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Organic Acid Testing with DUTCH

Organic Acid Testing with DUTCH:

Putting the puzzle pieces together

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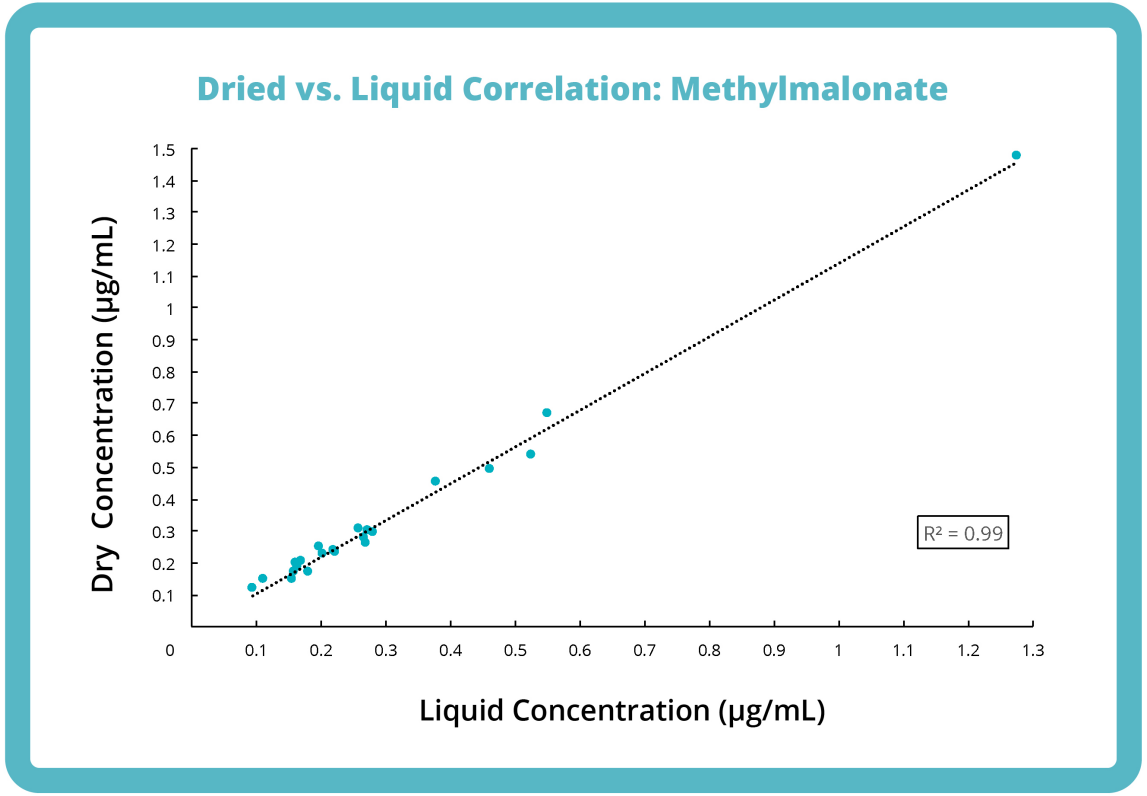
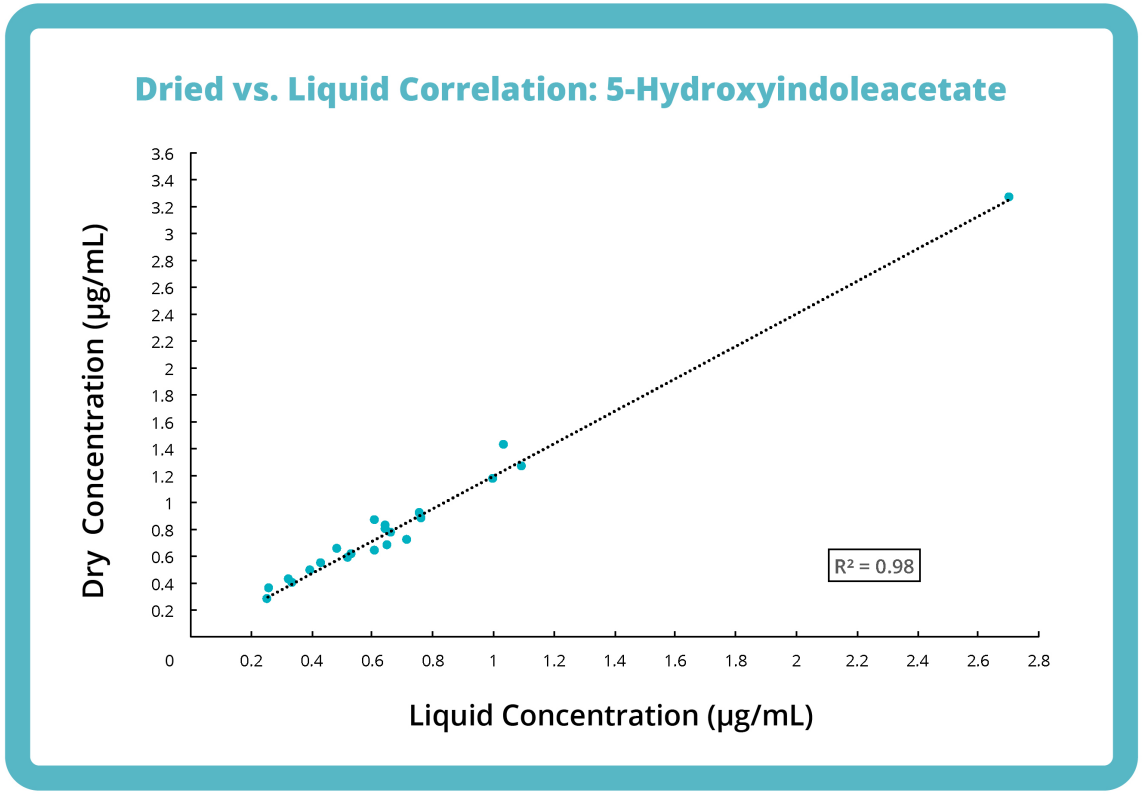
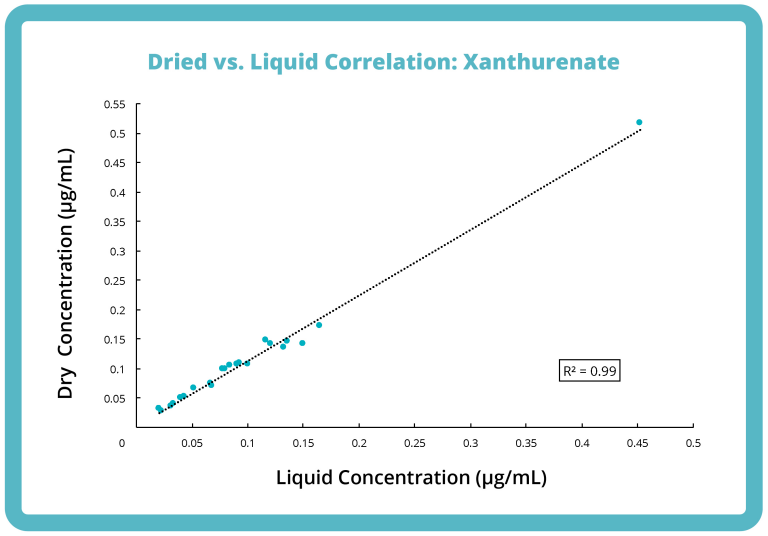
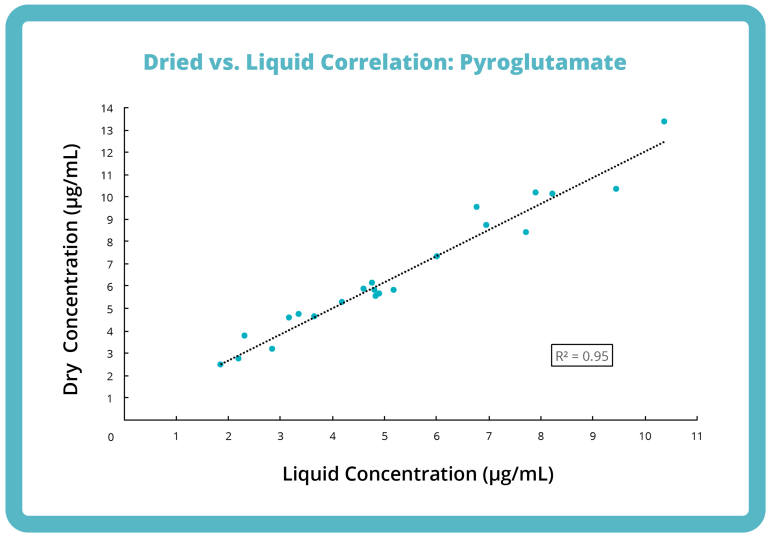
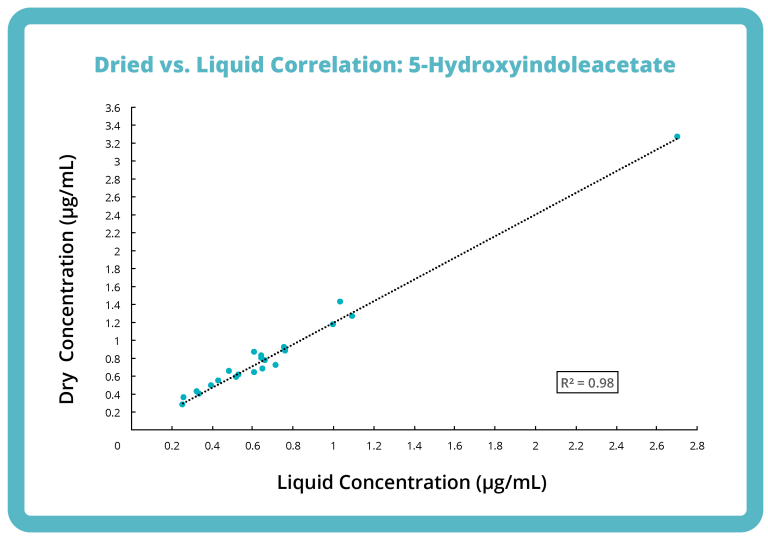
Organic Acid Test (OAT): Validation Data











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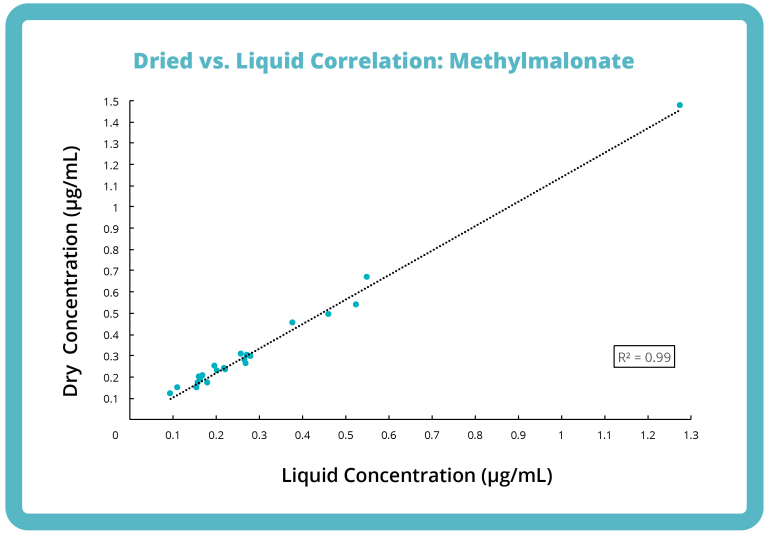

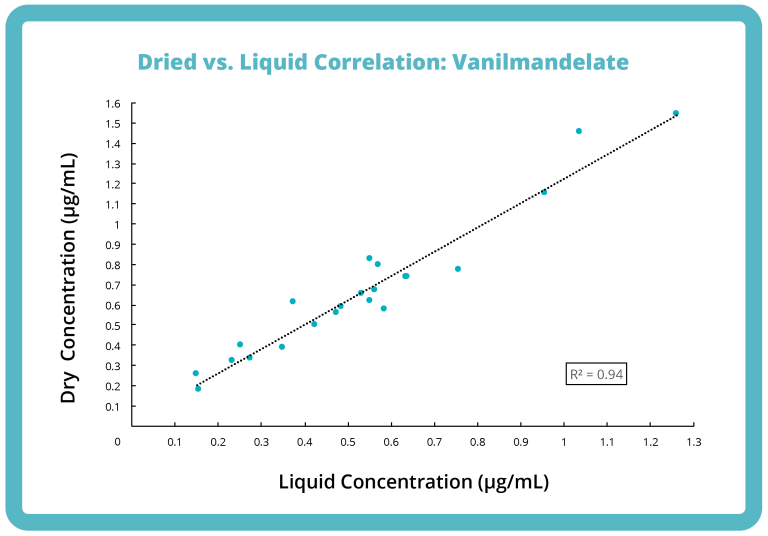

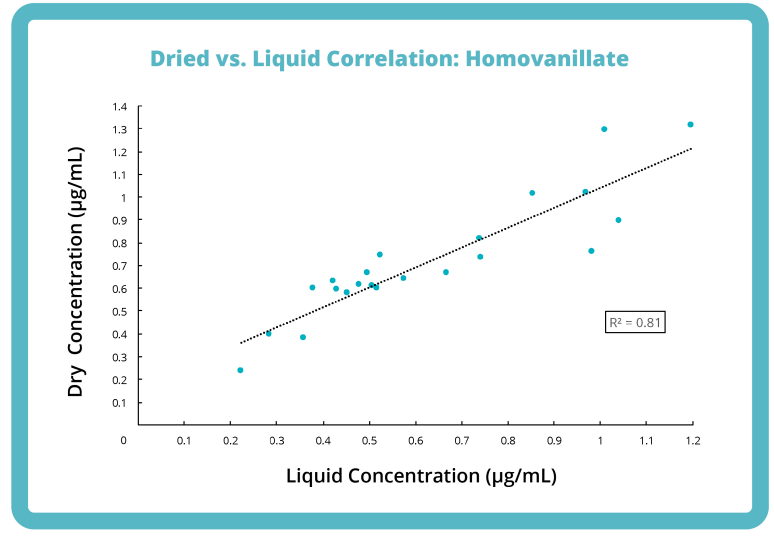

Organic Acid Test (OAT): Validation Data

- Dried values correlate to liquid
- Samples are stable at R.T. for weeks
- Precise and accurate
- LC-MS/MS analysis

Medical Disclaimer:

The medical information in this lecture is provided as an information resource only, and is not to be used or relied on for any diagnostic or treatment purposes. This lecture contains general information about medical conditions and treatments. The information is not advice, and should not be treated as such. This information is not intended to be patient education, does not create any patient-physician relationship, and should not be used as a substitute for professional diagnosis and treatment.

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Objectives

- What OATs are being tested
- What each OAT means
- Considerations for treatment
- Understand the relationship to the DUTCH hormone result
- Learn OAT patterns to watch out for
- Clinical case example

What are my testing options?

- **DUTCH test**
  - Collection by urinating on 4-5 strips of filter paper throughout the day (Saliva swabs for the CAR)
  - Reports the diurnal cortisol pattern (or CAR)
  - Reports free cortisol and free cortisone levels
  - Reports metabolized cortisol (about 80% of cortisol production)
  - Reports androgens and androgen pathways
  - Evaluates 3 estrogens and estrogen metabolism
  - Tests 8OHdG, Melatonin and OATs
- **Serum**
  - Requires a blood draw
  - Tests Estradiol, Progesterone, Testosterone, DHEA-S or DHEA
  - ~~No cortisol diurnal pattern or CAR~~
  - ~~Results are a combination of bound and unbound cortisol in one lump sum~~
  - ~~No androgen pathways or estrogen metabolism~~
  - ~~Does not test 8OHdG, melatonin or OATs~~
- **24-hour urine**
  - Requires collection of urine in one jug for 24 hours
  - Reports Estrogen, Testosterone, DHEA and Progesterone
  - ~~No diurnal pattern or CAR~~
  - Does metabolized cortisol
  - Does report free cortisol
  - Reports androgen pathways
  - Evaluates estrogen metabolism
  - Some labs test 8OHdG, melatonin or OATs (separate tests)
- **Saliva**
  - Collection by spitting in a tube 4 times throughout the day
  - Reports Estrogen, Progesterone, Testosterone and DHEA-S
  - Reports the cortisol diurnal pattern
  - Tests free cortisol only
  - Some companies evaluate OATs as a separate test
  - ~~Does not test metabolized cortisol – no good look at cortisol production~~
  - ~~Does not do androgen pathways~~
  - ~~Does not evaluate estrogen metabolism~~
  - ~~Does not test 8OHdG or melatonin or OATs~~

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With DUTCH you get it all:

1. Androgen Metabolism
2. Estrogen Metabolism
3. Progesterone Metabolites
4. Metabolized Cortisol/Cortisone
5. Free Cortisol/Cortisone
6. The Diurnal Pattern (Can include the CAR)
7. DUTCH Extras: includes OATs, Melatonin and 8-OHdG

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DUTCH Complete Test Collection

The Flagship dried urine only test

4 urine samples done throughout the day and dried

1. First thing on waking
2. 2 hours later
3. Around dinner
4. Before bed

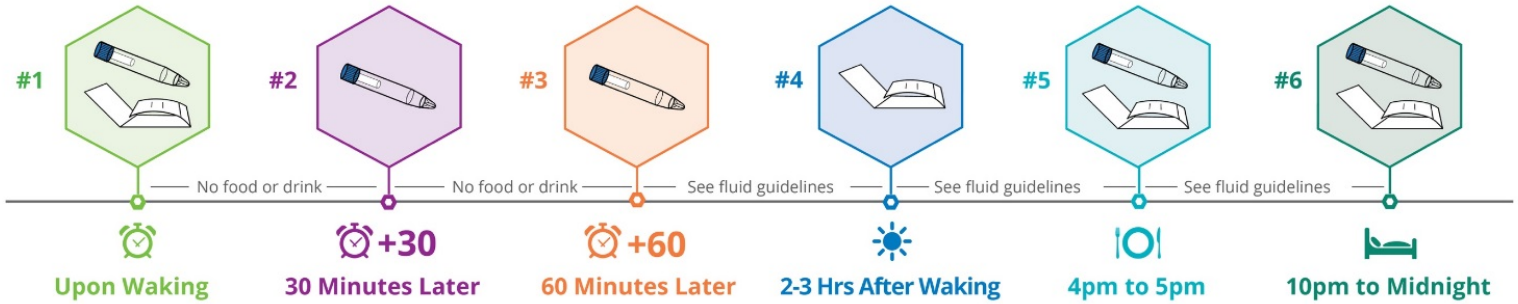
- Optional 5th strip if wake and urinate in the middle of the night

dutchplus
COMPLETE WITH CORTISOL AWAKENING RESPONSE

5 Saliva collections

- Waking, +30 min, +60 min, 5pm, Bedtime
- Easier collections using cotton swabs

4 Dried urine collections



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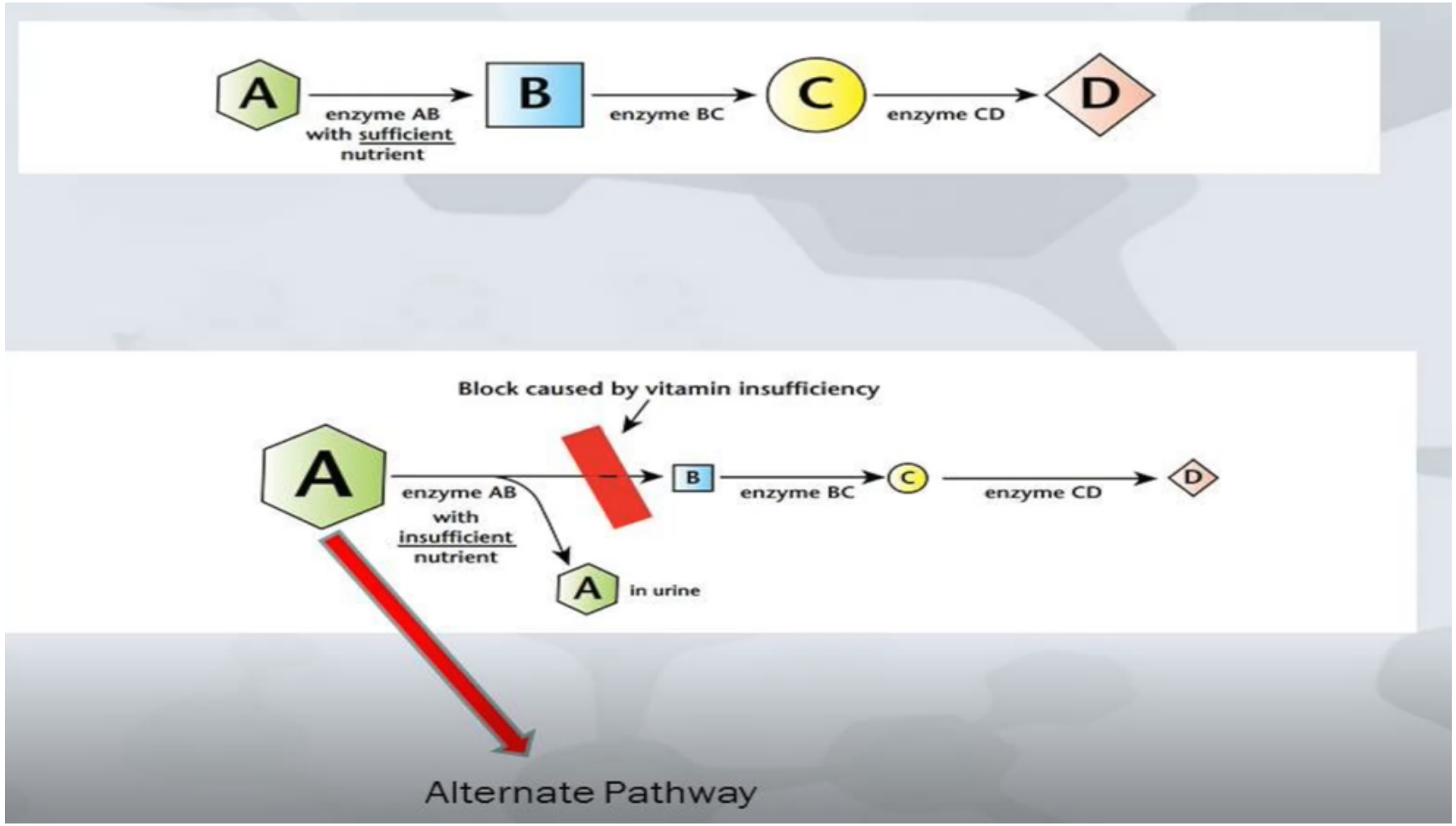
What are the DUTCH Extras?

What is an Organic Acid?



Dr. Eric Balcavage/Organic Acid Class: www.themethylationdoctor.com

DUTCH Extras					
Category	**Test**		**Result**	**Units**	**Normal Range**
Melatonin (*measured as 6-OH-Melatonin-Sulfate) - (Urine)					
	Melatonin* (Waking)	Low end of range	11.1	ng/mg	10 - 85
Oxidative Stress / DNA Damage, measured as 8-Hydroxy-2-deoxyguanosine (8-OHdG) - (Urine)					
	8-OHdG (Waking)	Within range	2.8	ng/mg	0 - 5.2
Nutritional Organic Acids					
Vitamin B12 Marker (may be deficient if high) - (Urine)					
	Methylmalonate (MMA)	Within range	1.2	ug/mg	0 - 2.8
Vitamin B6 Marker (may be deficient if high) - (Urine)					
	Xanthurenate	Within range	0.4	ug/mg	0 - 1.6
Glutathione Marker (may be deficient if low or high) - (Urine)					
	Pyroglutamate	Within range	62.2	ug/mg	37 - 70
Neurotransmitter Metabolites					
Dopamine Metabolite - (Urine)					
	Homovanillate (HVA)	Above range	15.6	ug/mg	4.5 - 13
Norepinephrine/Epinephrine Metabolite - (Urine)					
	Vanilmandelate (VMA)	Below range	0.5	ug/mg	2.7 - 6.4
Serotonin Metabolite - (Urine)					
	5-Hydroxyindoleacetate (5HIAA)	Below range	1.7	ug/mg	3 - 7.5

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The Basics:

Where do you start?

DUTCH Extras Summary

- **Melatonin (6-OH-MS)** – powerful anti-oxidant made in the pineal gland and gut
- **8-OHdG** = oxidative stress and marker of DNA damage

Nutritional Organic Acids:

- **Methylmalonate (MMA)** = if elevated, it reflects insufficient Vitamin B12
- **Xanthurenate** = if elevated, it reflects insufficient Vitamin B6
- **Pyroglutamate** = if decreased or elevated, it reflects insufficient Glutathione

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DUTCH Extras

Neurotransmitter Metabolites:

- **Homovanillate (HVA) =** Dopamine Metabolite, can also reflect genetic mutations and nutritional, neurotransmitter and adrenal problems

- **Vanilmandelate (VMA) =** Norepinephrine/Epinephrine Metabolite, can also reflect genetic mutations and nutrition, neurotransmitter and adrenal problems

- **5-Hydroxyindoleacetate (5-HIAA) =** Serotonin Metabolite, can also reflect nutritional, neurotransmitter, estrogen, inflammation, and adrenal problems.

HVA, VMA and 5-HIAA are particularly sensitive to certain foods, anti-depressant medication and amino acid supplements.

Please read the instructions carefully upon collection of the test.

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More Advanced:

Diving deeper down the rabbit hole

Before we get started…

Pay attention to words that are in italics and underlined,

They are associated DUTCH markers that can give you additional insight.

Methylmalonate (MMA)
Increased = Low Vitamin B12

Not eating it, not absorbing it in stomach/small intestines, not getting into cells, genetics

Common sx if low B12:

Fatigue, poor memory, brain fog, unsteady gait, numbness, tingling, and depression

Medications that interfere with or decrease B12:

H2 Blockers and PPIs for acid

Metformin/Glucophage

Birth Control Pills

Hydrocortisone and Ciprofloxacin

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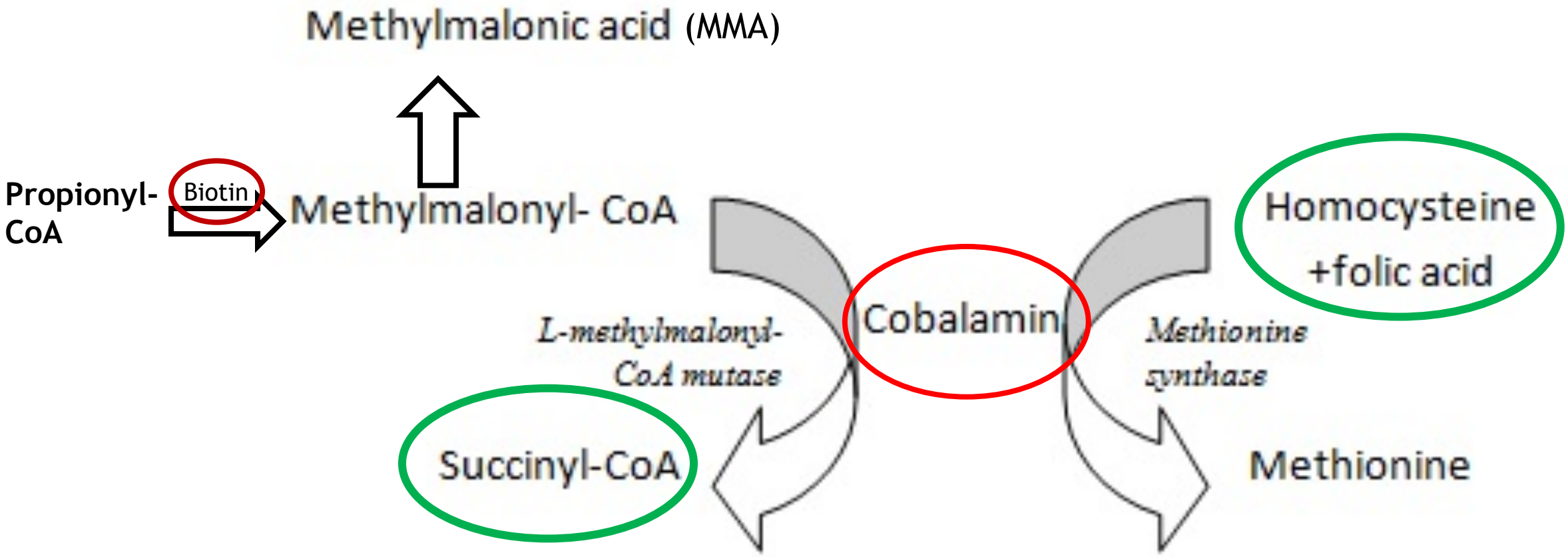
Methylmalonate



When serum B12 is “normal” but cellular levels are low (in this case due to a genetic defect in the transport protein), MMA still increases.

Table 1. Characteristics of study sample by transcobalamin II genotype

	Transcobalamin II genotype		
	PP	PR	RR
N	39	63	26
Methylmalonic acid (nM)	208 (± 96)	206 (± 80)	264 (± 138)‡

We conclude that the TCII 775G>C genotype significantly influences tissue B12 delivery and functional B12 status.

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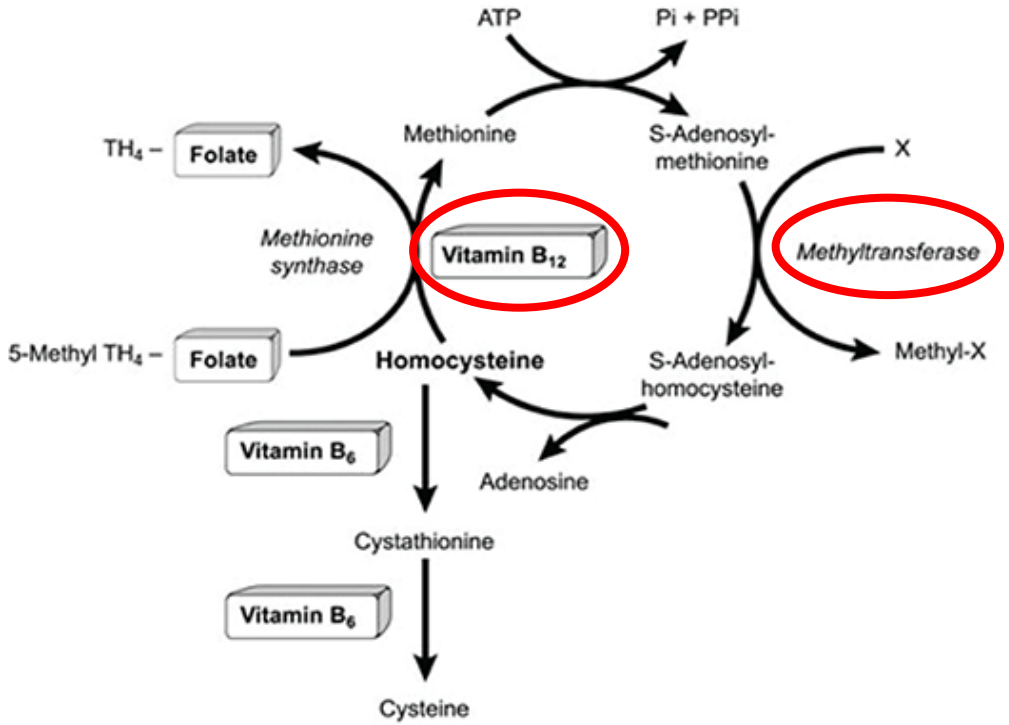
Methylmalonate (MMA)
How does it relate to the DUTCH Test?

1. It's needed as part of the methionine cycle for methylation of Estrogen/COMT with SAM
2. COMT also is responsible for Dopamine → HVA
3. Norepi → Epi uses PNMT
4. Norepi and Epi both use COMT to → VMA

Pseudo DUTCH Related:

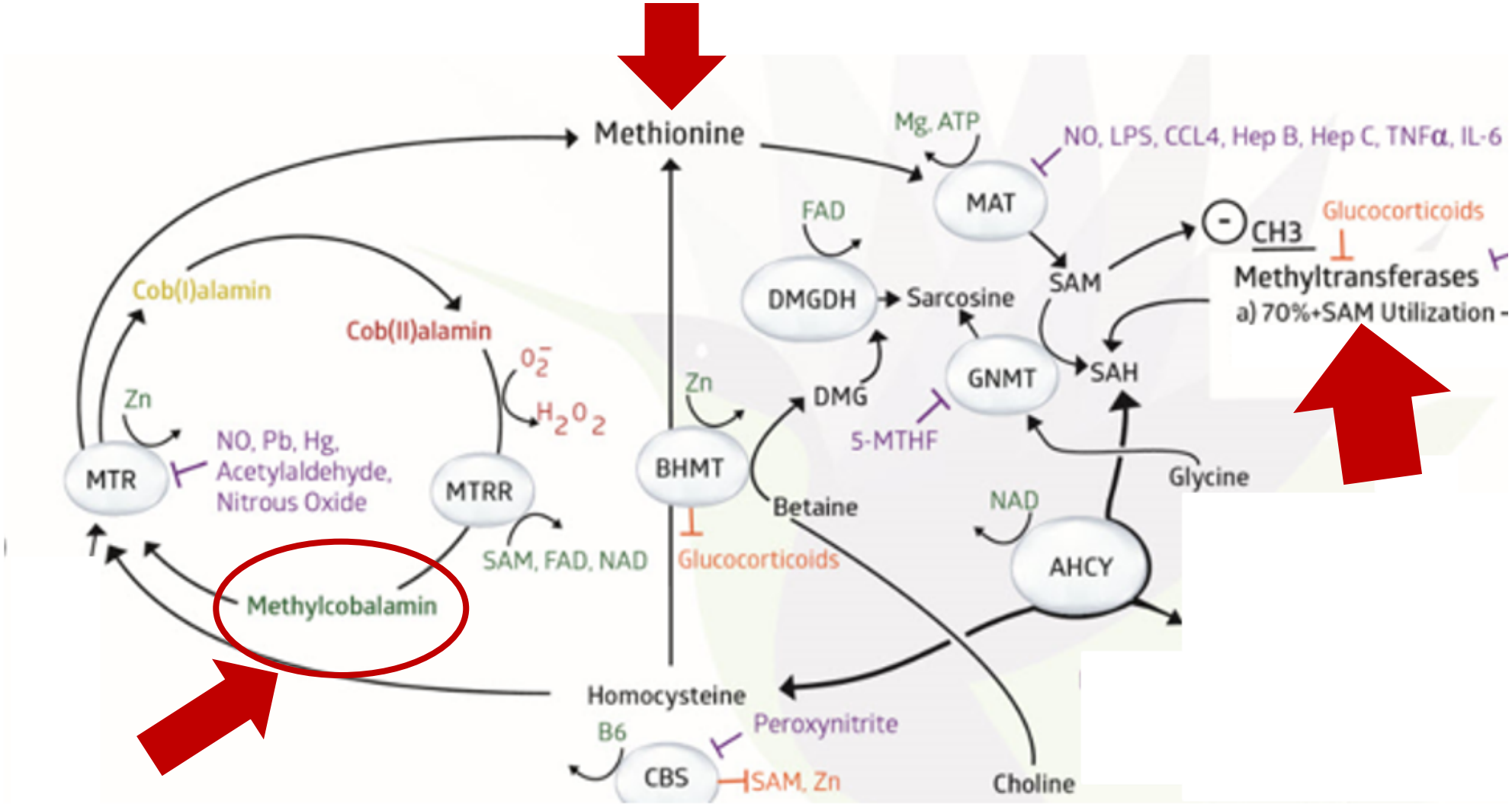
1. Needed to break down protein and fats to amino acids and fatty acids
2. Needed to create Succinyl CoA for the Krebs Cycle (NADH, FADH, ATP)
3. Needed to make methionine which makes SAM which methylates myelin sheath phospholipids

Figure 1. Vitamin B_{12} and Homocysteine Metabolism



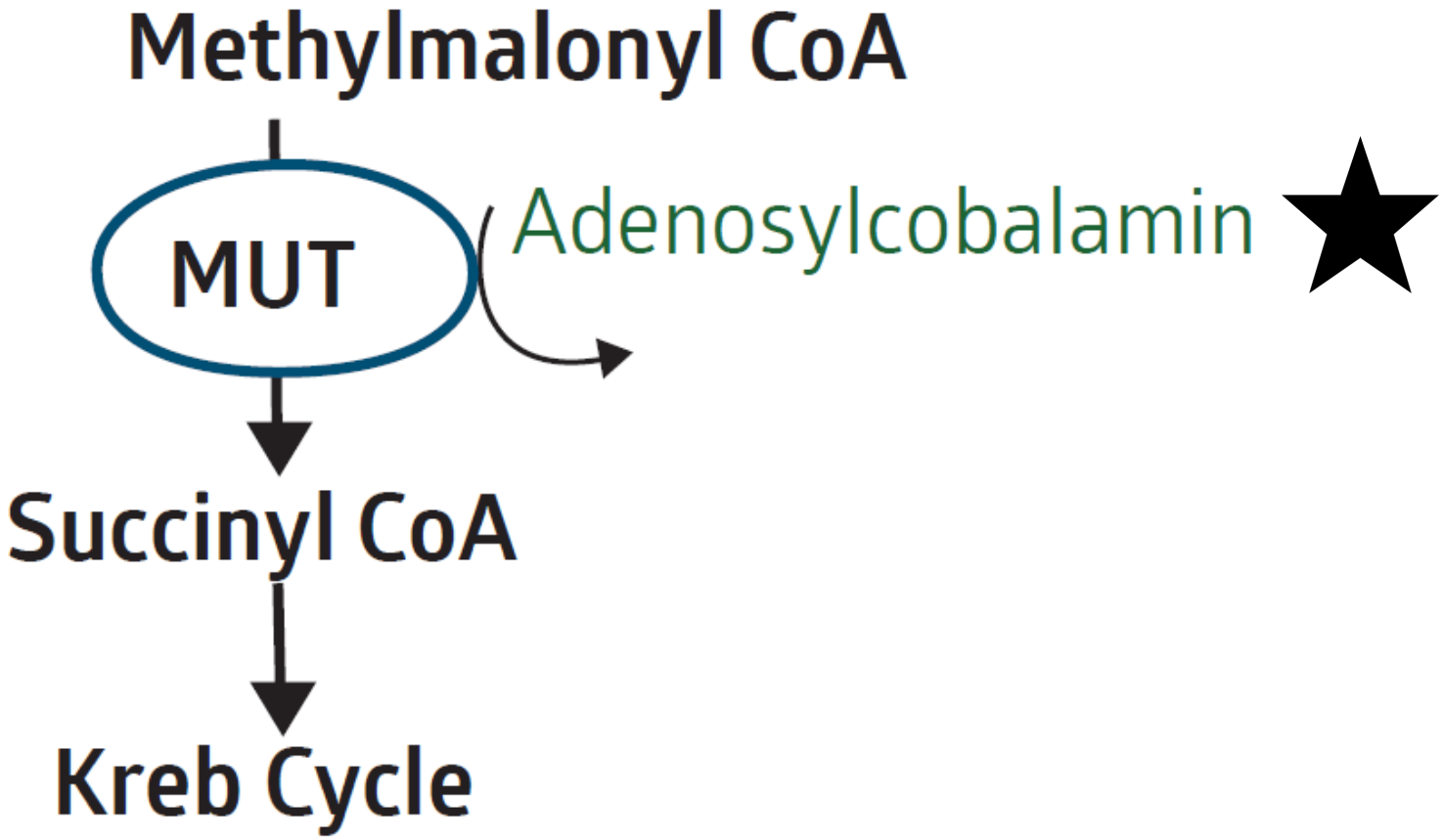
Methionine synthase is a vitamin B_{12}-dependent enzyme that catalyzes the formation of methionine from homocysteine using 5-methyltetrahydrofolate (5-methyl TH_4), a folate derivative, as a methyl donor. Another pathway catalyzed by betaine homocysteine methyltransferase also remethylates homocysteine to methionine using betaine as a methyl donor (not shown here). Methionine, in the form of S-adenosylmethionine, is required for most biological methylation reactions, including DNA methylation.

Photo: Linus Pauling Institute, Oregon State University



With permission: Dr. Ben Lynch/StrateGene: www.drbenlynch.com

Adenosylcobalamin or Methylcobalamin?



With permission: Dr. Ben Lynch/StrateGene: www.drbenlynch.com

Methylmalonate (MMA) Treatment Considerations:

1. Increase B12 foods (liver, sardines, lamb, wild caught-salmon, grass-fee beef, eggs…etc)
2. B12 supplementation
   - Methylcobalamin, Adenosylcobalamin, Hydroxycobalamin, Cyanocobalamin
3. Improve HCL levels in the stomach (to release B12 bound to proteins in food)
4. Consider H.Pylori/SIBO/GUT testing
5. Consider serum Intrinsic Factor or Parietal Cell Antibody testing
6. Consider Biotin testing (actually causes blunted MMA but B12 symptoms)
7. Mutations issues: MMMA, MMAB, MTRR, MTR, TCN-1, GIF (TCN-3) and MUT
   1. If they have MUT → they may need Adenosylcobalamin especially if unresponsive to Methyl B12 (see prior slide)

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Xanthurenate
Increased = Low Vitamin B6

Not eating it, not absorbing it in small intestines, not getting activated to P5P/PLP in liver, low cofactors that help with activation/tissue uptake/circulation, conditions affected (pyroluria)

Common sx if low B6:

It's involved in over 100 enzymatic reactions

Atrophic glossitis, angular cheilitis, impaired glucose intolerance/insulin problems, intertrigo, fatigue, neuropathy, mental confusion, depression

Medications that interfere with or decrease B6:

Birth Control Pills

Anti-convulsant medications

Hydrocortisone and Ciprofloxacin

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Xanthurenate

How does it relate to the DUTCH Test?

1. P5P is needed for the methylation of estrogen
2. P5P is used in the creation of neurotransmitters (HVA, VMA, 5-HIAA)
3. P5P used in the transsulfuration pathway to make cysteine and glutathione (Pyroglutamate)
4. Can complex with iron to increase 8-OHdG (this is bad)
5. Higher Xanthurenate = higher risk for diabetes (blood sugar/insulin affect hormones!)
   - Gluconeogenesis needs amino acids via transamination that is B6 dependent
   - Glycogen phosphorylase enzyme to start glycogenolysis is B6 dependent
   - Complexes with insulin so insulin is less effective/available to deal with glucose

Pseduo-DUTCH Related:

1. Excess estrogen, inflammation, cortisol and LPS from gram negative bacteria push the Kynurenine pathway away from serotonin. If there is not enough Vitamin B6 on this pathway, Xanthurenate forms
2. The Kynurenine pathway makes NAD
3. P5P helps enzymes get selenium from dietary form (selenomethionine) – thyroid issues

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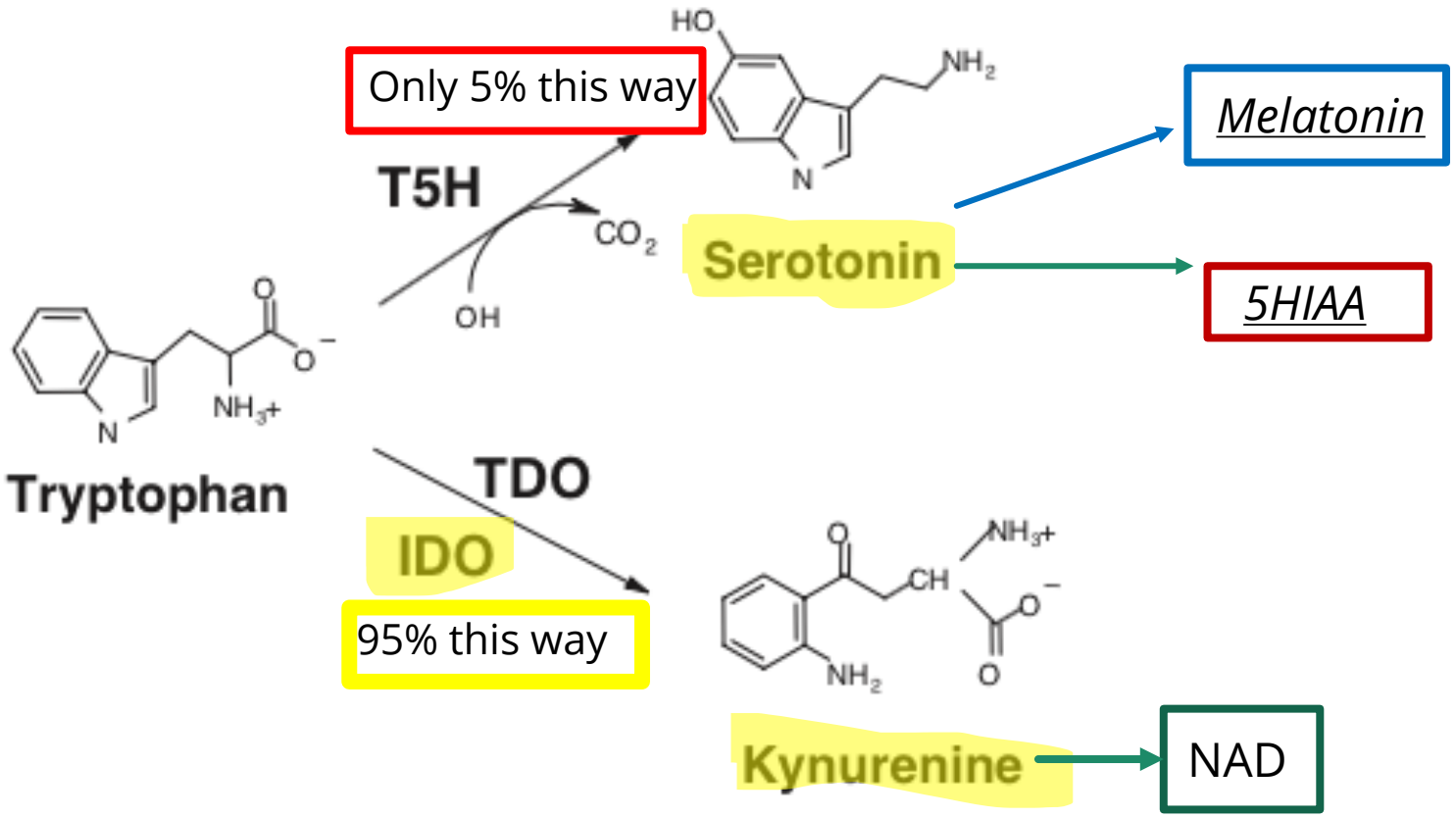
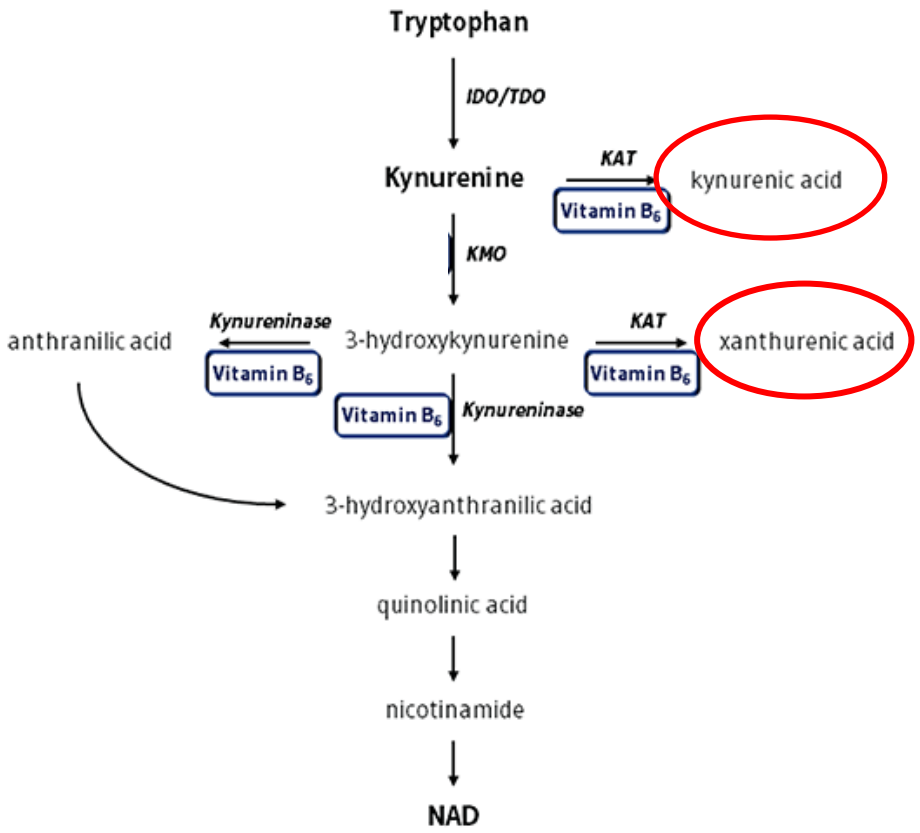
Tryptophan can choose 2 pathways



Excess estrogen, cortisol, inflammation and LPS push →

Figure 2. Overview of the Tryptophan-Kynurenine Metabolic Pathway



Pyridoxal 5'-phosphate, a vitamin B_6 coenzyme, is required for the activity of several key enzymes in tryptophan catabolic pathway: KAT, KMO, and kynureninase. Dietary restriction of vitamin B_6 most prominently affects kynureninase activity and results in the shift from 3-hydroxykynurenine metabolism and NAD formation to the production of kynurenic acid and xanthurenic acid. *IDO, indoleamine 2,3-dioxygenase; KAT, kynurenine aminotransferase; KMO, kynurenine 3-monooxygenase; NAD, nicotinamide adenine dinucleotide; TDO, tryptophan 2,3-dioxygenase.*

http://lpi.oregonstate.edu/mic/vitamins/vitamin-B6

Figure 1. Vitamin B_{12} and Homocysteine Metabolism

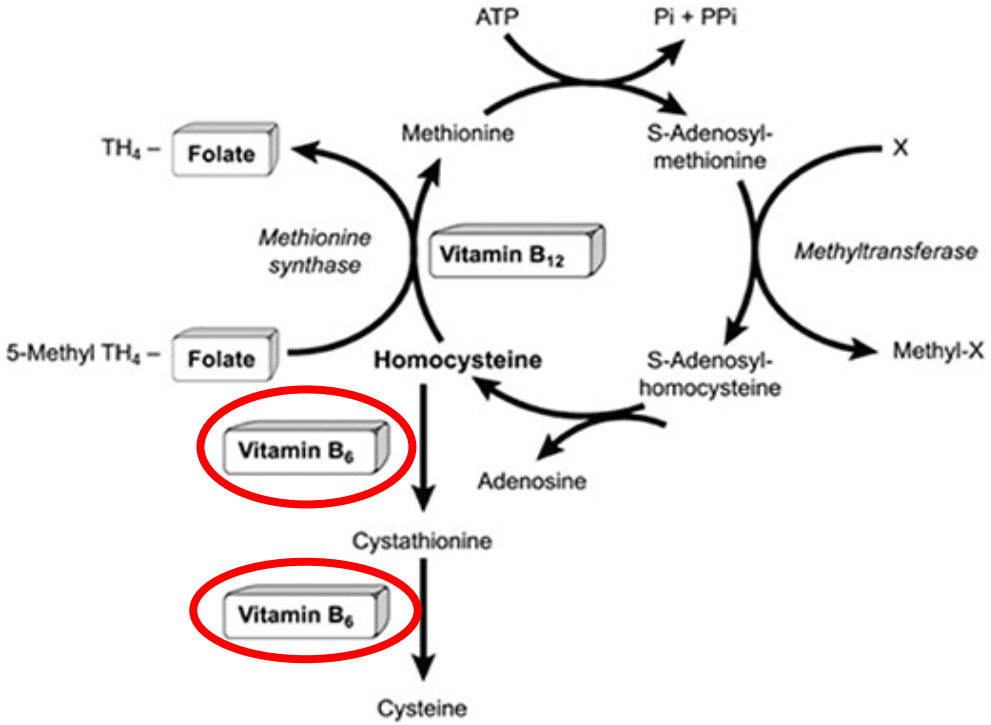


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Photo: Linus Pauling Institute, Oregon State University

Xanthurenate

Treatment Considerations:

1. Increase B6 Foods: Turkey breast, grass-fed beef, pork, pinto beans, avocado, pistachios, chicken, sesame seeds, sunflower seeds, chickpeas
2. Supplement with vitamin B6 (Pyridoxine) and/or P5P (PLP)
    - Be aware high doses Pyridoxine (sources vary, 200-1000mg) can damage the dorsal root ganglia causing worse neuropathy symptoms
3. Nutrient testing for co-factors: Riboflavin (B2), Zinc, ATP, and Lysine
    1. B2 helps activate it to P5P, Zinc and ATP help with absorption/tissue uptake/circulation and lysine sits in its active binding site to act as a Schiff base when it binds to catalyze reactions forward
4. Address the small intestines where it is absorbed (SIBO? Leaky gut?)
5. Address excess estrogen, inflammation, cortisol and LPS from gram negative bacteria
6. Test for Pyroluria (kryptopyrroles bind up B6 – check zinc status too)

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Pyroglutamate

Increased or decreased = Glutathione (GSH) problem

Either can't be made, recycled or it's being used up

Comes from cysteine, glutamate and glycine

Common sx if low Glutathione:

Powerful antioxidant in the body

Can have problems with detoxification, inflammation, infection, illness…etc.

Things that interfere with or decrease Glutathione:

Tylenol (Acetaminophen) and other pharmaceuticals

Environmental toxicants/solvents/chemicals/pesticides/herbicides/pollutants/cleaners,

Heavy metals, EMF, alcohol…etc.

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Pyroglutamate
How does it relate to the DUTCH Test?

1. Helps prevent 4-OH-E1 and 4-OH-E2 from going down the Quinone pathway and forming an adduct
2. Needs vitamin B6 (Xanthurenate) for transsulfuration pathway to make cysteine (Pyroglutamate)
3. Helps handle infection and inflammation
    - Hormones affected by infection and inflammation:
        1. 5a-DHT/5a-Reductase can increase
        2. Estrogen via aromatization
        3. 16-OH-E1 can increase
        4. 8-OHdG (oxidative stress and DNA damage marker) can increase
        5. Metabolized and/or free cortisol can increase
4. Glutathione helps recycle CoQ10, Vitamin E and Vitamin C = antioxidants and much more!

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Pyroglutamate
Treatment Considerations

1. Address any exposure, infection, inflammation, oxidative stress…etc
2. Glycine and sulfate
3. Supplement support:
   - Cysteine via NAC
   - Glutathione
4. Co-factor support:
   - FAD (B2), Selenium, ATP, Magnesium
5. Mutation issues: CBS, GCL, GSS, GST, GSR, GPX
6. Consider serum GGT testing as GGT starts the y-glutamyl cycle (GGC)
7. Ask about diet – need protein
8. Test methionine and homocysteine (high methionine/low homocysteine = likely not making cysteine)

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GGT →y-Glutamyl Amino Acid→Glutamic Acid

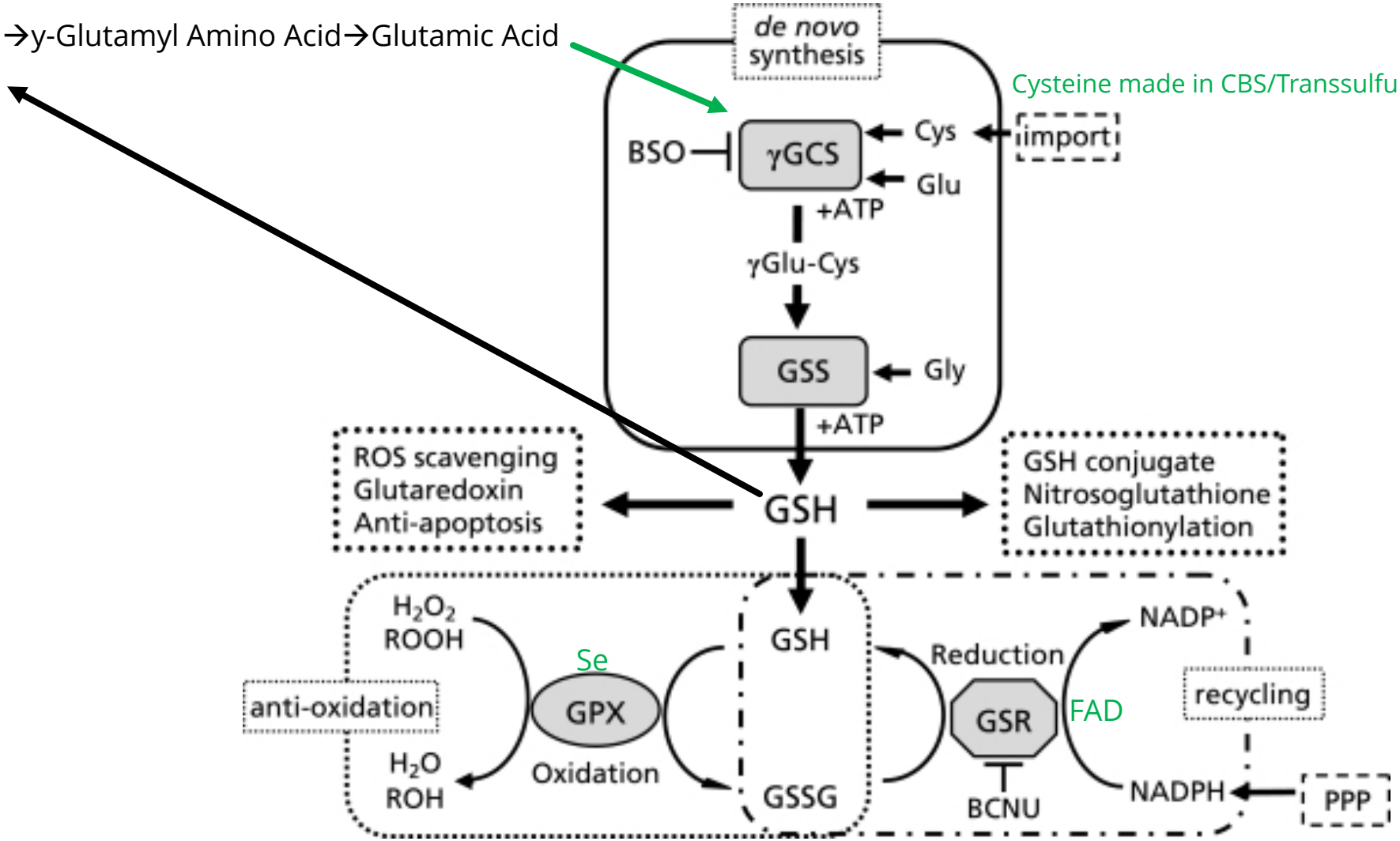

Photo: https://openi.nlm.nih.gov/detailedresult.php?img=PMC3171681_jcbn10-138SRf01&req=4
Additional info: Dr. Ben Lynch/Strategene www.drbenlynch.com

5-Hydroxyindoleacetate (5-HIAA)

Primary Serotonin Metabolite

- Approximately: 90% made in the gut (for gut motility and activates smooth muscle activity, can induce vomiting/diarrhea with food poisoning)
- 1% made in the brain
- The rest is made in peripheral tissue
- It's stored in platelets and mast cells
  - Released during injury and inflammation bc of its analgesic, clotting and vasoconstrictive effect

5-Hydroxyindoleacetate (5-HIAA)

Primary Serotonin Metabolite: Co-Factors

- TRYPTOPHAN needs BH4, iron and healthy estrogen levels to make 5HTP
- 5HTP needs Vitamin B6 to make serotonin (check Xanthurenate)
- SEROTONIN uses copper and vitamin B2 with MAO to break down to 5HIAA

- Tryptophan (BH4/Fe) —(ERb: Tryptophan Hydroxylase)→ 5HTP —(Vitamin B6)→ Serotonin —(Cu/B2/MAO)→ 5-HIAA

Serotonin —(Vit.B5/SAM, AANAT/ASMT)→ Melatonin

5-HIAA
↓Decreased Levels: Address the Cause

1. Excess estrogen, cortisol, inflammation and LPS from gram negative gut bacteria push away from serotonin to the Kynurenine pathway (so serotonin and melatonin go down)
2. But low estrogen (ie. menopause/amenorrhea) means Tryp. Hydroxylase can't make 5-HTP
3. Low Co-factors: BH4, Iron, B6, Copper and B2
4. MAO mutation
5. Low Tryptophan (ie. low protein diets)
6. Recent, even low levels, alcohol consumption (due to a competitive inhibition of aldehyde dehydrogenase by acetaldehyde, which inhibits 5–HIAA formation)
7. Low levels of platelets and/or mast cells

- IF on SSRI/SNRI and 5-HIAA is LOW, the med is not working, There are low levels of TRYPTOPHAN, it's not serotonin's fault. It may also be a serotonin receptor problem.

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5-HIAA
↑Increased Levels: Address the Cause

1. Ate high serotonin foods during testing: butternuts/black walnuts/pecans (and nut butters), plantains, banana, avocado, pineapple (and juice), eggplant, plums
2. On 5-HTP, Tryptophan, St. John's Wort, SAMe, SSRI/SNRI or Tricyclic Antidepressant medication
   - This is normal if levels are increased while taking these things
   - If you wanted baseline then you must stop these products (wean medications please!) for weeks.
3. Malabsorption/gut issues (celiac is the most studied) causing high serotonin/5-HIAA bc made in the gut
4. Stress
5. Metabolic Syndrome
6. Released from platelets due to injury/inflammation
7. Consider Mast cell issues (mixed in research)
8. Carcinoid tumor of enterochromaffin cells (very high levels)

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Homovanillate (HVA)
Primary Central Dopamine Metabolite

- Dopamine is made in the neurons in the brain and in small amounts in the adrenal medulla
  - There is no negative feedback loop

- In the brain, part of the reward center (rewards increase dopaminergic output), motivation, prolactin suppression, sexual gratification and motor control

Dopamine does not cross into or out of the blood brain barrier (L-dopa can).

- In periphery, it acts locally in specific tissues as a vasodilator to inhibit norepi, to increase urine and sodium output, reduce insulin output, reduce GI motility, and reduce lymphocyte activity.

Homovanillate (HVA)

Primary Central Dopamine Metabolite

1. Comes from TYROSINE with BH4(biopterin) and iron to make → DOPAMINE
2. DOPAMINE uses B6, B2, Magnesium and SAMe to make → HVA
3. DOPAMINE is broken down by MAO then COMT to → HVA
4. DOPAMINE can use copper, Vitamin C and DBH enzyme to make → NOREPI

Vanilmandelate (VMA)

Primary Norepinephrine/Epinephrine Metabolite

- Norepi/Epi are made in the brain and in the adrenal medulla
  - Stored in pre-synaptic vesicles to be released immediately on need
  - There is no negative feedback loop
  - Norepi and Epi can not cross into or out of the brain

- Primary action in the brain or the peripheral tissues is to prepare for fight/flight
  - Brain: alertness, attention, anxiety, vigilance, restlessness
  - Periphery: higher blood pressure and heart rate, increases glucose release (via glycogenolysis), diverts blood flow from GI tract to skeletal muscles…etc.

- It's lowest levels are in the night and highest levels in the morning UNLESS stimulated

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"Chronic stress, if continued for a long time, can damage many parts of the body.

A significant part of the damage is due to the effects of sustained norepinephrine release, because of norepinephrine's general function of directing resources away from maintenance, regeneration, and reproduction, and toward systems that are required for active movement.

The consequences can include sleeplessness, loss of libido, gastrointestinal problems, impaired disease resistance, slower rates of injury healing, depression, and increased vulnerability to addiction."

Chrousos, G. 2009. Stress and disorders of the stress system. DOI: 10.1038/nrendo.2009.106
https://en.wikipedia.org/wiki/Norepinephrine

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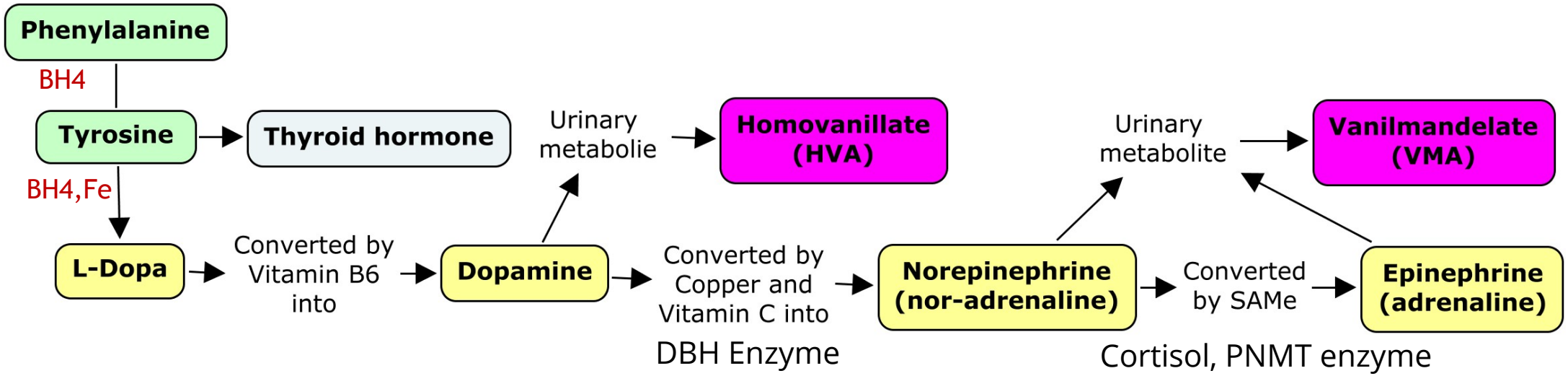

Photo: http://drsaulmarcus.com/mentalillness/Organicacidtestingmental.html

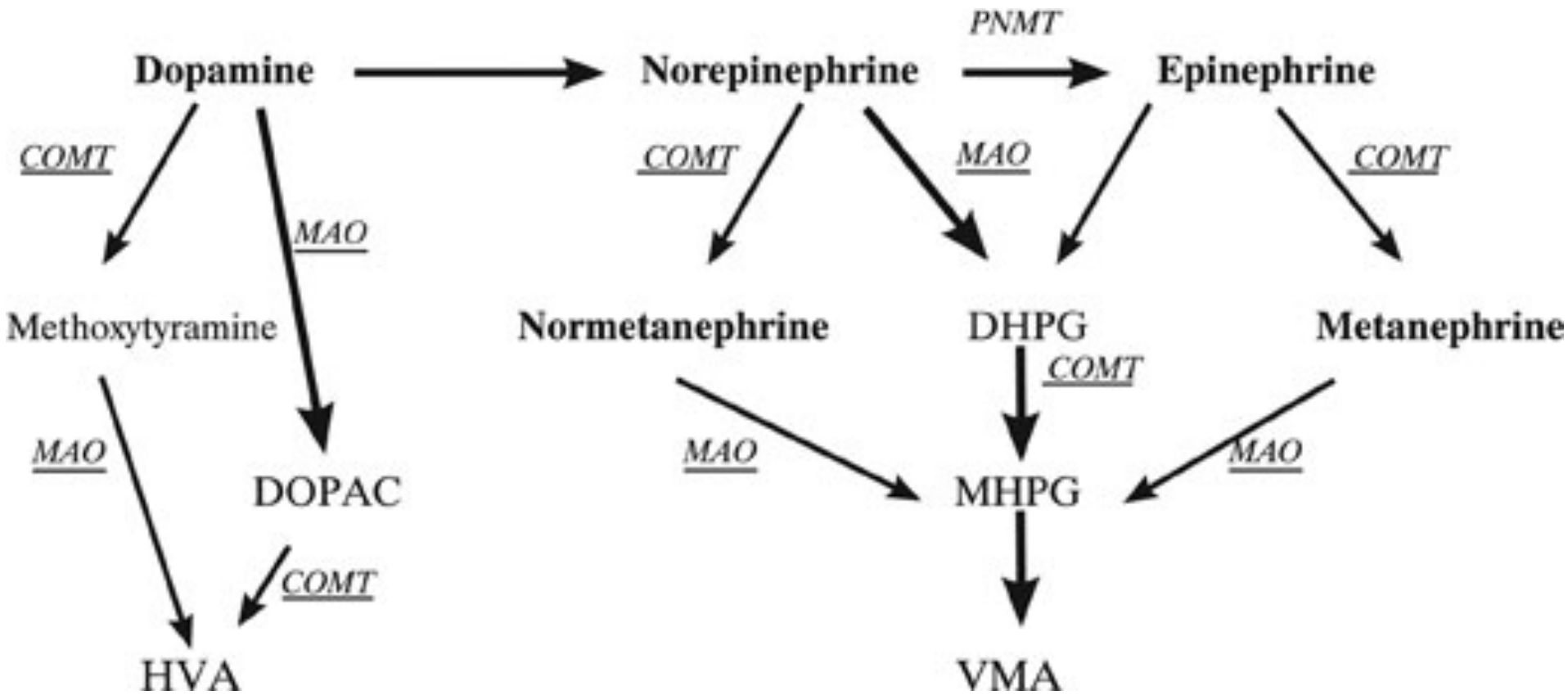

Photo: http://www.hormones.gr/93/article/article.html

If HVA is ↑ high and VMA is ↑ high

1. COMT or MAO mutations
2. High levels of or taking Tyrosine, DLPA, Dopamine and/or Macuna supplements
3. SNRI Medication (Wellbutrin (Bupropion)), Tricyclic Antidepressants (amitriptyline (Elavil))
4. Amphetamines/Amphetamine-like medications or drugs, Appetite suppressants (Phentermine), Caffeine (pills or drinks), Ephedrine (ie. Sudafed)
5. Opioids (VMA may be normal)
6. Elevated adrenal output – cortisol – address the stress
7. Inflammation – inflammatory cytokines increase sympathetic output
8. Neuroblastic Tumor
9. Pheochromocytoma (Very high levels of VMA, maybe HVA)

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If HVA is ↑ high and VMA is ↓ Low

1. Low copper or vitamin C so DBH enzyme can't move forward (VMA usually quite low)
2. Clostridia difficile (inhibits DBH enzyme so can't make VMA)
3. Bananas (contain high levels dopamine that doesn't cross BBB – VMA likely normal)
4. Quercetin supplements/foods – turn into HVA in the gut and can show up as artificial high HVA and normal VMA
5. Check adrenals – low levels of cortisol too? Then VMA is usually low.
6. Tetrahydrocannabinol (THC) use – short term use raises dopamine (VMA may be normal)
7. Opioids (VMA may be normal)
8. DBH enzyme deficiency (VMA very low) = orthostatic hypotension, exercise intolerance, ptosis of eyelid, psychological/behavior disorders
9. Neuroblastic tumor (very high levels)

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If HVA is ↓ Low and VMA is ↑ High

1. Check adrenals – high cortisol levels too?
2. HVA may be normal and VMA elevated with: Amphetamines/Amphetamine-like medications or drugs, Appetite suppressants (Phentermine), Caffeine (pills or drinks), Ephedrine (ie. Sudafed)
3. Dopamine reuptake inhibitors (ie. risperidone)
4. Pheochromocytoma
5. Higher risk for myocardial injury/dysfunction with elevated cardiac troponin I
    1. Consider age and CVD risk

If HVA is ↓ Low and VMA is ↓ Low

1. Low cofactors: BH4, iron, SAMe, Magnesium, Copper, B2, NAD (not eating? Not absorbing?)
2. COMT or MAO mutations
3. Low Tyrosine (ie. low protein diet or poor protein absorption)
4. Check adrenals – low cortisol levels too?
5. Oxidative stress (pushing PEA down other pathways)
    1. Look at 8-OHdG
6. Fungal/candida infections inhibit Tyrosinase activity (Can't make L-Dopa)
7. Glyphosate blocking the Shikamate pathway and depleting/binding co-nutrients (ie. Tyrosine and Tryptophan)
8. Tetrahydrocannabinol (THC) use – long term use? Possibly suppressive?

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Case: Depression and Anxiety on an SSRI

50yo female presents to the clinic with:

- On an SSRI but still reports mild depression and moderate anxiety
- Moderate fatigue
- Irregular cycles
- Does not report hot flashes/night sweats

DUTCH Extras					
Category	**Test**		**Result**	**Units**	**Normal Range**
Melatonin (*measured as 6-OH-Melatonin-Sulfate) - (Urine)					
	Melatonin* (Waking)	Low end of range	11.1	ng/mg	10 - 85
Oxidative Stress / DNA Damage, measured as 8-Hydroxy-2-deoxyguanosine (8-OHdG) - (Urine)					
	8-OHdG (Waking)	Within range	2.8	ng/mg	0 - 5.2
Nutritional Organic Acids					
Vitamin B12 Marker (may be deficient if high) - (Urine)					
	Methylmalonate (MMA)	Within range	1.2	ug/mg	0 - 2.8
Vitamin B6 Marker (may be deficient if high) - (Urine)					
	Xanthurenate	Within range	0.4	ug/mg	0 - 1.6
Glutathione Marker (may be deficient if low or high) - (Urine)					
	Pyroglutamate	Within range	62.2	ug/mg	37 - 70
Neurotransmitter Metabolites					
Dopamine Metabolite - (Urine)					
	Homovanillate (HVA)	Above range	15.6	ug/mg	4.5 - 13
Norepinephrine/Epinephrine Metabolite - (Urine)					
	Vanilmandelate (VMA)	Below range	0.5	ug/mg	2.7 - 6.4
Serotonin Metabolite - (Urine)					
	5-Hydroxyindoleacetate (5HIAA)	Below range	1.7	ug/mg	3 - 7.5

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Neurotransmitter Metabolites				
Dopamine Metabolite - (Urine)				
Homovanillate (HVA)	Above range	15.6	ug/mg	4.5 - 13
Norepinephrine/Epinephrine Metabolite - (Urine)				
Vanilmandelate (VMA)	Below range	0.5	ug/mg	2.7 - 6.4
Serotonin Metabolite - (Urine)				
5-Hydroxyindoleacetate (5HIAA)	Below range	1.7	ug/mg	3 - 7.5

High HVA = Anxiety type symptoms
Low VMA = fatigue
Low 5HIAA = depression

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Treatments to consider:

- **High HVA:**
  - Given the large discrepancy between HVA and VMA → check copper and vitamin C levels
  - Ask about gut issues – maybe C. diff?
- **Low VMA:**
  - Address the copper, vitamin C and C. diff as needed.
  - Look at the adrenals
- **Low 5HIAA:**
  - The SSRI is not working.
    - There is likely not enough TRYPTOPHAN to make SEROTONIN for the SSRI to work in the first place
  - She's near menopause and DUTCH estrogen (not shown) is in the post-menopausal range
    - Estrogen stimulates ERb to make Tryp. Dehydroxylase to make 5HTP
  - Talk with her about diet (protein) and alcohol

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Having the most comprehensive,
easy to collect
adrenal and hormone test available
allows you to make
a greater impact on your patients
at a deeper level.

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Questions?

If your question(s) aren't answered live, please look for an email or FAQ's we will be sending out after the webinar.

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