pyruvic acid (1.21× ULN) ▲ Cis-aconitic acid (9.72× ULN) ▲ Fumaric acid (1.08× ULN) ▲ Succinic acid (1.28× ULN) ▲ 2-Hydroxyglutaric acid (1.77× ULN)

▼ Isocitric acid (0.97× LLN)

● Within range: Citric acid, α-Ketoglutaric acid, Lactic acid, Malic acid, 3-Methylglutaric acid, 3-Methylglutaconic aci

PWCS v2 | testable=12 | markers=7.52 shared_disc=0.00 bonus=2.00 penalty=0.00 raw=9.52

NEUROTRANSMITTER METABOLISM

6.89/10 — HIGH

▲ Homovanillic acid (HVA) (1.13× ULN) ▲ Vanilmandelic acid (VMA) (1.18× ULN) ▲ 5-HIAA (2.37× ULN) ▲ Kynurenic acid (1.50× ULN)

● Within range: DOPAC, Picolinic acid, 2,3-Pyridinedicarboxyl, Uracil, Thymine

PWCS v2 | testable=9 | markers=5.60 shared_disc=0.00 bonus=2.00 penalty=0.60 raw=7.00

TOXIC EXPOSURE / DETOXIFICATION / REDOX

8.48/10 — ELEVATED

▲ Glucaric acid (2.40× ULN) ▲ Orotic acid (2.41× ULN) ▲ 2-Hydroxyhippuric acid (1.86× ULN) ▲ Bisphenol A (BPA) (1.12× ULN) ▲ Bisphenol B (BPB) (3.25× ULN) ▲ 8-OHdG (3.00× ULN)

● Within range: Pyroglutamic acid, 3-/4-Methylhippuric ac, 2-Methylhippuric acid

PWCS v2 | testable=11 | markers=10.60 shared_disc=1.00 bonus=2.00 penalty=0.30 raw=11.30

METHYLATION / B-VITAMIN FUNCTION

8.73/10 — ELEVATED

▲ FIGLU (1.24× ULN) ▲ Methylmalonic acid (MMA) (1.38× ULN) ▲ Pantothenic acid (B5) (1.55× ULN) ▲ 2-Methylcitric acid (1.94× ULN)

▼ Pyridoxic acid (B6) (0.90× LLN) ▼ Ascorbic acid (Vit C) (0.01× LLN) ▼ N-Acetylcysteine (NAC) (0.67× LLN)

● Within range: Methionine, Glutaric acid, Mevalonic acid, 3-Hydroxy-3-methylglut

PWCS v2 | testable=11 | markers=10.40 shared_disc=0.00 bonus=2.00 penalty=0.00 raw=12.40

AMINO ACID DEFICIENCY / SUBSTRATE INSUFFICIENCY

ELEVATED

▲ Tyrosine (1.28× ULN) ▲ Phenylalanine (1.56× ULN) ▲ Isoleucine (1.90× ULN) ▲ Lysine (2.51× ULN) ▲ Glutamic acid (1.12× ULN) ▲ Leucine (1.49× ULN)

▼ Histidine (0.99× LLN) ▼ Alanine (0.66× LLN) ▼ Glycine (0.91× LLN) ▼ O-Phosphorylethanolamine (0.46× LLN) ▼ N-Acetyl-L-aspartic acid (0.36× LLN)

● Within range: Methionine, Serine, Valine, Aspartic acid, Arginine, Threonine, Cystine

PWCS v2 | testable=19 | markers=9.06 shared_disc=1.11 bonus=1.65 penalty=0.00 raw=9.60

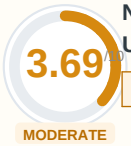
BCKD / BRANCHED-CHAIN AXIS

ELEVATED

▲ 3-Methyl-2-oxovaleric acid (6.72× ULN) ▲ α-Ketoisocaproic acid (3.60× ULN) ▲ Leucine (1.49× ULN) ▲ Isoleucine (1.90× ULN)

● Within range: α-Ketoisovaleric acid, Valine, Valerylglycine, Ethylmalonic+Methylsuc, Butyrylglycine, Isovalerylglycine, 3-Hydroxyisovaleric ac

PWCS v2 | testable=11 | markers=11.00 shared_disc=2.00 bonus=1.50 penalty=0.00 raw=10.50



NITROGEN METABOLISM / UREA CYCLE

MODERATE

▲ Orotic acid (2.41× ULN) ▲ Creatine (1.99× ULN)

▼ Glycine (0.91× LLN)

● Within range: Arginine, Argininosuccinic acid, Phosphoric acid, Aspartic acid

PWCS v2 | testable=7 | markers=3.12 shared_disc=1.56 bonus=1.20 penalty=0.00 raw=2.76

GUT-DERIVED / CARDIOMETABOLIC MARKERS

MODERATE

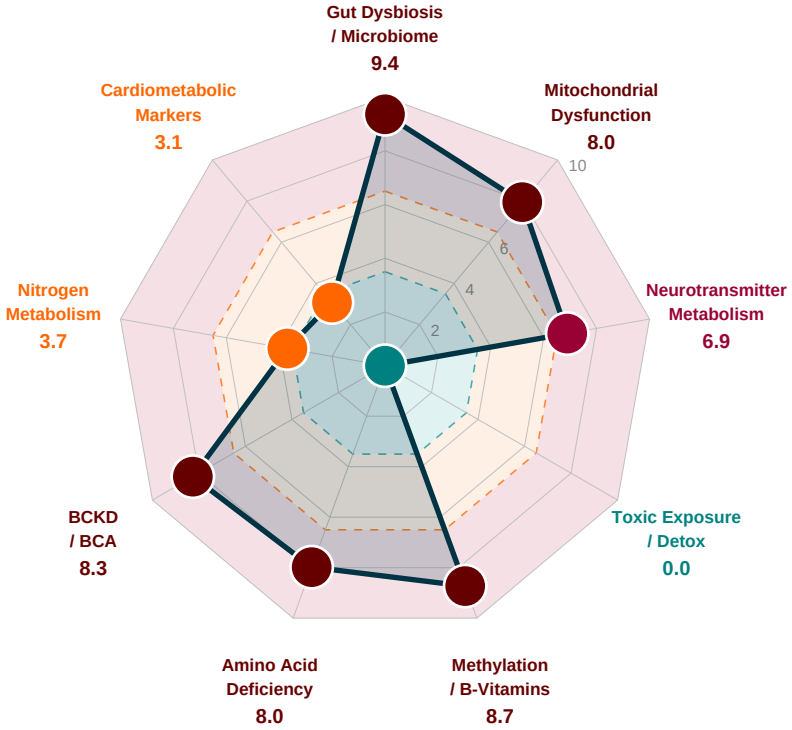
▲ TMAO (4.32× ULN) ▲ p-Cresyl sulfate (1.33× ULN)

● Within range: HPHPA, Hippuric acid

PWCS v2 | testable=4 | markers=3.80 shared_disc=1.90 bonus=0.30 penalty=0.00 raw=2.20

● Result Key:	▲ **HIGH** — above reference range	▼ **LOW** — below reference range	● **Normal** — within reference range	N/AP — not applicable / not available
● Abbreviations:	**ULN** — Upper Limit of Normal	**LLN** — Lower Limit of Normal	**× ULN / × LLN** — fold above/below limit	**mmol/mol creat.** — creatinine-corrected

Functional Domain Profile



9.4	8.0	6.9	0.0	8.7	8.0	8.3	3.7	3.1
Elevated	Elevated	High	Minimal	Elevated	Elevated	Elevated	Moderate	Moderate

Paulose Christina

Minimal 0–2.9 | Moderate 3.0–5.4 | High 5.5–7.4 | Elevated 7.5–10

SECTION 1 — INTESTINAL MICROBIAL OVERGROWTH

Yeast & Fungal Markers

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
1	Citramalic acid	2.59	1.00×	● N	≤ 10.00
2	5-Hydroxymethyl-2-Furoic acid (Aspergillus)	3.46	1.00×	● N	≤ 14.00
3	3-Oxoglutaric acid	0.21	1.00×	● N	≤ 35.00
4	Furan-2,5-dicarboxylic acid (Aspergillus)	10.19	1.00×	● N	≤ 16.00
5	Furancarbonylglycine (Aspergillus)	0.52	1.00×	● N	≤ 1.90
6	Tartaric acid (Aspergillus)	14.26	3.17×	▲ H	≤ 4.50
7	Arabinose	12.04	2.41×	▲ M	≤ 5.00
8	Carboxycitric acid				≤ 12.00
9	Tricarballylic acid (Fusarium)	0.81	1.84×	▲ M	≤ 0.44

Bacterial Markers

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
10	Hippuric acid	118.8	1.00×	● N	100 – 613.00
11	Phenylacetic acid	1.63	1.48×	▲ M	≤ 1.10
12	2-Hydroxyphenylacetic acid	2.43	1.22×	▲ M	0.06 – 2.00
13	4-Hydroxybenzoic acid	0.4	1.00×	● N	≤ 1.30
14	4-Hydroxyhippuric acid	26.14	1.54×	▲ M	0.79 – 17.00
15	Benzoic acid	0.2	1.00×	● N	≤ 3.00
16	Benzoylformic acid	0.44	1.00×	● N	≤ 3.00
17	DHPPA	1.4	3.68×	▲ H	≤ 0.38
18	Trimethylamine-N-Oxide (TMAO)	21.58	4.32×	▲ H	≤ 5.00

Clostridia Bacterial Markers

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
19	4-Hydroxyphenylacetic acid (C. difficile)	21.12	1.11×	▲ M	≤ 19.00
20	HPHPA (C. sporogenes, C. botulinum)	15.25	1.00×	● N	≤ 208.00
21	p-Cresyl sulfate (C. difficile)	100.04	1.33×	▲ M	≤ 75.00
22	3-Indoleacetic acid (Clostridia spp.)	2.76	1.00×	● N	≤ 11.00
23	3-Hydroxypropionic acid	2.34	1.00×	● N	1.00 – 36.00

SECTION 2 — OXALATE METABOLITES & GLYCOLYTIC CYCLE

Oxalate Metabolites

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
24	Glyceric acid	1.14	1.00×	● N	0.77 – 7.00
25	Glycolic acid	17.88	1.00×	● N	≤ 117.00
26	Oxalic acid	57.67	1.28×	▲ M	≤ 45.00

Glycolytic Cycle Metabolites

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
27	Lactic acid	7.16	1.00×	● N	5 – 60.00
28	Pyruvic acid	11.03	1.21×	▲ M	2 – 9.10

SECTION 3 — MITOCHONDRIAL MARKERS

Krebs Cycle Metabolites

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
29	Succinic acid	11.87	1.28×	▲ M	0.5 – 9.30
30	Fumaric acid	38.78	1.08×	▲ M	10 – 36
31	Malic acid	0.3	1.00×	● N	0.06 – 1.80
32	α-Ketoglutaric acid	27.26	1.00×	● N	5 – 35.00
33	Cis-aconitic acid	272.23	9.72×	▲ H	6.8 – 28.00
34	Citric acid	268.11	1.00×	● N	150 – 507.00
35	Isocitric acid	19.5	0.97×	▼ L	20 – 77.00

Amino Acid Metabolites (Mitochondrial) & Cofactor/Redox

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
36	3-Methylglutaric acid	0.63	1.00×	● N	≤ 0.76
37	3-Methylglutaconic acid	2.93	1.00×	● N	≤ 4.50
38	2-Hydroxyglutaric acid	26.62	1.77×	▲ M	≤ 15.00
39	2-Methylglutaric acid	0.44	1.00×	● N	≤ 0.50
40	3-Hydroxyglutaric acid	1.35	1.00×	● N	≤ 6.20
41	Succinylacetone	0.56	1.00×	● N	≤ 2.00

SECTION 4 — NEUROTRANSMITTER METABOLITES

Phenylalanine & Tyrosine Metabolites (Catecholamines)

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
43	Vanilmandelic acid (norepinephrine, epinephrine)	4.38	1.18×	▲ M	0.46 – 3.70
44	Homovanillic acid / HVA (dopamine)	4.07	1.13×	▲ M	0.80 – 3.60
45	HVA / VMA Ratio				N/AP
46	Dihydroxyphenylacetic acid (DOPAC)	0.57	1.00×	● N	0.08 – 3.50
47	HVA / DOPAC Ratio				N/AP

Tryptophan Metabolites (Serotonin & Kynurenine Pathway)

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
48	5-Hydroxyindole-3-acetic acid (serotonin)	28.64	2.37×	▲ M	3.8 – 12.10
49	2,3-Pyridinedicarboxylic acid	3.83	1.00×	● N	0.85 – 3.90
50	Kynurenic acid	3.29	1.50×	▲ M	1.00 – 2.20
51	Picolinic acid	0.83	1.00×	● N	≤ 12.39

Pyrimidine Metabolites — Folate Metabolism

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
52	Uracil	2.42	1.00×	● N	≤ 9.70
53	Thymine	0.35	1.00×	● N	≤ 0.56

SECTION 5 — KETONE & FATTY ACID OXIDATION

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
54	3-Hydroxybutyric acid	0.93	1.00×	● N	≤ 3.10
55	Acetoacetic acid	0.76	1.00×	● N	≤ 10.00
56	Adipic acid	8.07	2.12×	▲ M	0.04 – 3.80
57	Suberic acid	0.28	1.00×	● N	0.18 – 2.20
58	Sebacic acid	0.05	1.00×	● N	≤ 0.24
59	Ethylmalonic acid + Methylsuccinic acid	3.27	1.00×	● N	0.54 – 5.00
60	Malonic acid	3.88	1.00×	● N	≤ 9.70
61	Tiglylglycine	0.06	1.00×	● N	≤ 2.00
62	Pimelic acid	0.08	1.00×	● N	≤ 2.0

SECTION 6 — NUTRITIONAL MARKERS

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
63	Methylmalonic acid (Vitamin B12 marker)	3.17	1.38×	▲ M	≤ 2.30
64	Formiminoglutamic acid / FIGLU (Folate marker)	3.98	1.24×	▲ M	≤ 3.20
65	Pyridoxic acid (Vitamin B6)	4.52	0.90×	▼ L	5.00 – 34.00
66	Pantothenic acid (Vitamin B5)	15.51	1.55×	▲ M	2.00 – 10.00
67	Glutaric acid (Vitamin B2 / Riboflavin marker)	0.29	1.00×	● N	0.04 – 0.50
68	Ascorbic acid (Vitamin C)	0.29	0.12×	▼ L	2.50 – 13.00
69	3-Hydroxy-3-methylglutaric acid (CoQ10 marker)	2.56	1.00×	● N	0.17 – 39.00
70	Mevalonic acid (Cholesterol biosynthesis)	0.11	1.00×	● N	≤ 0.60
71	N-Acetylcysteine (Glutathione precursor)	0.1	0.67×	▼ L	0.15 – 0.28
72	2-Methylcitric acid (Biotin / Vitamin H)	5.24	1.94×	▲ M	0.19 – 2.70

SECTION 7 — INDICATORS OF DETOXIFICATION

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
73	Pyroglutamic acid (Glutathione / Redox)	31.73	1.00×	● N	16 – 34
74	Glutathione Reduced (GSH)	0.07	1.00×	● N	≤ 0.50
75	Glutathione Disulfide (GSSG)	0.03	1.00×	● N	≤ 0.10
76	GSH / GSSG Ratio				N/AP
77	2-Hydroxybutyric acid (Methylation / Toxic)	1.41	1.00×	● N	0.03 – 1.80
78	Orotic acid (Ammonia excess)	1.69	2.41×	▲ M	0.06 – 0.70
79	2-Hydroxyhippuric acid (Salicylates / GI)	2.42	1.86×	▲ M	≤ 1.30
80	2-Methylhippuric acid (Xylene exposure)	0.02	1.00×	● N	≤ 0.28
81	3-/4-Methylhippuric acid (Xylene)	0.16	1.00×	● N	≤ 3.50
82	8-Hydroxydeoxyguanosine (8-OHdG)	0.06	3.00×	▲ M	≤ 0.02
83	8-Hydroxyguanine (8-oxoG)				≤ 0.02
84	Bisphenol A (BPA)	1.12	1.12×	▲ M	≤ 1.00
85	Bisphenol B (BPB)	0.65	3.25×	▲ H	≤ 0.20
86	Acrolein				≤ 10.00
87	3-Nitrotyrosine (Peroxynitrite / NO stress)				≤ 1.00
88	Malondialdehyde (Lipid peroxidation)				≤ 4.00
89	1,4-Dihydroxynonane mercapturic acid				≤ 3.00

90	8-iso-Prostaglandin F2α				≤ 0.80

SECTION 7A — FUNCTIONAL RATIO INDICES

Derived metabolic ratios provide functional context beyond individual marker levels. These indices reflect enzymatic efficiency, cofactor balance, and pathway flux across key metabolic domains. Values outside reference ranges should be interpreted alongside the individual marker data and the clinical interpretation section.

Sl. No.	Ratio / Index	Calculated Value	Reference Range	Status	Clinical Significance
	Mitochondrial Function				
91	**Lactate / Pyruvate**	**0.649**	10 – 25	▼ LOW	Cytosolic NADH:NAD■ redox balance; elevated L/P reflects impaired pyruvate entry into mitochondria or excess cytosolic lactate production — indicates cytosolic redox imbalance, not direct electron transport chain failure.
92	**Citrate / cis-Aconitate**	**0.985**	2 – 15	▼ LOW	Aconitase enzyme activity; influenced by oxidative stress and iron-dependent mitochondrial function.
93	**cis-Aconitate / Isocitrate**	**13.96**	0.1 – 1.5	▲ HIGH	Balance between proximal Krebs cycle intermediates and metabolic flow.
94	**α-KG / Succinate**	**2.30**	10 – 80	▼ LOW	Krebs cycle flux efficiency; reflects B-complex and lipoic acid–dependent metabolism.
95	**Succinate / Fumarate**	**0.306**	1 – 10	▼ LOW	May reflect riboflavin (B2)-dependent enzyme activity and mitochondrial efficiency.
96	**Fumarate / Malate**	**129.3**	0.1 – 1.5	▲ HIGH	Distal Krebs cycle flux and overall mitochondrial energy efficiency.
	Neurotransmitter Balance				
97	**HVA / VMA**	**0.929**	0.2 – 2.0	● NORMAL	Balance between dopamine and catecholamine metabolism.
98	**HVA / DOPAC**	**7.14**	0.1 – 2.0	▲ HIGH	May reflect COMT enzyme activity and methylation efficiency.
99	**Kynurenic / Xanthurenic**	**8.66**	1 – 5	▲ HIGH	Balance of B6-dependent tryptophan metabolism pathways.
100	**Kynurenic / Picolinic**	**3.96**	0.5 – 2.5	▲ HIGH	Balance between neuroprotective and immune-regulatory tryptophan pathways.
101	**Quinolinate / Kynurenate**	**1.16**	0.5 – 3.0	● NORMAL	Neurotoxic vs neuroprotective tryptophan balance.
102	**Pyridoxic / Serotonin**	**0.158**	5 – 20	▼ LOW	Adequacy of vitamin B6 for serotonin synthesis.
103	**Pyridoxic / Kynurenic**	**1.37**	5 – 25	▼ LOW	B6 availability in neuroprotective pathways.
	Methylation & B-Vitamin Function				
104	**Pyridoxic / Xanthurenic**	**11.89**	5 – 30	● NORMAL	Functional sufficiency of vitamin B6 in metabolic pathways.
105	**MMA / FIGlu**	**0.796**	0.1 – 3.0	● NORMAL	Relative functional status of vitamin B12 versus folate metabolism.
106	**Methionine / 2-Hydroxybutyric**	**1.07**	0.5 – 3.5	● NORMAL	Balance between methylation capacity and oxidative stress demand.
	Redox, Detoxification & Nitrogen Balance				
107	**Ascorbate / Pyroglutamate**	**0.009**	2 – 10	▼ LOW	Vitamin C status relative to glutathione demand.

108	**Glycine / Pyroglutamate**	**4.29**	2 – 8	● NORMAL	Phase II detoxification capacity relative to glutathione stress.
109	**Serine / Pyroglutamate**	**1.94**	2 – 10	▼ LOW	Balance between neuronal repair substrates and detoxification demand.
110	**Pantothenic / Pyroglutamate**	**0.489**	0.1 – 1.5	● NORMAL	CoA-dependent metabolism (B5) relative to glutathione turnover.
Nitrogen Balance					
111	**Orotate / Arginine**	**0.735**	≤ 0.7	▲ HIGH	Urea cycle efficiency and ammonia handling capacity.

sl 112 — Section boundary index (reserved; not reported). Amino acid panel serial numbers commence at sl 113 (Section 8).

SECTION 8 — AMINO ACIDS

Essential Amino Acids

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
113	Histidine	**29.64**	0.99×	▼ L	30 – 300
114	Isoleucine	**5.51**	1.90×	▲ M	≤ 2.90
115	Leucine	**10.76**	1.49×	▲ M	3.5 – 7.2
116	Lysine	**83.91**	2.51×	▲ M	5 – 33.4
117	Methionine	**1.51**	1.00×	● N	1.0 – 1.7
118	Phenylalanine	**17.28**	1.56×	▲ M	5 – 11.1
119	Threonine	**16.91**	1.00×	● N	≤ 43.40
120	Valine	**2.52**	1.00×	● N	≤ 8.30

Non-Essential Amino Acids

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
121	Alanine	**16.62**	0.66×	▼ L	25 – 55.0
122	Arginine	**2.3**	1.00×	● N	≤ 7.40
123	Aspartic acid	**0.59**	1.00×	● N	0.4 – 1.4
124	Cystine	**15.21**	1.00×	● N	5 – 16.1
125	Glutamic acid	**7.85**	1.12×	▲ M	2 – 7.0
126	Glycine	**136.07**	0.91×	▼ L	150 – 460.2
127	Proline	**0.25**	1.00×	● N	≤ 9.0
128	Tyrosine	**22.46**	1.28×	▲ M	8 – 17.5
129	Serine	**61.62**	1.00×	● N	30 – 74.4

SECTION 9 — AMINO ACID METABOLITES

Branched-Chain Ketoacids & Other Catabolism Markers

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
130	2-Hydroxyisovaleric acid	0.38	1.00×	● N	≤ 2.00
131	α-Ketoisovaleric acid	0.84	1.00×	● N	≤ 2.10
132	3-Methyl-2-oxovaleric acid	13.45	6.72×	▲ H	≤ 2.00
133	2-Hydroxyisocaproic acid	0.02	1.00×	● N	≤ 2.00
134	α-Ketoisocaproic acid	7.21	3.60×	▲ H	≤ 2.00
135	2-Oxo-4-methiolbutyric acid (Met/Sulfur)				≤ 2.00
136	Mandelic acid	2.28	1.14×	▲ M	≤ 2.00
137	3-Phenyllactic acid	2.53	1.26×	▲ M	≤ 2.00
138	Phenylpyruvic acid	0.08	1.00×	● N	≤ 2.00
139	Homogentisic acid	0.61	1.00×	● N	≤ 2.00
140	4-Hydroxyphenyllactic acid	1.27	1.00×	● N	≤ 10.00
141	4-Hydroxyphenylpyruvic acid	0.01	1.00×	● N	≤ 5.00
142	Xanthurenic acid (Kynurenine / Tryptophan)	0.38	1.00×	● N	≤ 0.46
143	3-Hydroxyisovaleric acid	1.66	1.00×	● N	≤ 40.00
144	N-Acetyl-L-aspartic acid	3.59	0.36×	▼ L	10 – 38.00
145	α-Ketobutyric acid	1.03	1.00×	● N	≤ 3.00
146	4-Hydroxybutyric acid	0.22	1.00×	● N	≤ 4.80
147	O-Phosphorylethanolamine	0.92	0.46×	▼ L	2 – 51.00
148	Creatine	3.98	1.99×	▲ M	0.50 – 2.00
149	Argininosuccinic acid	0.43	1.00×	● N	≤ 5.00

Acylglycines

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
150	Propionylglycine	0.12	1.00×	● N	≤ 0.30
151	Butyrylglycine	0.9	1.00×	● N	0.10 – 2.00
152	Isobutyrylglycine	1.59	1.00×	● N	≤ 9.00
153	3-Methylcrotonylglycine	1.11	1.00×	● N	≤ 1.50
154	2-Methylbutyrylglycine	0.97	1.13×	▲ M	0.01 – 0.86

155	Isovalerylglycine	**0.99**	1.00×	● N	≤ 10.00
156	Valerylglycine	**0.04**	1.00×	● N	≤ 0.12
157	Hexanoylglycine	**0.23**	1.00×	● N	≤ 0.80
158	3-Phenylpropionylglycine	**0.03**	1.00×	● N	≤ 0.60
159	Suberylglycine	**0.18**	1.00×	● N	≤ 5.40

Other Metabolites

Sl.	Metabolic Marker	Observed Value (mmol/mol creat.)	×	Result	Reference Range (mmol/mol
160	Glucaric acid (Oxidized Sugar)	**11.74**	2.40×	▲ M	0.10 – 4.90
161	Phosphoric acid (Inorganic Phosphate)	**1156.58**	1.00×	● N	1000 – 5000
162	*Creatinine (Fluid intake indicator)	**2.34 mmol/L**	1.00×	● N	1.10 – 20.00 mmol/L

INTEGRATED CLINICAL INTERPRETATION & NUTRIENT RECOMMENDATIONS

Domain · Clinical priority	Abnormal findings (key markers)	Clinical significance (bullet points)
Gut Dysbiosis / Microbiome ELEVATED Domain score: 9.36 / 10	▲ Tartaric acid — 14.26 (ref ≤ 4.50; 3.17× ULN) ▲ Arabinose — 12.04 (ref ≤ 5.00; 2.41× ULN) ▲ DHPPA — 1.4 (ref ≤ 0.38; 3.68× ULN) ▲ p-Cresyl sulfate — 100.04 (ref ≤ 75.00; 1.33× ULN) ▲ 4-Hydroxyhippuric acid — 26.14 (ref 0.79 – 17.00; 1.54× ULN) ▲ Phenylacetic acid — 1.63 (ref ≤ 1.10; 1.48× ULN)	• Tartaric acid elevated at 3.17× ULN (14.26) — consistent with yeast/fungal overgrowth pattern. • Arabinose elevated at 2.41× ULN (12.04) — marker of yeast/Candida overgrowth. • DHPPA elevated at 3.68× ULN (1.40) — dysbiotic bacterial activity. • 4-Hydroxyphenylacetic acid elevated (21.12) — microbial fermentation. • p-Cresyl sulfate markedly elevated (100.04) — Clostridium spp. overgrowth.
Mitochondrial Dysfunction / Krebs Cycle ELEVATED Domain score: 7.95 / 10	▲ Pyruvic acid — 11.03 (ref 2 – 9.10; 1.21× ULN) ▲ Cis-aconitic acid — 272.23 (ref 6.8 – 28.00; 9.72× ULN) ▲ Fumaric acid — 38.78 (ref 10 – 36; 1.08× ULN) ▲ Succinic acid — 11.87 (ref 0.5 – 9.30; 1.28× ULN) ▲ 2-Hydroxyglutaric acid — 26.62 (ref ≤ 15.00; 1.77× ULN) ▼ Isocitric acid — 19.5 (ref 20 – 77.00; 0.97× LLN)	• Cis-aconitic acid elevated at 9.72× ULN (272.23) — aconitase impairment. • Fumaric acid elevated at 1.08× ULN (38.78) — distal Krebs cycle block. • Pyruvic acid elevated at 1.21× ULN (11.03) — impaired PDC activity. • Ethylmalonic+Methylsuccinic acid elevated (3.27) — short-chain FA oxidation impairment. • B1, B2, lipoic acid, and antioxidant cofactor support are primary mitochondrial interventions.
Neurotransmitter Metabolism HIGH Domain score: 6.89 / 10	▲ Homovanillic acid / HVA — 4.07 (ref 0.80 – 3.60; 1.13× ULN) ▲ Vanilmandelic acid — 4.38 (ref 0.46 – 3.70; 1.18× ULN) ▲ 5-HIAA (2.37× ULN) ▲ Kynurenic acid — 3.29 (ref 1.00 – 2.20; 1.50× ULN)	• 5-HIAA elevated (28.64) — increased serotonin turnover. • HVA elevated (4.07) — increased dopamine turnover. • Pyridoxic acid (B6) below reference (4.52) — impairs AADC activity. • Address B6 and tryptophan/tyrosine availability before initiating direct neurotransmitter support.
Toxic Exposure / Detoxification / Redox ELEVATED Domain score: 8.48 / 10	▲ Glucaric acid — 11.74 (ref 0.10 – 4.90; 2.40× ULN) ▲ Orotic acid — 1.69 (ref 0.06 – 0.70; 2.41× ULN) ▲ 2-Hydroxyhippuric acid — 2.42 (ref ≤ 1.30; 1.86× ULN) ▲ Bisphenol A — 1.12 (ref ≤ 1.00; 1.12× ULN) ▲ Bisphenol B — 0.65 (ref ≤ 0.20; 3.25× ULN) ▲ 8-Hydroxydeoxyguanosine — 0.06 (ref ≤ 0.02; 3.00× ULN)	• Glucaric acid elevated at 2.40× ULN (11.74) — elevated Phase II demand. • Oxalic acid elevated at 1.28× ULN (57.67). • Ascorbic acid below reference (0.29; ref 2.5–13.0 mmol/mol creatinine) — reduced antioxidant reserve. • N-Acetylcysteine below reference (0.10) — limiting glutathione precursor. • Bisphenol A elevated at 1.12× ULN (1.12) — xenobiotic exposure.

Domain · Clinical priority	Abnormal findings (key markers)	Clinical significance (bullet points)
Methylation / B-Vitamin Function ELEVATED Domain score: 8.73 / 10	▲ Formiminoglutamic acid / FIGLU — 3.98 (ref ≤ 3.20; 1.24× ULN) ▲ Methylmalonic acid — 3.17 (ref ≤ 2.30; 1.38× ULN) ▲ Pantothenic acid — 15.51 (ref 2.00 – 10.00; 1.55× ULN) ▲ 2-Methylcitric acid — 5.24 (ref 0.19 – 2.70; 1.94× ULN) ▼ Pyridoxic acid — 4.52 (ref 5.00 – 34.00; 0.90× LLN) ▼ Ascorbic acid — 0.29 (ref 2.50 – 13.00; 0.12× LLN) ▼ N-Acetylcysteine — 0.1 (ref 0.15 – 0.28; 0.67× LLN)	• MMA elevated at 1.38× ULN (3.17) with concurrent FIGLU (3.98) — combined B12 and folate insufficiency. • 2-Methylcitric acid elevated at 2.05× ULN (5.24) — propionyl-CoA pathway loading. • Pyridoxic acid (B6) below reference (4.52) — impairs transsulfuration. • Pantothenic acid elevated at 1.55× ULN (15.51) — confirm B5 supplementation. • 5-MTHF, methylcobalamin, P5P supplementation as indicated; reassess at 3 months.
Amino Acid Deficiency / Substrate Insufficiency ELEVATED Domain score: 7.98 / 10	▲ Tyrosine (1.28× ULN) ▲ Phenylalanine — 17.28 (ref 5 – 11.1; 1.56× ULN) ▲ Isoleucine — 5.51 (ref ≤ 2.90; 1.90× ULN) ▲ Lysine — 83.91 (ref 5 – 33.4; 2.51× ULN) ▲ Formiminoglutamic acid / FIGLU — 3.98 (ref ≤ 3.20; 1.24× ULN) ▼ Histidine — 29.64 (ref 30 – 300; 0.99× LLN) ▼ Furancarbonylglycine — 0.52 (ref ≤ 1.90;) ▼ O-Phosphorylethanolamine — 0.92 (ref 2 – 51.00; 0.46× LLN) ▼ N-Acetyl-L-aspartic acid — 3.59 (ref 10 – 38.00; 0.36× LLN)	• Low urinary amino acid levels may reflect reduced dietary protein intake, increased tissue utilisation, or impaired absorption — clinical context essential. • Glutamic acid elevated (7.85) — may indicate increased protein catabolism. • Dietary protein quality assessment and gut mucosal integrity evaluation recommended.
BCKD / Branched-Chain Axis ELEVATED Domain score: 8.26 / 10	▲ 3-Methyl-2-oxovaleric acid — 13.45 (ref ≤ 2.00; 6.72× ULN) ▲ α-Ketoisocaproic acid — 7.21 (ref ≤ 2.00; 3.60× ULN) ▲ Isoleucine — 5.51 (ref ≤ 2.90; 1.90× ULN)	• AKBM elevated at 6.72× ULN (13.45) — impaired BCKD complex. • AKIC elevated at 3.60× ULN (7.21) — BCKA accumulation. • BCKD elevation consistent with acquired cofactor insufficiency. • Do not initiate BCAA supplementation without first addressing cofactor status.
Nitrogen Metabolism / Urea Cycle MODERATE Domain score: 3.69 / 10	▲ Orotic acid — 1.69 (ref 0.06 – 0.70; 2.41× ULN) ▲ Creatine — 3.98 (ref 0.50 – 2.00; 1.99× ULN) ▼ Furancarbonylglycine — 0.52 (ref ≤ 1.90;)	• Orotic acid elevated (1.69) — increased urea cycle nitrogen demand. • Creatine elevated (3.98) — confirm dietary creatine supplementation. • Urea cycle structural integrity should be evaluated alongside protein intake.
Gut-Derived / Cardiometabolic Markers MODERATE Domain score: 3.07 / 10	▲ Trimethylamine-N-Oxide — 21.58 (ref ≤ 5.00; 4.32× ULN) ▲ p-Cresyl sulfate — 100.04 (ref ≤ 75.00; 1.33× ULN)	• TMAO elevated at 4.32× ULN (21.58) — sustained elevation associated with cardiometabolic risk. • Targeted microbiome intervention recommended; avoid isolated L-carnitine supplementation.

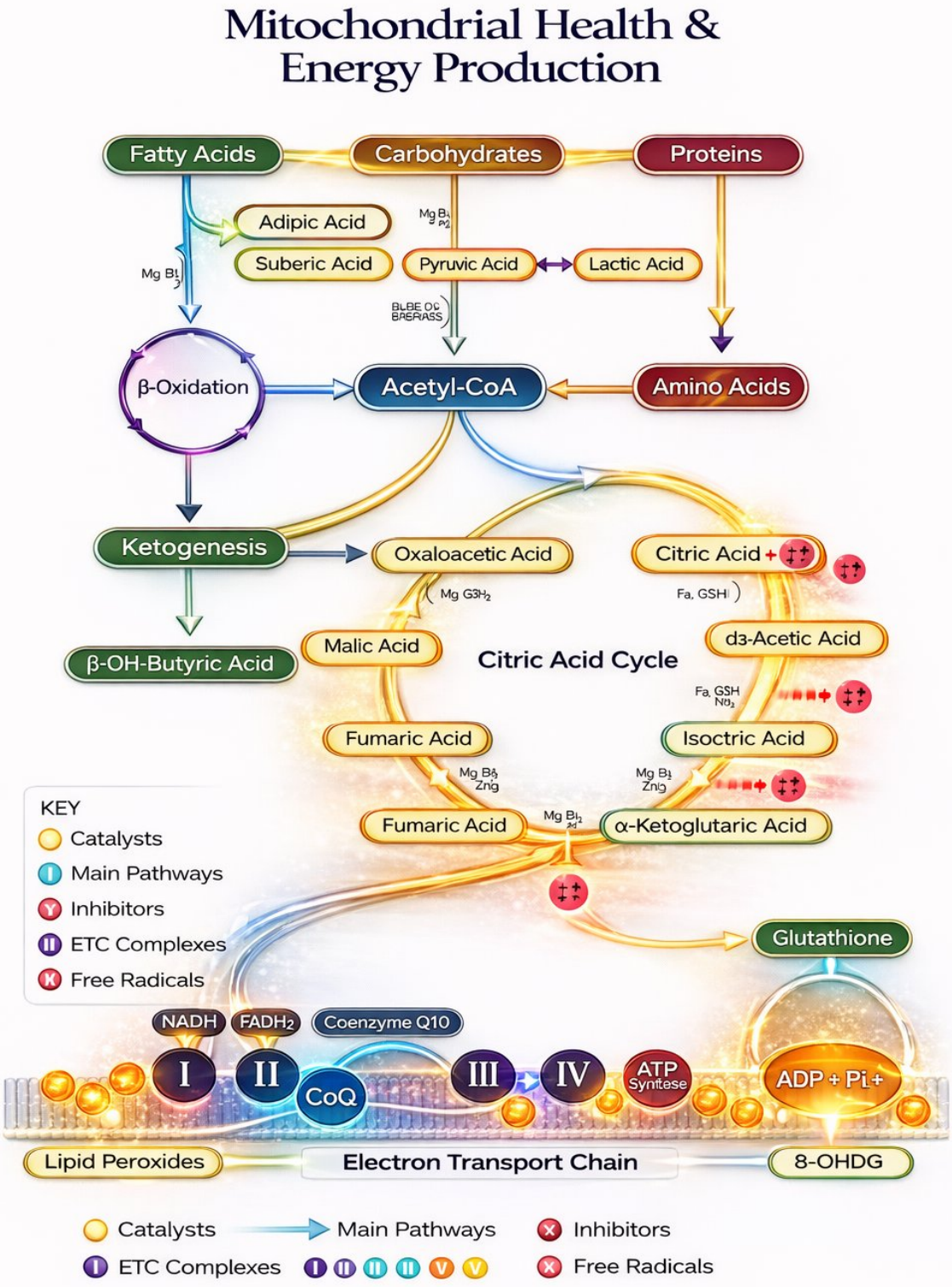
Clinical Priority	Result Symbols	Abbreviations

ELEVATED	Strong multi-marker concordance; warrants immediate clinical attention
HIGH	Important finding; warrants clinical attention
MODERATE	Worth monitoring; secondary to priority domains
MINIMAL	No current concern; review at follow-up

▲	Above reference range
▼	Below reference range
●	Within range / note

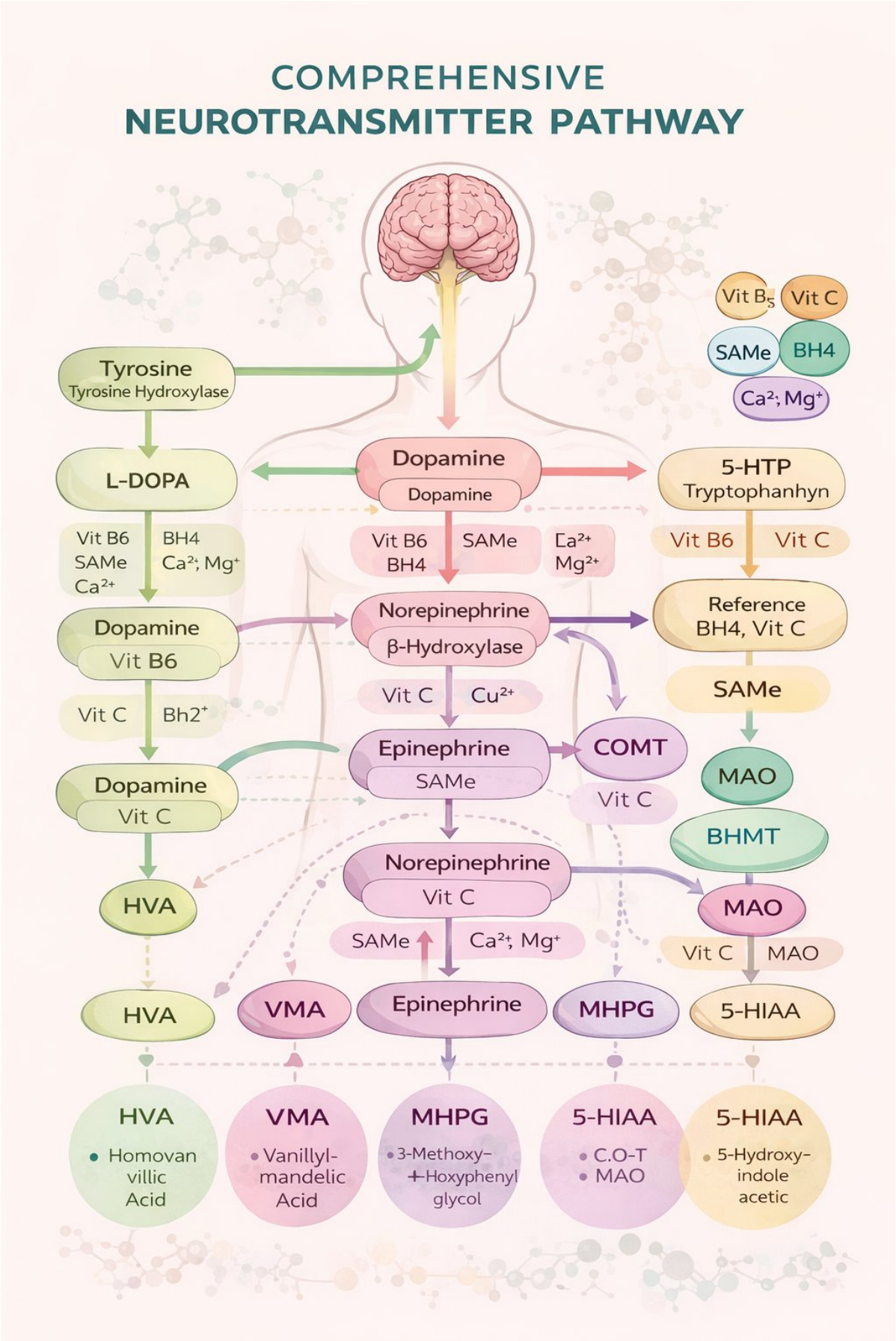
ULN	Upper Limit of Normal
LLN	Lower Limit of Normal
× ULN / × LLN	Fold above / below the reference limit
mmol/mol creat.	Creatinine-corrected concentration
N/AP	Not applicable / ratio not calculable
N/AV	Not available / not detected
LC-MS/MS	Liquid chromatography–tandem mass spectrometry

PATHWAY REFERENCE — MITOCHONDRIAL HEALTH & ENERGY PRODUCTION



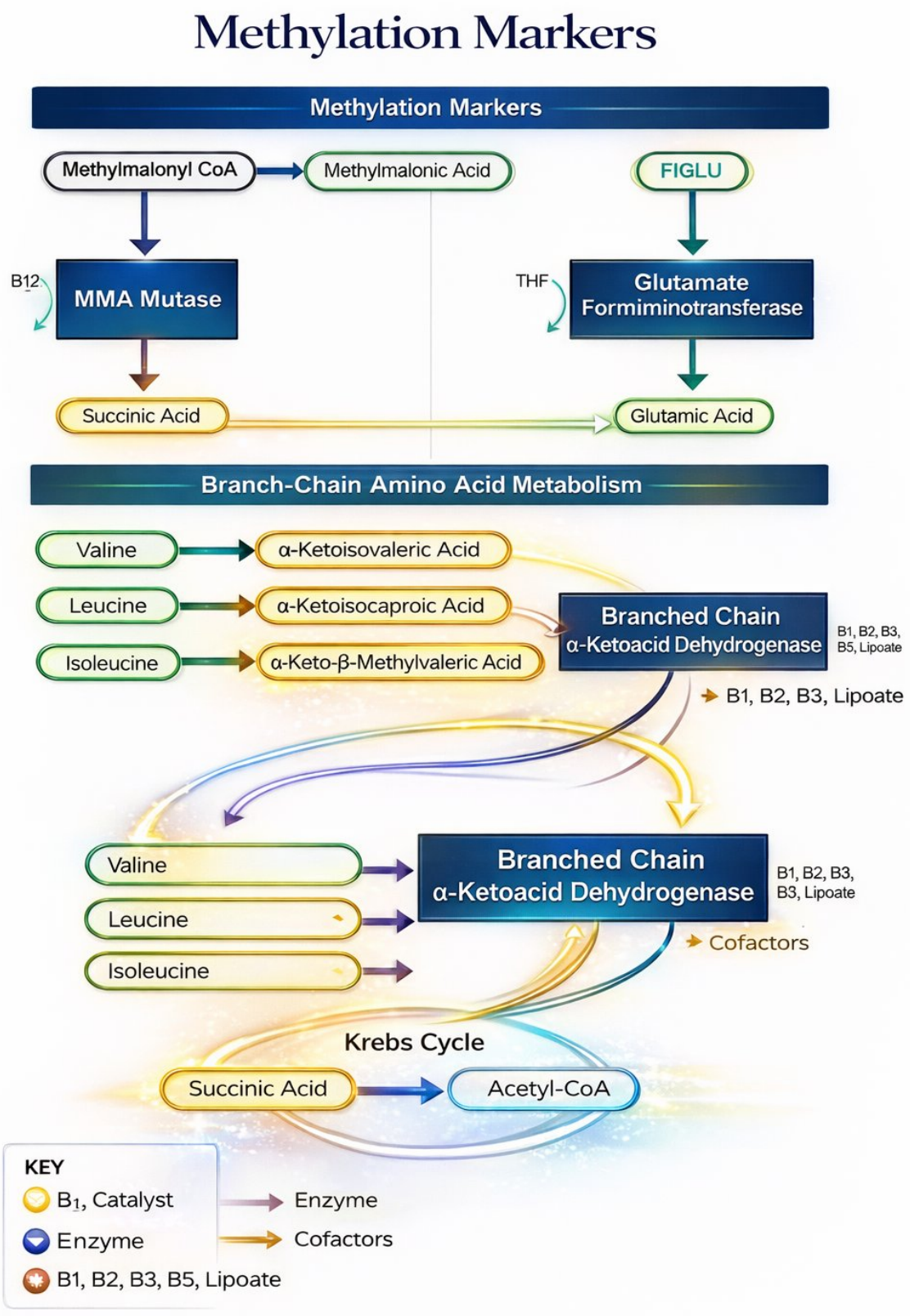
Citric acid cycle, beta-oxidation, electron transport chain, and key cofactor dependencies.

PATHWAY REFERENCE — COMPREHENSIVE NEUROTRANSMITTER PATHWAY



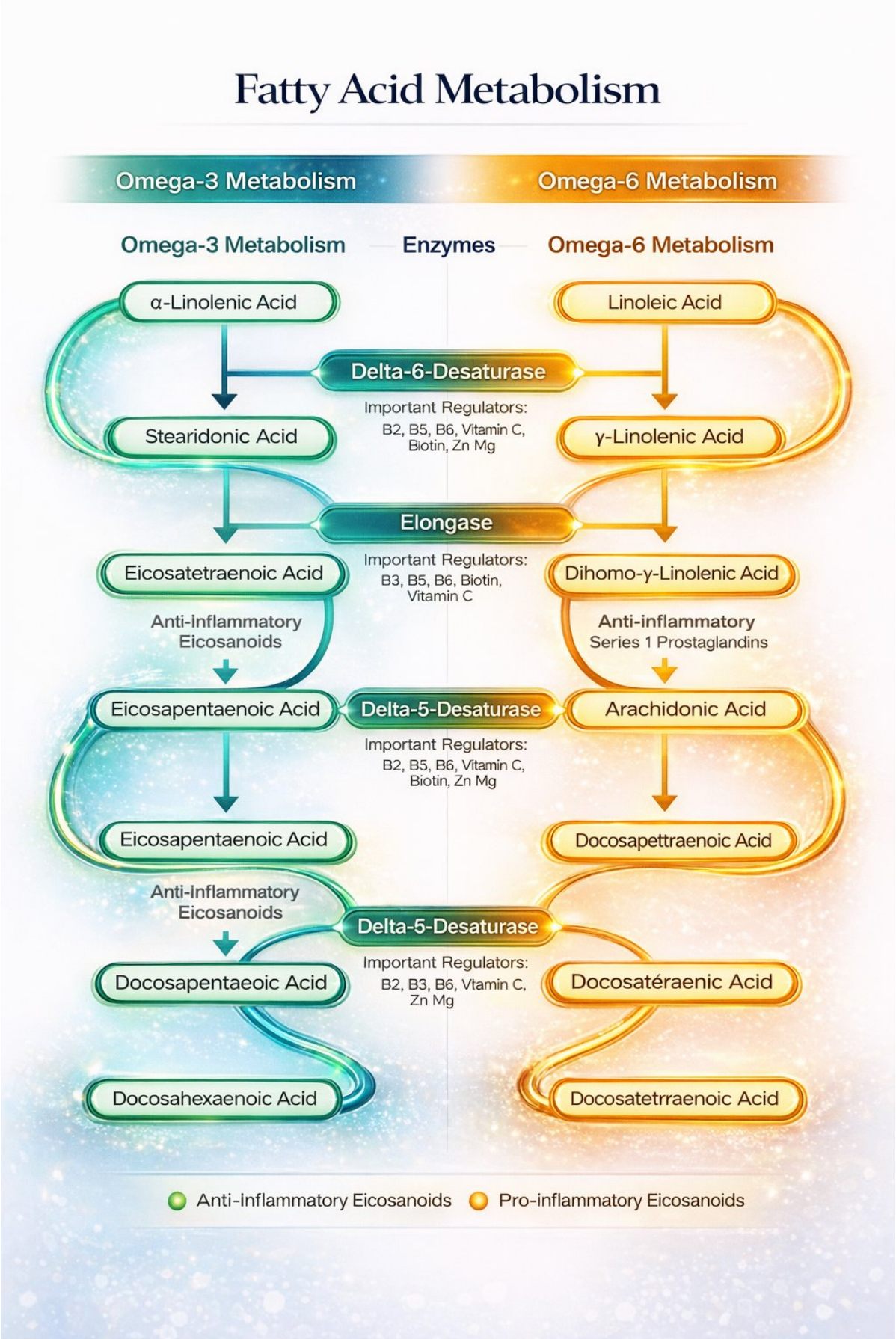
Dopamine, serotonin, and catecholamine synthesis routes with cofactor requirements.

PATHWAY REFERENCE — METHYLATION MARKERS & BRANCHED-CHAIN AMINO ACID METABOLISM



FIGLU / folate cycle, MMA / B12 pathway, and BCAA catabolism via BCKD complex.

PATHWAY REFERENCE — FATTY ACID METABOLISM



Omega-3 and Omega-6 desaturation and elongation pathways with enzyme regulators.

ABBREVIATIONS & GLOSSARY

Analytical & Laboratory			
LC-MS/MS	Liquid Chromatography–Tandem Mass Spectrometry — analytical method used for quantitative metabolite measurement	**ISO 15189**	International standard for quality and competence in medical laboratories
NABL	National Accreditation Board for Testing and Calibration Laboratories (India)	**mmol/mol creat.**	Millimoles per mole of creatinine — creatinine-corrected urine concentration unit
N/AP	Not Applicable — result or ratio not calculable for this sample	**N/AV**	Not Available — marker not detected or below quantification limit
Biomarkers & Metabolites			
5-HIAA	5-Hydroxyindole-3-acetic acid — principal urinary serotonin metabolite	**5-MTHF**	5-Methyltetrahydrofolate — active, methylated form of dietary folate
8-OHdG	8-Hydroxydeoxyguanosine — oxidative DNA damage marker	**AKBM**	3-Methyl-2-oxovaleric acid — isoleucine catabolism intermediate; BCKD complex marker
AKIC	α-Ketoisocaproic acid — leucine catabolism intermediate; BCKD complex marker	**BPA**	Bisphenol A — endocrine-disrupting plasticiser compound
BPB	Bisphenol B — endocrine-disrupting plasticiser compound	**DHPPA**	3-(3-Hydroxyphenyl)-3-hydroxypropionic acid — marker of dysbiotic polyphenol-metabolising bacteria
DOPAC	Dihydroxyphenylacetic acid — intermediate dopamine metabolite	**FIGLU**	Formiminoglutamic acid — histidine catabolite; elevated when folate cycle is functionally impaired
GSH	Glutathione (reduced form) — principal intracellular antioxidant tripeptide	**GSSG**	Glutathione disulfide (oxidised form) — produced during oxidative stress; recycled to GSH by glutathione reductase
HPHPA	3-Hydroxyphenylhydracrylic acid — Clostridium sporogenes / botulinum bacterial marker	**HVA**	Homovanillic acid — principal urinary dopamine metabolite
MMA	Methylmalonic acid — functional marker of vitamin B12 status	**TMAO**	Trimethylamine N-oxide — gut-derived metabolite of choline and carnitine; cardiometabolic marker
VMA	Vanilmandelic acid — urinary metabolite of norepinephrine and epinephrine	**α-KG**	α-Ketoglutaric acid — Krebs cycle intermediate; also called 2-oxoglutaric acid
Enzymes & Pathways			
AADC	Aromatic Amino Acid Decarboxylase — P5P-dependent enzyme converting 5-HTP→serotonin and L-DOPA→dopamine	**BCKD**	Branched-Chain α-Ketoacid Dehydrogenase — multienzyme complex requiring B1, B2, B3, lipoate cofactors
CoA	Coenzyme A — central metabolic cofactor for acetyl group transfer; synthesised from pantothenic acid (B5)	**CoQ10**	Coenzyme Q10 (Ubiquinol) — lipid-soluble electron carrier in mitochondrial respiratory chain
FTCD	Formiminotransferase-Cyclodeaminase — folate-dependent enzyme catalysing histidine catabolism; elevated FIGLU indicates reduced FTCD activity	**SCAD**	Short-Chain Acyl-CoA Dehydrogenase — mitochondrial enzyme for short-chain fatty acid β-oxidation
SHMT	Serine Hydroxymethyltransferase — transfers one-carbon units from serine to the folate cycle		
Nutrients & Cofactors			
B1	Thiamine — cofactor for pyruvate dehydrogenase, α-KG dehydrogenase, and BCKD complex	**B2**	Riboflavin — cofactor for flavoenzymes including succinate dehydrogenase and BCKD; measured indirectly via glutaric acid
B3	Niacin (Nicotinamide) — precursor to NAD■; essential for redox metabolism	**B5**	Pantothenic acid — precursor to CoA; measured directly in urine as pantothenic acid
B6 / P5P	Pyridoxine / Pyridoxal-5-Phosphate — active B6 cofactor for AADC, transaminases, and transsulfuration; measured as pyridoxic acid	**B12**	Cobalamin — cofactor for MMA mutase; functional status measured via MMA

Folate	Vitamin B9 — functional status assessed via FIGLU elevation and MMA/FIGLU ratio	**NAC**	N-Acetylcysteine — cysteine precursor; supports glutathione synthesis via transsulfuration
NAD■	Nicotinamide Adenine Dinucleotide — essential redox cofactor for Krebs cycle dehydrogenases, Complex I, PARP, and sirtuins	**SAM**	S-Adenosylmethionine — universal methyl donor; synthesised from methionine and ATP
Reference Ranges & Report Terms			
LLN	Lower Limit of Normal — the lower boundary of the reference range; values below = Low (▼)	**ULN**	Upper Limit of Normal — the upper boundary of the reference range; values above = High (▲)
× ULN	Fold above the Upper Limit of Normal (e.g. 2.3× ULN = 2.3 times the upper limit)	**× LLN**	Fold below the Lower Limit of Normal (e.g. 0.16× LLN = 16% of the lower limit)
BCAA	Branched-Chain Amino Acids — leucine, isoleucine, valine	**NMDA**	N-Methyl-D-Aspartate — glutamate receptor subtype; kynurenic acid is an endogenous NMDA antagonist
O-PEA	O-Phosphorylethanolamine — precursor to membrane phospholipids; low levels suggest impaired phospholipid synthesis	**PHI**	Protected Health Information — individually identifiable health data governed by applicable privacy regulations
SAMe	S-Adenosylmethionine (abbreviated SAMe in clinical context) — see SAM		

Disclaimer

This report is intended for informational and supportive clinical use only. It must be interpreted by a qualified healthcare professional in conjunction with the patient's complete clinical history, presenting symptoms, medications, dietary status, and other relevant laboratory investigations.

The findings presented are suggestive and indicative of metabolic patterns and should not be considered as standalone diagnostic evidence for any specific inborn error of metabolism, infection, microbial colonisation, or nutrient deficiency without appropriate clinical correlation and confirmatory testing.

Any recommendations, including nutritional or biochemical considerations, are provided as general guidance or starting points and must be validated and tailored by the treating physician based on the patient's clinical condition.

Report Authentication

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