Neurology & Cognitive Vitality

Strategies for Lifelong Brain Health

Session 1

Dr. Eboni Cornish, MD

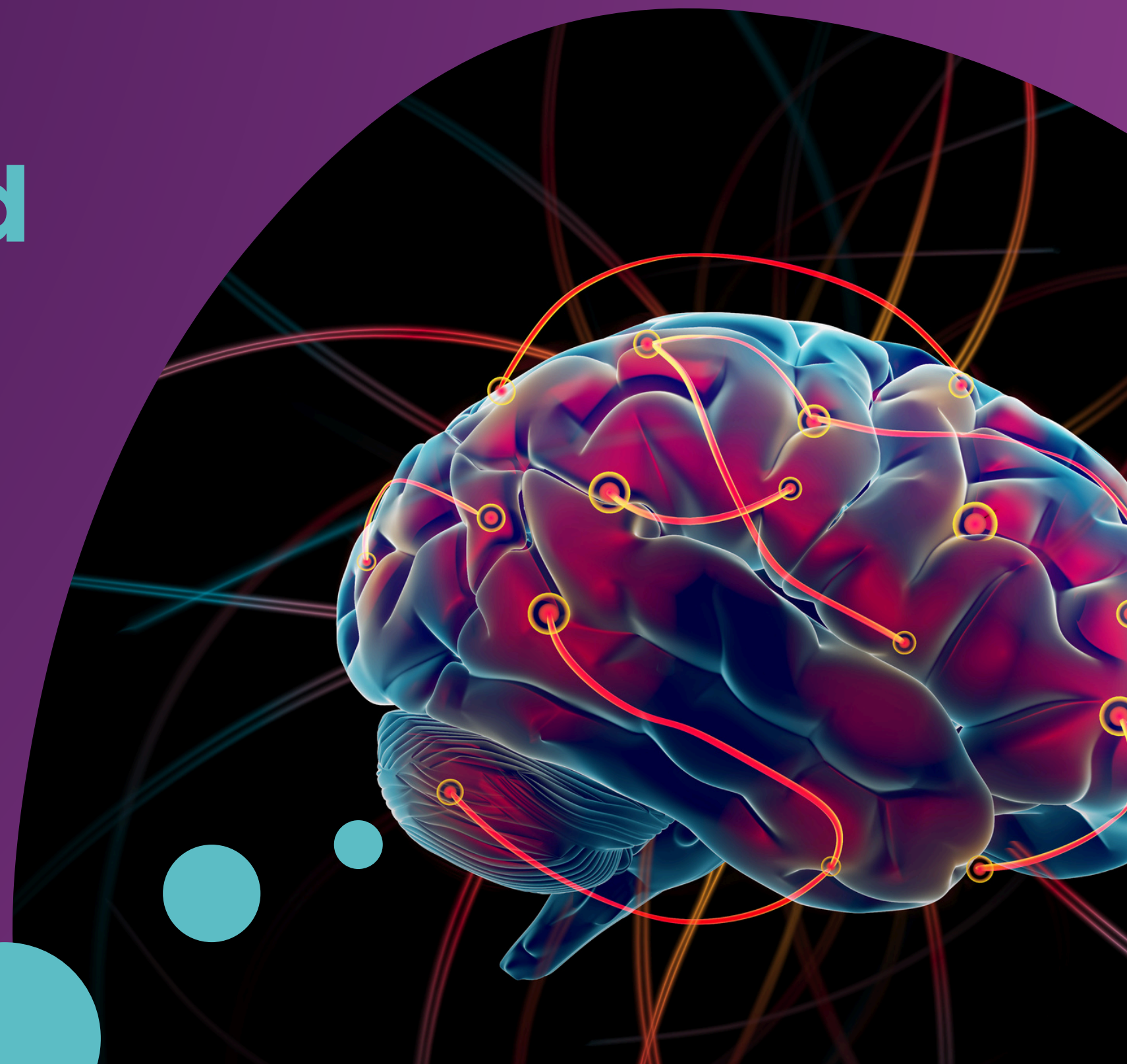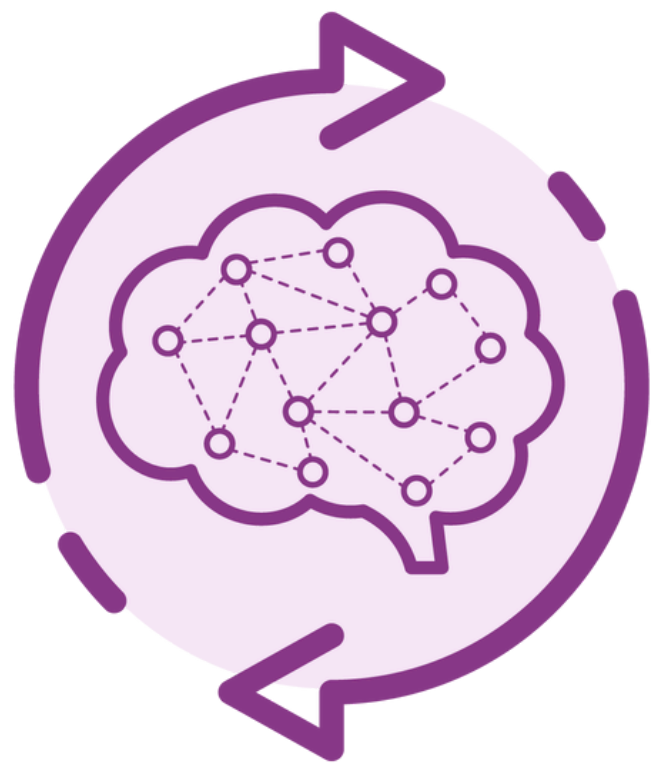# Early Detection of Neuroinflammation and Neurodegeneration

Integrating Advanced Biomarkers and SPECT Imaging in Longevity Medicine

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Meet Your **Speaker**

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Longevity Conference 2025

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Learning Objectives

- Understand neuroinflammation as an early driver of neurodegenerative processes

- Review evidence-based biomarkers: immune activation, permeability, genetic risk, oxidative stress, methylation imbalances

- Interpret Vibrant Wellness testing: Neural Zoomer Plus, BBB Panel, ApoE genotyping, Healthspan Assessment

- Integrate functional SPECT imaging into diagnostic and treatment planning

- Develop brain longevity programs with early detection and personalized intervention

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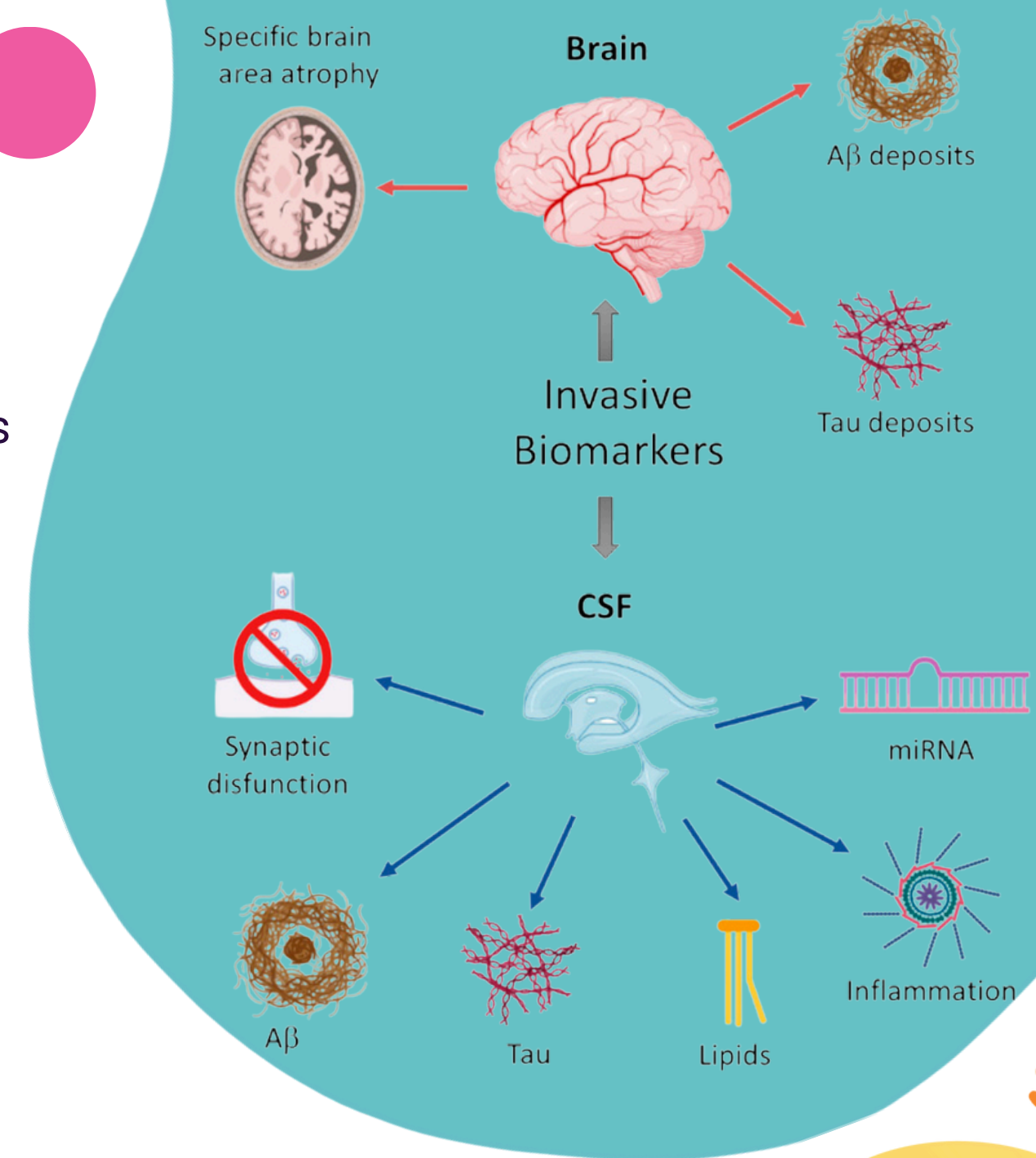
The Clinical Problem

- Neurodegeneration begins decades before symptoms manifest

- MRI-detectable atrophy reflects advanced neuronal loss

- Standard exams often miss early cognitive or mood changes

- Patients increasingly present with post-viral cognitive burnout, fatigue, mild memory issues

- Need diagnostics that identify risk before irreversible pathology

Reference: Jack CR et al. Lancet Neurol 2010.

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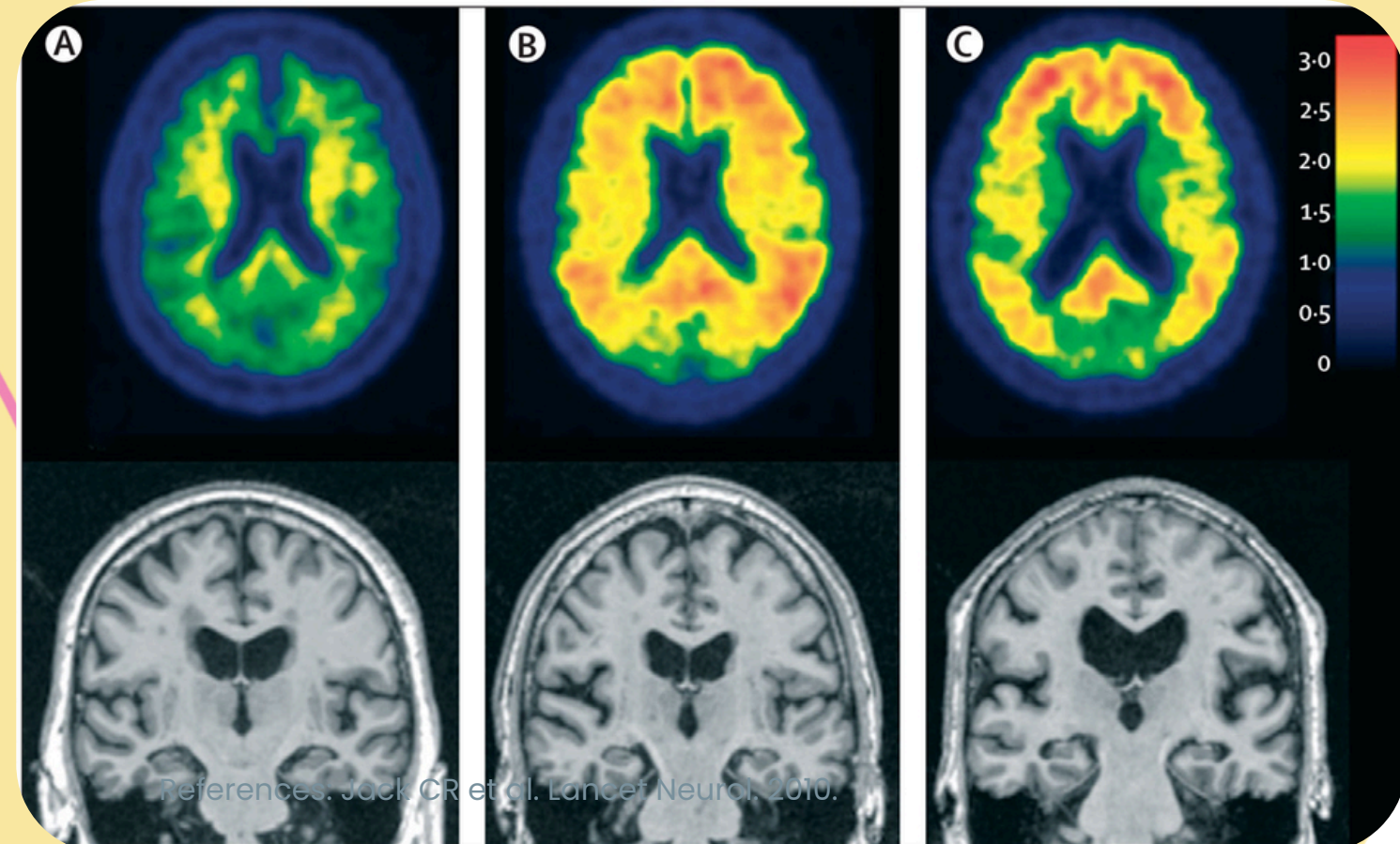
Introduction to Neuroinflammation

○ Neuroinflammation precedes structural atrophy and symptom onset by years

○ Activated microglia and astrocytes release inflammatory cytokines and ROS

○ Triggers include infection, toxins, trauma, and chronic immune dysregulation

○ Identifying early changes enables intervention before irreversible damage
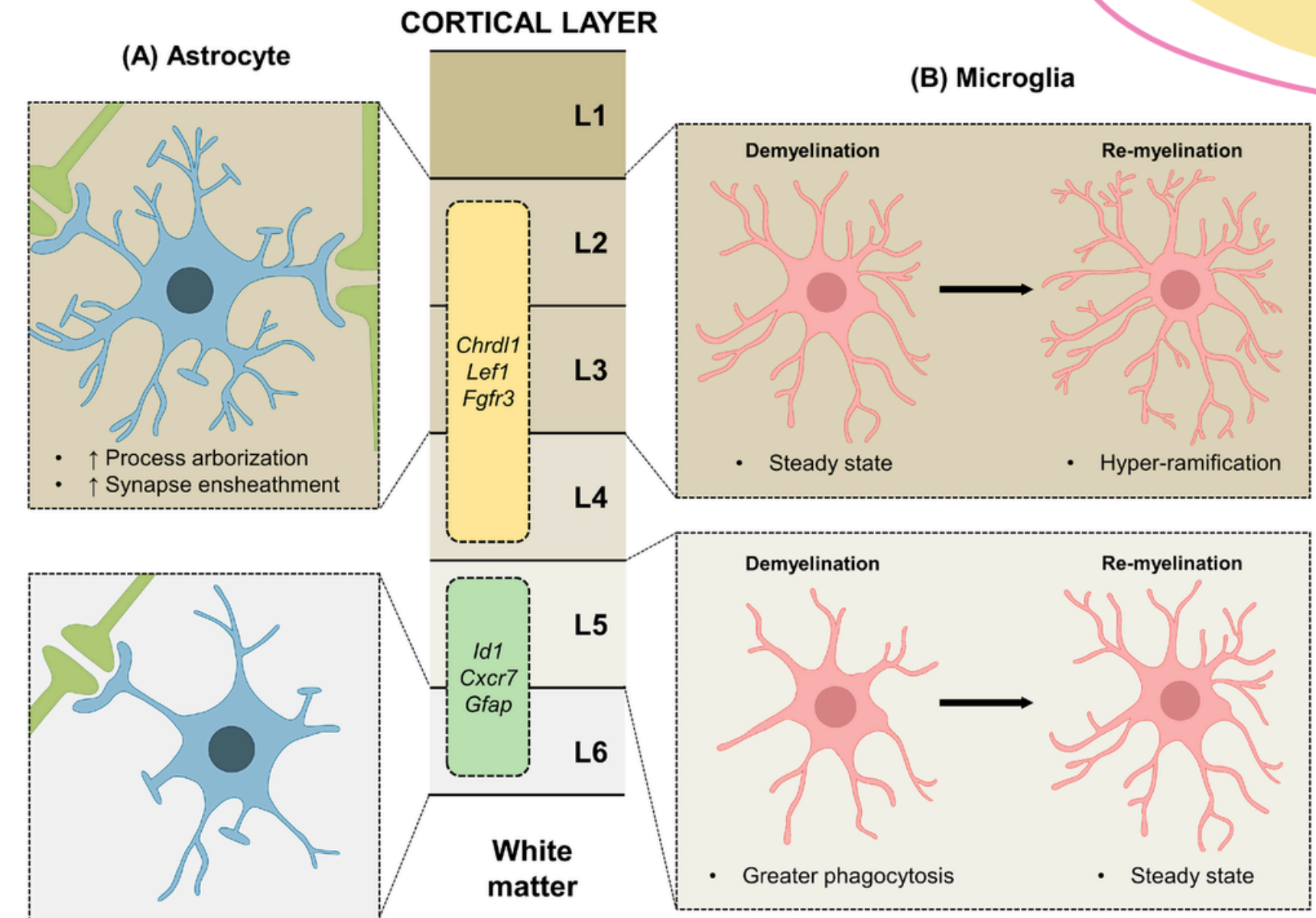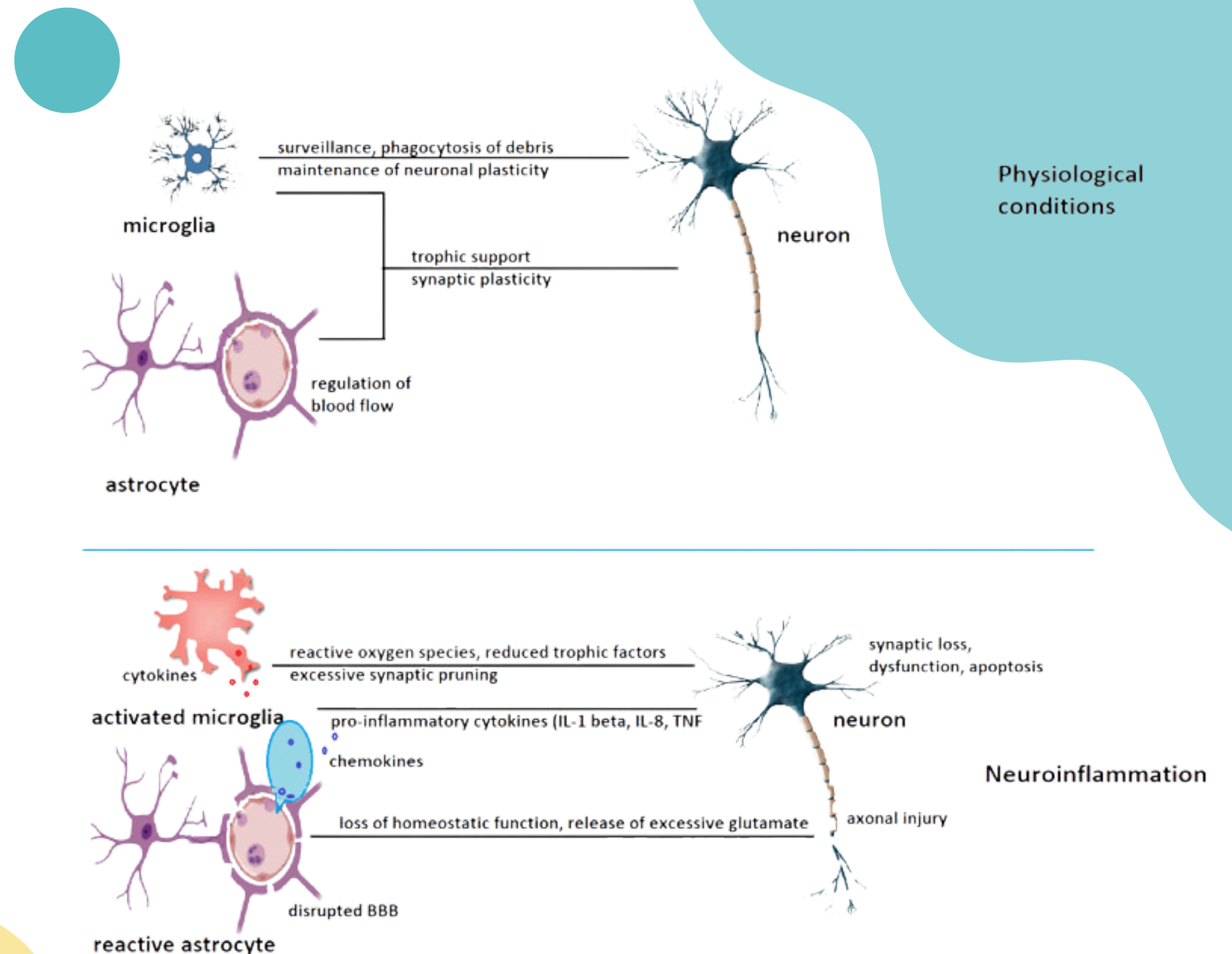

References:

Soraci L et al. Neuroinflammaging: Aging and Neurodegeneration. Aging Dis. 2024;15(4):1726–1747.

Andronie-Cioara FL et al. Molecular Mechanisms of Neuroinflammation. IJMS. 2023;24(3):1869.

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Role of Microglia and Astrocytes

- Microglia: CNS-resident macrophages that respond to injury, toxins, and pathogens

- Activated microglia release IL-1β, TNF-α, and chemokines that sustain inflammation

- Astrocytes regulate neurotransmitter levels and maintain the blood-brain barrier (BBB)

- Chronic glial activation contributes to synaptic loss and mood/cognitive symptoms

References: Andronie-Cioara FL et al. Neuroinflammation in Aging and Alzheimer's. IJMS. 2023;24(3):1869. Gambino CM et al. Aging and Neuroinflammatory Disorders. Curr Pharm Des. 2019;25(39):4168–4174.

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Pro-inflammatory Cytokines

○ IL-1β and TNF-α drive neuroinflammation and promote excitotoxicity

○ IL-6 increases blood-brain barrier permeability and impairs neurogenesis
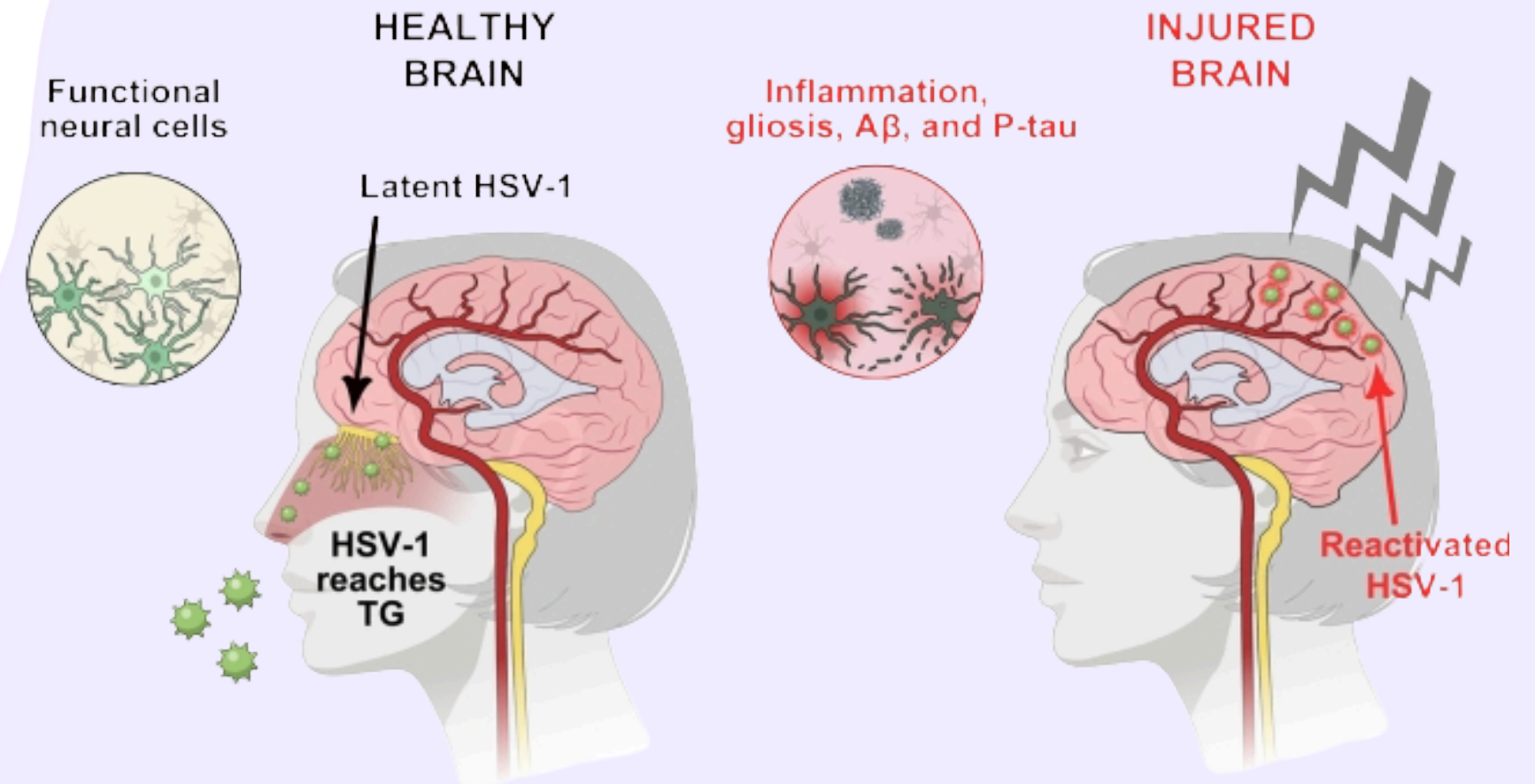
○ High cytokine levels correlate with fatigue, brain fog, and mood disorders

○ Markers like CRP, IL-6, TNF-α are clinically useful in complex patients

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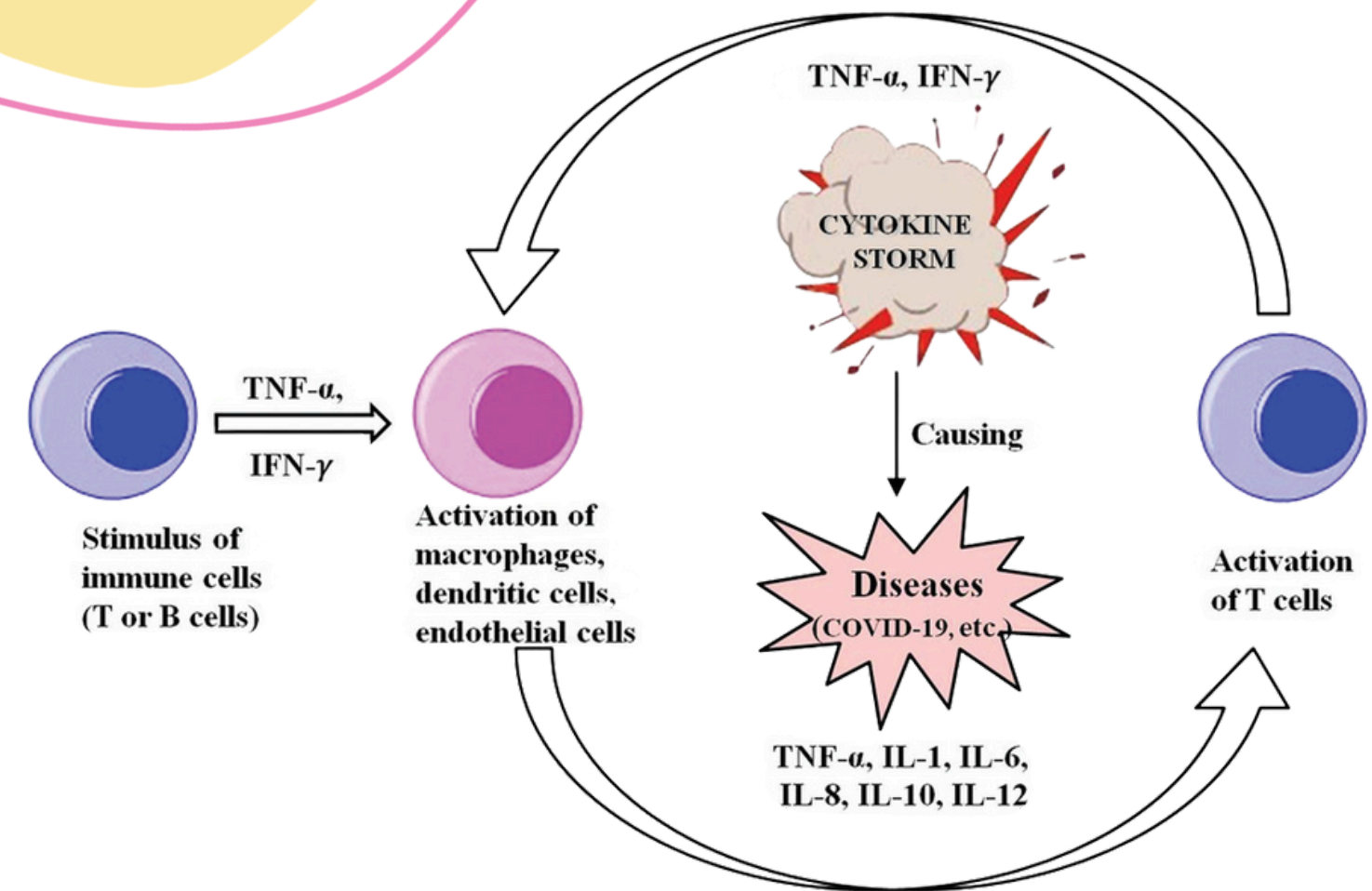
Triggers: Infections, Toxins, Trauma

- Chronic infections like Lyme, EBV, and long COVID activate microglia and cytokine release

- Mycotoxins and heavy metals impair mitochondrial and glutathione pathways

- Traumatic brain injury primes microglia for exaggerated responses to future insults

- Toxic burden and immune activation must be evaluated together in neuroinflammatory cases

Functional neural cells

HEALTHY BRAIN

Latent HSV-1

HSV-1 reaches TG

Inflammation, gliosis, Aβ, and P-tau

INJURED BRAIN

Reactivated HSV-1

References:
Sian-Hulsmann J, Riederer P. Virus-Induced Brain Pathology and Inflammation. J Neural Transm. 2024.
Gambino CM et al. Biomarkers and Therapeutics in Neuroinflammation. Curr Pharm Des. 2019.

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Progression to Neurodegeneration

○ Neuroinflammation increases oxidative stress and damages neuronal mitochondria

○ Excitotoxicity from excess glutamate leads to synaptic loss and cell death

○ Leads to tau phosphorylation, beta-amyloid deposition, and cortical atrophy

○ Preventing chronic inflammation may delay or reverse early neurodegeneration
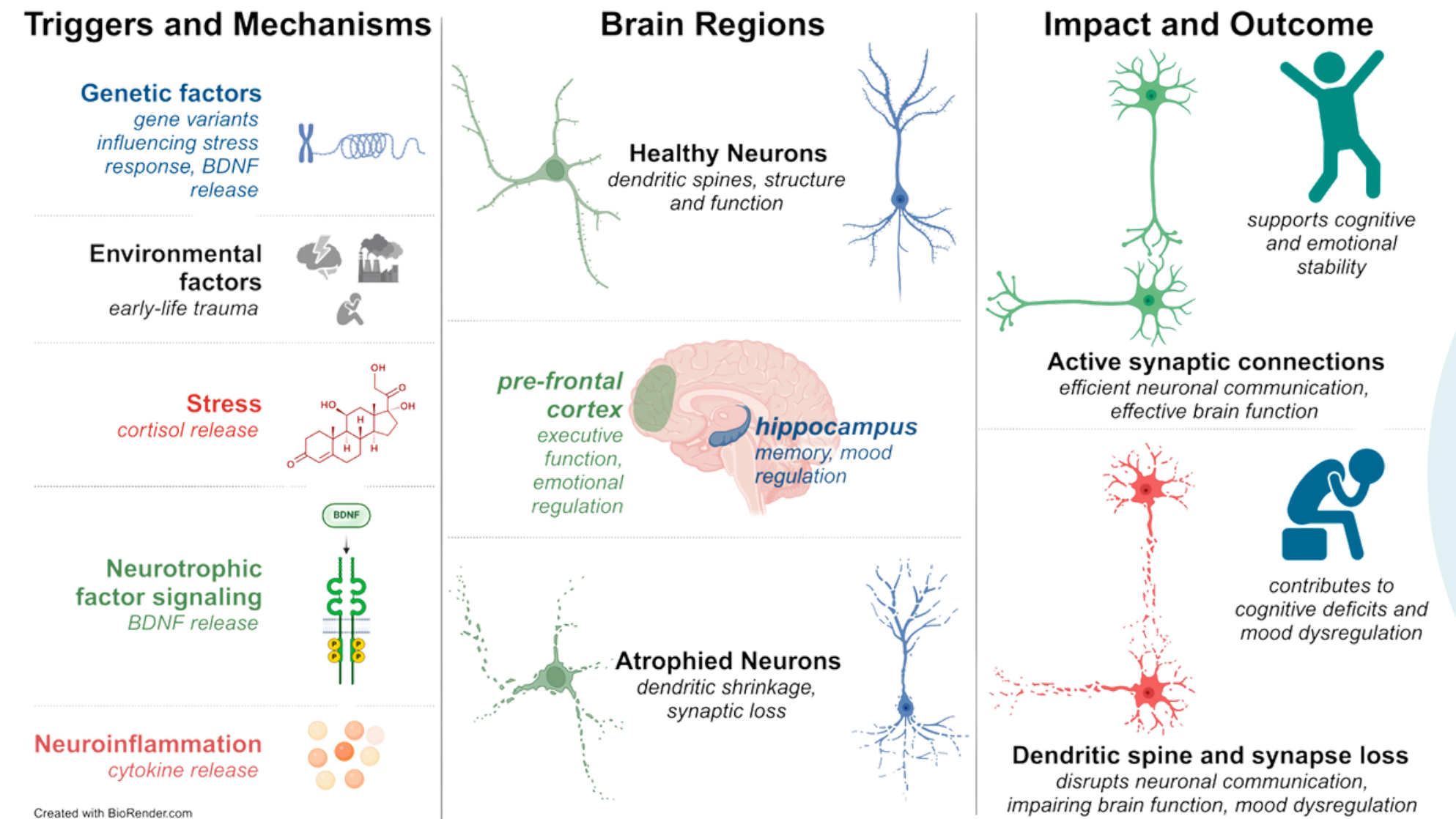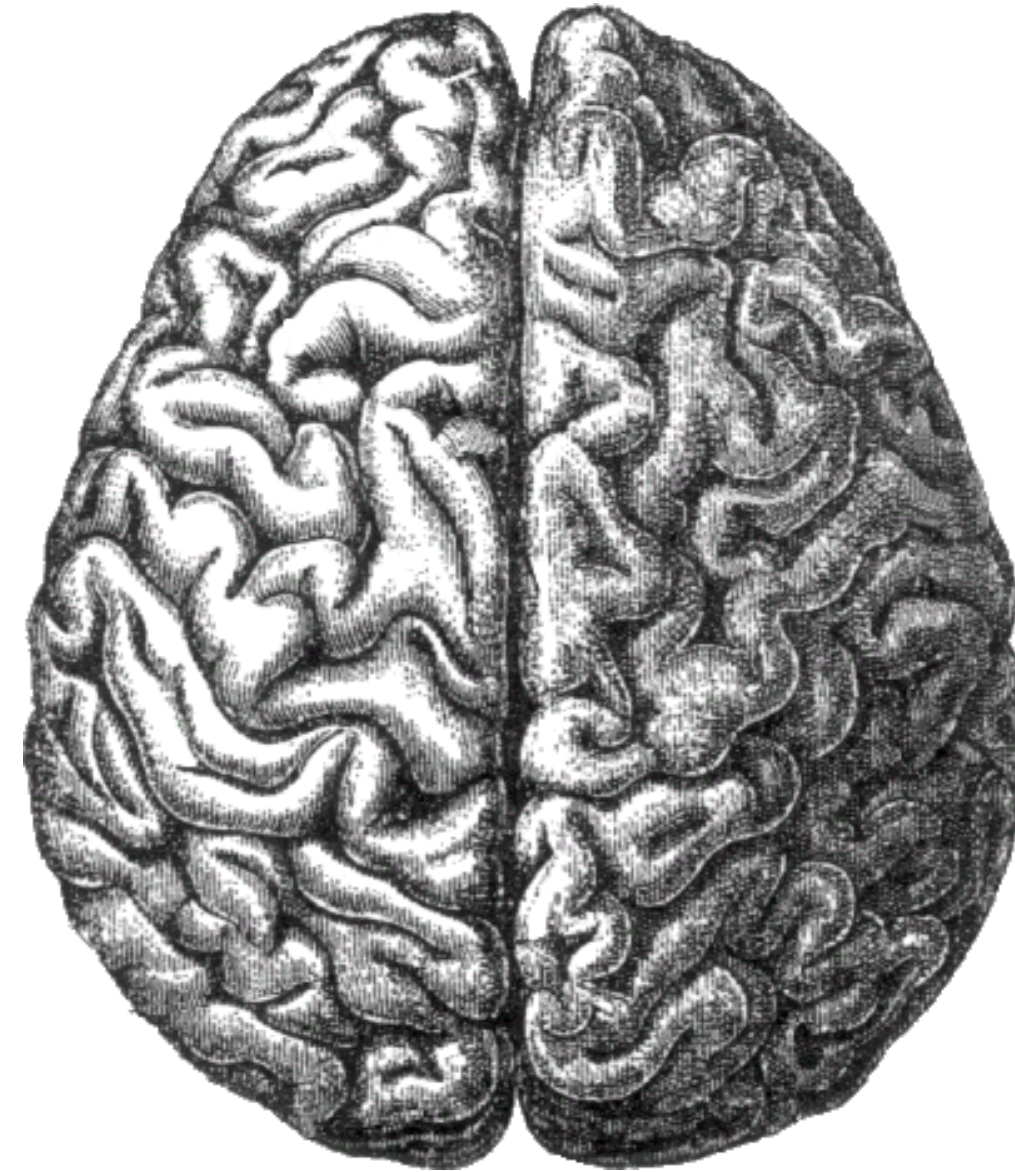

References:
Chaudhary S et al. Imaging Neuroinflammation in Aging. Neurosci Biobehav Rev. 2025.
Soraci L et al. Neuroinflammmaging in Aging and Cognitive Decline. Aging Dis. 2024

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Early vs Late Brain Changes

- Microglia: CNS-resident macrophages that respond to injury, toxins, and Early: elevated cytokines, mitochondrial dysfunction, and perfusion deficits on SPECT

- Late: structural atrophy on MRI and advanced loss of executive and memory function

- Biomarkers and functional imaging identify pathology before irreversible damage occurs

- Early intervention allows brain recovery and improved long-term outcomes

References:
Chouliaras L, O'Brien JT. Imaging Techniques in Early Dementia. Mol Psychiatry. 2023.
Valotassiou V et al. SPECT and PET Imaging in Alzheimer's. Ann Nucl Med. 2018.

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SPECT Imaging Overview

- SPECT evaluates cerebral blood flow and functional brain activity

- Can detect hypoperfusion patterns in prefrontal, limbic, and cerebellar regions

- Useful in diagnosing neuroinflammation, toxin effects, and traumatic brain injury

- Amen Clinics SPECT protocol includes 3D surface and active scans

References:
Ferrando R, Damian A. Brain SPECT as a Biomarker. Front Neurol. 2021;12:629442.
Valotassiou V et al. SPECT and PET Imaging in Alzheimer's Disease. Ann Nucl Med. 2018.

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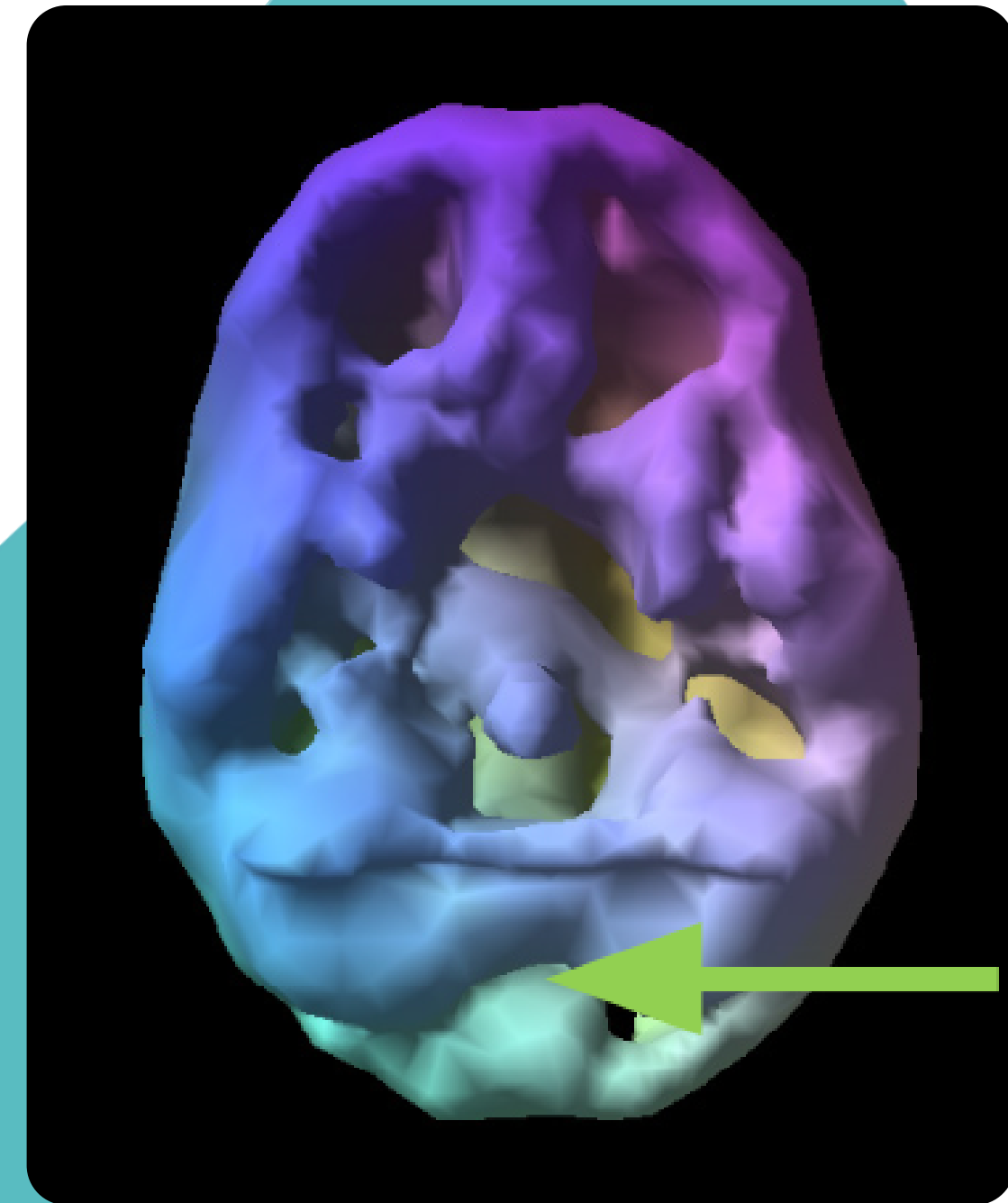
SPECT in Neurodegenerative Disease

- SPECT reveals functional changes in Alzheimer's, PANDAS, Lyme, and long COVID

- Prefrontal and temporal hypoperfusion linked to memory and mood dysfunction

- Cerebellar hypoperfusion increasingly recognized in neuropsychiatric illness

- Supports early diagnosis, treatment guidance, and longitudinal tracking
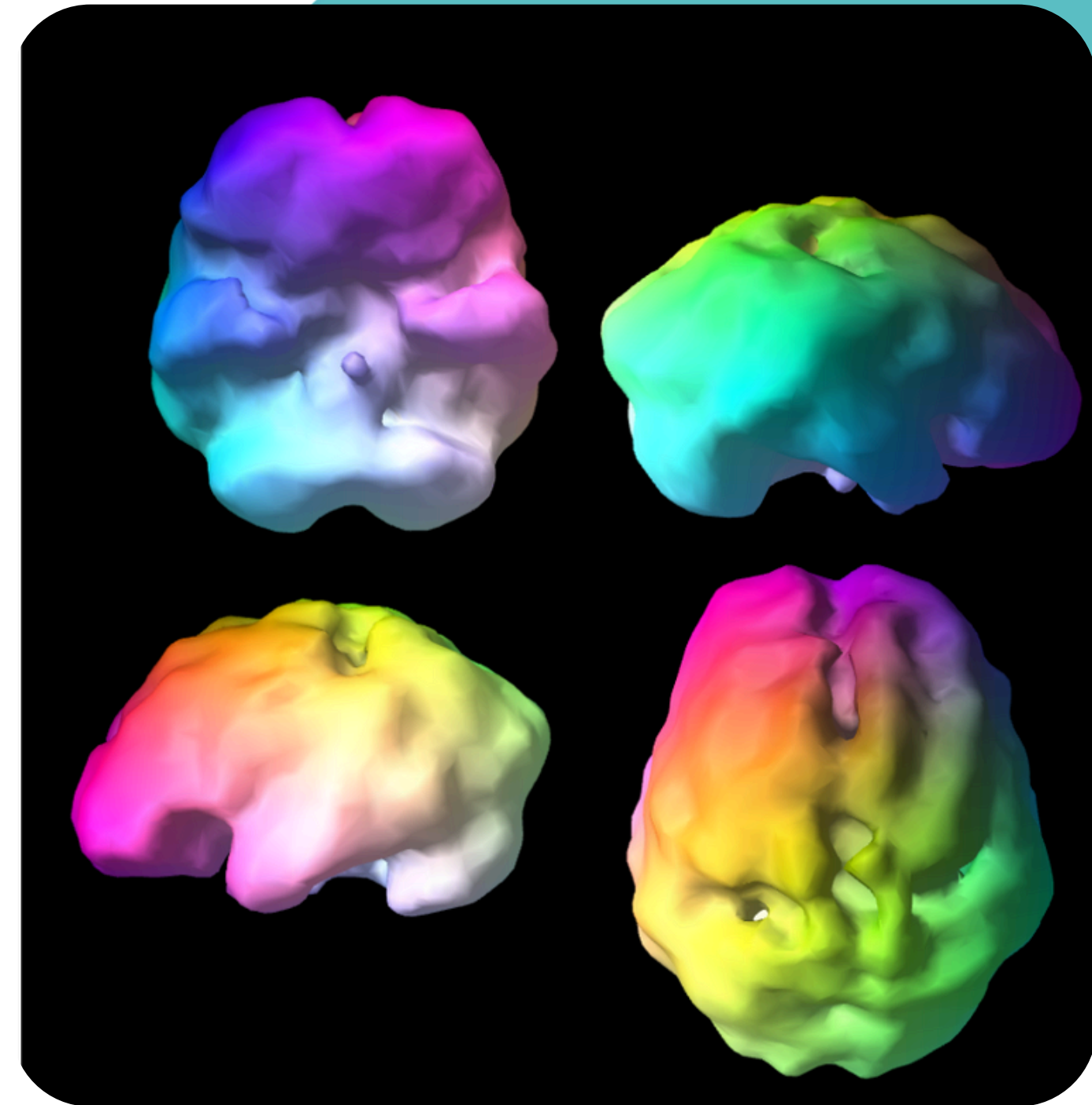
References:
Chouliaras L, O'Brien JT. Early Diagnosis of Dementia with Imaging. Mol Psychiatry. 2023.
Chaudhary S et al. Neuroinflammation in Aging and Dementia. Neurosci Biobehav Rev. 2025

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Perfusion Patterns in SPECT

- Frontal lobe hypoperfusion: executive dysfunction, poor decision-making, attention issues

- Temporal lobe deficits: memory loss, language problems, mood volatility

- Cerebellar hypoperfusion: balance issues, coordination deficits, and emotional dysregulation

- Each perfusion pattern offers functional clues to guide diagnostic direction

Alzheimer's   **TBI**
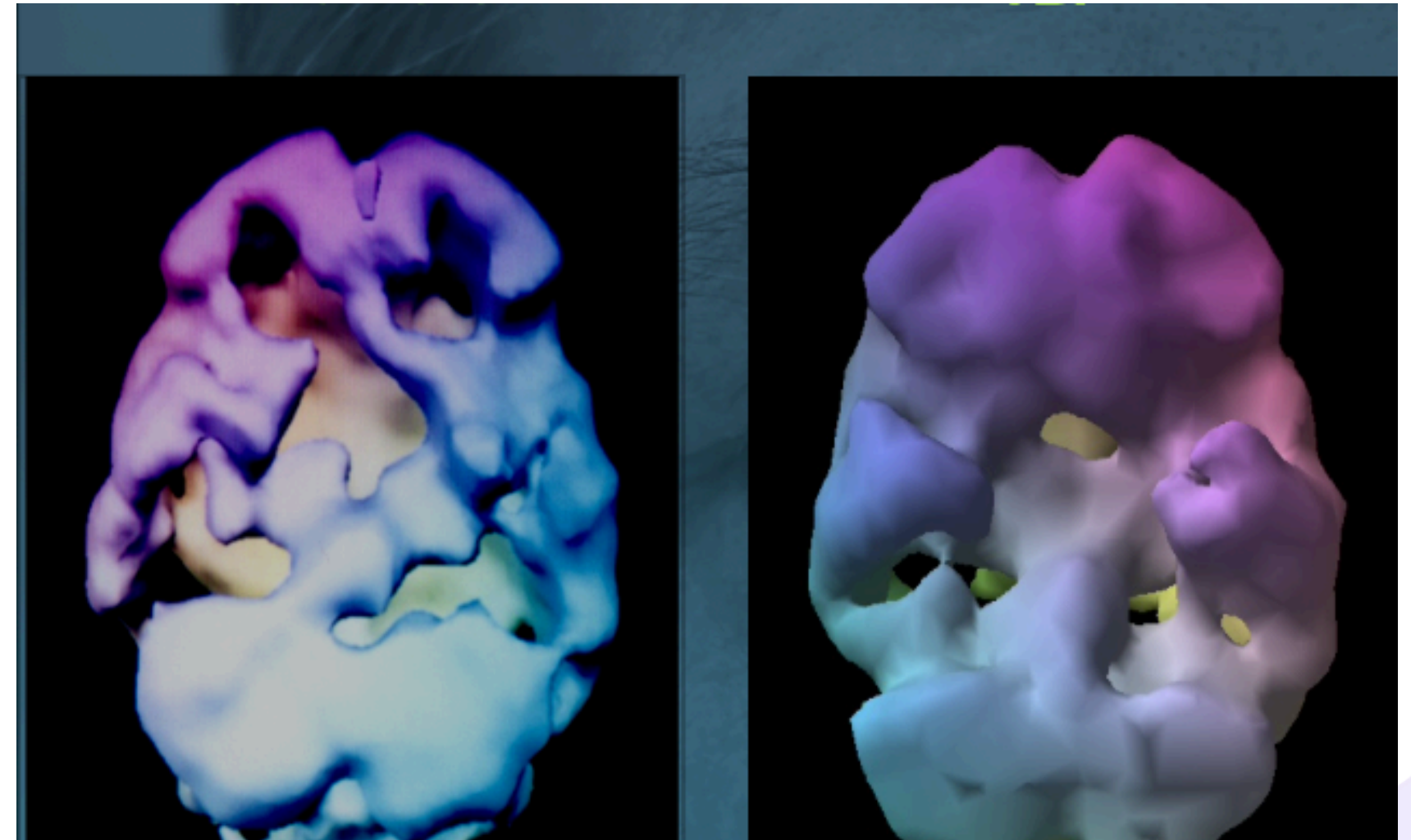
References:
Ferrando R, Damian A. Brain SPECT Biomarkers. Front Neurol. 2021.
Valotassiou V et al. Perfusion Imaging in Alzheimer's. Ann Nucl Med. 2018.

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Case Study: SPECT Before & After

- ○ Microglia: CNS-resident macrophages that respond to injury, toxins, and Early: elevated cytokines, mitochondrial dysfunction, and Patient: 42-year-old with mold exposure, panic attacks, and cognitive slowing

- ○ Initial SPECT: hypoperfusion in frontal and cerebellar regions; poor limbic activation

- ○ Treatment: detox protocol, IV glutathione, antifungals, and limbic retraining

- ○ Follow-up SPECT: improved perfusion, patient reports clarity, sleep, and mood normalization

Before
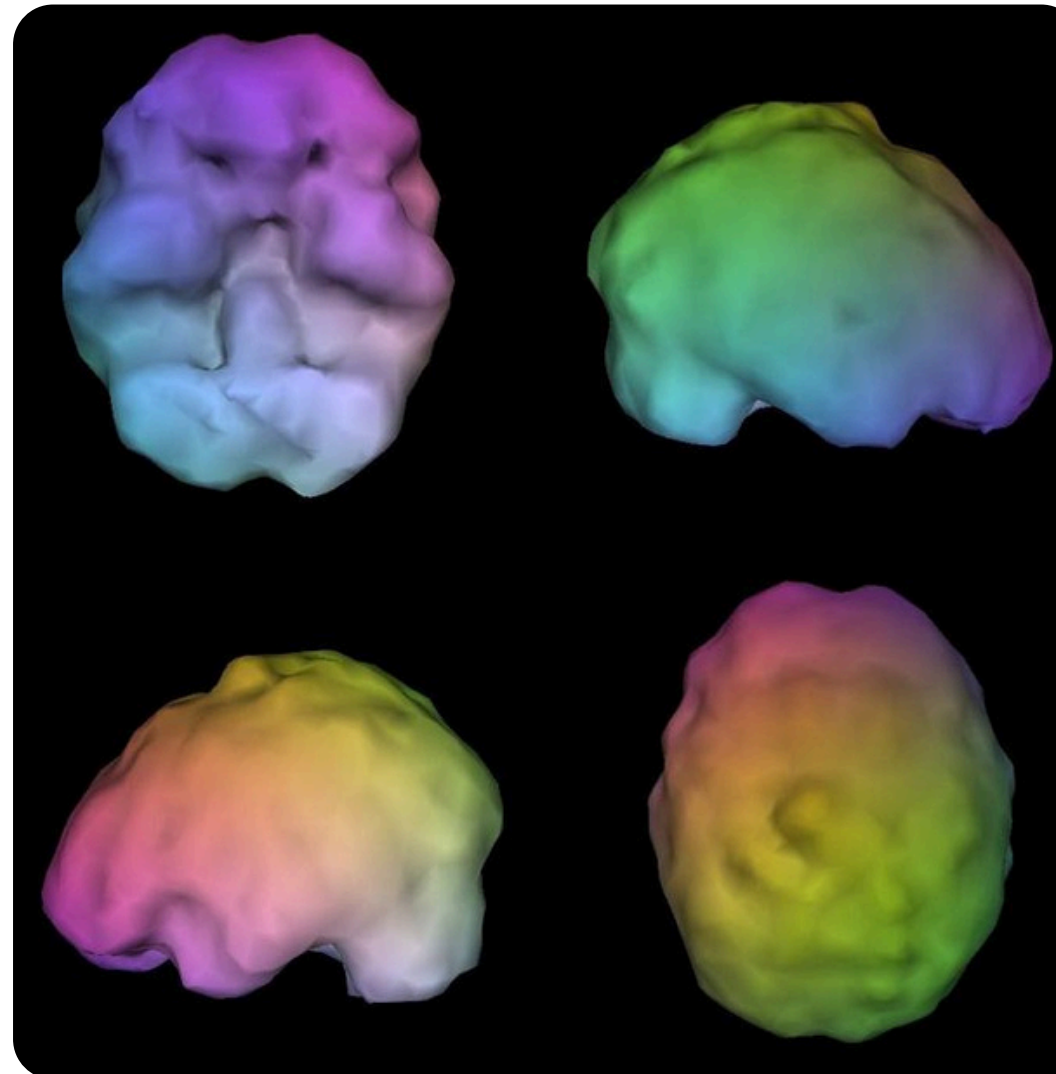
After
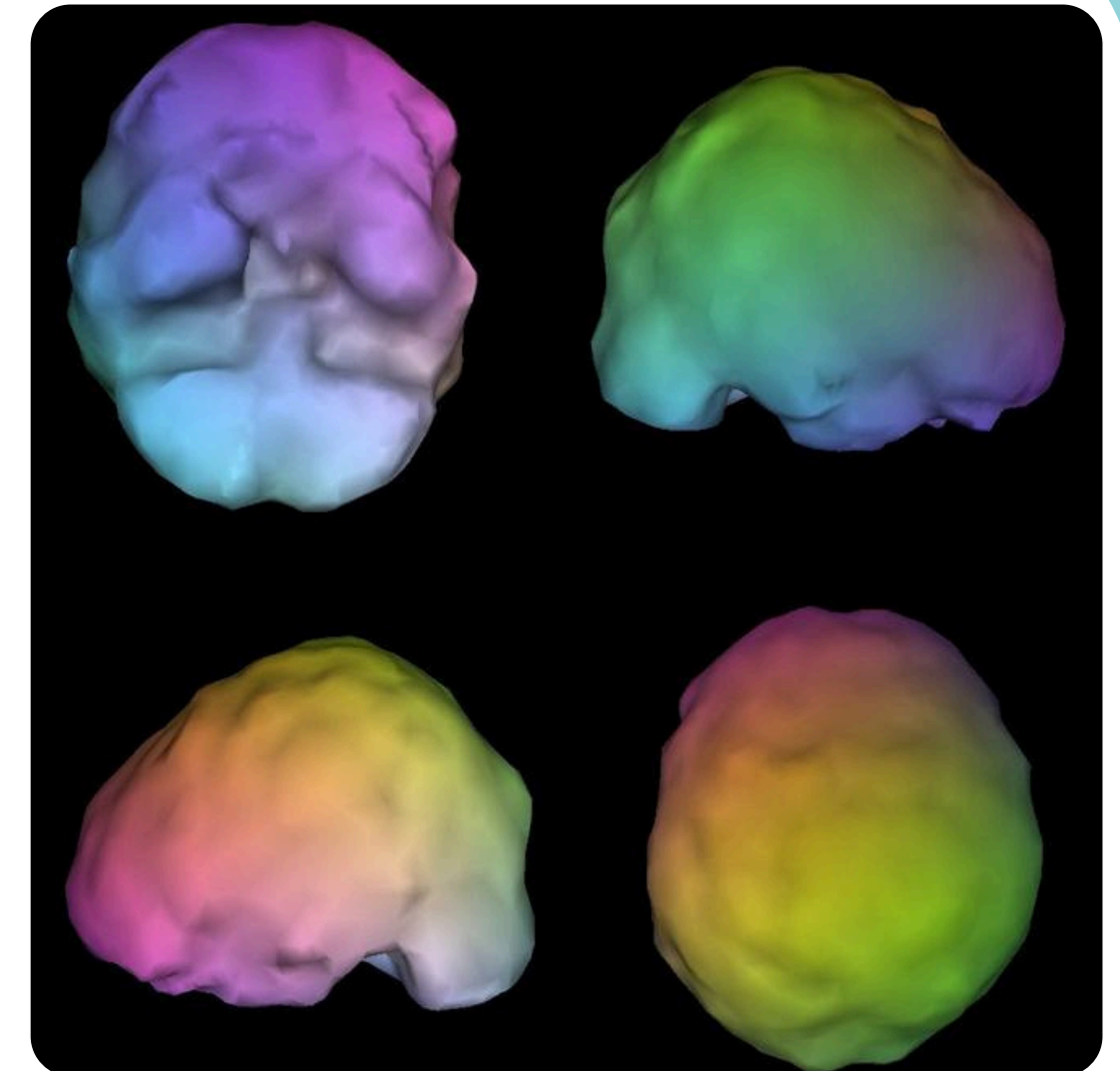
References:
Amen Clinics case archives – mold toxicity case examples (clinical documentation).
Vibrant Wellness – Neural Zoomer Plus, BBB Panel, Healthspan Assessment Guides.
Krawczuk D et al. Blood Biomarkers in Neurodegeneration. IJMS. 2024;25(15):8132.

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Neural Zoomer Plus Overview

○ Screens for antibodies to myelin basic protein, S100B, tubulin, GAD65, and more

○ Helpful for diagnosing autoimmune encephalitis, PANS/PANDAS, post-viral syndromes

○ Correlates with SPECT perfusion patterns in frontal, limbic, and cerebellar regions

○ Positive findings often precede structural MRI changes
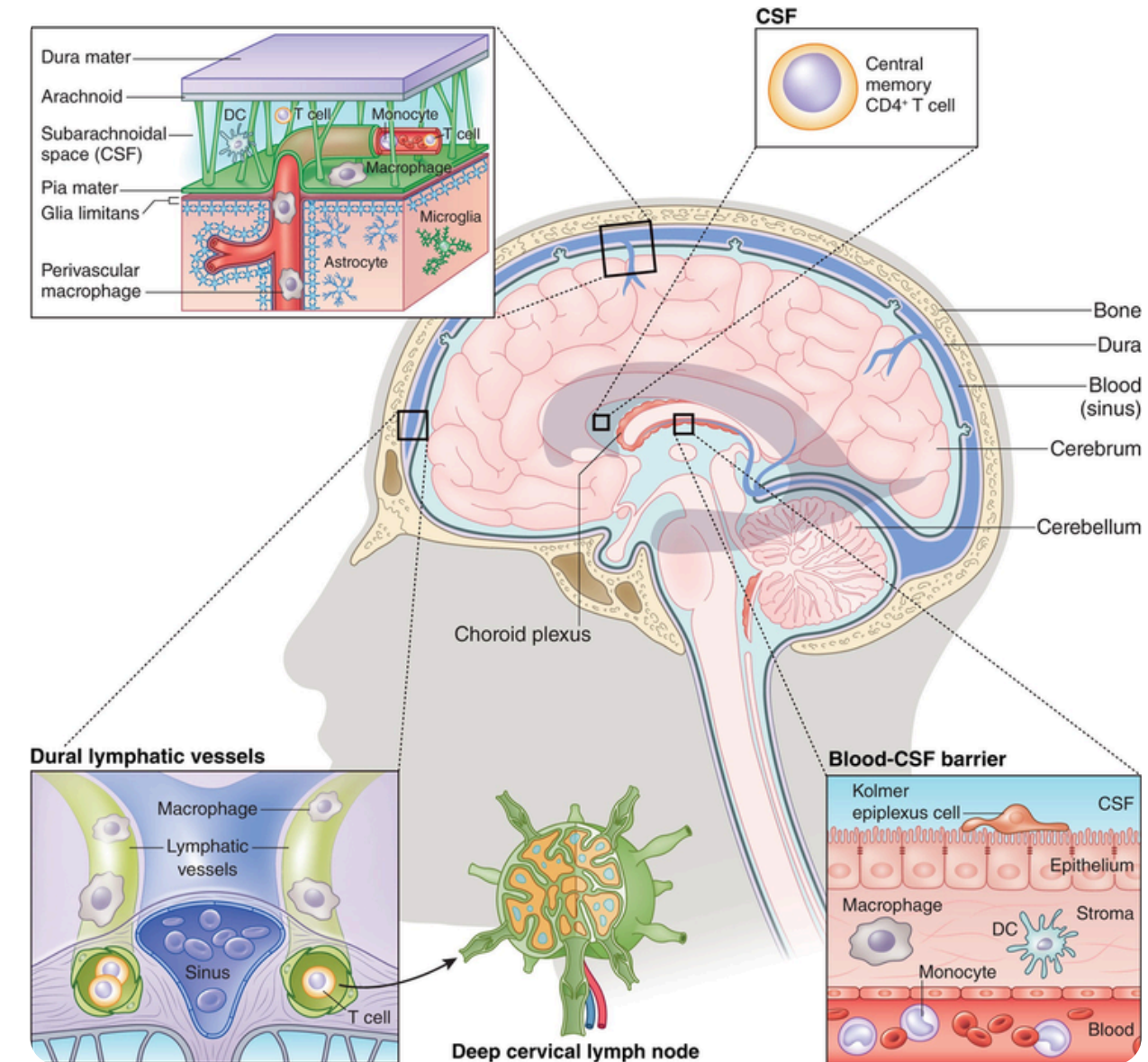
References: Vibrant Wellness – Neural Zoomer Plus Panel Interpretation Guide. Gambino CM et al. New Biomarkers in Aging Brain. Curr Pharm Des. 2019.

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Autoantibodies: MBP, S100B, α-Synuclein

- Anti-MBP: marker of CNS demyelination, seen in MS and post-infectious states

- Anti-S100B: glial marker for BBB disruption and astrocyte damage

- Anti-α-synuclein: associated with neurodegenerative risk (e.g., Parkinson's)

- These markers help differentiate autoimmune, infectious, and toxic encephalopathies

References: Andronie-Cioara FL et al. Neuroinflammation and Aging. IJMS. 2023.
Vibrant Clinical Panel Resources – Autoantibody Interpretation.

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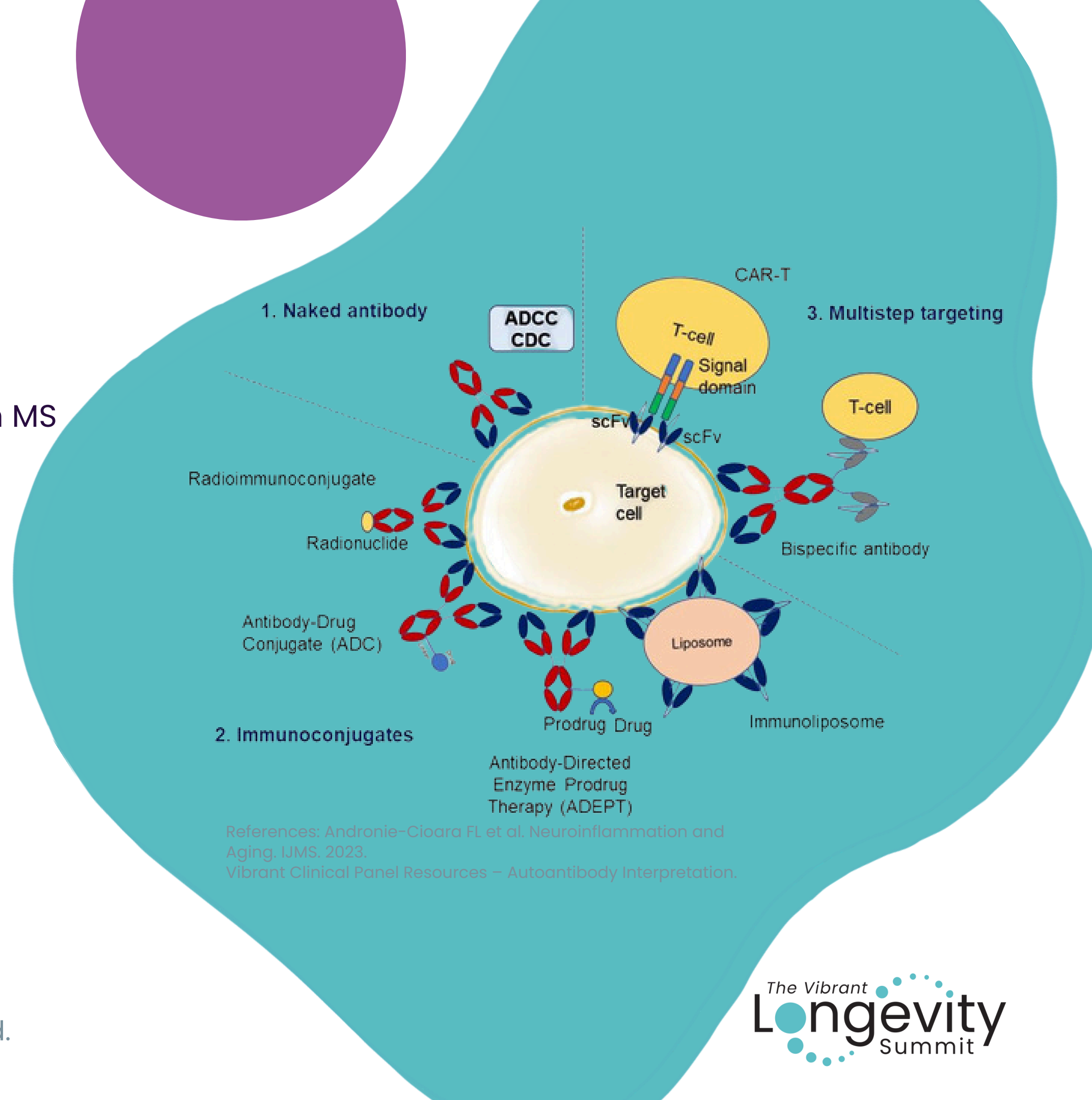
Blood–Brain Barrier Markers

○ Zonulin and occludin regulate tight junctions in the BBB and gut barrier

○ S100B enters peripheral blood during glial stress and BBB leakage

○ Anti-GAD65 links to autoimmune encephalitis and stiff person syndrome

○ Assessing BBB markers reveals immune and toxin-related brain permeability
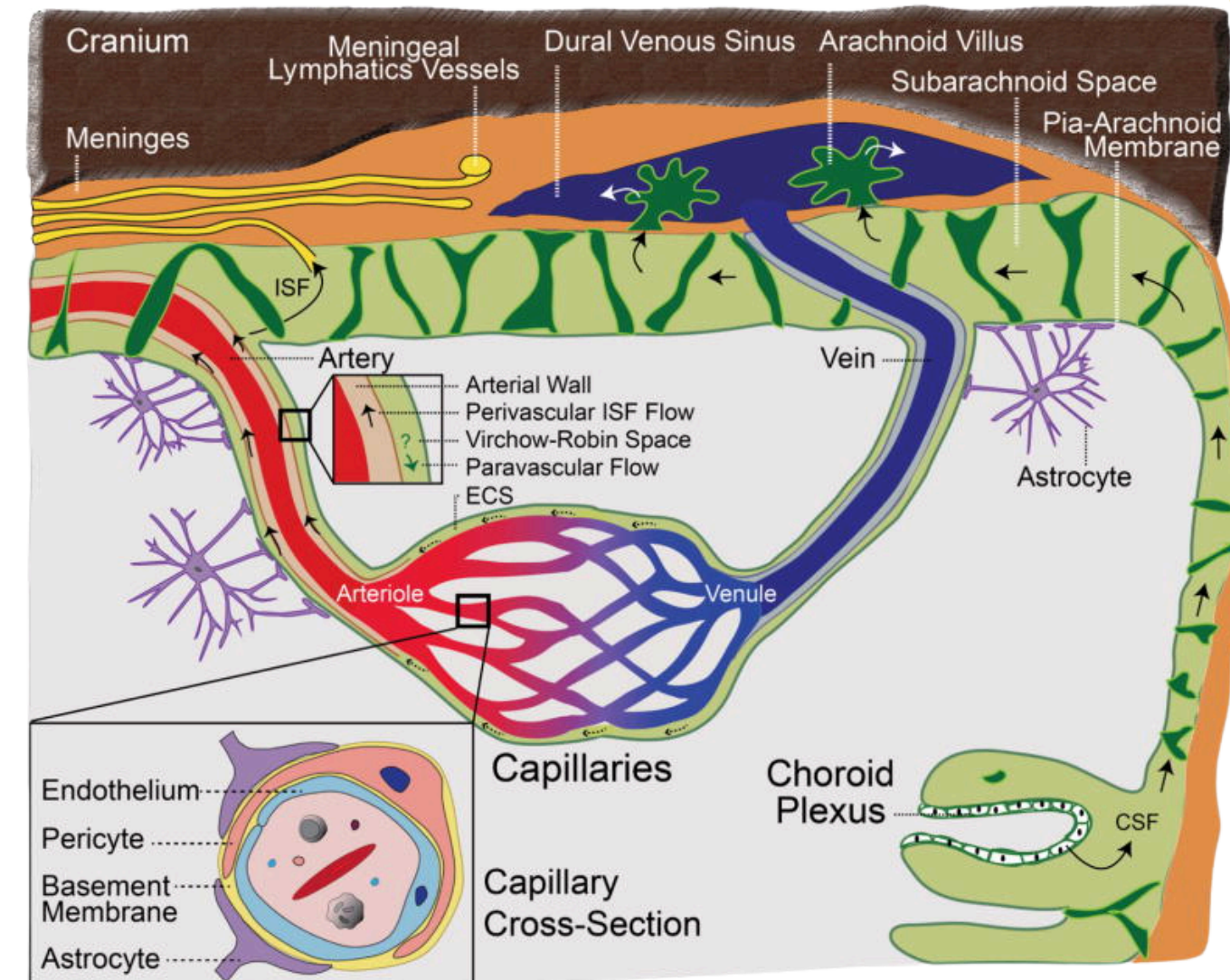
References: Janelidze S et al. BBB Dysfunction Biomarkers in Alzheimer's. Neurology. 2018.
Vibrant Wellness – BBB Panel Reference Guide.

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Zonulin, Occludin, Anti-GAD65

- Zonulin elevated in patients with gluten sensitivity, mold, and Lyme-related gut-brain axis issues

- Occludin breakdown indicates compromised barrier function and neuroinflammatory entry points

- Anti-GAD65 contributes to inhibitory neurotransmitter (GABA) loss and excitotoxicity

- Testing guides immunomodulatory, dietary, and detox interventions

Psychological Comorbidity: Stress Anxiety Depression

Food Composition

Altered Microbiota and Metabolites

Disturbed Gut-Brain Interaction

Impaired Barrier

Immune Activation

Visceral Hypersensitivity Dysmotility

Neuronal Hyperexcitability

References: Alcolea D et al. Blood Biomarkers in Neurodegeneration. Neurology. 2023.
Vibrant Wellness – GAD65 and Barrier Marker Panel Resources.

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Methylation & Detox Markers

- SAM/SAH ratio indicates methylation sufficiency – key for neurotransmitter metabolism

- 8-OHdG reflects oxidative DNA damage from toxins or inflammation

- Homocysteine elevation linked to vascular risk, neurodegeneration, and glutathione depletion

- Evaluate B12, folate, and magnesium status in cognitive and mood decline

References:
Qin Q et al. Biomarkers of Oxidative Stress in Alzheimer's. J Alzheimers Dis. 2025.
Vibrant Healthspan Assessment Panel Guide.

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8-OHdG, Homocysteine, SAM/SAH

○ 8-OHdG correlates with mitochondrial dysfunction and chronic inflammatory exposure

○ High homocysteine is both a neurotoxicant and vascular disruptor

○ SAM/SAH ratios reveal capacity to support detox, myelination, and neurotransmission

○ These markers should be monitored during neuroinflammation recovery

References:
Gambino CM et al. Oxidative Stress Markers in Aging. Curr Pharm Des. 2019.
Healthspan Panel Reference Manual – Vibrant Wellness.

ApoE4, MTHFR & Cognitive Risk

- ApoE4 polymorphism increases amyloid deposition, oxidative stress, and brain aging

- MTHFR mutations impair methylation, homocysteine clearance, and detoxification

- Combination increases risk of Alzheimer's, vascular damage, and mood disorders

- Personalized strategies: folate/B12 repletion, lipid support, and neuroinflammatory control

References:
Alcolea D et al. Genetic Risk Factors in Cognitive Decline. Neurology. 2023.
Vibrant Wellness – ApoE/MTHFR Panel Reference Overview.

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Mitochondrial Dysfunction in Brain Aging

- Neurons are highly energy dependent; mitochondrial failure impacts cognition and emotion

- Toxins, infections, and chronic inflammation lead to impaired ATP production

- Linked to brain fog, neurodegeneration, fatigue, and neuropsychiatric decline

- Markers: 8-OHdG, lactate, CoQ10 deficiency, and abnormal OAT findings

References:
Gambino CM et al. Oxidative and Mitochondrial Stress in Brain Aging. Curr Pharm Des. 2019.
Vibrant Wellness – Mitochondrial Markers and Interpretation.

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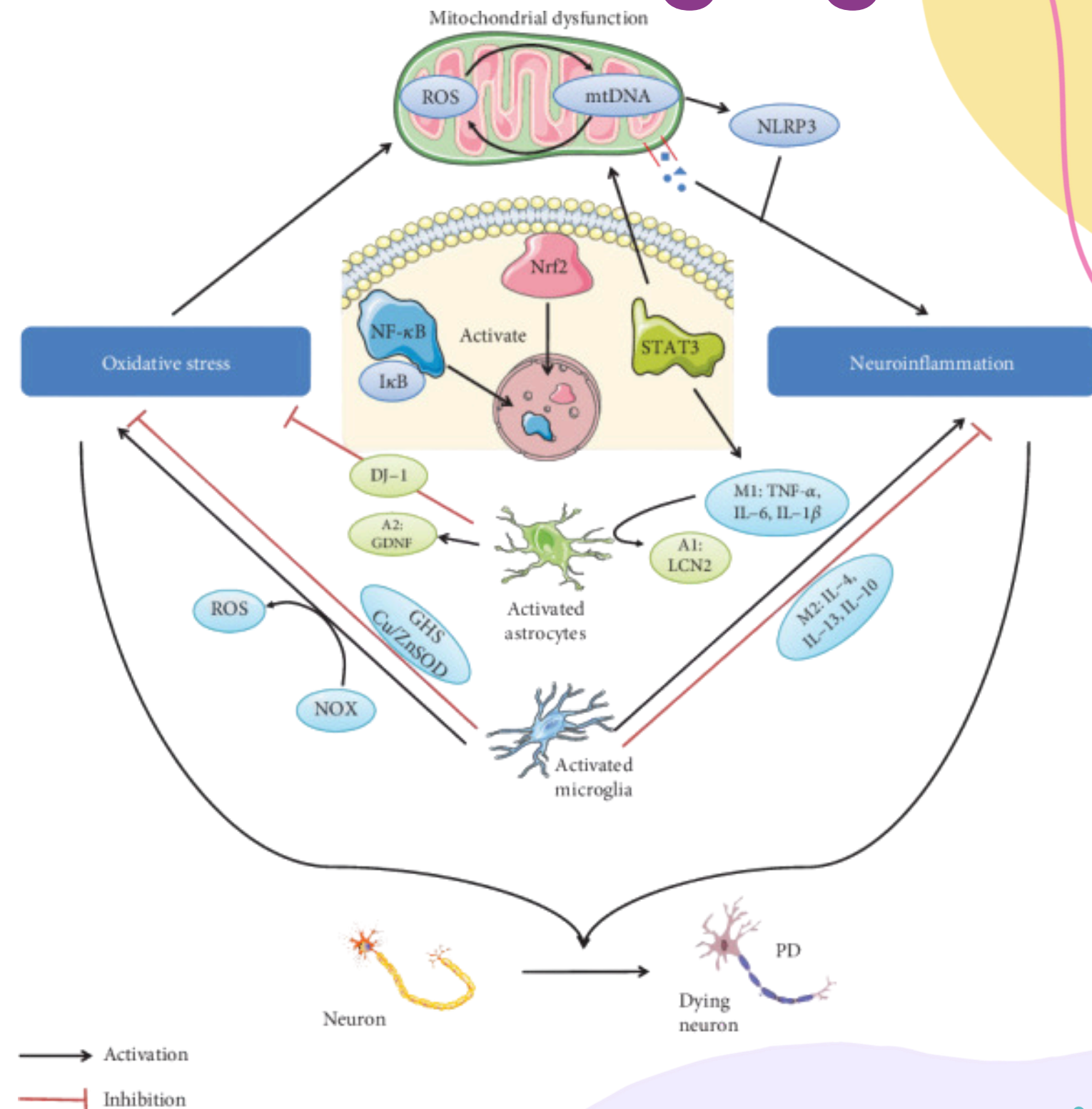
Clinical Interpretation of Biomarkers

- Integrate antibody positivity with patient symptoms, history, and scan patterns

- Look for correlation between neuropermeability and neural autoimmunity

- Elevated inflammation with mitochondrial or methylation deficits = priority for intervention

- Use labs longitudinally to monitor recovery and adjust treatment

References:

Krawczuk D et al. Clinical Use of Neuroinflammatory Biomarkers. IJMS. 2024.

Vibrant Panels – Clinical Algorithms and Use Case Reports.

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Functional Integration with Imaging

- SPECT identifies functional brain changes from immune, toxic, or infectious drivers

- Lab data (e.g., Neural Zoomer) confirms pathophysiologic mechanism

- Example: cerebellar hypoperfusion + S100B elevation + mold exposure = detox priority

- Multimodal diagnostics accelerate diagnostic confidence and targeted therapy

References:
Ferrando R, Damian A. SPECT Biomarkers in Functional Imaging. Front Neurol. 2021.
Chaudhary S et al. Blood Biomarkers with Imaging Correlation. Neurosci Biobehav Rev. 2025.

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Case Study: Early Detection

- Patient: 38-year-old executive with memory issues and cognitive burnout

- Labs: anti-MBP+, elevated 8-OHdG, zonulin high, ApoE4+/MTHFR+/low SAM:SAH

- **SPECT**: hypoperfusion in prefrontal cortex, anterior cingulate, and cerebellum

- **Intervention**: targeted methylation, detox, limbic retraining = full clinical recovery
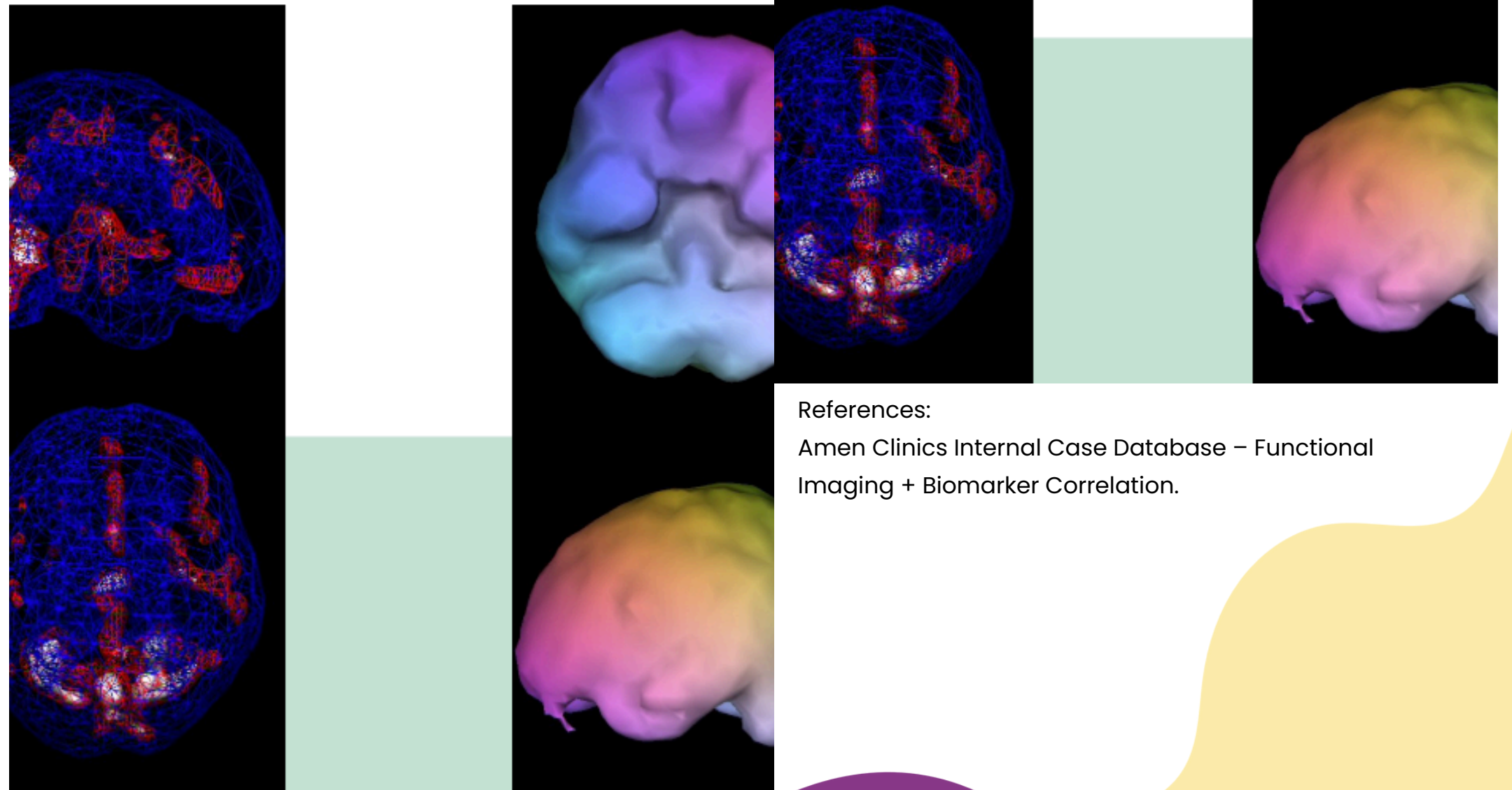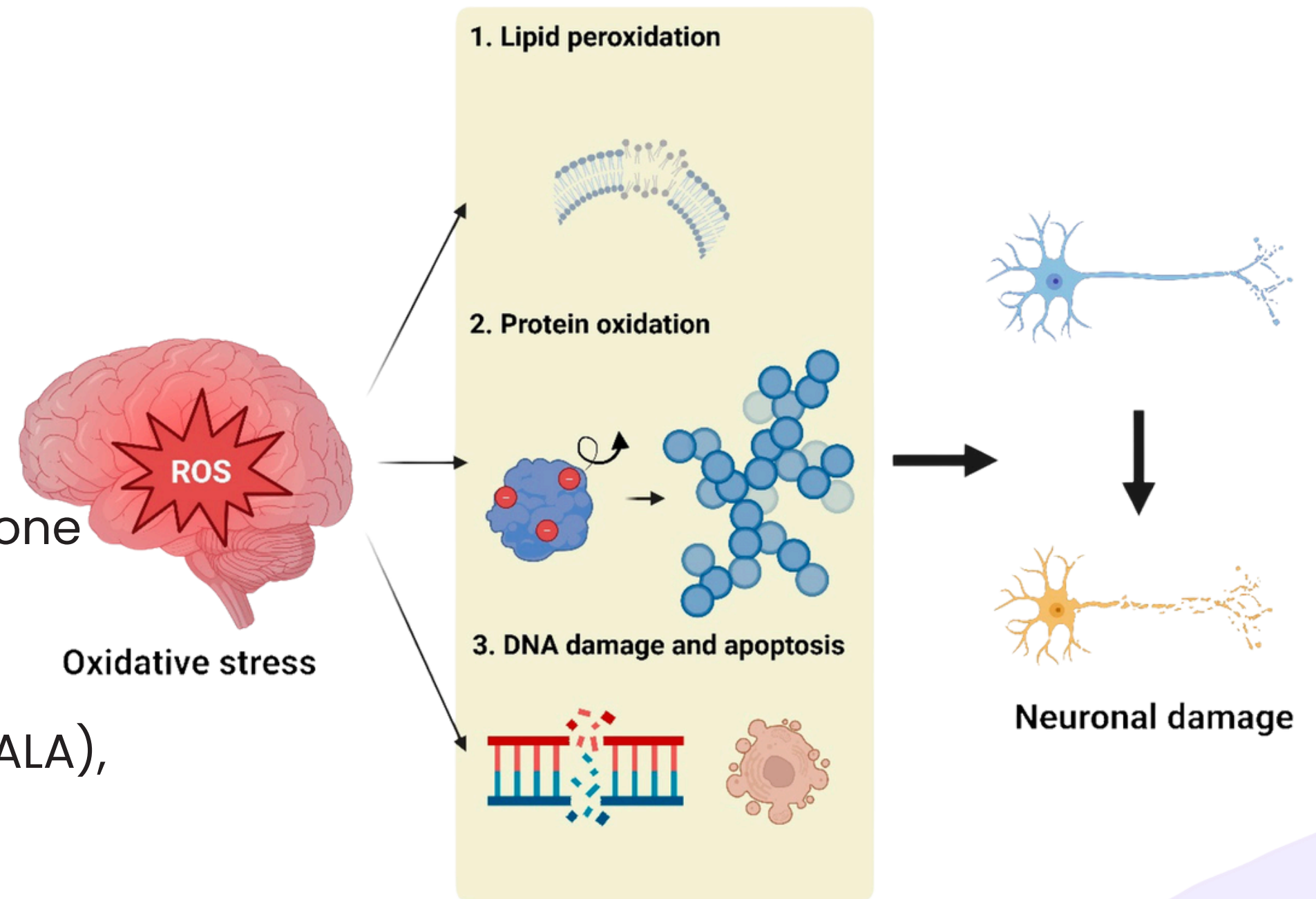

References:
Amen Clinics Internal Case Database – Functional Imaging + Biomarker Correlation.

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Oxidative Stress and Brain Health

- Excess ROS damages DNA, lipids, and mitochondria, impairing neural signaling

- Common in mold, metal exposure, viral infections, and trauma survivors

- Markers: 8-OHdG, lipid peroxides, glutathione status (GSH:GSSG ratio)

- Treat with antioxidants (NAC, resveratrol, ALA), detox, and nutrient support

Oxidative stress

ROS

1. Lipid peroxidation

2. Protein oxidation

3. DNA damage and apoptosis

Neuronal damage

References:
Gambino CM et al. Redox Imbalance in Neurodegenerative Aging. Curr Pharm Des. 2019.
Healthspan Assessment – Redox Markers. Vibrant Wellness.

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Chronic Neuroinflammation Impact

- Sustained glial activation leads to synaptic pruning and neurotransmitter imbalance

- Mood disorders, cognitive decline, and neurodegeneration share inflammatory pathways

- Neuroinflammation drives disconnection across key networks: limbic, executive, sensory

- Addressing triggers early prevents structural loss and stabilizes function

References:
Rauf A et al. Inflammation and Synaptic Impairment. Molecules. 2022.
Chaudhary S et al. Inflammation in Aging Brains. Neurosci Biobehav Rev. 2025.

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Post-Viral Neuroimmune Dysregulation

- Post-viral syndromes involve persistent immune activation and autoimmunity

- COVID, EBV, HHV-6 linked to brain fog, fatigue, autonomic instability, and dysbiosis

- **Common patterns:** high S100B, anti-GAD65, zonulin, and low mitochondrial markers

- **SPECT**: frontal/limbic hypoperfusion with poor cerebellar regulation

References:
Sian-Hulsmann J, Riederer P. Viral Neuroinflammation and Dysregulation. J Neural Transm. 2024.
Amen Clinics COVID and Post-viral SPECT Cases – Internal Database.

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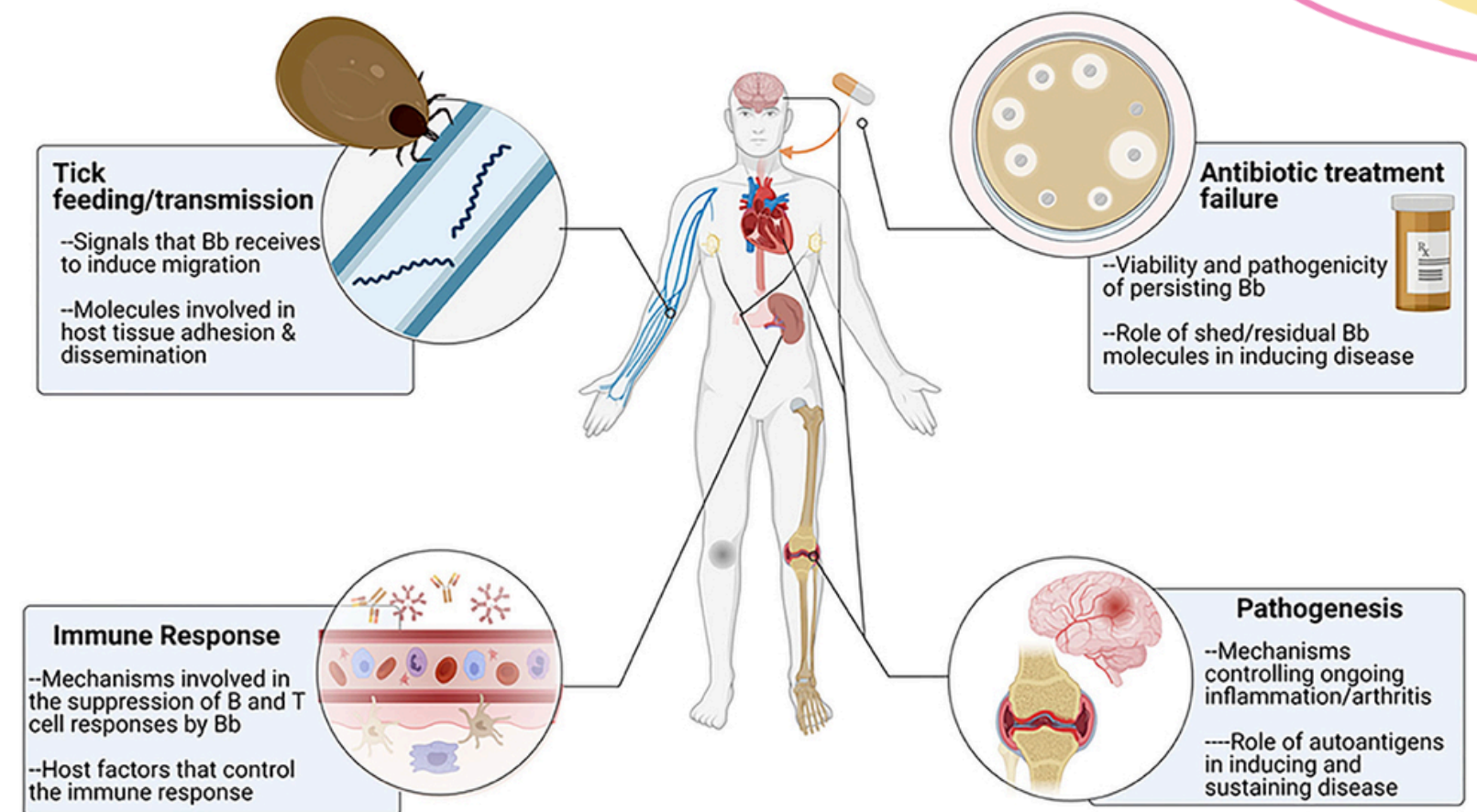Summit

Neuroimmune Cascade in Lyme Disease

- Lyme Disease patients show sustained cytokine elevation and neural autoantibodies

- Symptoms: executive dysfunction, memory issues, depression, tachycardia

- SPECT shows frontal, cerebellar, and basal ganglia perfusion changes

- Treatment: neuroimmune stabilization, limbic rehab, mitochondrial support

Host/pathogen interactions in Lyme disease: gaps in knowledge

Tick feeding/transmission
--Signals that Bb receives to induce migration
--Molecules involved in host tissue adhesion & dissemination

Antibiotic treatment failure
--Viability and pathogenicity of persisting Bb
--Role of shed/residual Bb molecules in inducing disease

Immune Response
--Mechanisms involved in the suppression of B and T cell responses by Bb
--Host factors that control the immune response

Pathogenesis
--Mechanisms controlling ongoing inflammation/arthritis
----Role of autoantigens in inducing and sustaining disease

References:
Chaudhary S et al. Imaging and Biomarkers in Post-COVID Neurocognitive Syndrome. Neurosci Biobehav Rev. 2025.
Valotassiou V et al. COVID-Related SPECT Findings. Ann Nucl Med. 2018.

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Cognitive Burnout & Early Intervention

- High-functioning patients with burnout show neuroinflammatory brain changes

- Cerebellar and prefrontal hypoperfusion common with disrupted limbic processing

- Intervene with methylation, detox, mitochondrial repair, and emotional retraining

- Outcome: improved executive function, mood resilience, and brain performance
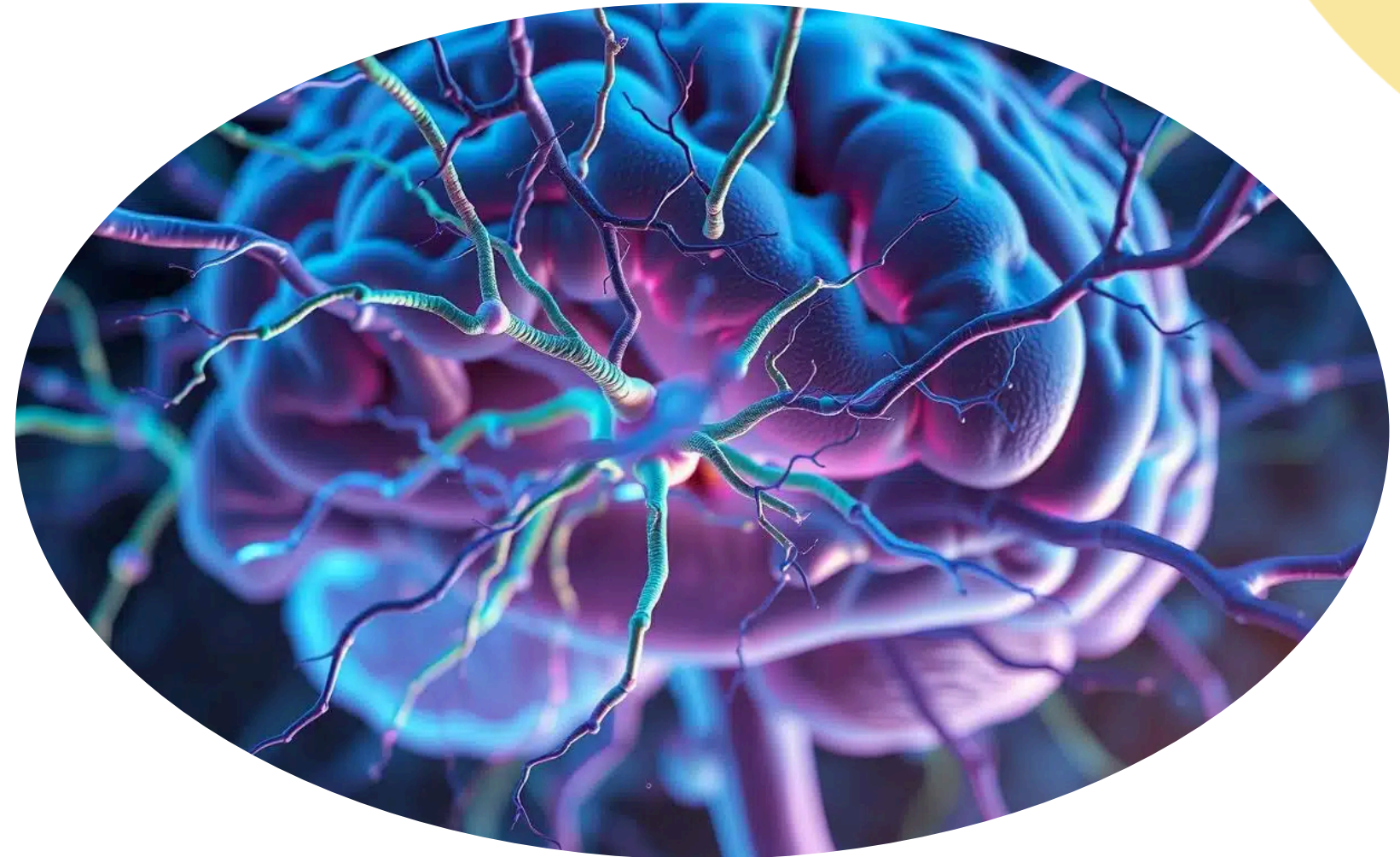
References:
Ferrando R, Damian A. Functional SPECT in Cognitive Fatigue. Front Neurol. 2021.
Amen Clinics Clinical Case Review – Executive Brain Burnout and Recovery.

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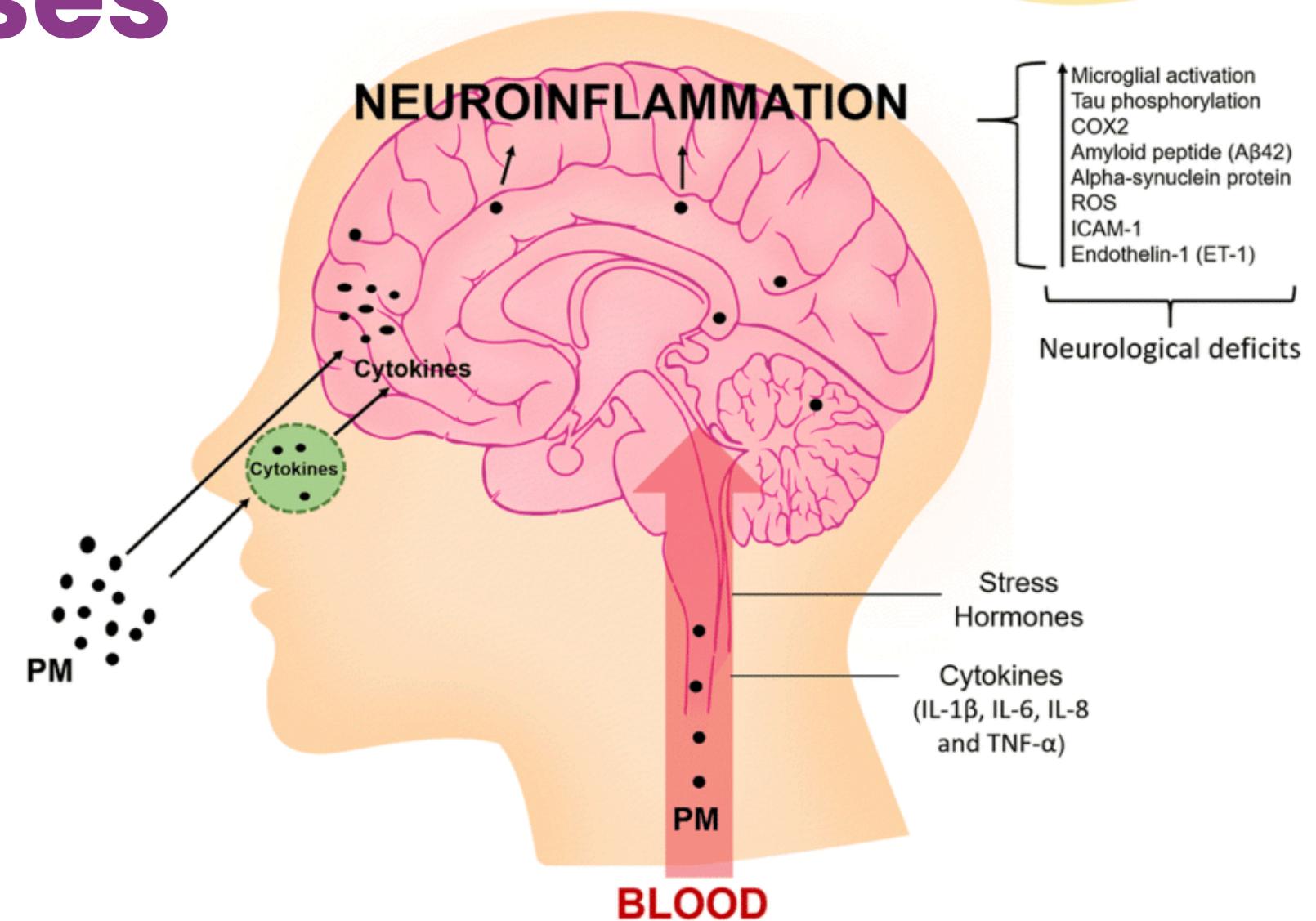Summit

Treatment Strategies: Addressing Root Causes

- Identify infections (Lyme, viruses), toxins (mold, metals), trauma, and dysbiosis

- Match lab results and SPECT findings to underlying pathophysiology

- Begin with stabilization: detox pathways, sleep, nutrients, limbic regulation

- Avoid symptom suppression—focus on causative mechanisms

References:

Fornari Laurindo L et al. Immunomodulatory Approaches to Neuroinflammation. Front Immunol. 2023.

Vibrant Clinical Strategy Guides – Multisystem Chronic Illness.

NEUROINFLAMMATION

Cytokines

Cytokines

PM

Microglial activation
Tau phosphorylation
COX2
Amyloid peptide (Aβ42)
Alpha-synuclein protein
ROS
ICAM-1
Endothelin-1 (ET-1)

Neurological deficits

Stress Hormones

Cytokines (IL-1β, IL-6, IL-8 and TNF-α)

PM

BLOOD

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Targeted Anti-inflammatory Protocols

- Use quercetin, curcumin, luteolin, boswellia to reduce microglial activation

- Consider low-dose naltrexone (LDN) for neuroimmune modulation

- Use histamine-lowering strategies in MCAS/PANS (DAO, low-histamine diet)

- Taper carefully in autoimmunity or mold recovery —watch immune rebound

References:

Soraci L et al. Neuroinflammaging and Immune Modulators. Aging Dis. 2024.

Clinical Review of Low-Dose Naltrexone for Neuroinflammation. IJMS. 2024.

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Redox Balance & Methylation Support

- Support glutathione with NAC, liposomal glutathione, or IV GSH when needed

- Correct SAM/SAH imbalance using methylated B vitamins, TMG, magnesium

- Consider OAT to track oxalates, arabinose, mitochondrial intermediates

- Optimize antioxidant network: ALA, vitamin C, resveratrol, CoQ10

References:
Healthspan Assessment Interpretation Manual – Vibrant Wellness.
Qin Q et al. Redox and Methylation Markers in Cognitive Aging. J Alzheimers Dis. 2025.

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Nutraceuticals and Clinical Dosing

- Resveratrol: 200–400mg daily—NF-κB and inflammasome modulation

- Curcumin (Meriva/BCM-95): 500–1000mg BID for microglial control

- NAC: 600–1800mg for glutathione repletion and detox support

- Lumbrokinase or nattokinase: reduce biofilm and microcirculatory inflammation

References:
Rauf A et al. Bioactive Compounds in Neuroinflammation. Molecules. 2022.
Integrated Supplement Strategies in Functional Neurology. Curr Pharm Des. 2024.

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Immunomodulatory Interventions

- IVIG or SCIG considered in autoimmune neuroinflammation with positive Cunningham/Vibrant markers

- Peptide therapies (BPC-157, thymosin beta-4) used for neuroregeneration

- LDN and microdose immunotherapy (MDI) in mast cell and neuroimmune overlap

- Support vagal tone: biofeedback, gargling, humming, limbic retraining
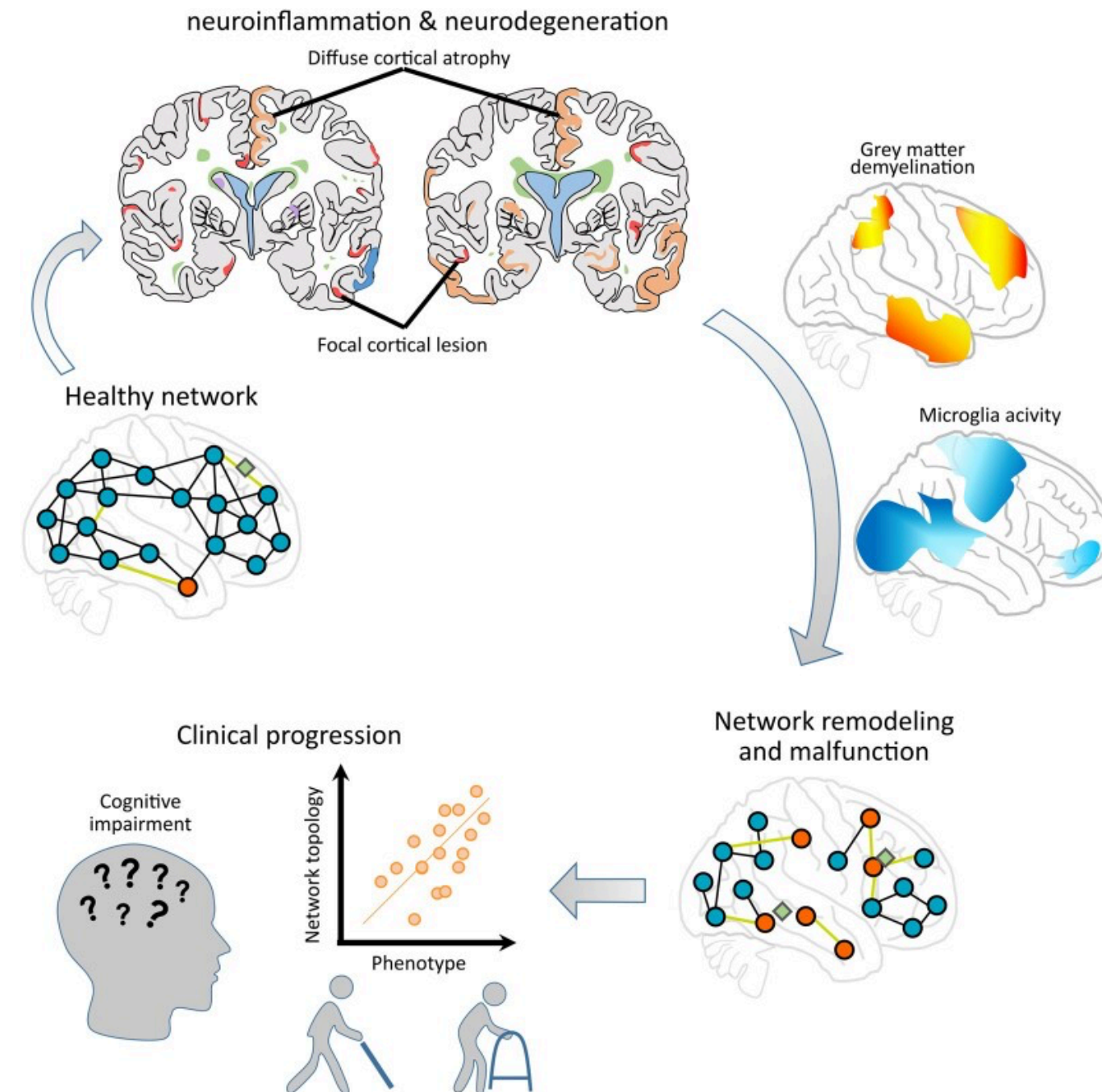
References:
Clinical Applications of Immunoglobulins in Neuroimmune Disorders. Front Immunol. 2023.
Integrative Approaches to Autoimmune Encephalopathy. Neurotherapeutics. 2024.

Supporting BBB Integrity

- Use butyrate (sodium or tributyrin) to enhance tight junction stability

- Flavonoids (e.g., luteolin, rutin) calm mast cells and preserve endothelium
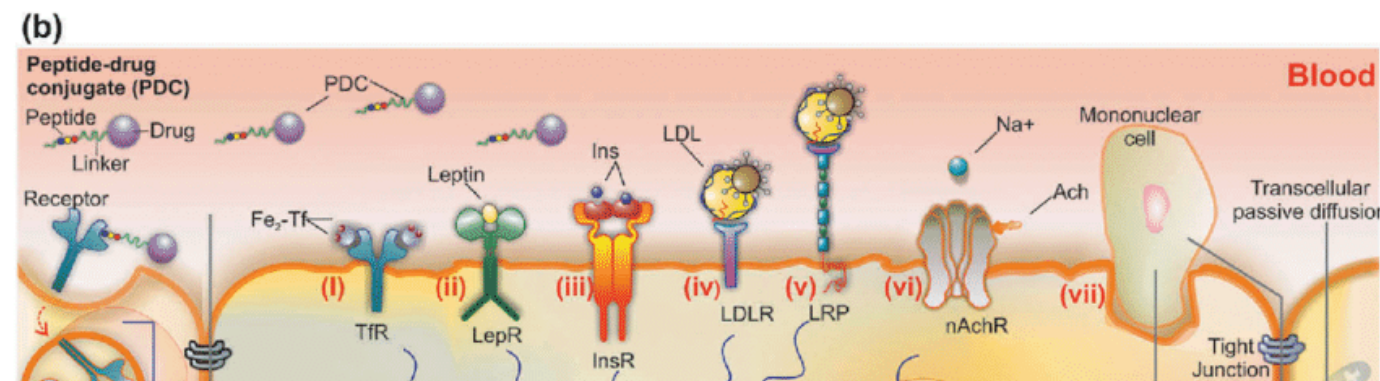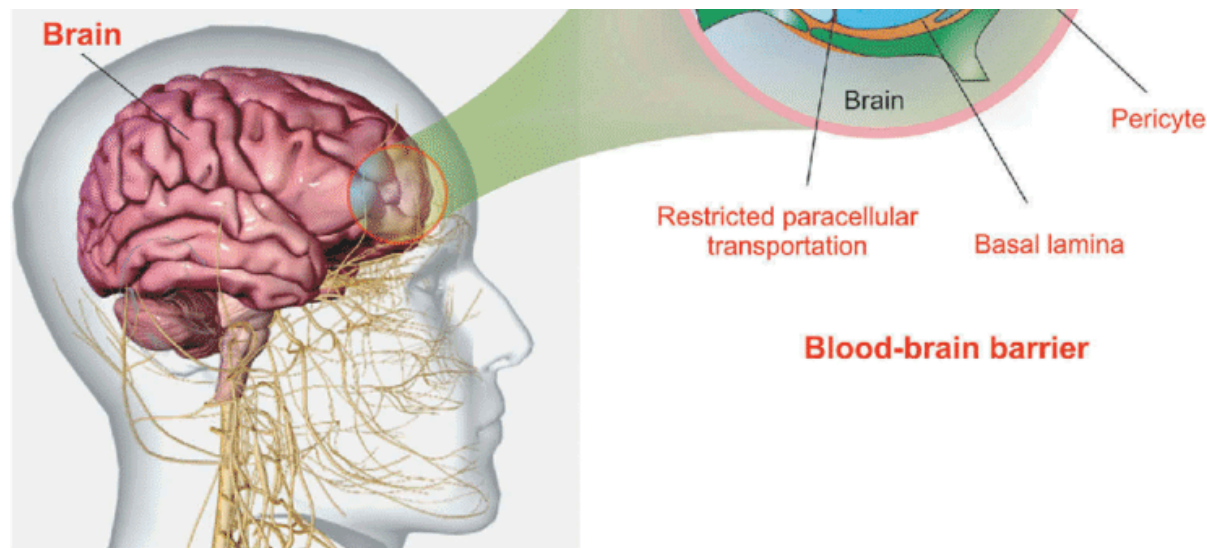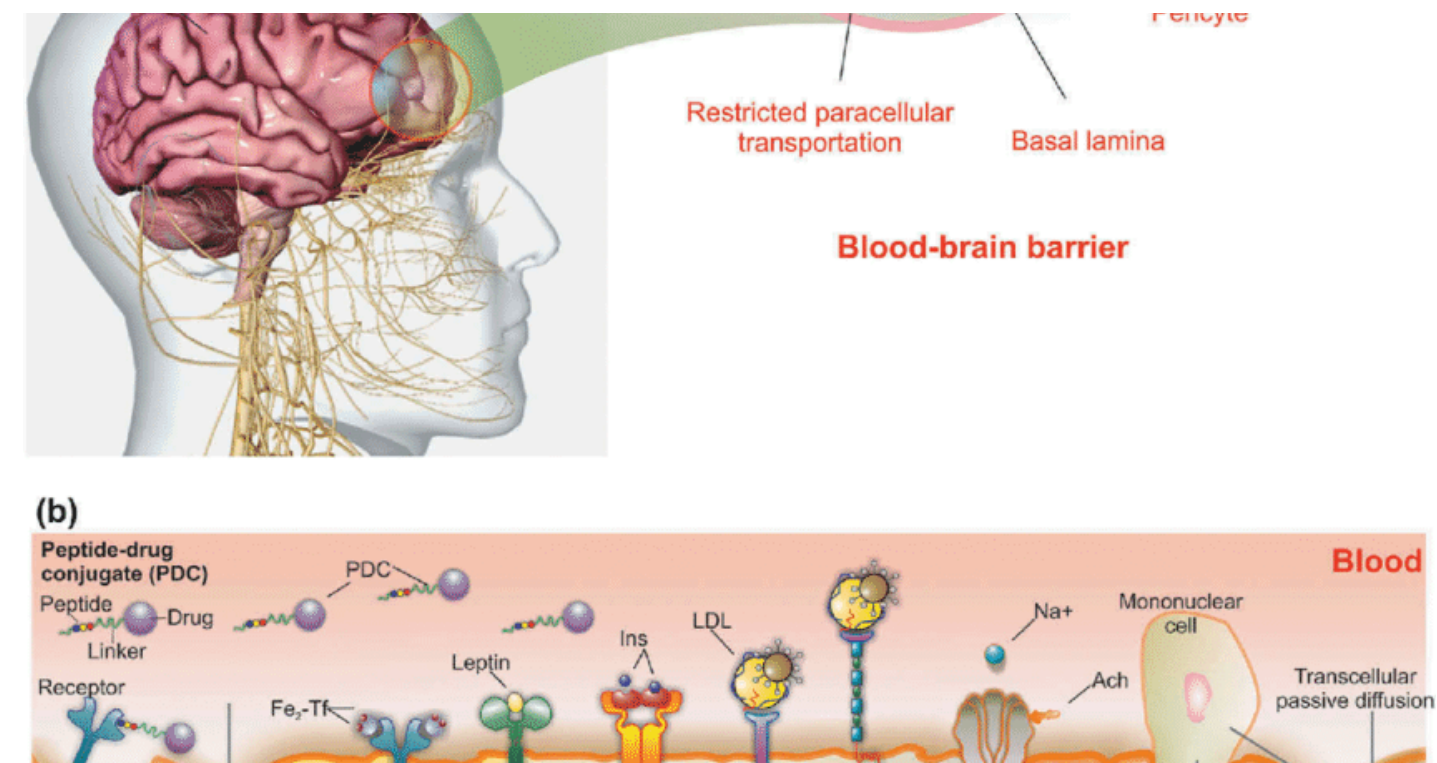
- Fish oil (EPA/DHA) and phosphatidylcholine support membrane fluidity

- Consider low-histamine diet and microbiome-directed therapy to reduce BBB stress

References:
Gambino CM et al. Blood–Brain Barrier Restoration in Aging. Curr Pharm Des. 2019.
Zonulin and Permeability Modulators – Functional Nutrient Review. IJMS. 2023.

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Lifestyle & Environmental Factors

- Sleep and circadian rhythm optimization key for glymphatic detox

- EMF, fragrance, and mold avoidance reduce neuroinflammatory triggers

- Breathwork, exercise, and trauma processing reduce limbic reactivity

- Treat patient environment with same priority as internal lab results
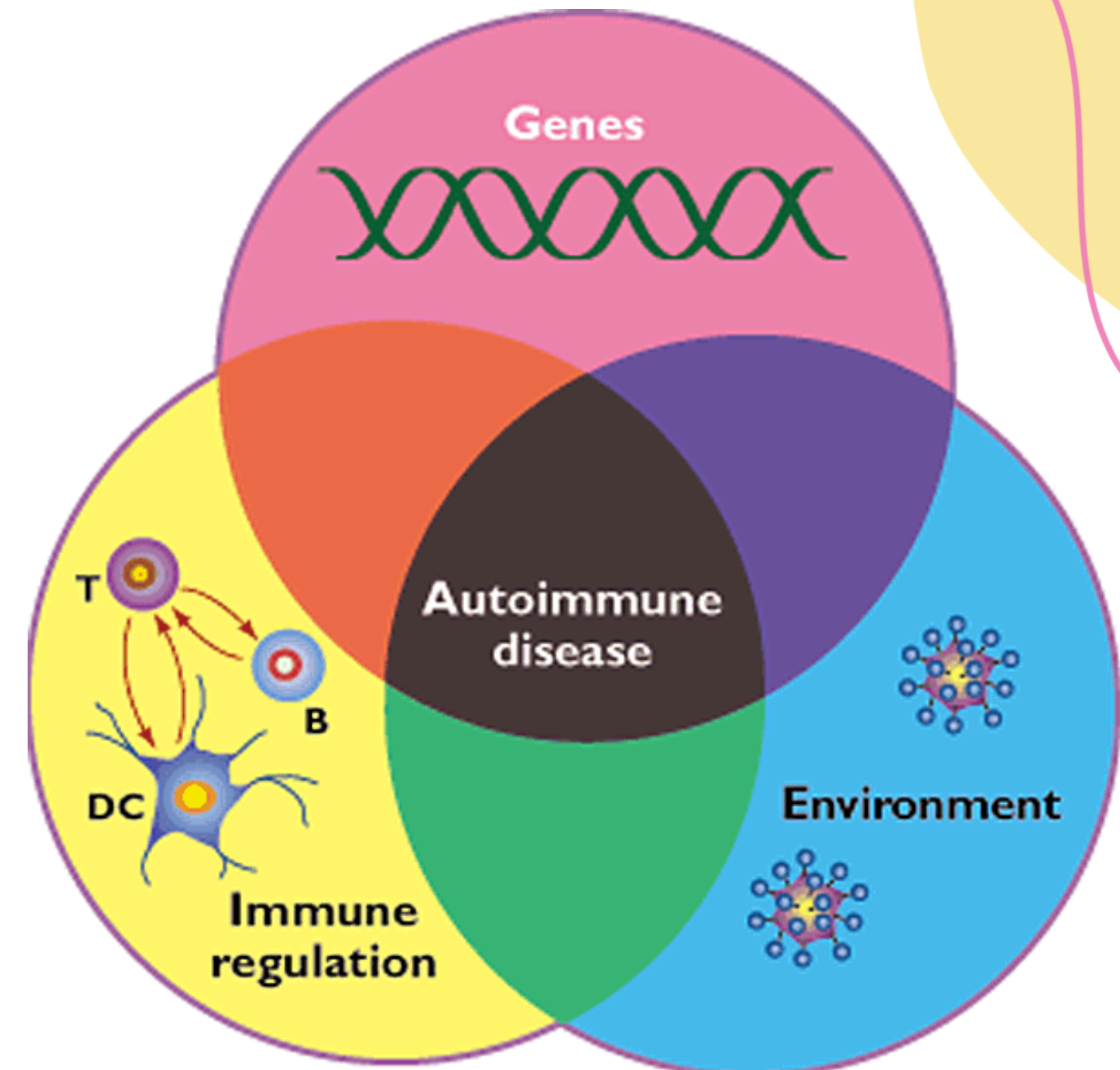
References:
Lifestyle Modulation of Brain Inflammation. Neurosci Biobehav Rev. 2025.
Environmental Triggers and Neuroimmune Activation. Curr Opin Immunol. 2024.

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Brain Longevity Program Design

- Combine SPECT and biomarker analysis for baseline stratification

- Offer 8–12 week program targeting detox, brain nutrition, sleep, and neuroplasticity

- Customize protocols for executives, athletes, or post-viral recovery

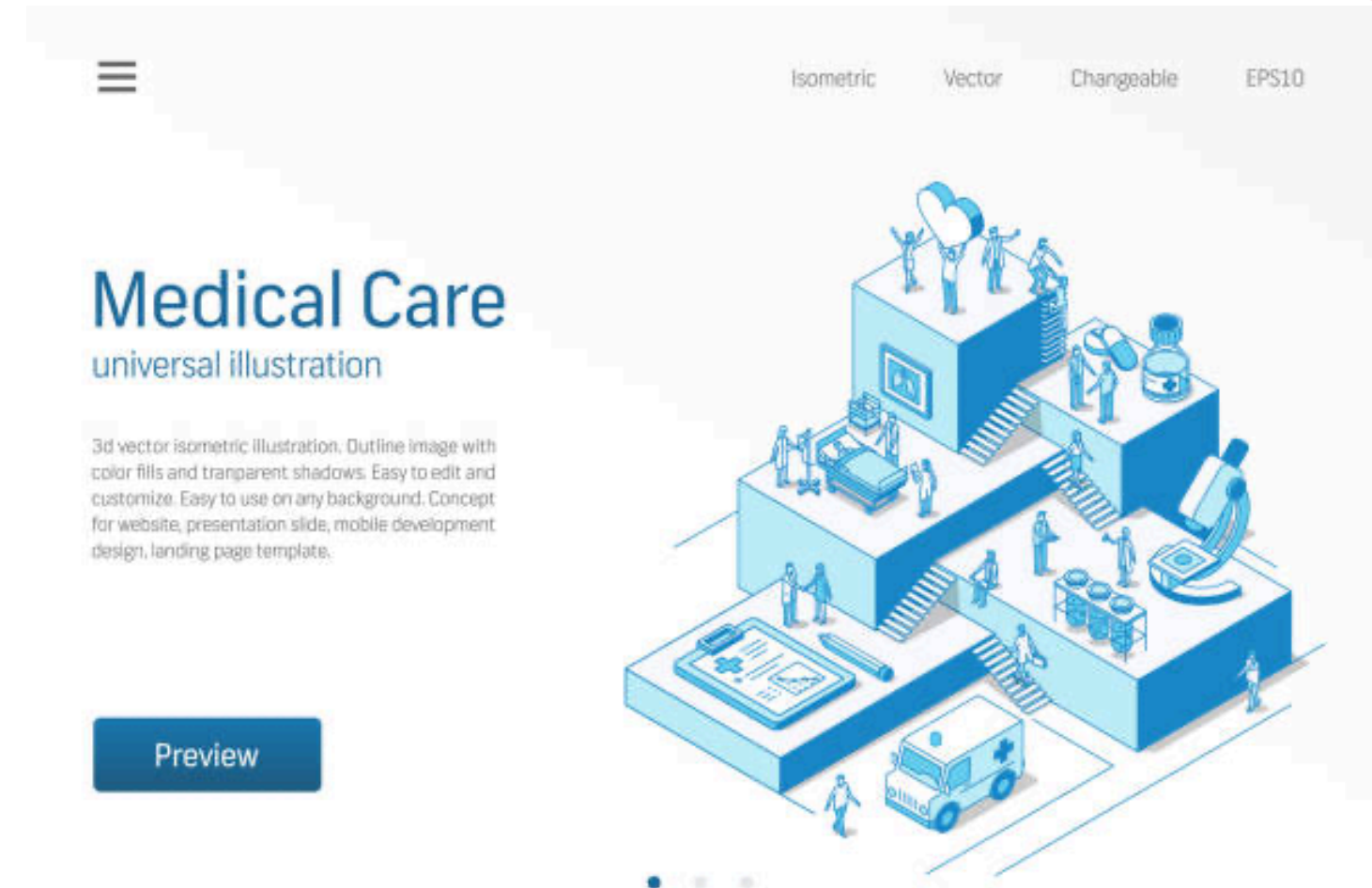- Track outcomes with labs, repeat SPECT, and cognitive assessments

References:
Ferrando R, Damian A. Clinical Use of Functional SPECT. Front Neurol. 2021.
Personalized Brain Longevity Programs. Functional Neurology Reviews. 2024.

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Building Patient-Centered Models

- Empower patients with visual results from SPECT and biomarker review

- Integrate coaching, emotional resilience work, and brain retraining

- Offer concierge-level tracking or group model for education and compliance

- Optimize care teams around neuroimmune recovery, not symptom suppression

Medical Care
universal illustration

3d vector isometric illustration. Outline image with color fills and transparent shadows. Easy to edit and customize. Easy to use on any background. Concept for website, presentation slide, mobile development design, landing page template.

Isometric   Vector   Changeable   EPS10

Preview

References:
Models of Integrative Care in Neuroinflammatory Conditions. Front Psychiatry. 2023.
Patient Empowerment through Functional Brain Metrics. Clin Integr Med. 2024.

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High-Functioning Patient Protocols

- Identify 'walking wounded'—patients with normal MRI but SPECT/lab abnormalities
- Optimize methylation, reduce toxic load, and modulate inflammation with precision
- Create resilience protocols: polyphenols, sleep cycles, digital detox, HRV training
- Use advanced biomarkers to guide high-performance cognitive recovery

References:
Functional Neurorehabilitation for Cognitive Optimization. Curr Pharm Des. 2024.
Amen Clinics Performance Recovery Protocols – Case Compilation 2023.

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Thank You!

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An Integrated Model for NeuroCognitive Disorders

Casting your Diagnostic Nets Wide
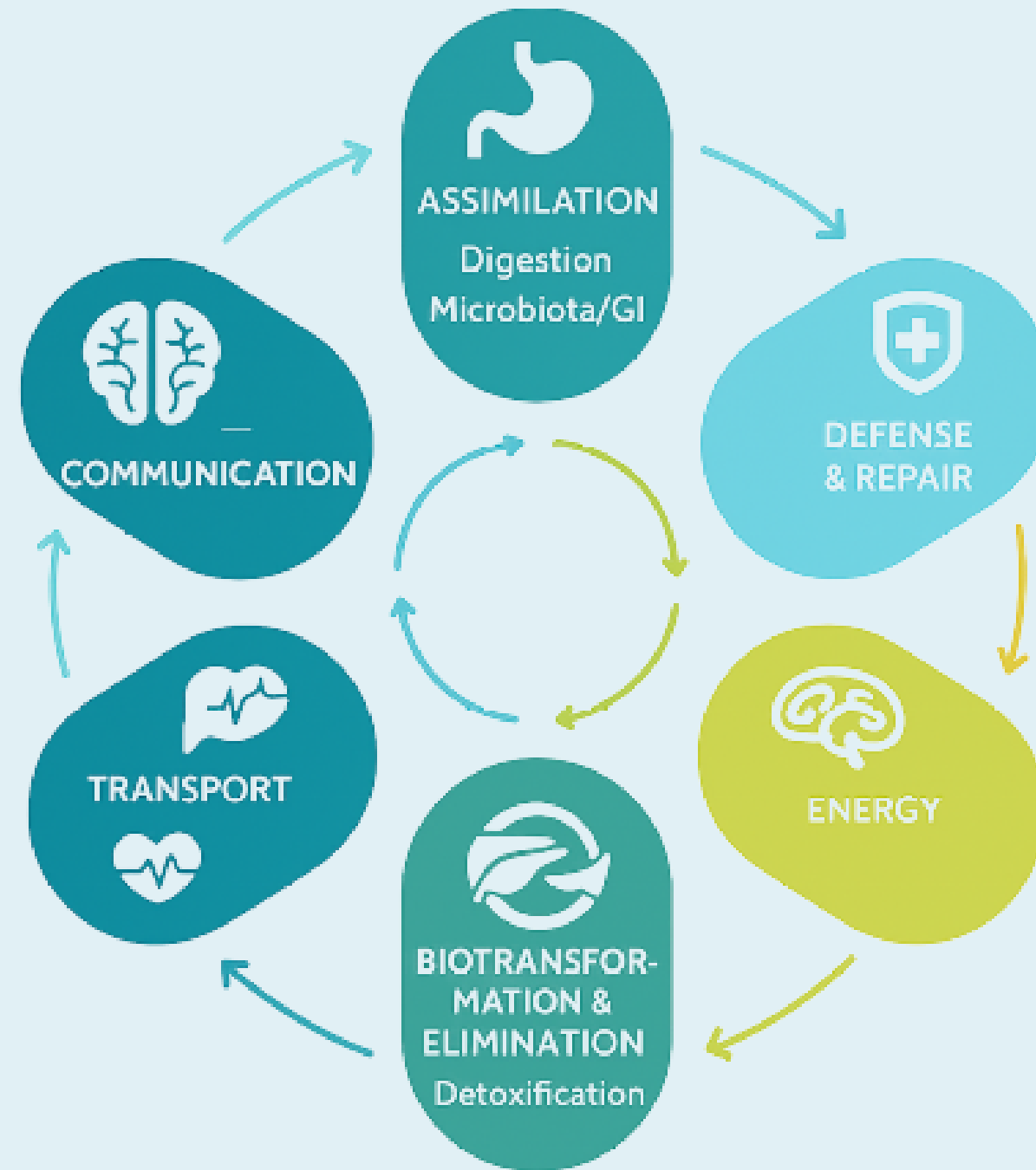
N.D. Victor Carsrud

PhD, MD, DC, MBBS, DABCI, DCBCN

Meet Your Speaker

Dr. N.D. Victor Carsrud
PhD, MD, DC, MBBS, DABCI, DCBCN

- Naturologica, PLLC
- Lakeline Wellness Center, PLLC
- Head of Functional Medicine & Health Innovation
  - BreatherMae Inc.
- Associate Editor
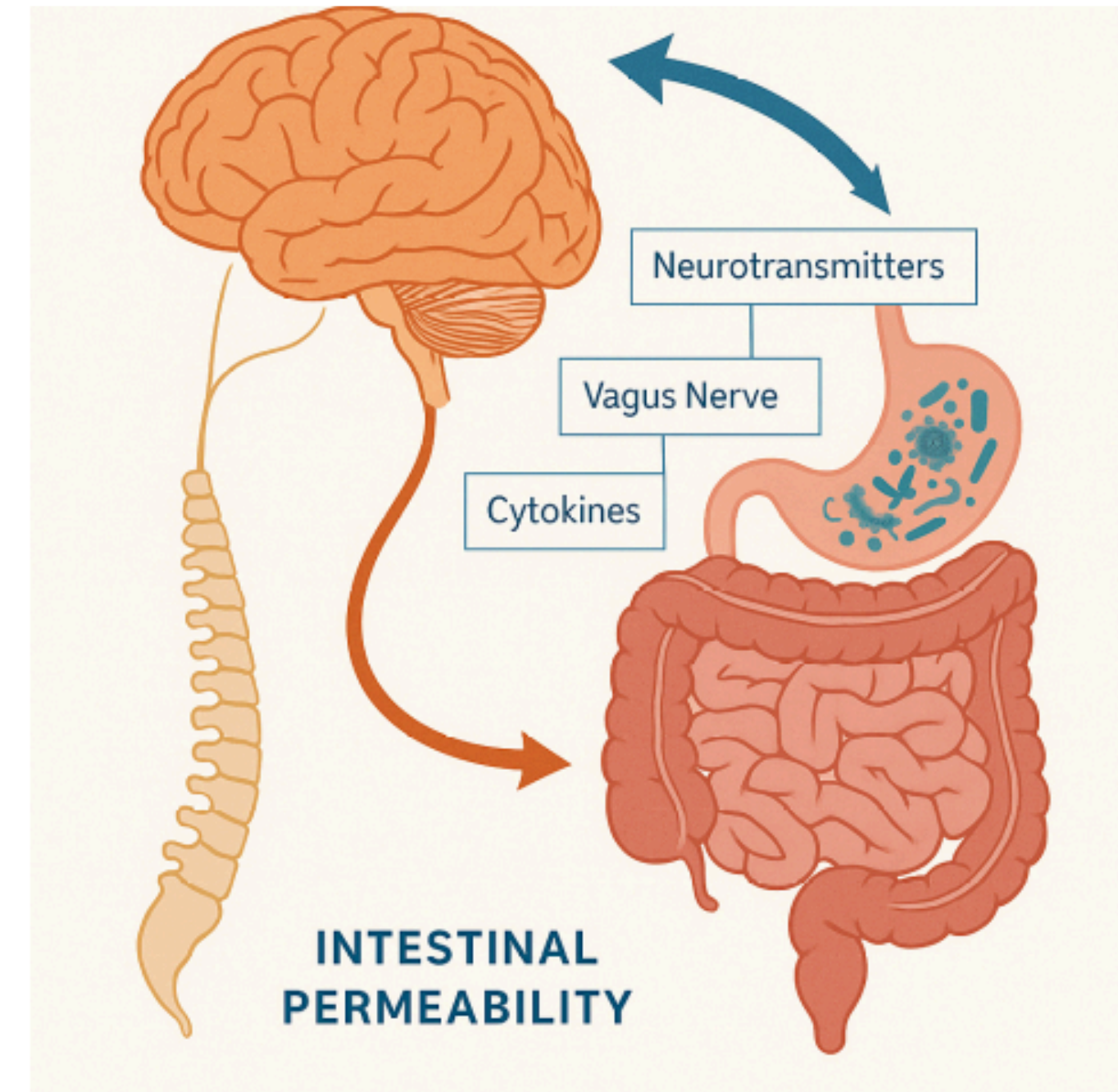 - Independent Global Medical Research Consortium (IGMRC)

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A Fundamental Philosophy of Functional Medicine is the Integration and Interaction of Function across Multiple Body Systems.
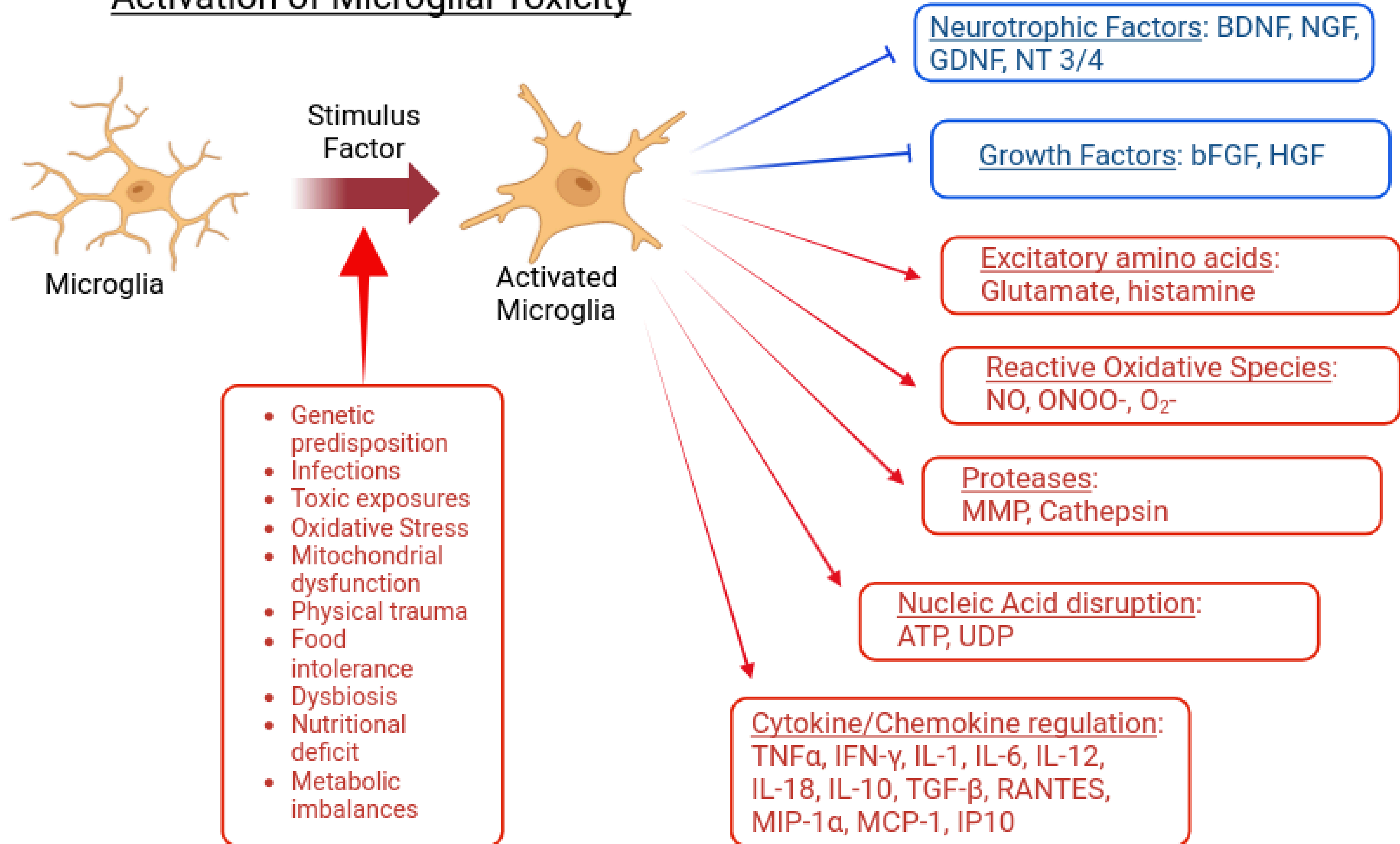
An Example:
The Gut Brain Axis

Always assess gut permeability and microbiome composition alongside neural autoimmunity.

Neural Zoomer Plus
Wheat Zoomer
Gut Zoomer

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Functional Medicine Assessment of Neurocognitive Disorders

FUNCTIONAL ASSESSMENT

INFECTIONS

METABOLIC AND NUTRITIONAL DEFICITS

HORMONAL IMBALANCE

NEURO TRANSMITTERS

DYSBIOSIS

TOXICITY

FOOD ALLERGIES

AUTO IMMUNITY

The Vibrant Longevity Summit

A Functional Medicine Model of Neurocognitive Decline

Genetic predispositions, Infections, Toxic exposures, Oxidative Stress, Mitochondrial dysfunction, Physical trauma, Food intolerance, Dysbiosis, Methylation & Nutritional deficits, Metabolic imbalances

Microglial Activation

TNF-a, IFN gamma, IL-1, IL-12, IL-18, IL-10, TGF-beta, RANTES, MIP-1 alpha, MCP-1, IP10

Inflammatory Cytokines

NO, ONOO-, O2, Environmental and endotoxemic radicals

Oxidative Stress

Loss of internal metabolic energy production
Destruction of MT reproduction.
Inhibition of electron transport chain

Mitochondrial Failure

Neurofibriliary tangles and decrease cortical volume (AD)
Decreased Acetylcholine (Parkinson's)
Demyelination and random lesions (Multiple Sclerosis)

Neuronal Death

Translational
Neurodegeneration

Neurodegenerative disorders, metabolic icebergs, and mitohormesis

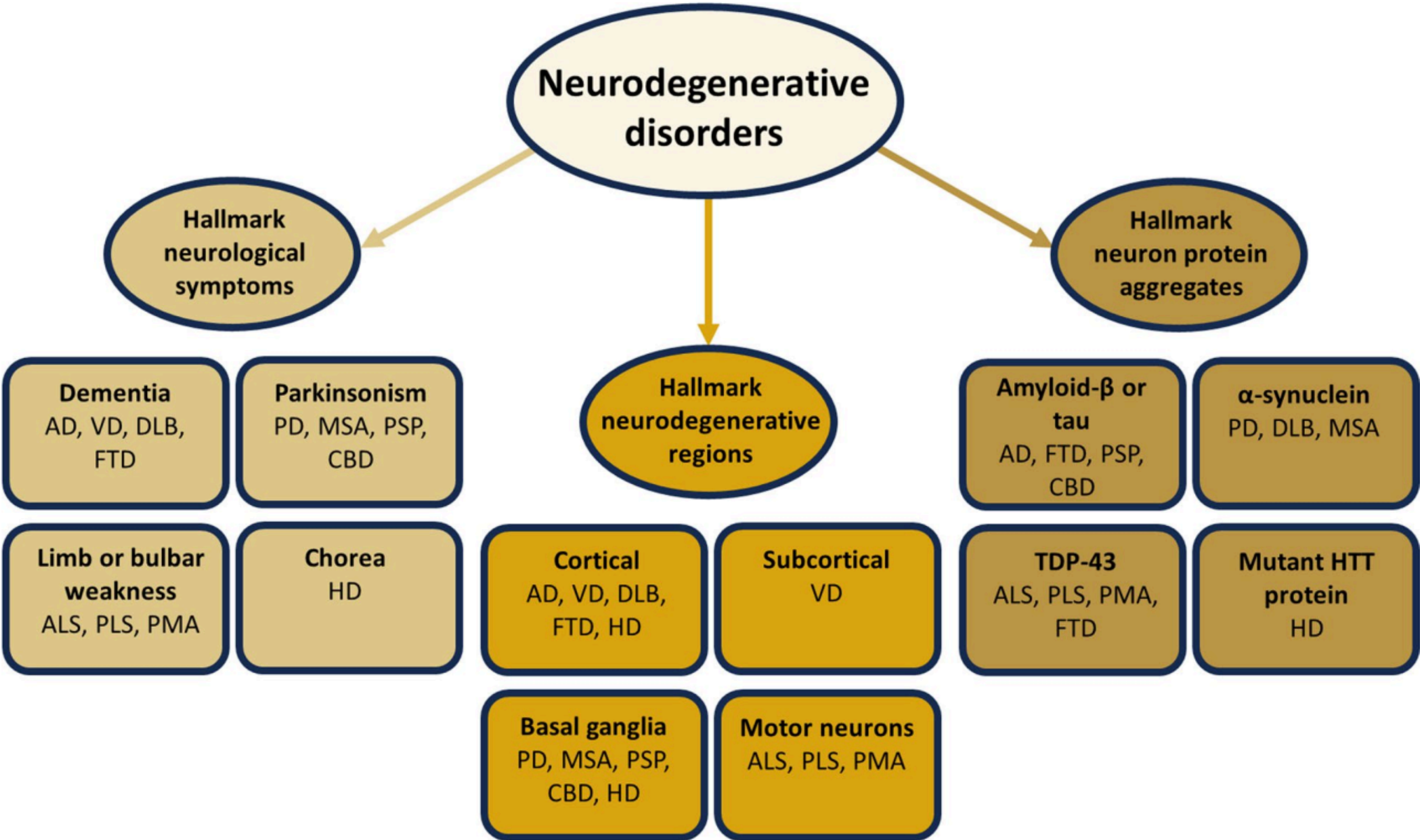Matthew C. L. Phillips[1,2]* and Martin Picard[3,4,5,6]

Fig. 1 Splitting perspective of neurodegenerative disorders. *AD* Alzheimer's disease, *VD* vascular dementia, *DLB* dementia with Lewy bodies, *FTD* frontotemporal dementia, *PD* Parkinson's disease, *MSA* multiple systems atrophy, *PSP* progressive supranuclear palsy, *CBD* corticobasal degeneration, *ALS* amyotrophic lateral sclerosis, *PLS* primary lateral sclerosis, *PMA* progressive muscular atrophy, *HD* Huntington's disease, *TDP-43* transactive response DNA binding protein 43, *HTT* Huntingtin
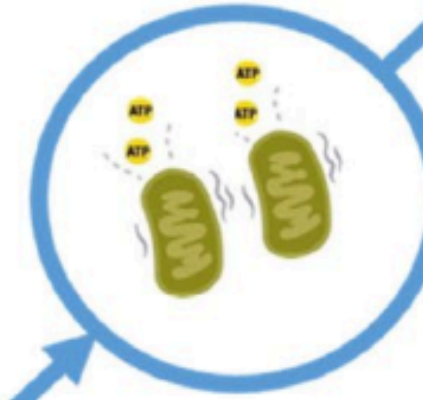
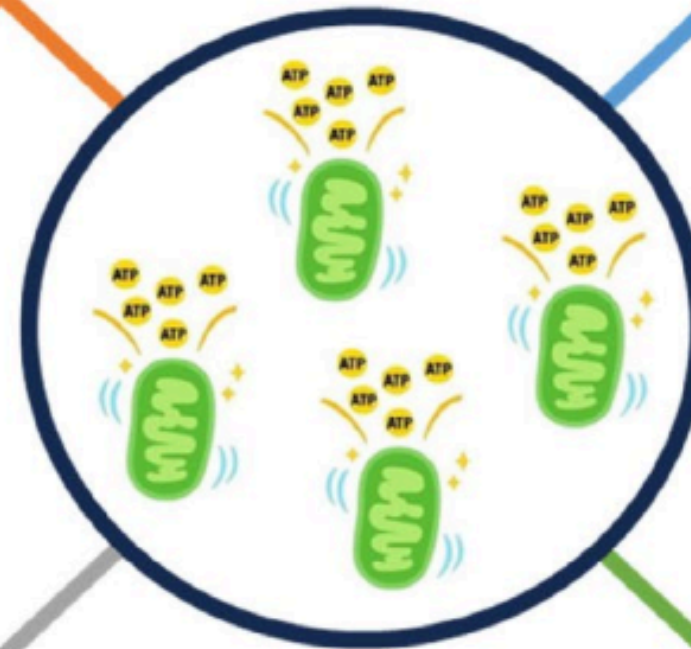Impaired mitotypes abundant in **hippocampus, entorhinal cortex, and cerebral cortex**

AD
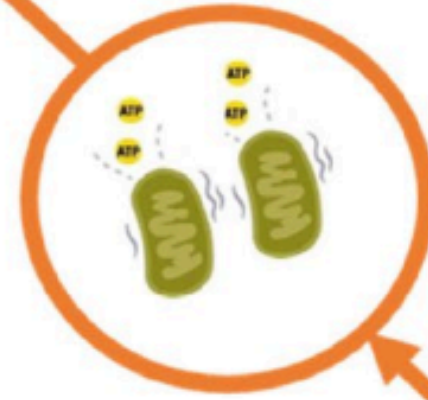
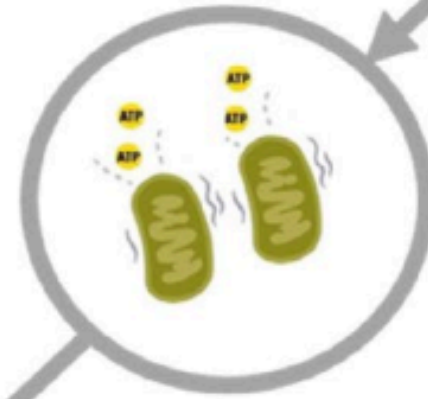Impaired mitotypes abundant in **substantia nigra, striatum, and cerebral cortex**

PD

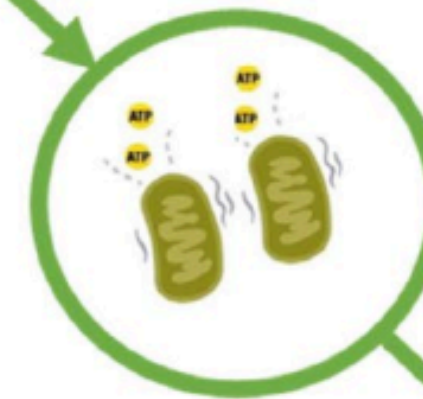Healthy mitochondrial pool in brain and body, which consists of many cell-specific mitotypes

Impaired mitotypes abundant in **brainstem and motor cortex**

ALS

Impaired mitotypes abundant in **striatum and cerebral cortex**

HD

Tip
- Hallmark neurological symptoms
- Hallmark neurodegenerative regions
- Hallmark neuronal protein aggregates

Bulk
- Impaired cellular metabolism
- Impaired cell-specific mitotypes
- Impaired mitochondrial behaviours
- Impaired mitochondrial functions
- Impaired mitochondrial activities
- Impaired mitochondrial features

Base
- Modern industrial toxins, dietary lifestyle, and cognitive, physical and social behaviours, as well as mutant genes

AD

Tip
- Cognitive impairment and dementia
- Atrophy in hippocampus, entorhinal cortex, and cerebral cortex
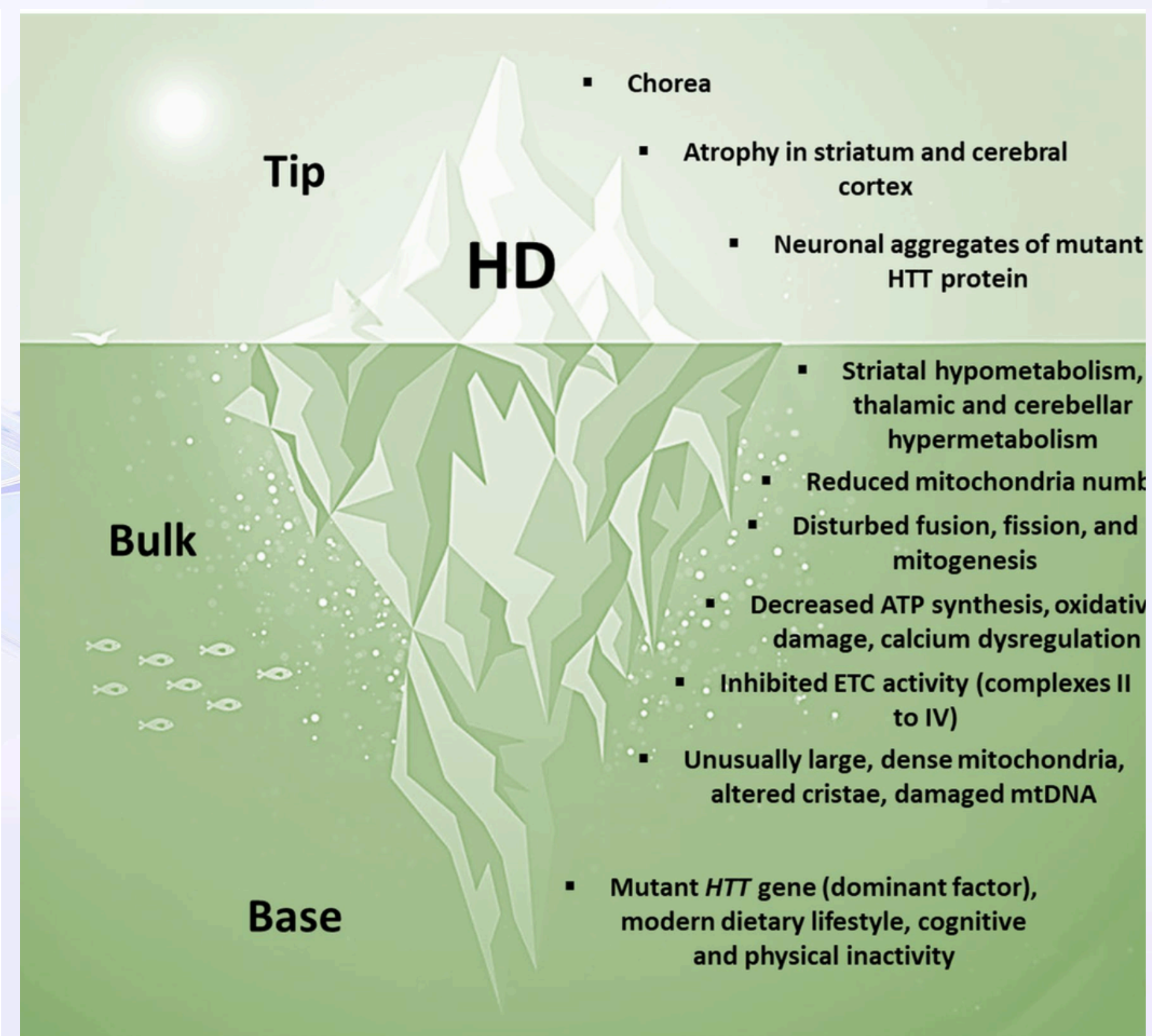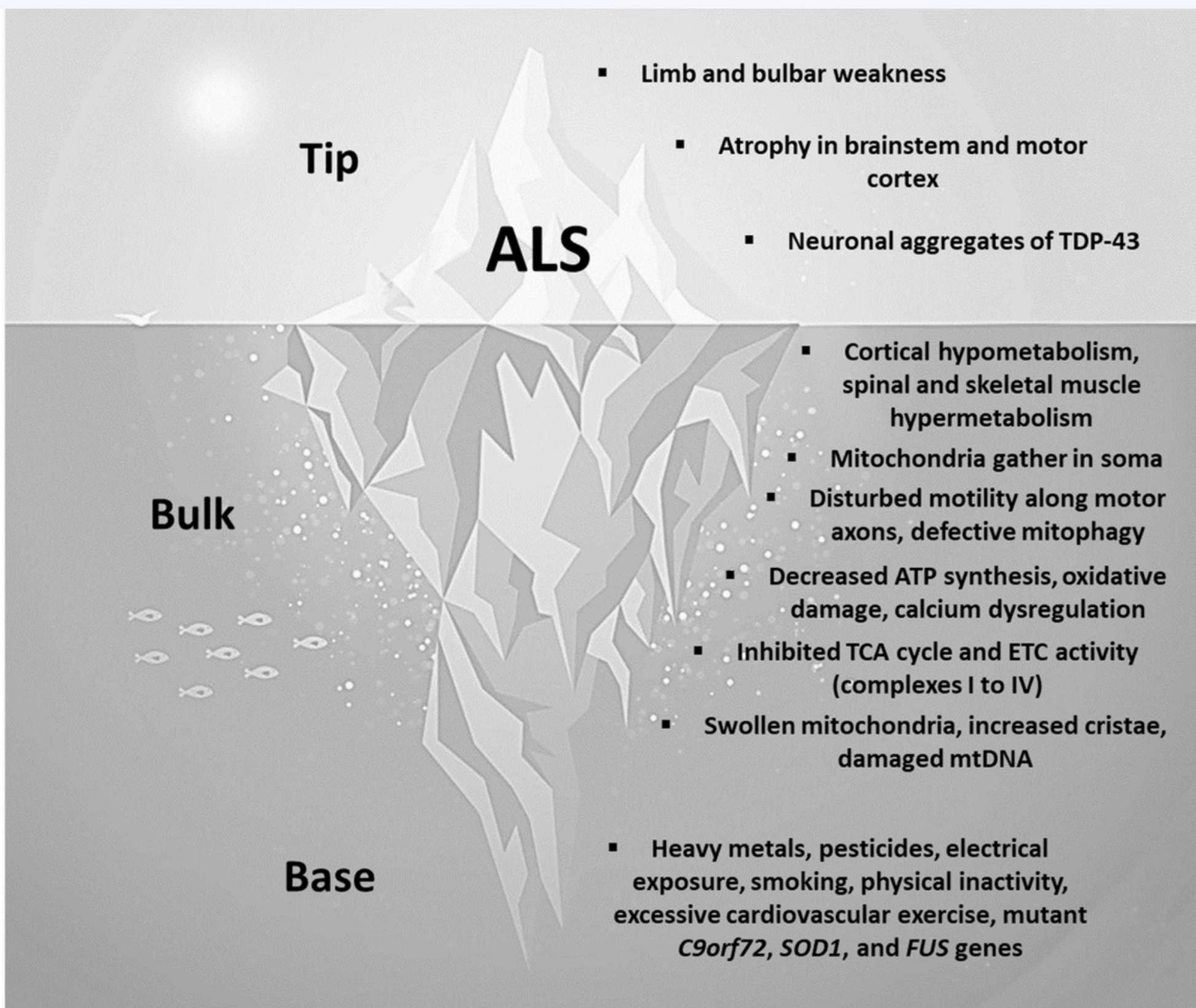- Neuronal aggregates of amyloid-β and tau

Bulk
- Hippocampal, entorhinal, and cortical hypometabolism
- Reduced mitochondria numbers in synapses
- Disturbed fusion, fission, motility, and mitophagy
- Decreased ATP synthesis, oxidative damage, calcium dysregulation
- Inhibited TCA cycle and ETC activity (particularly complex IV)
- Variable mitochondria shape, decreased size, altered cristae, damaged mtDNA

Base
- Heavy metals, air pollutants, pesticides, chemicals, modern dietary lifestyle, cognitive and physical inactivity, social isolation, poor sleep, *APOE4*, mutant amyloid precursor protein and presenilin genes

PD

Tip
- Parkinsonism
- Atrophy in substantia nigra, striatum, and cerebral cortex
- Neuronal aggregates of α-synuclein

Bulk
- Nigral, striatal, and cortical hypometabolism
- Mitochondria accumulate around nucleus
- Disturbed fusion, fission, motility, mitogenesis, and mitophagy
- Decreased ATP synthesis, oxidative damage
- Inhibited ETC activity (particularly complex I)
- Swollen mitochondria, pale matrix, few cristae, mtDNA deletions

Base
- Heavy metals, pesticides, chemicals, modern dietary lifestyle, physical inactivity, social isolation, poor sleep, mutant *PRKN* and *PINK1* genes

Case Study – "David"

- 65 yo Caucasian male
- Father, grandfather, husband
- Pastor, missionary
- His active lifestyle and calling had recently been withering
- Increasing difficulty walking
- Balance issues
- Forgetfulness
- Extreme fatigue and slowness
- GERD and IBS
- Hiatal hernia
- "Lactose Intolerant"
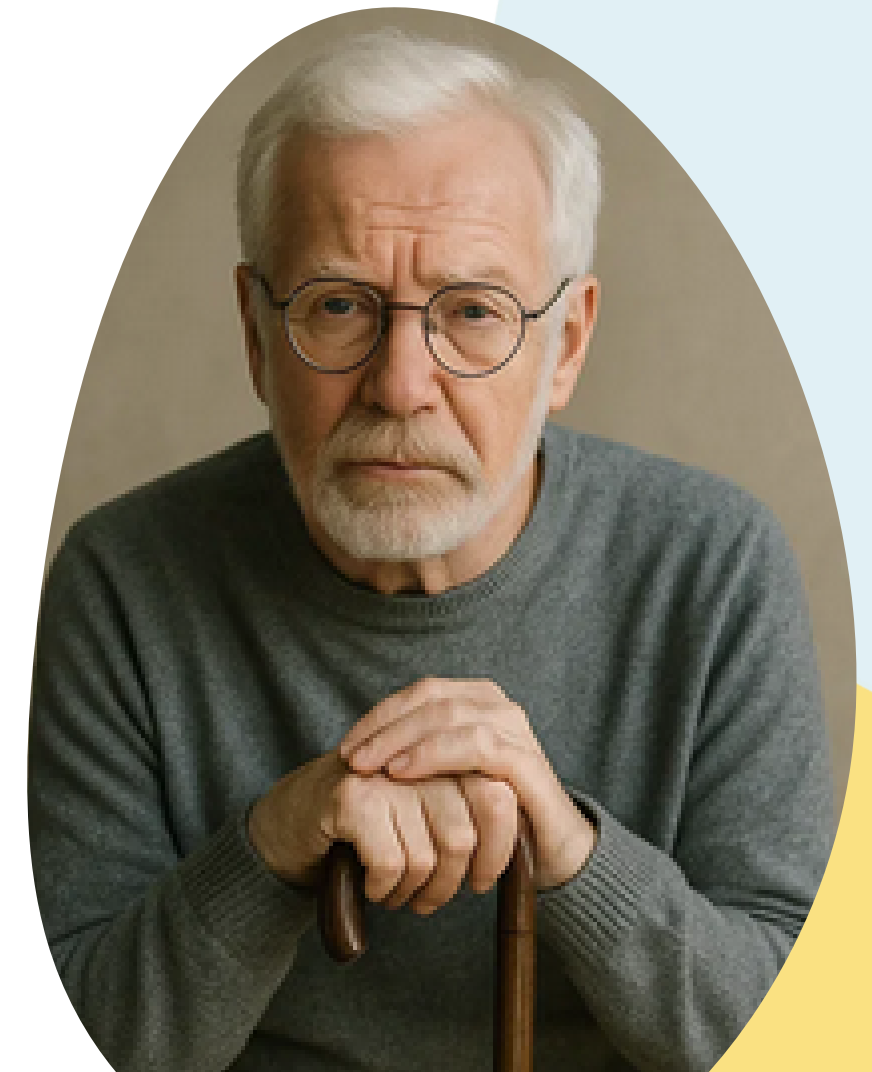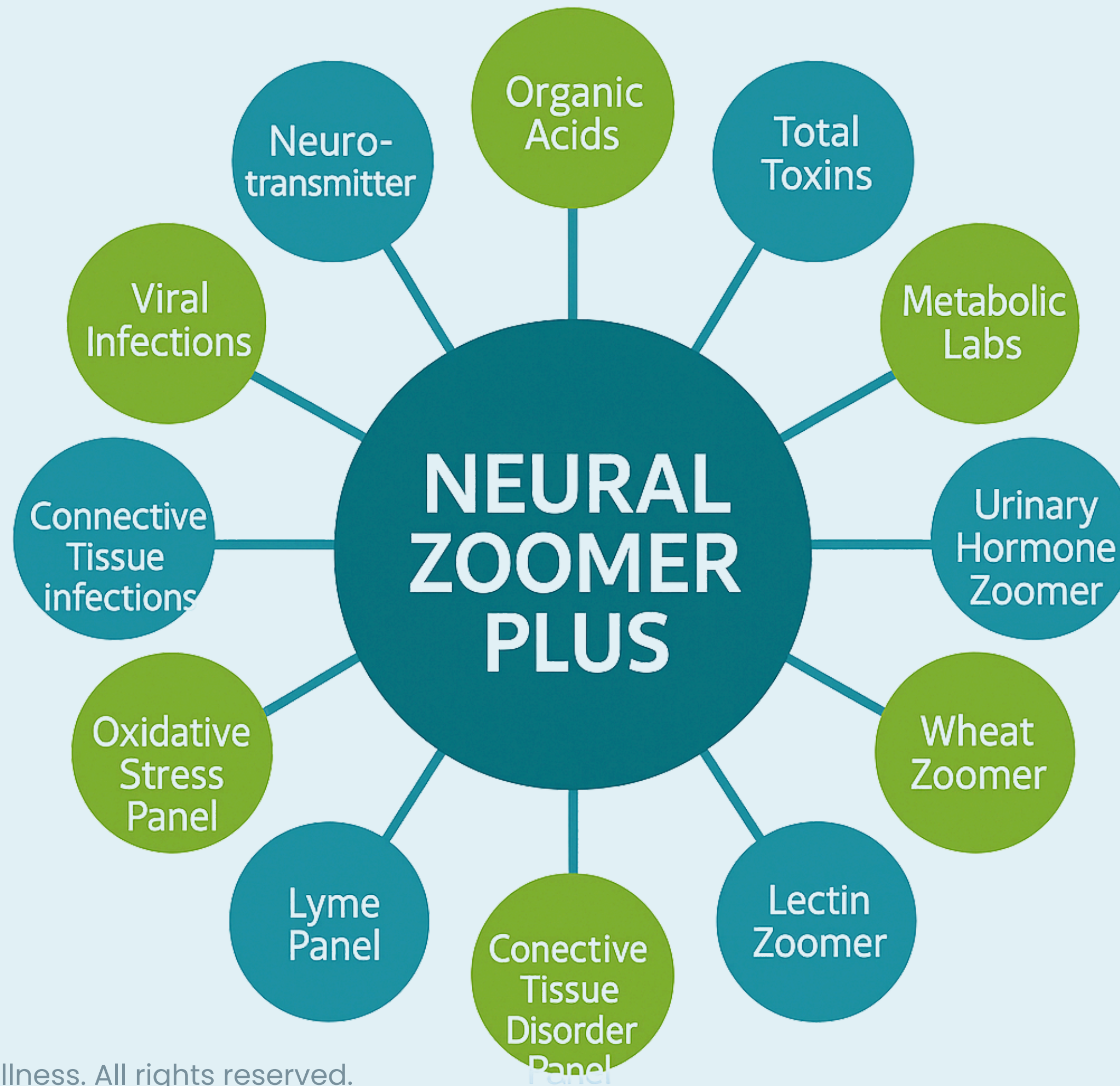
Anti-MAG

Anti-S100B

Anti-Glial Fibrillary Acidic Protein

Anti-Microglia

Anti-Glucose Regulated Protein 78

Anti-Neuron Specific Enolase

Anti-Aquaporin 4

Anti-Recoverin

Anti-CV2

Anti-Purkinje cell

Anti-Yo

Anti-Amyloid Beta (25-35)

Anti-Amyloid Beta (1-42)

Anti-RAGE Peptide

Anti-Tau

Anti-Glutamate

Anti-Dopamine

Anti-Hydroxytryptamine

Anti-HSV-1

Anti-HSV-2

Anti-EBV

Anti-CMV

Anti-HHV-6

Anti-HHV-7

Anti-Streptococcal A

Anti-NMDA Receptor

Anti-AMPA Receptor

Anti-Dopamine Receptors

Anti-GABA Receptors

Anti-Dipeptidyl

Aminopeptidase-Like

Protein 6

Anti-Glycine Receptor

Anti-Neurexin 3

Anti-MAG

Anti-S100B

Anti-Glial Fibrillary Acidic Protein

Anti-Microglia

Anti-Glucose Regulated Protein 78

Anti-Neuron Specific Enolase

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Anti-Amyloid Beta (25-35)

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Anti-RAGE Peptide

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Anti-Glutamate

Anti-Dopamine

Anti-HSV-1

Anti-HSV-2

Anti-EBV

Anti-CMV

Anti-HHV-6

Anti-HHV-7

Anti-Streptococcal A

Anti-NMDA Receptor

Anti-AMPA Receptor

Anti-Dopamine Receptors

Anti-GABA Receptors

Anti-Dipeptidyl

Aminopeptidase-Like

Protein 6

Anti-Glycine Receptor

Anti-Neurexin 3
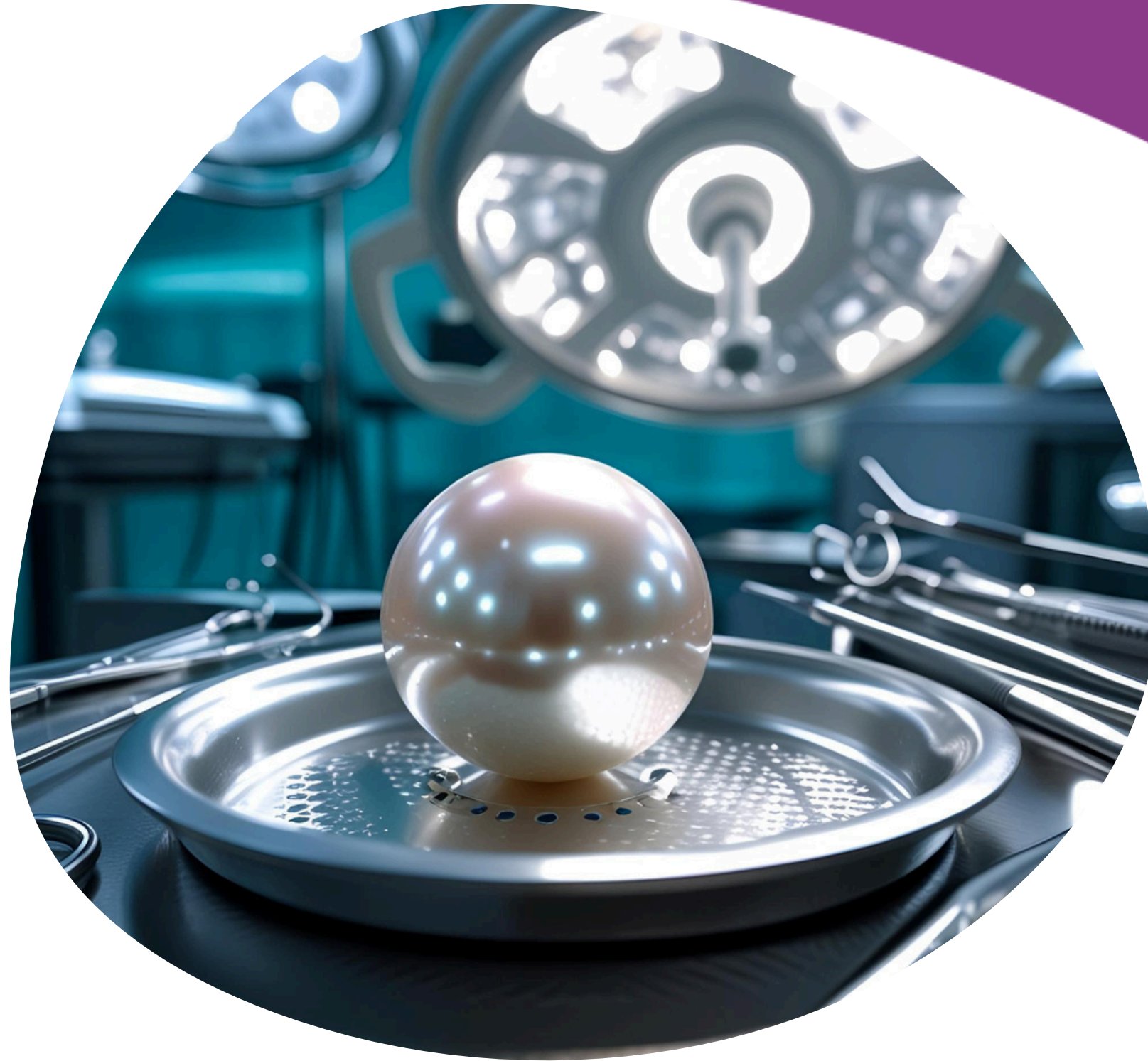
But first some clinical pearls

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Autonomic NS Markers

Anti-aquaporin antibodies

- Associated Issues: Corn and soy aquaporins

- Recommended Tests: Lectin Zoomer

Anti-CV2 antibodies

- Associated Issues: Cross reactivity with TTG6

- Recommended Tests: Wheat Zoomer

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BBB Disruption Markers

General markers

All Exacerbated by xenobiotics or impaired Detox
- Recommended Tests: Total Toxins, Toxin Genetics

Anti-s100B

- Associated Issues: Concussions,
    LPS antibodies, TtG2 Ab
- Recommended Tests: Wheat Zoomer

Anti-glucose Regulated Protein 78

- Associated Issues: anti-aquaporin antibodies
- Recommended Tests: Lectin Zoomer

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Brain Autoimmunity

<u>Anti-cerebellum antibodies</u>

- Associated Issues: Molecular mimicry with
  alpha-gliadin and milk butyrophilin
- Recommended Tests: Wheat Zoomer, Dairy Zoomer

<u>Anti-purkinje antibodies</u>

- Associated Issues: CoQ10 deficiency, altered GABA function,
  disrupted microbiome, infections (Lyme, EBV),
  cross reactivity with gliadin
- Recommended Tests:
  Micronutrients Panel, Neurotransmitter Panel,
  Lyme Autoimmune panel

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🧩 Brain Autoimmunity

Anti-RAGE peptide
- Associated Issues: Stealth infections, blood sugar issue
- Recommended Tests: Vibrant America blood sugar panels, Viral
   Infection panels

Anti-Glutamate
  - Associated Issues: Alteration of glutamate function
  - Recommended Tests: Neurotransmitter Panel

Anti-Dopamine
  - Associated Issues: Alteration of dopamine function
  - Recommended Tests: Neurotransmitter Panel

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Brain Inflammation

Anti-Dopamine receptors 1 and 2 Antibodies
- Associated Issues: Alteration of dopamine function
- Recommended Tests: Neurotransmitter Panel

Anti-NMDA Antibodies
- Associated Issues: Cross reactivity with anti-ds-DNA ab.
- Worsened by electrolyte imbalance
- Recommended Tests: Connective tissue disorder panel

Anti-GABA Antibodies
- Associated Issues: May block GABA function
- Recommended Tests: Neurotransmitter Panel

Anti-Ma Antibodies
- Associated Issues: May reduce testicular function as well
- Recommended Tests: **Urinary Hormone Zoomer**

DeMyelination Markers

Anti-Tubulin Antibodies
- Associated Issues: Thyroid (Hashimoto's, Graves)
- Recommended Tests:
    Vibrant America Thyroid panel

Anti-Myelin Antibodies
- Associated Issues:
    Elevated BPA, B6 deficiency, Aquaporin 4 mimicry
- Recommended Tests:
   Total Toxin panel, Micronutrient panel,
    Lectin Zoomer

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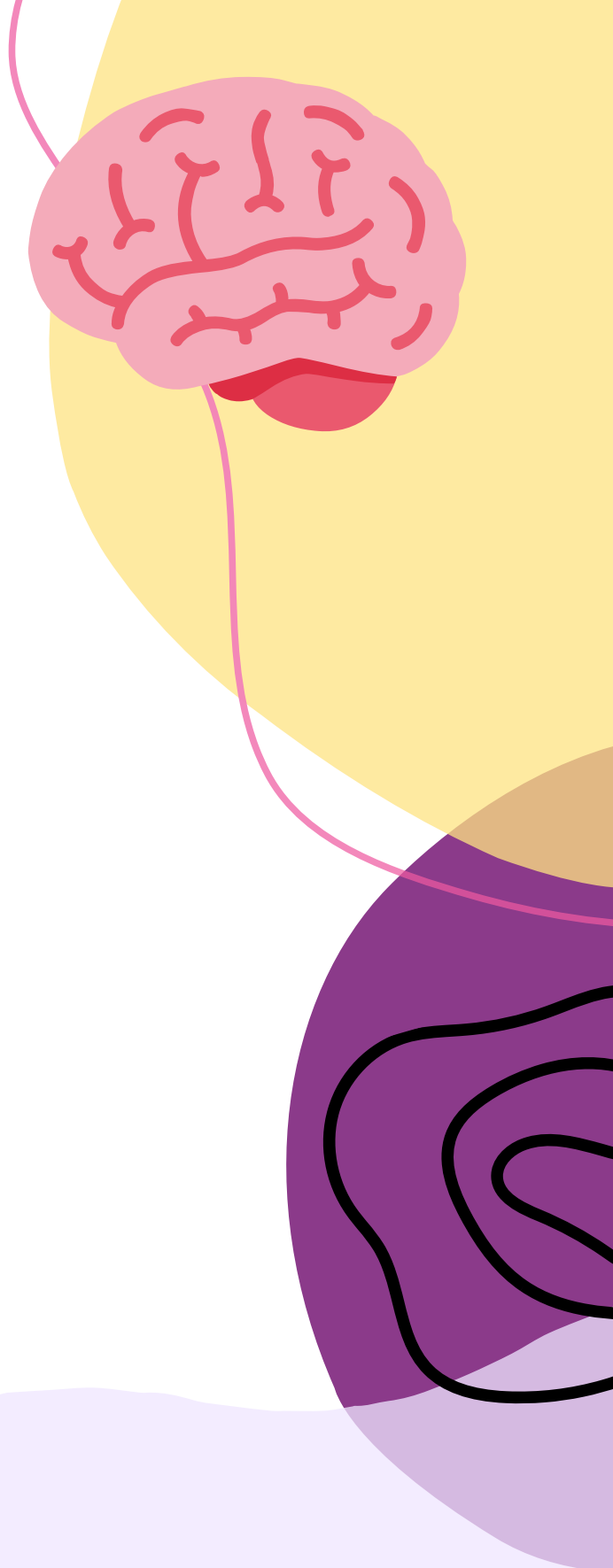
DeMyelination Markers

<u>Anti-Myelin Oligodendrocyte Glycoprotein</u>
- Associated Issues: Cross reactivity to milk butyrophilin
- Recommended Tests: Dairy Zoomer

Myelin Basic Protein
- Associated Issues: Cross reactivity with Gut derived antigens
- Recommended Tests: Dairy Zoomer, Gut Zoomer, Organic Acids, Oxidative Stress Panel
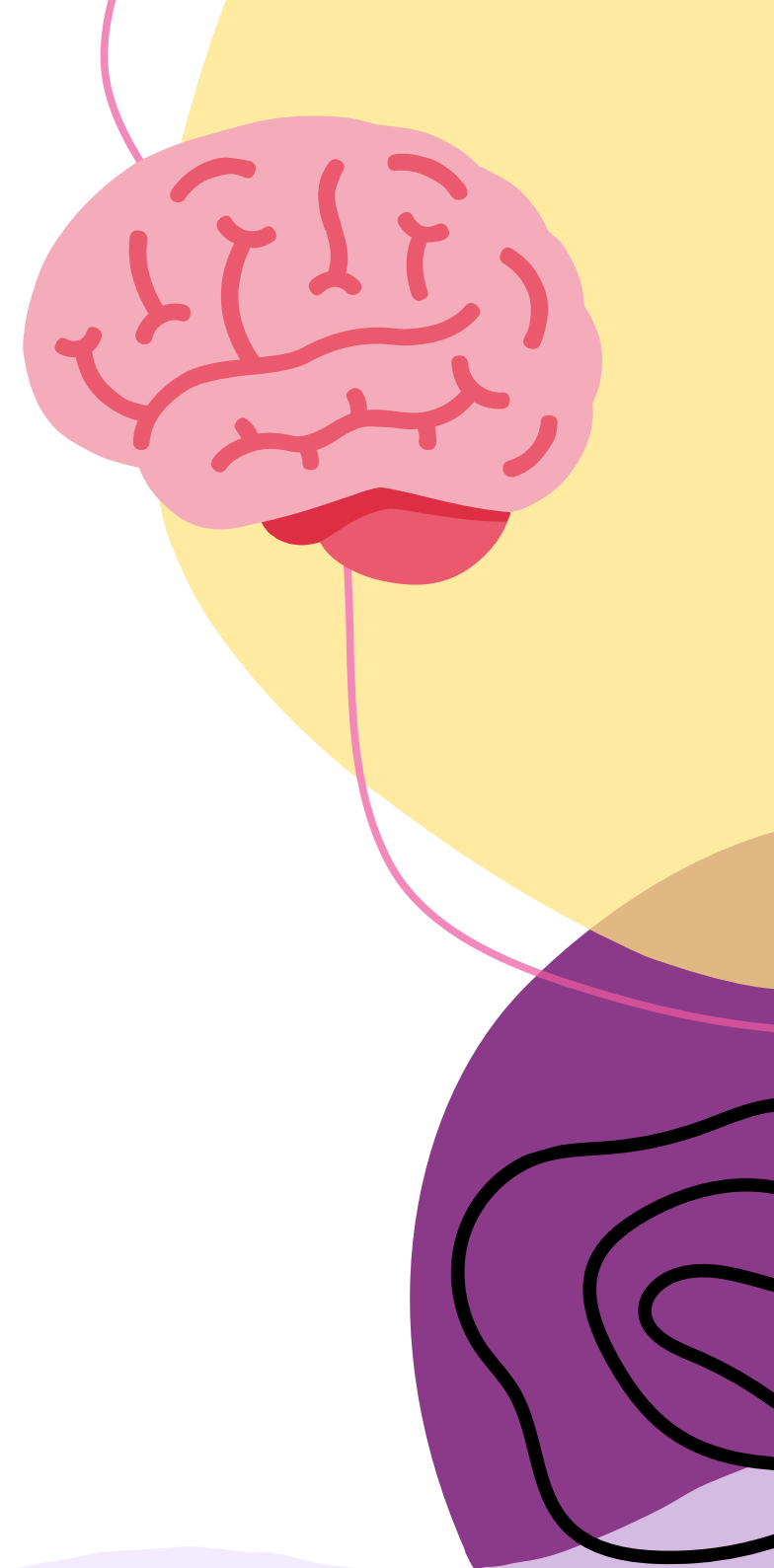
Infection Markers

HSV1, HSV2, EBV, HHV6 and 7, CMV, Streptococcus

- Associated Issues: May demonstrate a repressed or altered immune function
- Recommended Tests: Viral Infection panels, Total Immunoglobulins

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Summit
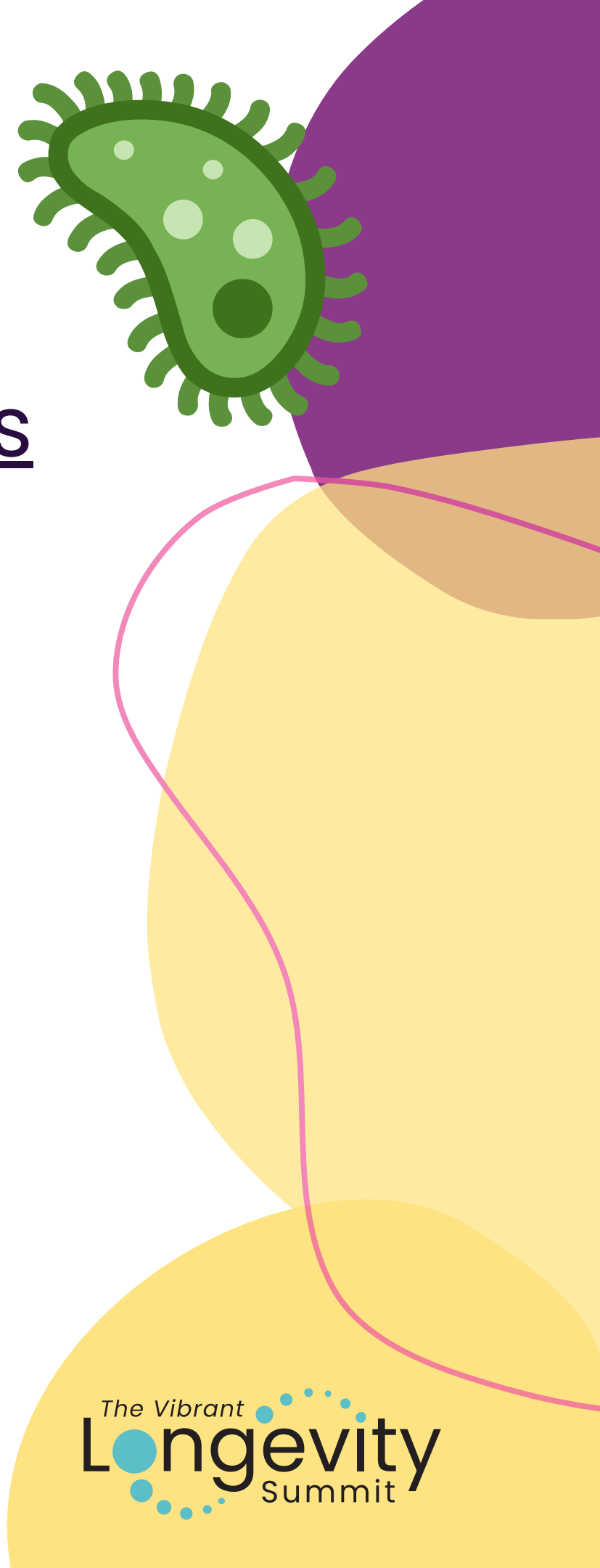
Neuromuscular Disruption

Anti-acetylcholine receptor antibodies
- Associated Issues: Acetylcholine blockage
- Recommended Tests: Neurotransmitter Panel

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Peripheral Neuropathy

<u>Anti-GM1 and GM2 antibodies</u>
- Associated Issues:
    Molecular mimicry with C. jejuni,
    correlation with celiac antibodies,
    CMV infection
- Recommended Tests:
    Gut Zoomer, Wheat Zoomer

Case Study – "David"

SUMMARY

Positive		Moderate		Negative
(IgG + IgA)	IgM	(IgG + IgA)	IgM	
Infection Epstein Barr Virus EA Antigen Epstein Barr Virus EBNA1 Epstein Barr Virus VCA gp125		Brain Autoimmunity Anti-Purkinje cell Brain Inflammation Anti-Dopamine receptor 2 Infection Cytomegalovirus p150 Cytomegalovirus p65 Epstein Barr Virus p18 Streptococcal A		

Demyelination Antigens

Anti-Tubulin	Anti-Myelin basic protein	Anti-Myelin oligodendrocyte glycoprotein	Anti-Myelin proteolipid protein
Anti-Neurofascin	Anti-MAG		

Blood Brain Barrier Disruption

Anti-s100b	Anti-Glial fibrillary acidic protein	Anti-Microglia	Anti-Glucose regulated protein 78

Optical and Autonomic nervous system disorder

Anti-Neuron specific enolase	Anti-Aquaporin4	Anti-Recoverin	Anti-CV2

Peripheral Neuropathy

Anti-GM1 Anti-Amphiphysin	Anti-GM2	Anti-Hu	Anti-Ri

Neuromuscular disorders

Anti-Acetylcholine receptors Anti-Titin	Anti-Muscle specific kinase	Anti-Voltage gated calcium channels	Anti-Voltage gated potassium channels

Brain Autoimmunity

Anti-Cerebellum Anti-RAGE peptide Anti-Hydroxytryptamine	Anti-Yo Anti-Tau Anti-Alpha-synuclein	Anti-Amyloid beta (25-35) Anti-Glutamate Anti-α1 and β2 adrenergic receptors	Anti-Amyloid beta (1-42) Anti-Dopamine Anti-Endothelin A receptor

Brain Inflammation

Anti-NMDA receptor Anti-Dipeptidyl aminopeptidase like protein 6 Anti-Leucine-rich glioma-inactivated protein 1 (Anti-LGI1)	Anti-AMPA receptor Anti-Glycine receptor Anti-Ma	Anti-Dopamine receptor 1 Anti-Neurexin 3	Anti-GABA receptors Anti-Contactin-Associated Protein-like 2 Antibodies

Infection

Cytomegalovirus EIA Antigen Cytomegalovirus p38 HHV-6	Cytomegalovirus GlyB Epstein Barr Virus p23 HHV-7	Cytomegalovirus p28 HSV-1	Cytomegalovirus p52 HSV-2

NEUROTRANSMITTERS SUMMARY HIGH/LOW

Test name	Current Result	Previous	Reference Range
Acetylcholine	8.78		1.70~5.90 mcg/g
5-HTP	8.93		11.40~185.60 mcg/g
Quinolinic acid/5-HIAA Ratio	0.27		0.32~1.10

Nutrition

Test Name	Current	Previous	Result	Reference
Vitamin D, 25-OH* (ng/mL)	19.2		0　29.9　108	30.0-108.0

Thyroid

Test Name	Current	Reference Range	Previous
Free T3 (pg/mL)	2.3	2.0~4.4	

	Current	Result	Reference
Wheat Zoomer	>6	0　2　4	≤2.0
Egg Zoomer (Egg Yolk)	3.5	0　2　4	≤2.0
Egg Zoomer (Egg White)	3.2	0　2　4	≤2.0
Intestinal Permeability	3.3	0　2　4	≤2.0
Dairy Zoomer	1.3	0　2　4	≤2.0

Mitochondrial dysfunction from toxins

TOXINS AND MITOCHONDRIAL FUNCTION
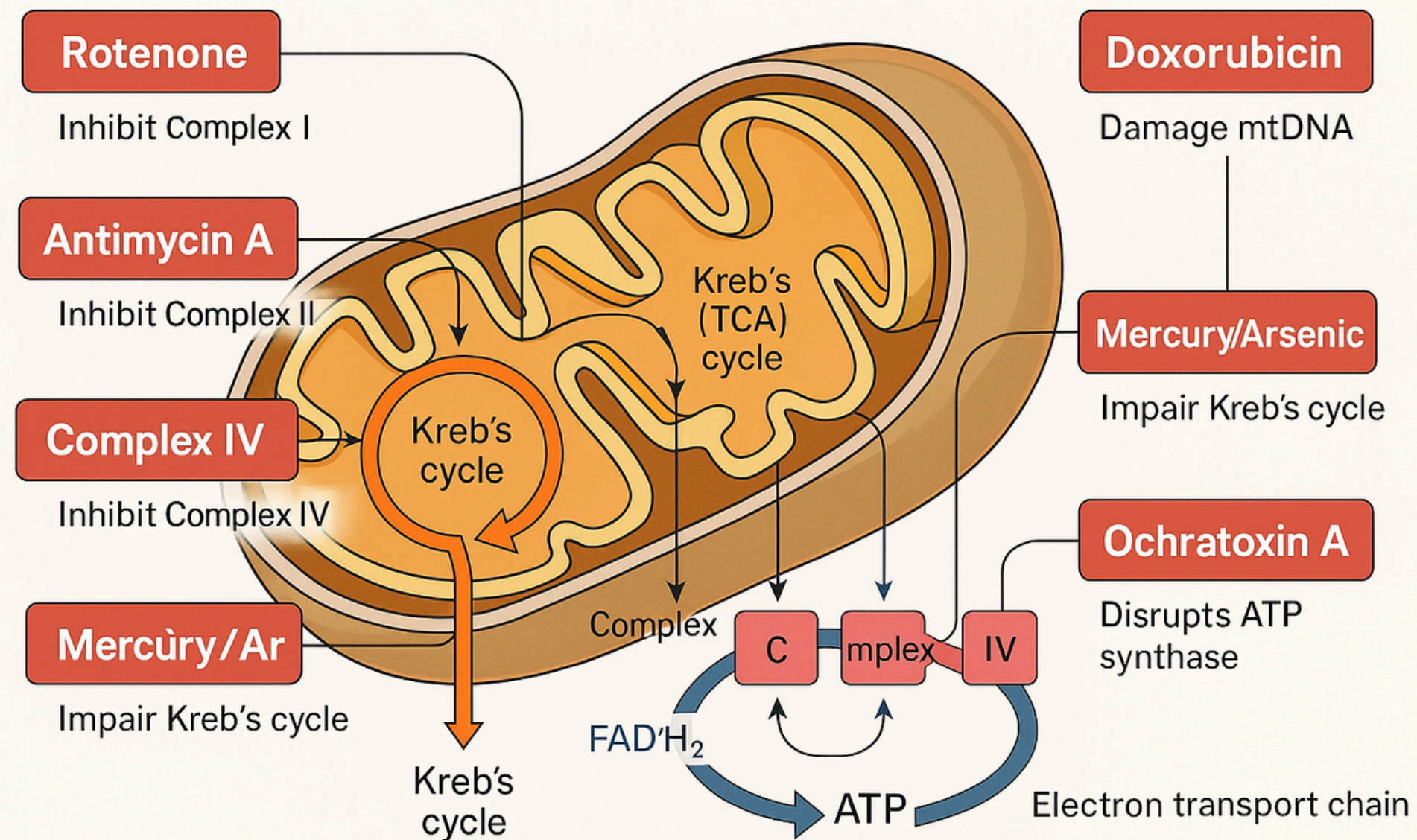
Mitochondrial dysfunction from toxins

Toxin / Compound	Sources	Mechanism of Mitochondrial Disruption
Mercury (Hg)	Fish, dental amalgams	Disrupts electron transport chain, increases ROS
Arsenic (As)	Contaminated water, pesticides	Inhibits ATP production, induces oxidative stress
Lead (Pb)	Paint, pipes, industrial waste	Damages mitochondrial membranes, disrupts enzyme
Cadmium (Cd)	Batteries, cigarettes	Inhibits mitochondrial respiration
Rotenone	Insecticide	Complex I inhibitor, mimics Parkinson's pathology
Paraquat	Herbicide	Generates superoxide radicals in mitochondria
Trichloroethylene (TCE)	Solvent, degreasers, industrial waste	Impaired mitochondrial respiration and membrane pot
Doxorubicin	Chemotherapy drug	Inhibits mitochondrial DNA replication and function
Dioxins	Industrial byproducts	Binds mitochondrial membranes, disrupts signaling
Ochratoxin A	Contaminated grains, coffee	Induces oxidative damage to mitochondria

Wallace, K. B., & Starkov, A. A. (2000). Mitochondrial targets of drug toxicity. Annual Review of Pharmacology and Toxicology, 40, 353–388. https://doi.org/10.1146/annurev.pharmtox.40.1.353

Li, N., et al. (2003). Ultrafine particulate pollutants induce oxidative stress and mitochondrial damage. Environmental Health Perspectives, 111(4), 455–460. https://doi.org/10.1289/ehp.5849

Kirkinezos, I. G., & Moraes, C. T. (2001). Reactive oxygen species and mitochondrial diseases. Seminars in Cell & Developmental Biology, 12(6), 449–457. https://doi.org/10.1006/scdb.2001.0275

Feng, Y., et al. (2013). Mercury exposure induces mitochondrial dysfunction in rat kidney cells. Toxicology Letters, 221(2), 135–142. https://doi.org/10.1016/j.toxlet.2013.07.002

- Ramanathan, G., et al. (2020). Ochratoxin A induces oxidative stress-mediated mitochondrial dysfunction in human renal cells. Toxicology In Vitro, 65, 104799. https://doi.org/10.1016/j.tiv.2020.104799
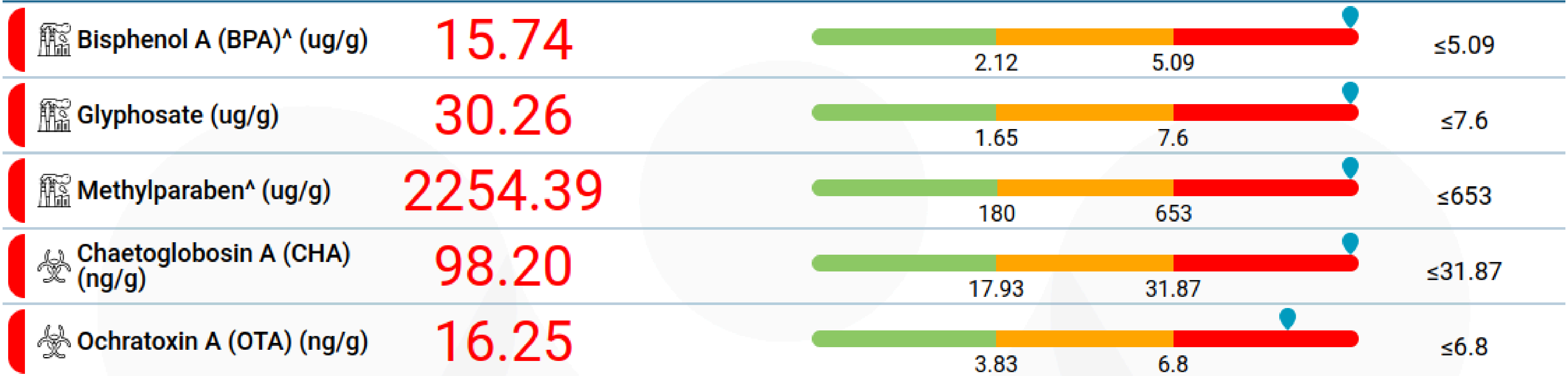
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Hypogonadism and Mitochondrial Dysfunction
(Focus on testosterone as a simplified model)

- Dropping Testosterone
- Impaired Mitochondrial Function
- ↓ Mitochondrial biogenesis
- ↓ ATP production
- ↑ Oxidative stress
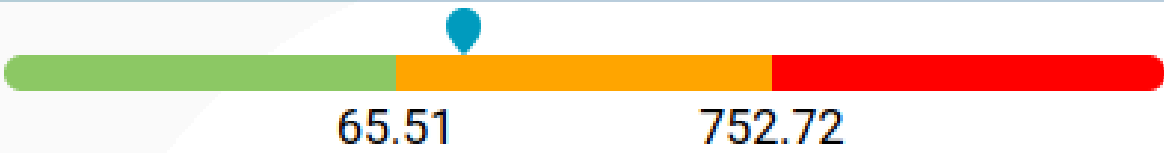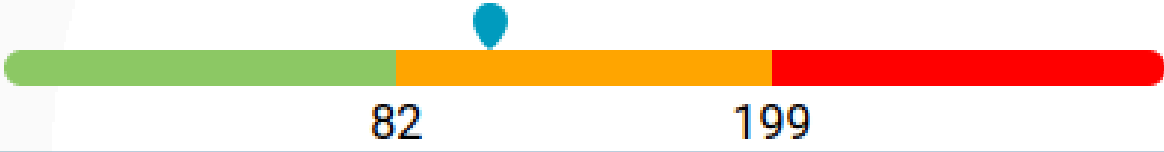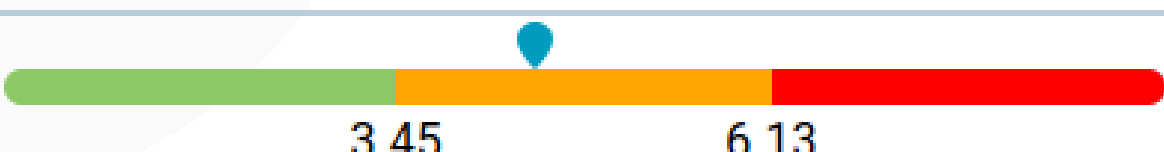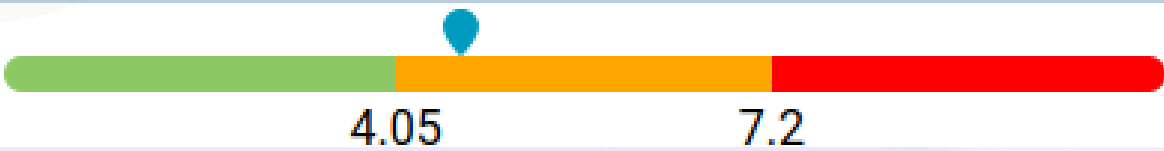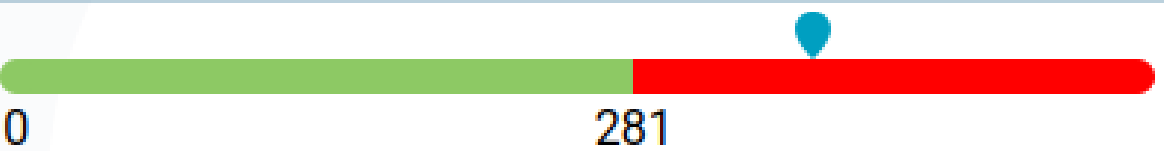
- Testosterone Enhances Mitochondrial Biogenesis & Efficiency
- Androgen receptors are present in mitochondria and can directly influence mitochondrial gene expression.
- Testosterone stimulates PGC-1α, a master regulator of mitochondrial biogenesis.
- It enhances the efficiency of the electron transport chain, reducing ROS (reactive oxygen species) leakage.
- Declining Testosterone = Impaired Mitochondria
- As testosterone drops (with aging, stress, toxins, etc.), several negative mitochondrial consequences occur, which promotes a loss cycle:
- ↓ Mitochondrial biogenesis (fewer mitochondria per cell)
- ↓ ATP production, contributing to fatigue, poor muscle performance, and brain fog
- ↑ Oxidative stress, accelerating aging and cellular damage
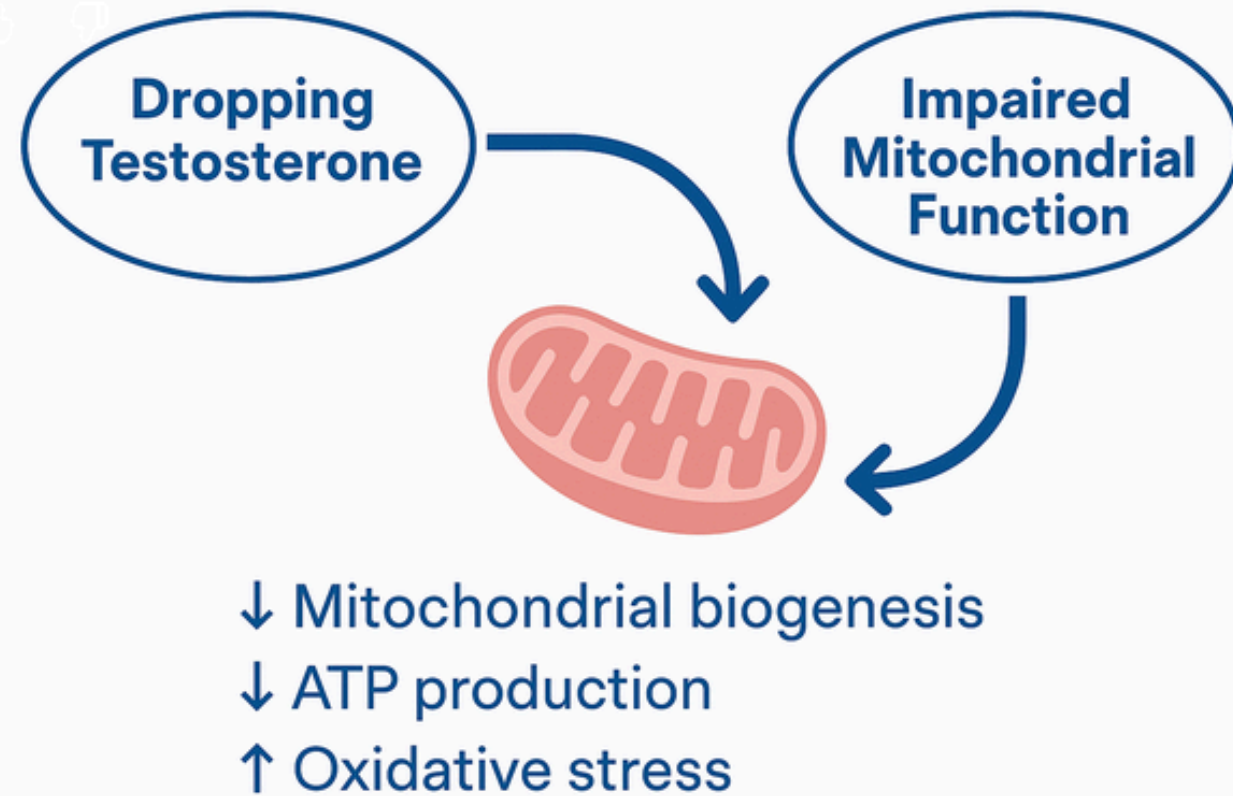
- Chen, Y., et al. (2005). Androgens and mitochondrial gene expression in prostate cancer cells. Endocrinology, 146(7), 3521–3527.
- Liao, W., et al. (2014). Testosterone induces mitochondrial biogenesis and improves oxidative metabolism in skeletal muscle cells. Endocrinology, 155(6), 2456–2466.
- Coviello, A. D., et al. (2005). Testosterone supplementation improves mitochondrial function and insulin sensitivity in aging men. Journal of Clinical Endocrinology & Metabolism, 90(3), 1502–1508.
- Pitteloud, N., et al. (2005). Testosterone levels and mitochondrial function in healthy men. Journal of Clinical Endocrinology & Metabolism, 90(6), 3568–3573.
- Safarinejad, M. R., et al. (2012). Relationship between testosterone levels and oxidative stress markers in infertile men. Journal of Urology, 187(2), 707–711.
- Kumar, A., et al. (2020) Mitochondrial dysfunction and male reproductive aging: Role of oxidative stress and antioxidants. Free Radical Biology and Medicine, 152, 107–120.
- Tenover, J. L. (1992). Effects of testosterone supplementation in the aging male. Journal of Clinical Endocrinology & Metabolism, 75(5), 1092–1098.

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LH (mIU/mL)	3.5	1.7~8.6
SHBG (nmol/L)	36.9	16.5~55.9
Testosterone, Total (ng/dL)	383.0	203.4~1415.5
Free Testosterone (ng/dL)	7.24	3.25~30.66
Prolactin (ng/mL)	10.10	4.04~15.20

Bisphenol A (BPA)^ (ug/g)	15.74	2.12 — 5.09	≤5.09
Glyphosate (ug/g)	30.26	1.65 — 7.6	≤7.6
Methylparaben^ (ug/g)	2254.39	180 — 653	≤653
Chaetoglobosin A (CHA) (ng/g)	98.20	17.93 — 31.87	≤31.87
Ochratoxin A (OTA) (ng/g)	16.25	3.83 — 6.8	≤6.8

Marker	Value	Range	Limit
4-Methylhippuric Acid (4MHA) (ug/g)	112.07	65.51 – 752.72	≤752.72
N-Acetyl (2,Hydroxypropyl) Cysteine (NAHP)^ (ug/g)	145.60	101 – 403	≤403
N-acetyl-S-(2-carbamoylethyl)-cysteine^ (ug/g)	101.03	82 – 199	≤199
Tiglylglycine (TG) (ug/g)	0.72	0.09 – 3.24	≤3.24
Triclosan (TCS)^ (ug/g)	39.41	29.9 – 358	≤358
Arsenic^ (ug/g)	19.98	11.9 – 52	≤52
Aflatoxin B1 (AFB1) (ng/g)	5.03	3.9 – 6.93	≤6.93
Aflatoxin G2 (ng/g)	9.42	6.08 – 10.8	≤10.8
Citrinin (CTN) (ng/g)	9.89	7.05 – 12.53	≤12.53
Fumonisins B1 (ng/g)	4.33	3.45 – 6.13	≤6.13
Fumonisins B2 (ng/g)	4.23	4.05 – 7.2	≤7.2
Human Anti-Lipopolysaccharide IgG+IgM	351.3	0 – 281	≤281.0 (U/ml)

Take Home Summary

Aging of the Brain is a mitochondrially mediated process that is strongly influenced by endocrinologic and metabolic changes that affect mitochondrial function, determining the progression toward pathology in aging neural networks. A multifactoral evaluation including GI health, hormone balance, mitochondrial function, toxic load are essential when approaching Neuronal health from a cellular energetics approach.

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So What happened to "David"?

David is now more independent and improving. He is working more, enjoying his family, and traveling without assistance.

Don't wait to help your own "David". Identify the factors that might be the biggest stressors to your health Every day we wait, more memories are lost, more lives slip away.

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Thank You!

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Neurologic Vector Math

How to Design Treatment Protocols that Get Results

Neela Sandal, M.D.

Meet Your Speaker

Neela Sandal, M.D.

Founder and Clinical Director, ATMA Clinic

Vibrant Longevity Summit 2025

Contact: neelasandal@gmail.com
| Youtube: @TheAtmaMD

www.atmaclinic.com

Learning Objectives

- Establish a framework for understanding Neurologic Injury and Repair

- Learn to Design Personalized Treatment Protocols

- Establish Tools for Testing your Hypotheses

- Survey some typical Therapeutic Protocols

- Take a "breather" and have some fun!

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Understanding Neurologic Injury and Repair

○ Brain tissue can be both wounded and repaired

○ Imagine a Vector Equation: +a, -a

○ "Healing" or "Damage" of brain tissue depends upon the sum of positive and negative vectors

○ Can be approached with INCREASING support or DECREASING irritants

○ These vectors are all quantifiable

○ Situation is always MULTIVARIATE

a

-a

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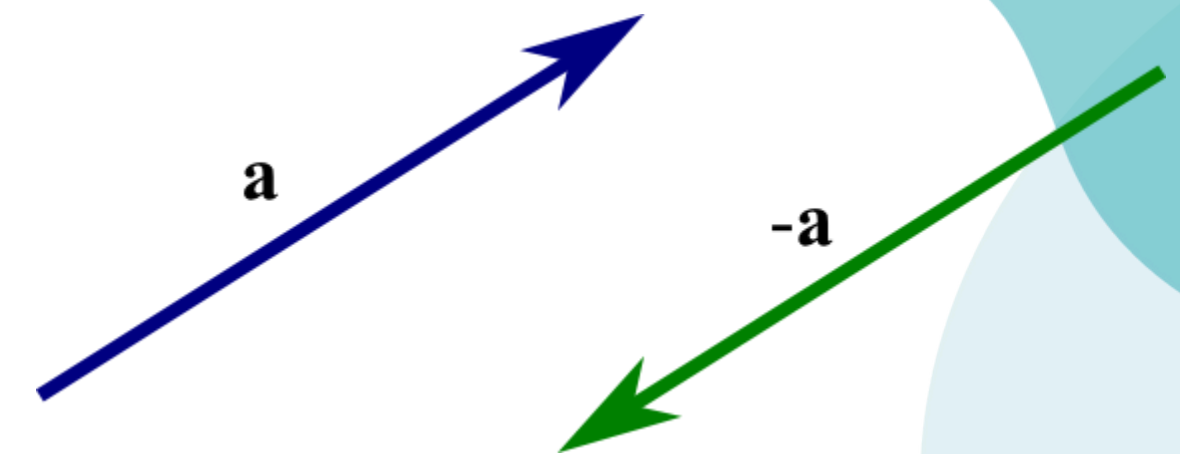
Personalization is Key

- We are all SCIENTISTS first and foremost

- Do not forget that your job is to develop cutting edge therapies for the patient in front of you

- An excellent protocol begins with the appropriate diagnosis

- What is THIS PATIENT'S root cause(s)?

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Designing your Treatment Protocol

- The Scientific Method

  - Building Personalized Hypotheses

  - Testing your hypotheses (Metrics!)

  - Treat

  - Retest

- It is OKAY to move multiple variables at a single time – SYNERGY

- Get the "Low Hanging Fruit" and move to the next

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Building Personalized Hypotheses
The Usual Suspects

- Toxins

- Viruses

- Bacteria

- Autoimmune Reactivity

- Dietary Irritants (Blood Sugar, Allergens)

- Trauma, Hypoxia, and Vascular Limitation

- Lack of Raw Materials

- Neuroreceptor Strain

- Mitochondrial Damage

- Chronic Sympathetic Strain

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Testing your Hypotheses

- Neural Zoomer Plus

- Other useful testing:
  - MMP9, Toxin Panels
  - HsCRP, A1c, Insulin
  - Hormone Levels (Trophic Factors)
  - Gut Zoomer etc

- Standardized testing protocols are an acceptable STARTING point

- Clinical Markers: ADLs, MOCA, etc
  - Make these as objective and quantifiable as possible

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Neurologic Degeneration / Regeneration

So you know what you're chasing
Now what?

A Survey of Treatment Options

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A Quick Note on Disclosure

I have no financial incentive to represent any discussed branded product

All protocols should be PERSONALIZED

Dosing that follows is suggestive, not definitive

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Building Personalized Hypotheses
The Usual Suspects

- **Toxins**
- **Viruses**
- **Bacteria**
- Autoimmune Reactivity
- Dietary Irritants (Blood Sugar, Allergens)
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Toxins

○ **Upregulate Mobilization**
- Sauna — 20min 5x weekly at 200 degrees F
- Exercise
- Hydration — Don't forget Mineralization
- Circadian optimization

○ **Support Chemical Conjugation**
- Glutathione — Liposomal, 500mg-1g BID
- NAC — 600mg-1g BID
- Silymarin — 500mg-1g BID
- Alpha Lipoic Acid — 400mg-600mg BID

○ **Ensure Elimination**
- Binders — Activated Charcoal, Zeolite, Bentonite
- Sweating

High	Mycotoxins	Heavy Metals	Environmental Toxins

Test Name	Current	Previous	Result (75th / 95th)	Reference
Glyphosate (ug/g)	9.29		1.65 / 7.6	≤7.6
Aluminum (ug/g)	62.42		17.83 / 45.15	≤45.15
Gliotoxin (ng/g)	209.13		116.93 / 207.87	≤207.87
Ochratoxin A (OTA) (ng/g)	19.56		3.83 / 6.8	≤6.8

Suboptimal	Mycotoxins	Heavy Metals	Environmental Toxins

Test Name	Current	Previous	Result (75th / 95th)	Reference
Bisphenol A (BPA)^ (ug/g)	2.69		2.12 / 5.09	≤5.09
Mercury^ (ug/g)	1.59		0.57 / 1.61	≤1.61
Aflatoxin G1 (ng/g)	4.40		3.68 / 6.53	≤6.53
Roridin A (ng/g)	4.73		4.28 / 7.6	≤7.6

Creatinine				
Test Name	Current	Previous	Result	Reference
Urine Creatinine (mg/mL)	1.65		0 / 0.24 / 2.16	0.25-2.16

		Current	Result	Reference
Cysteine	Serum	3.0	0 / 3.3 / 37	3.4-37.0 (nmol/mL)
Cysteine	Cellular	42.7	0 / 59.9 / 565	60.0-565.0 (pg/MM WBC)
Glutathione	Cellular	54.1	0 / 98.6 / 1163	98.7-1163.0 (pg/MM WBC)

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Viral Infection

- Pharmaceuticals
  - Acyclovir vs Valacyclovir   1g BID

- Herbals and Nutraceuticals
  - Cat's Claw, Astragalus, Bilberry
  - Goldenseal, Oregano
  - Monolaurin, Lysine
  - Combination Products   QS Cat's Claw Elite 2 squirts BID

    Biocidin LSF 1 squirt BID

- Oxidative Therapy
  - Ozone infusion
  - High dose Vitamin C
  - High dose Methylene Blue

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Bacterial Infections

- Tissue Specific Therapy
  - Biofilms and Colonization
  - Sinus   BEGI sprays, Colloidal Silver, Neti
  - Gut   Rifaximin, Interfase Plus
  - Oral   Oil Pulling, Cavitation Therapies

- Systemic Therapy
  - Oxidative Therapies
  - Proteases
  - Role of Antibiotics

GUT INFLAMMATORY MARKERS				
Test Name	Current	Previous	Result	Reference
Calprotectin (mcg/g)	14.5		0 50 119	≤50.0
Fecal Eosinophil Protein X (mcg/g)	9.7		0 4.8	≤4.8
Fecal lactoferrin (mcg/ml)	2.0		0 6.4	≤6.4
MMP 9 (ng/mL)	0.3		0 0.2	≤0.2
Beta defensin 2 (ng/mL)	25.2		0 34.9	≤34.9
Lysozyme (ng/mL)	514.2		0 575	≤575.0
S100A12 (mcg/ml)	12.0		0 50	≤50.0

GUT ANTIBODIES				
Test Name	Current	Previous	Result	Reference
Lipopolysaccharide Antibody	24.5		0.1 10 20	≤10.0

Building Personalized Hypotheses

The Usual Suspects

- Toxins

- Viruses

- Bacteria

- **Autoimmune Reactivity**

- **Dietary Irritants (Blood Sugar, Allergens)**

- Trauma, Hypoxia, and Vascular Limitation

- Lack of Raw Materials

- Neuroreceptor Strain

- Mitochondrial Damage

- Chronic Sympathetic Strain

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Autoimmune Reactivity

○ Treat the root of erroneous cross reactivity

○ Direct autoimmune reactivity suppression
   • LDN 4.5mg PO qD

○ Inflammatory Dampening
   • Resveratrol   200mg BID
   • Curcumin   500mg-1g BID
   • IVIG   0.4g/kg x5 days
   • BPC-157   500mcg-1mg PO qD

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Dietary Irritants

- Blood Sugar
  - Carb Reduction
  - Continuous Glucose Monitoring
  - Herbal/Mineral Therapies

- Allergens
  - True Allergy
  - Delayed Immunologic Sensitivity

- Food/Biome Mismatch
  - Trial and Error
  - Ayurvedic Dosha Typing

DIGESTION AND IMMUNE BALANCE

Test Name	Current	Previous	Result	Reference
Pancreatic Elastase 1 (mcg/g)	353.4		0 100 199	≥200.0
Fecal Immunochemical Test (FIT) (mcg/g)	3.1		0 10	≤10.0
Fecal Zonulin (ng/mL)	267.5		0 25 160	25.1-160.8
pH	6.5		0 6 7.8	6.1-7.8
sIgA (mcg/g)	234.7		0 425 1450	426.0-1450.0

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Building Personalized Hypotheses
The Usual Suspects

- Toxins

- Viruses

- Bacteria

- Autoimmune Reactivity

- Dietary Irritants (Blood Sugar, Allergens)

- **Trauma, Hypoxia, and Vascular Limitation**

- **Lack of Raw Materials**

- Neuroreceptor Strain

- Mitochondrial Damage

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Trauma, Hypoxia, Vascular Limitation

- Mechanical Manipulation
  - MSK work
  - Fascial work
  - Craniosacral reintegration
- Nitrous Oxide Upregulation
  - Nasal breathing
  - Beet root extracts (ie Neo40)

- Glycocalyx Therapy
  - Endocalyx Pro
- Tissue Regeneratives
  - NAD+ (IV vs Oral)
  - Stem Cell Therapy

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Lack of Raw Materials
Common Limitations

- Cholesterol
    - Statins: The good, the bad, the ugly
- Methyl Donors
- Phospotidylcholine
- Creatine
- Magnesium

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Building Personalized Hypotheses
The Usual Suspects
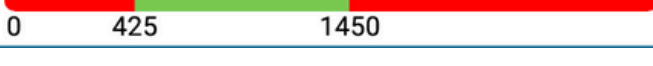
- Toxins

- Viruses

- Bacteria

- Autoimmune Reactivity

- Dietary Irritants (Blood Sugar, Allergens)

- Trauma, Hypoxia, and Vascular Limitation

- Lack of Raw Materials

- **Neuroreceptor Strain**

- **Mitochondrial Damage**

- **Chronic Sympathetic Strain**

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Neurologic Receptor Strain

- Receptor "Fasts"
  - Dopamine
  - Caffeine, Nicotine, Etc
  - Other

- High Dose Intravenous NAD+ Protocols

Neural Zoomer Plus				
Reference Range: In Control: ≤10 Moderate: 10.1-20 Risk: >20				
Brain Inflammation	Current (IgG + IgA)	IgM	Previous (IgG + IgA)	IgM
Anti-Dipeptidyl aminopeptidase like protein 6	8.5	2.5		
Anti-Glycine receptor	>30	3.7		
Anti-Neurexin 3	8.3	3.4		
Anti-Contactin-Associated Protein-like 2 Antibodies	>30	3.9		
Anti-Leucine-rich glioma-inactivated protein 1 (Anti-LGI1)	7.3	3.9		
Anti-Ma	4.8	2.8		
Anti-Dopamine receptor 1	>30	3.1		
Anti-Dopamine receptor 2	12.3	3.0		

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Mitochondrial Damage

- Minimizing Damage
  - Blue light
  - Proper circadian rhythms

- Maximizing Repair
  - NAD+   500mg-2g PO qD
  - L-carnitine   500mg-1g PO BID
  - Magnesium Threonate   80-144mg PO qD
  - CoQ10   100mg PO qD

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Chronic Sympathetic Strain

- Self-reflection therapy or Limbic Retraining

- Vagal Nerve Stimulation

- Proactive stress management

- "Yin" attitude

- Sleep Optimization

- Breath Work
  - Pranayama

Breath As Endogenous Technology

- State of Research

- Implications on Neurologic Health

- Let's "Take a Breather"
  - Contraindications for vigorous breathwork – "When you strain, you lose the gain"
    - Unstable BP elevation, increased intracranial or ocular pressure, pregnancy, menstruation, significant sinus congestion

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Putting it all Together
A Case Study

60 yo F attorney with acute CVA while mountain climbing

- Previous clean bill of health from her conventional MD

- 1 year out from injury - Persistent and static post-stroke deficits
  - LLE str 4-/5, stiff, dragging, loss of proprioception
  - Upturning Babinski, loss of sensation
  - Limited gait

- Neurology - "There's nothing we can do"

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Vector Math Framework

○ Brain tissue can be both wounded and repaired

○ Imagine a Vector Equation: +a, -a

○ "Healing" or "Damage" of brain tissue depends upon the sum of positive and negative vectors

○ Can be approached with INCREASING support or DECREASING irritants

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○ Situation is always MULTIVARIATE

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-a

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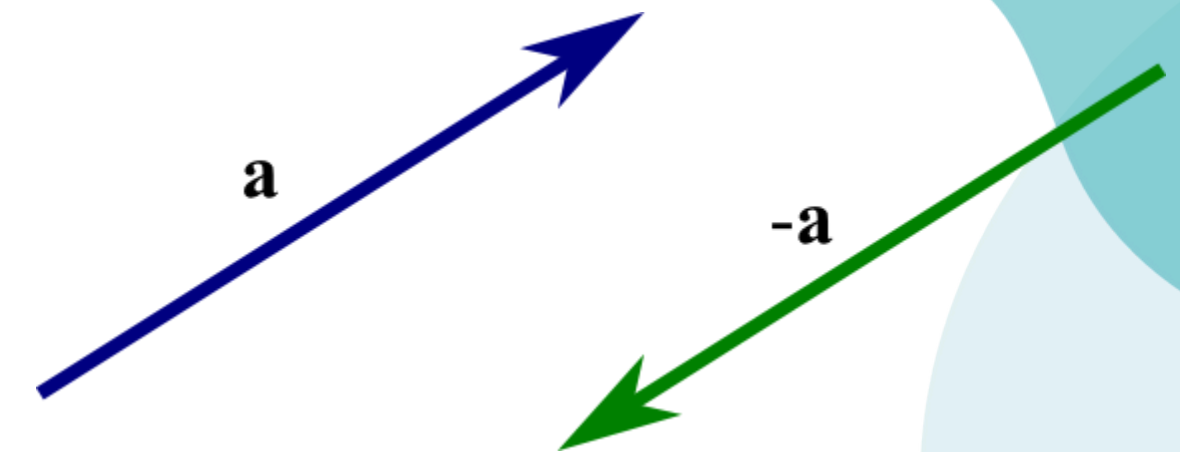
Putting it all Together

Building a Personalized, Synergistic Treatment Plan

- Cerebrovascular accident
  - NAD+
  - Stem Cell Infusion
  - Craniosacral Therapy
- Toxins
  - NAC, Silymarin, ALA
  - Sauna

- Reactivated EBV
  - Ozone infusions

- Excess Blood Sugar
  - Ketogenic Cycle

- Chronic Sympathetic Strain
  - Daily Pranayama

- Optimizing Cellular Nutrients
  - Magnesium
  - Methylated Bs
  - Choline donors

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Putting it all Together
Synergy Brings Results

Normalized:

- Inflammatory Markers
- Viral Markers
- Metabolic Markers
- HRV
- Toxin levels

Strength returned to 5/5 with full ROM

Normalized reflexes and sensation

Back to playing tennis daily

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Resilience Code

We Unlock Your Code
You Control Your Outcome

Dr. Chad Prusmack, MD

What if you had a health data driven platform that predicted outcomes to world's best solutions for brain health, performance, and longevity delivered in **one** program?

360° VIEW
Under One Roof

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Meet Your **Speaker**

Dr. Chad Prusmack, MD

- Board One Spine and Sport Neurosurgery (Englewood CO) Certified Neurosurgeon – Health
- Undergraduate – Harvard BS Biophysics
- Medical School – Columbia College of Physicians and Surgeons
- Neurosurgical training – University of Miami: Fellowships Skull Base Vascular & Minimally Invasive Spine
- On field Neurosurgical Consultant Denver Broncos since 2007
- Neurosurgical / Performance Consultant Vegas Golden Knights, Winnepeg Jets, Colorado Avalanche
- Board Certified in Functional Medicine by IFM in 2015
- Founder / Medical Director Resilience Code 2016
- Board of Directors International Lyme and Associated Diseases (ILADS) 2017

Precision Medicine

•Formally defined by the National Institutes of Health (NIH), precision medicine is **"an innovative approach that takes into account individual differences in patients' genes, environments, and lifestyles"**.

•This definition rests on three foundational pillars that, when integrated, create a comprehensive and dynamic understanding of an individual's health trajectory.

 The ultimate objective is to deliver **"the right treatment for the right patient at the right time,"** representing a fundamental departure from the traditional **"one-size-fits-all"** model that has long dominated healthcare.

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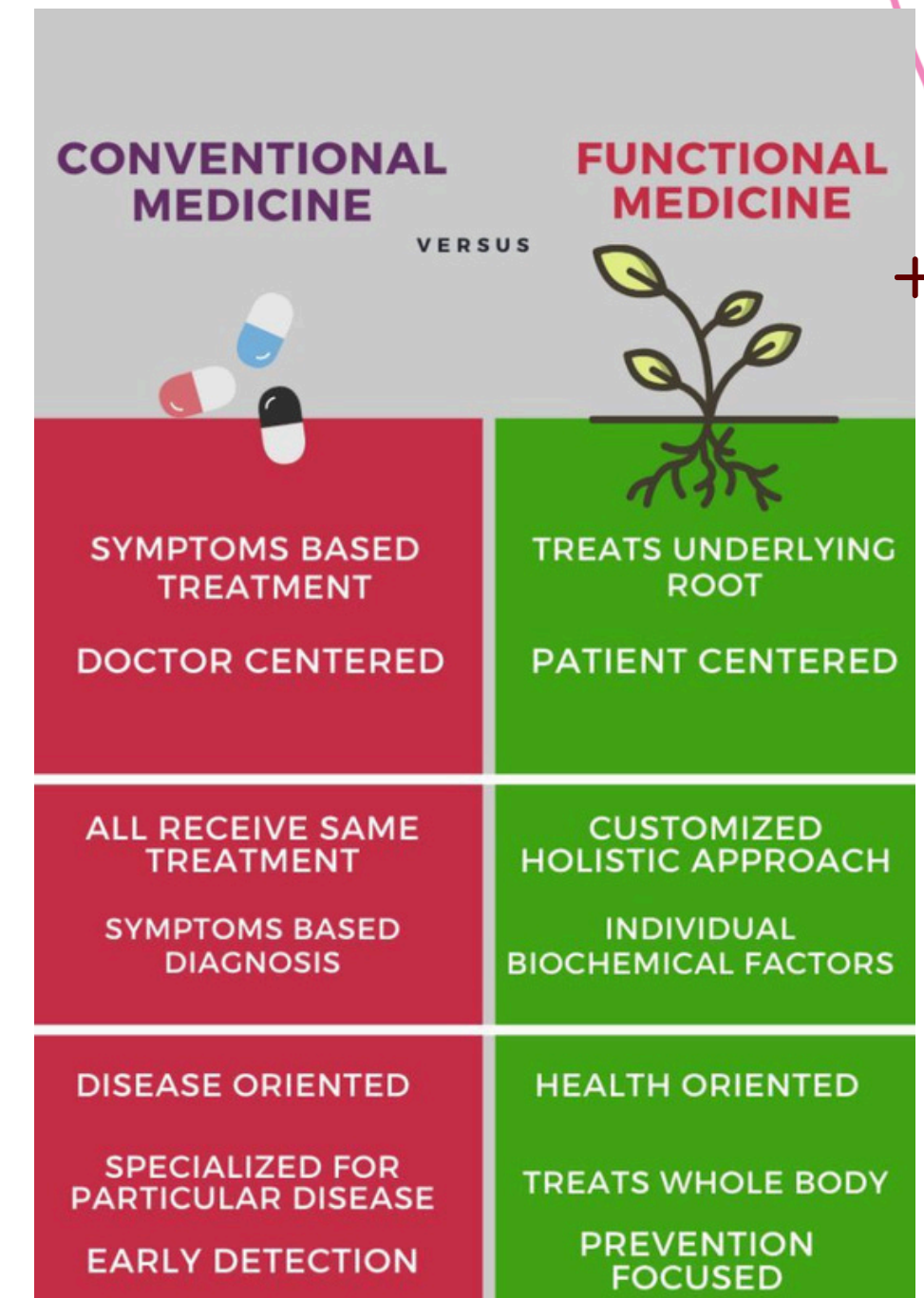
Holistic Vs Genomic Centric

- The aging process is an intricate, multifactorial phenomenon where genetics represents only one component of a much larger equation.

- The limitations of a genomics-only approach are readily apparent when addressing the complex, interacting systems that govern healthspan

- This gap between the promise of a truly holistic approach and the constraints of its current application creates a significant opportunity for models that can successfully integrate all three pillars:
  - your unique genetic predispositions
  - real-time environmental inputs
  - dynamic lifestyle factors, creating a complete picture of your health—into a cohesive clinical strategy

LONGEVITY PYRAMID

EXPERIMENTAL STRATEGIES

At the top of the Longevity Pyramid are the experimental strategies which represent promising solutions for targeting the hallmarks of aging and reshaping the landscape of aging-related research and interventions.
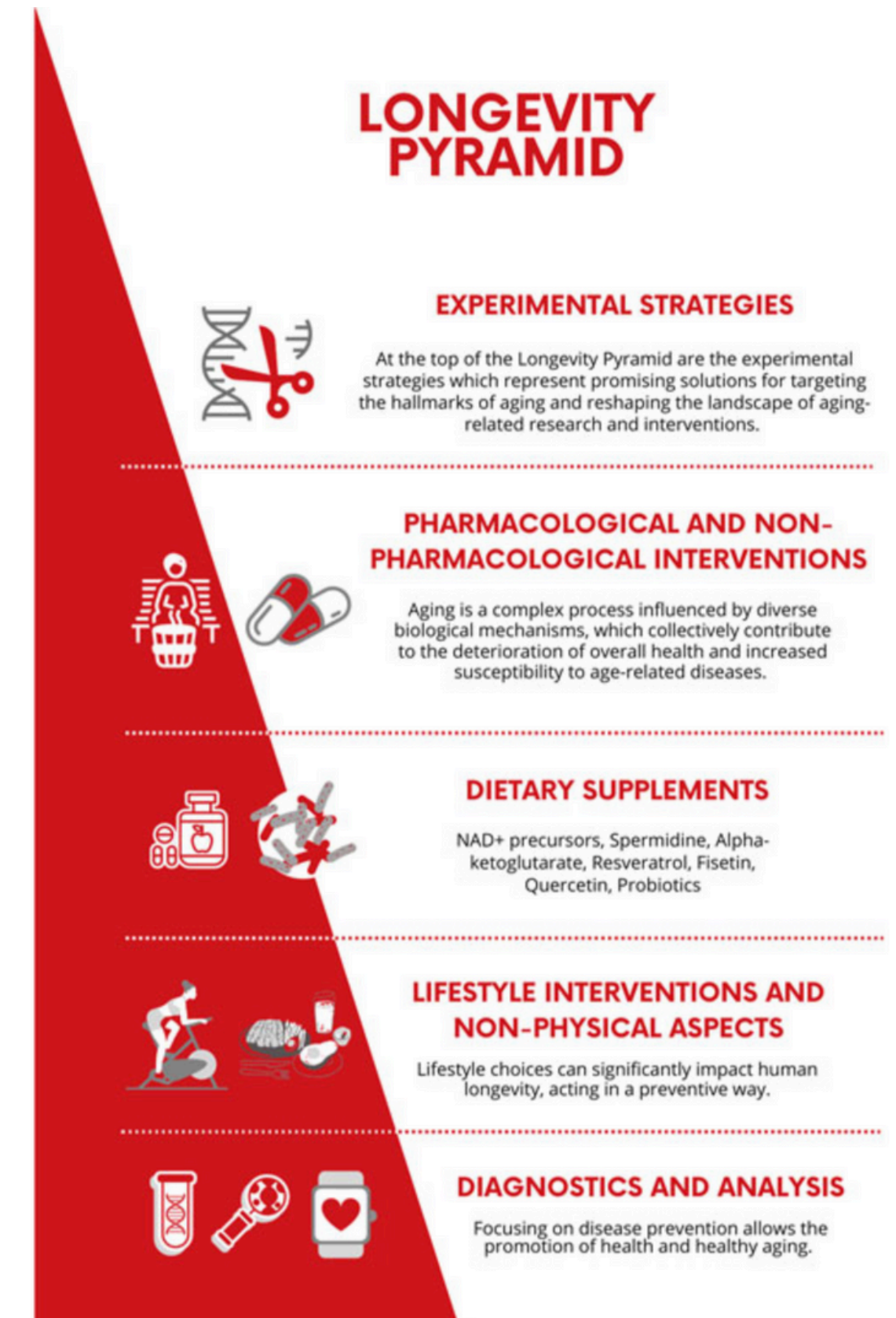
PHARMACOLOGICAL AND NON-PHARMACOLOGICAL INTERVENTIONS

Aging is a complex process influenced by diverse biological mechanisms, which collectively contribute to the deterioration of overall health and increased susceptibility to age-related diseases.

DIETARY SUPPLEMENTS

NAD+ precursors, Spermidine, Alpha-ketoglutarate, Resveratrol, Fisetin, Quercetin, Probiotics

LIFESTYLE INTERVENTIONS AND NON-PHYSICAL ASPECTS

Lifestyle choices can significantly impact human longevity, acting in a preventive way.

DIAGNOSTICS AND ANALYSIS

Focusing on disease prevention allows the promotion of health and healthy aging.

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Precision Medicine in Practice: The Neuro-Cognitive Frontier

- Nowhere is the need for a multi-domain, data-driven approach more evident than in the field of brain health
- A significant obstacle in treating neurocognitive impairment is the high degree of clinical and biological heterogeneity observed among patients
- **Leveraging AI** finally unlocks the potential for a comprehensive precision medicine approach to neurocognitive optimization, placing what was once theory firmly within our clinical reach
- The next frontier In health is not just access to data – it's the ability to interpret in real time and act with precision
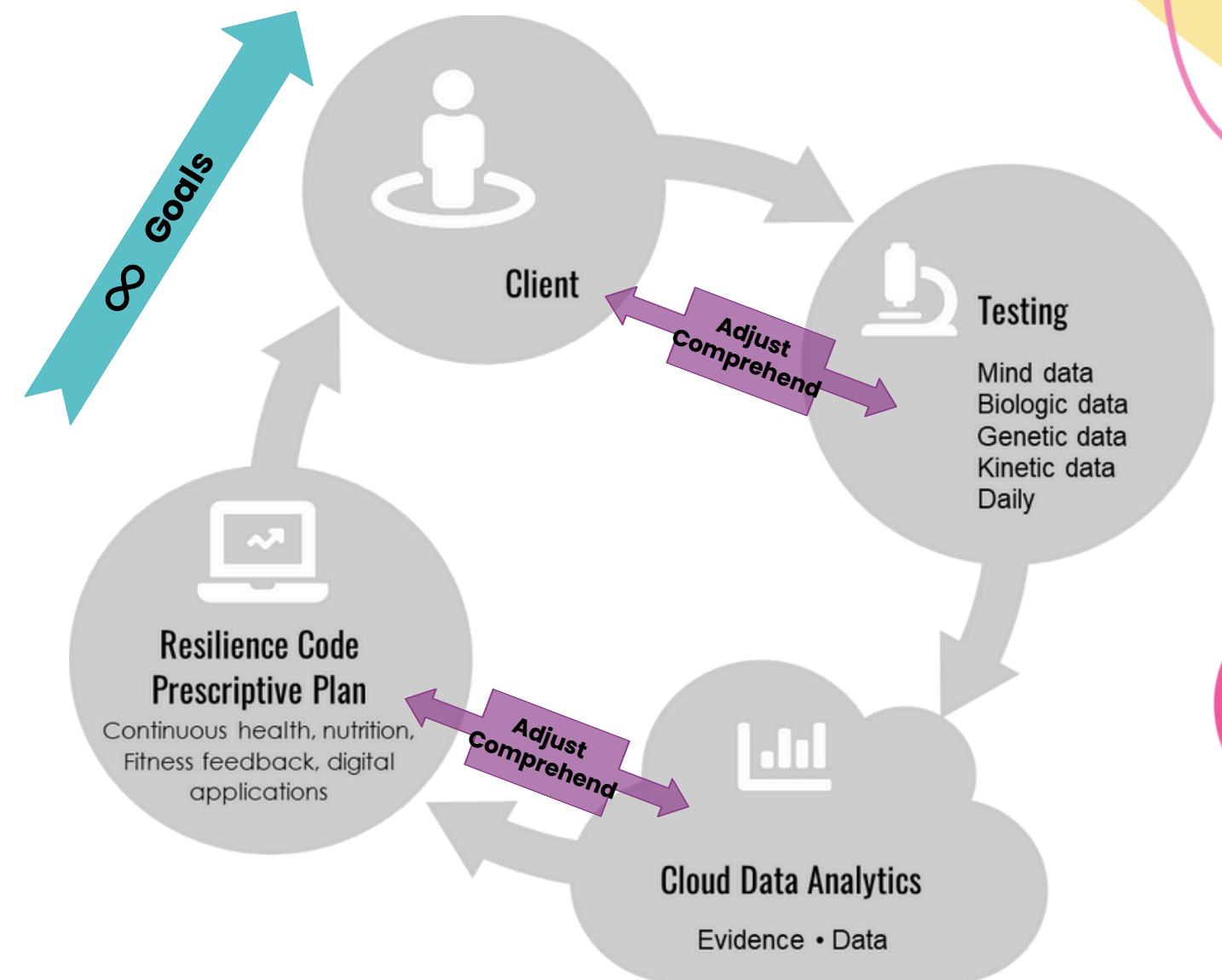

Data Analysis Generate Report

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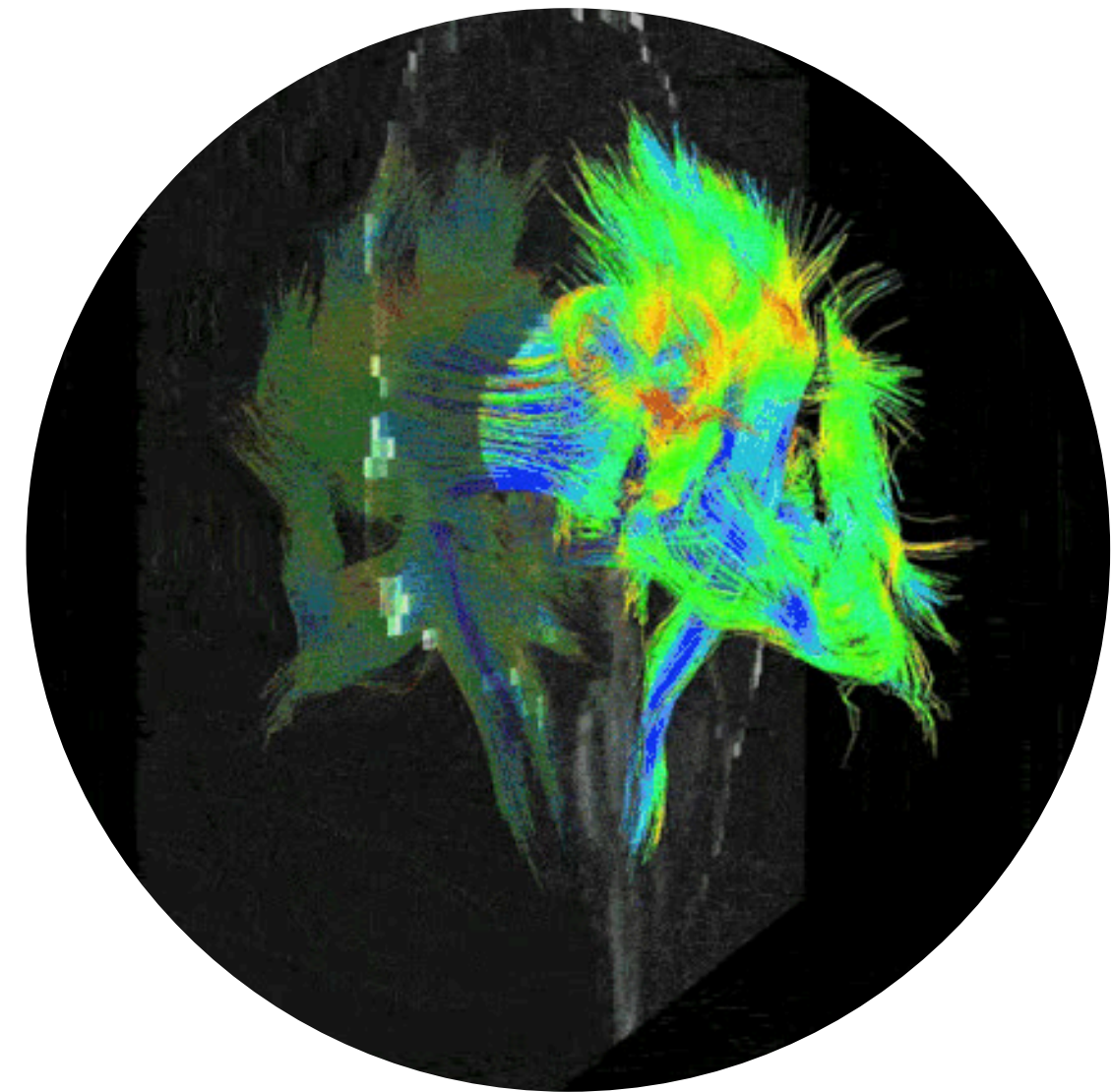
Resilience Code Medicine: Unlock your Code

Deep Personalization: Comprehensive Exhaustive Data Capture from physical, biological, neurological, and medical domains

The Power of Integration: Our proprietary platform integrates disparate data streams—genetic, metabolomic, microbiomic, neuronal, cognitive, radiological, kinetic—to uncover complex patterns and root causes that would be missed in siloed analyses.

Objective, Quantifiable, Baselines: We establish a multi-faceted, objective baseline of your health, particularly your brain's performance. This "Infinite Health" signature becomes the ultimate reference point against which all future interventions and lifestyle modifications are measured for true, data-driven results.

∞ Goals

Client

Adjust Comprehend

Testing
Mind data
Biologic data
Genetic data
Kinetic data
Daily

Resilience Code Prescriptive Plan
Continuous health, nutrition, Fitness feedback, digital applications

Adjust Comprehend

Cloud Data Analytics
Evidence • Data

Data Analysis Generate Report

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Resilience Code Medicine: Own Your Outcome

- **Population to N-of-1:** *We focus on creating an "N-of-1" clinical strategy where every recommendation—from nutrition to cognitive training—is tailored specifically to your individual data*
- **Proactive & Predictive Health Optimization:** *By understanding the specific biological mechanisms at play—identified through our rigorous testing—we design highly targeted interventions, from personalized nootropic regimens to specific neurofeedback protocols*
- **Longitudinal Tracking for Dynamic, Adaptive Programming:** *We provide our clients with the wearables, apps tracking their progress and interventions. With continuous monitoring and iterative program adjusting, We use your data to create a feedback loop that evolves with you for sustained peak performance.*

Population to N-of-1
We focus on creating an "N-of-1" clinical strategy where every recommendation—from nutrition to cognitive training—is tailored specifically to your individual data

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### Longitudinal Tracking for Dynamic, Adaptive Programming
We provide our clients with the wearables, apps tracking their progress and interventions. With continuous monitoring and iterative program adjusting, We use your data to create a feedback loop that evolves with you for sustained peak performance

Data Analysis Generate Report

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Living the Code: The Patient- Centric Performance Loop

- **Your Health, Decoded:** We believe that you should have access to and understand your own biological data. We provide a comprehensive "playbook" to your body and brain, translating complex data into actionable insights.
- **Partnership In Health:** Collaborative team of doctors, physical therapists, data scientists, physician assistants, and researchers create personalized plan
- **Clarity in a Complex World:** In a world of conflicting health advice, we provide clarity. Our precision medicine approach filters out the noise, telling you exactly what your body needs—and what it doesn't—based on your unique biology saving you time, money, and frustration.
- From Healthspan to "Performancespan"
- Retest and re-optimize
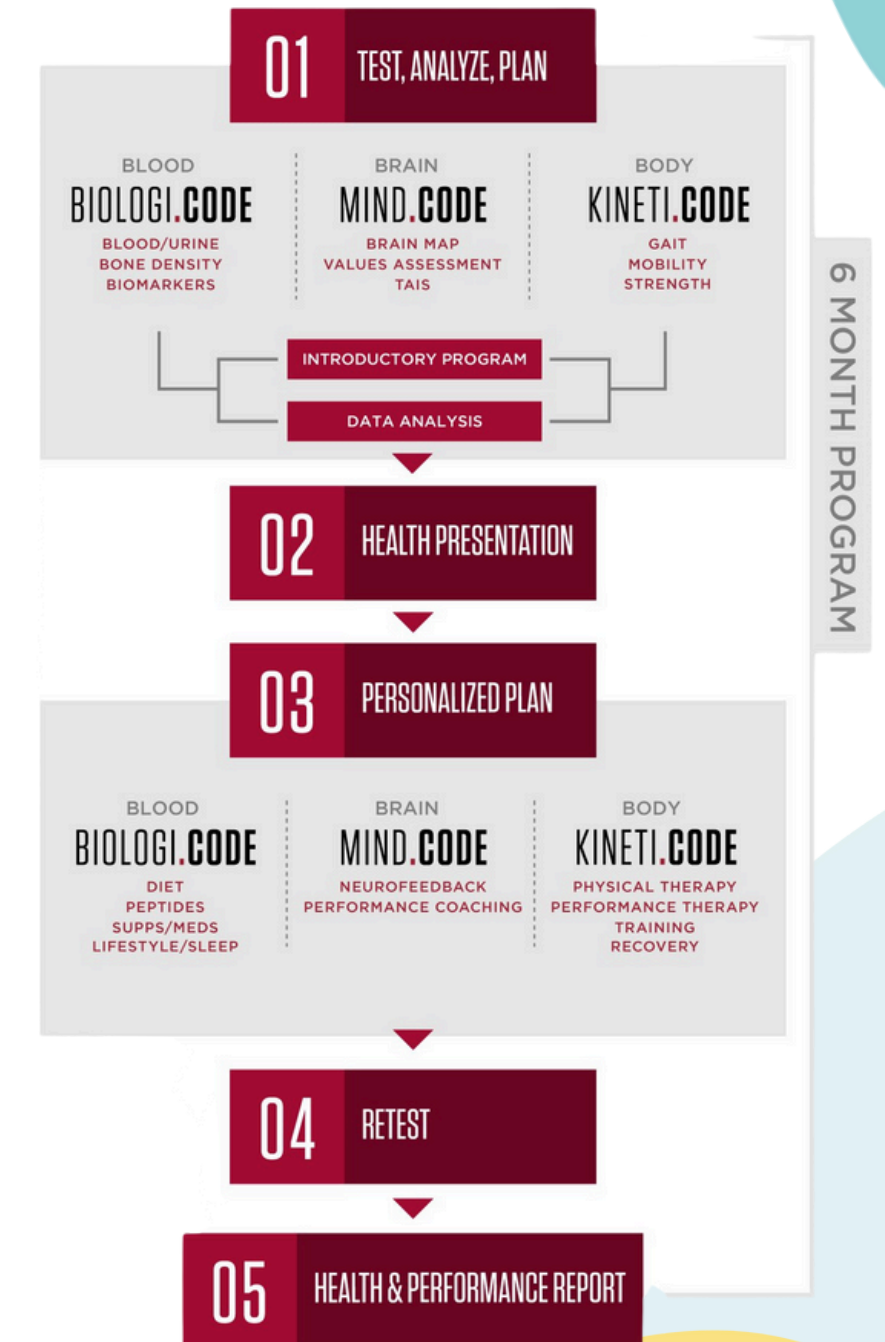
What is the Code?

- "360-degree testing of your health," which systematically examines the domains of blood, body, & brain
  - BiologicCode — "Blood" Millions Of Biomarkers To Analyze Health
  - Kineticode — "Movement And Performance" Kinetics And Kinematics
  - Mindcode — "Brain": Insight Into Cognitive Function
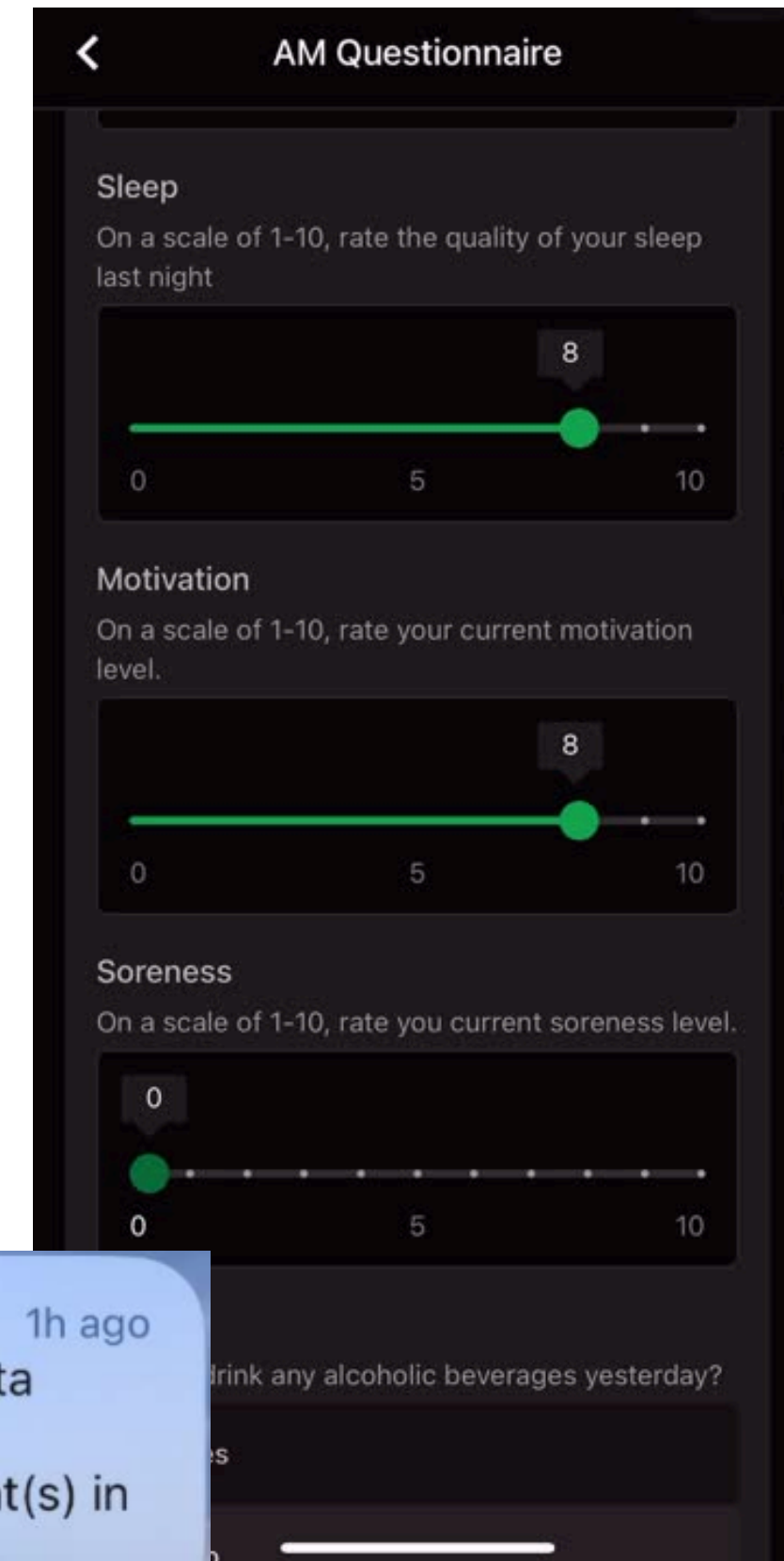

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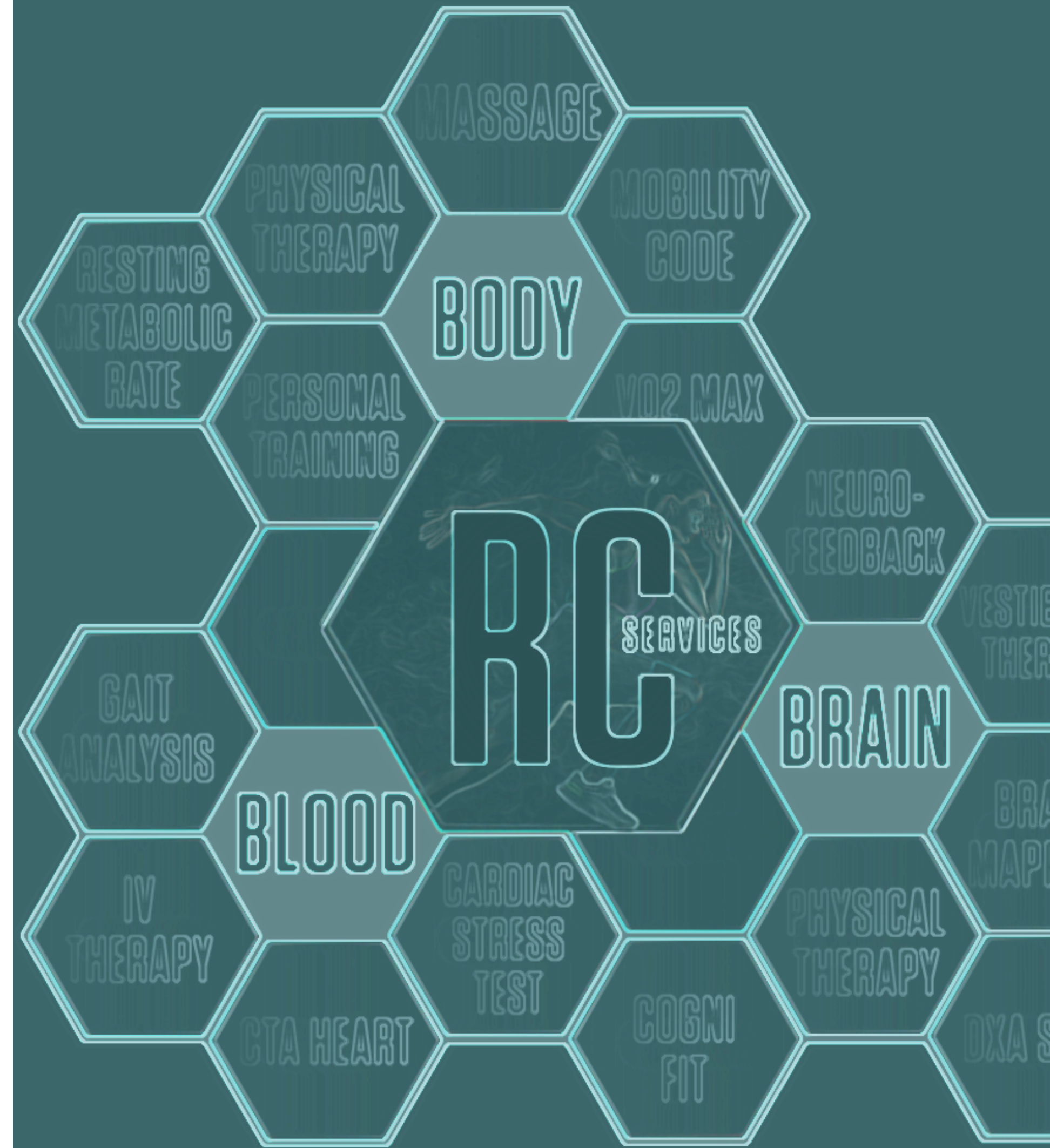
Who are our Patients?

- Professional Athletes
- Performance Seekers
- Health Span / Longevity Seekers
- Complex Chronic Brain Injury
  Complex Illness / Vector Born disease

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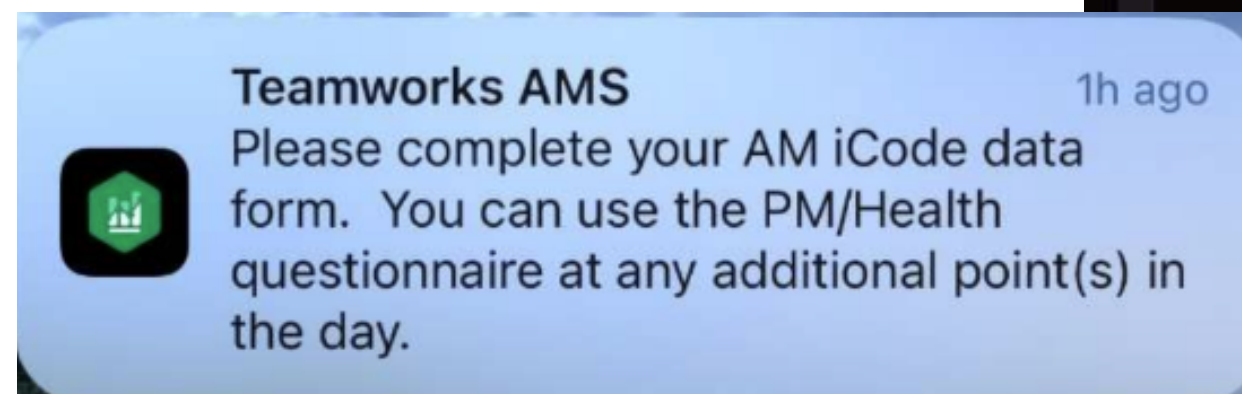Longevity
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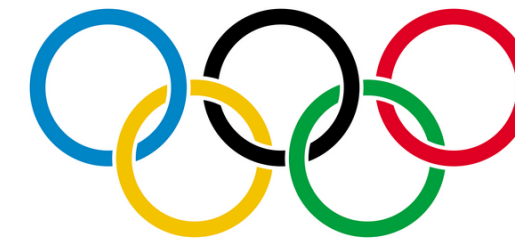
Daily Data Collection

- Clients log physical, cognitive, and emotional states daily through an integrated app
- Data includes mood, focus, sleep quality, perceived energy, stress levels, and more
- Integrated with wearable tech for seamless physiological, health and training biomarkers

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Longevity Data Powerhouse

- Combining Imaging, genomics, microbiome, cognitive function, lifestyle, nutritional biochemistry, hormone function, immune-inflammation markers, environmental toxins, gut-brain axis, epigenetics, social-emotional wellness, and more

- Unifies patient care for precise intervention.

- RC Database for predicting longevity is massive (595 tot. patients, 1.7 million biomarker data points)

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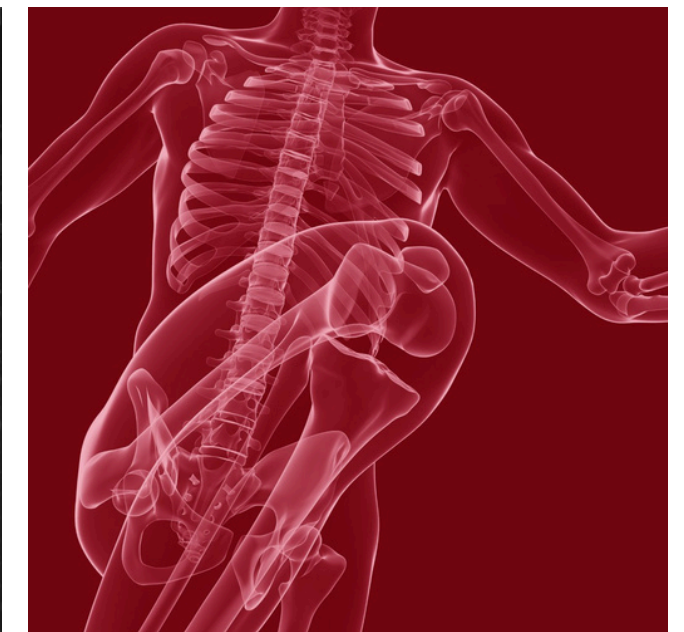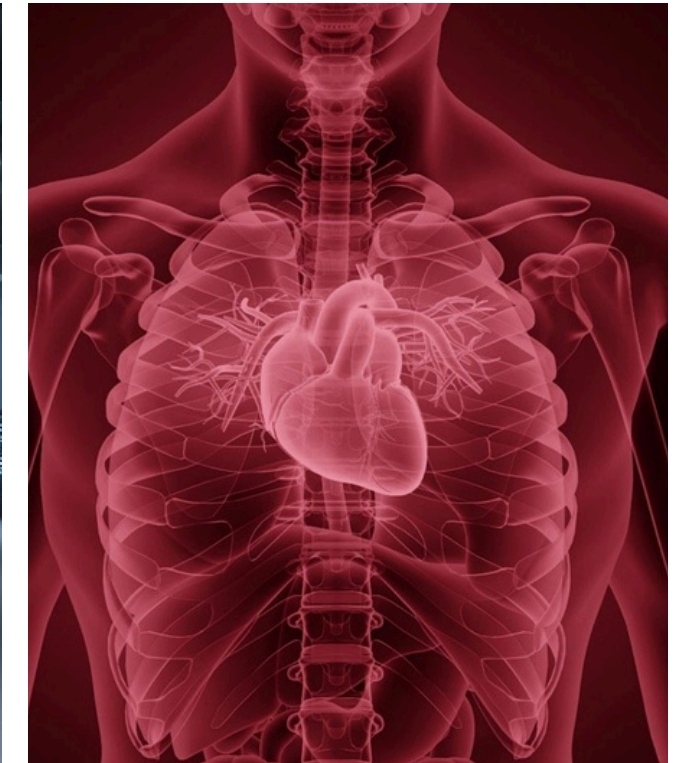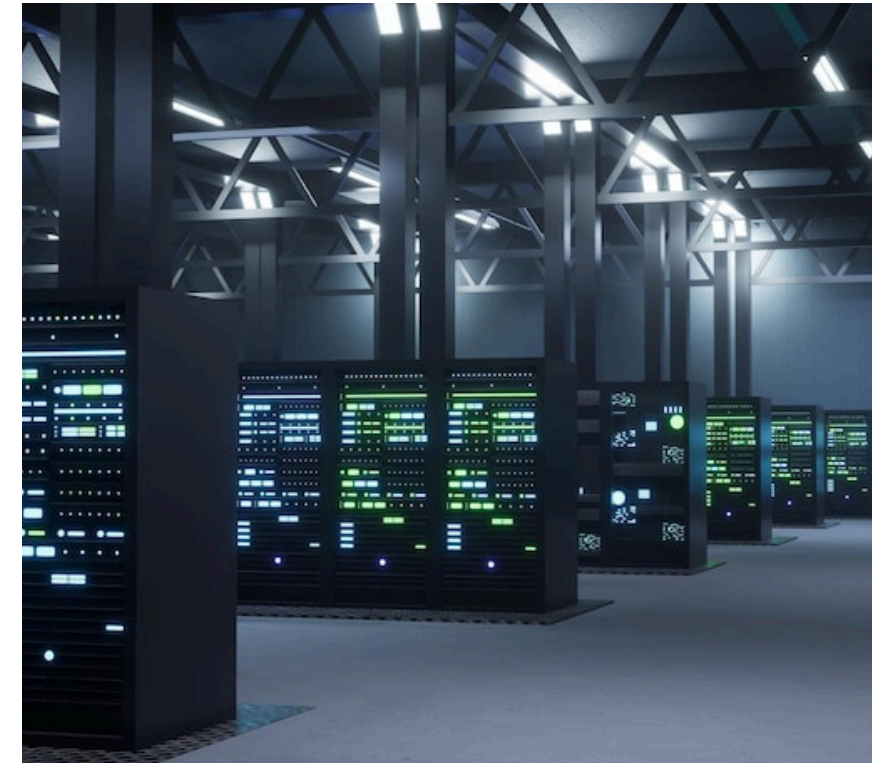
Pioneering Medical & Performance Data

Biological & Physiological Data

Imaging, genomics, microbiome, epigenetics
cognitive function
nutritional biochemistry
hormone function
immune-inflammation markers, environmental toxins, gut brain axis
social-emotional wellness
Blood Testing & Biomarkers
Body Composition (incl. bone density, weight)
Cardiovascular Metrics
Heart Rate, Heart Rate Variability (HRV), Blood Pressure, Postural Orthostatics

Lifestyle & Recovery

Sleep Quality Stages, Duration, Ratings
Diet & Nutrition
Food Logs, Fasting, Glucose, Metabolism
Fitness & Activity
Movement, Strength, Exercise
Sauna, Massages, footwear
Performance Training

Neurocognitive & Mental Health

Reaction Time, Neuromechanical coupling
Meditation & Mindfulness
Mood, Mind & Cognition
QEEG biofeedback training
Brain volumetrics & Imaging

Digital Life Tracking

Covers all non-biological inputs that influence health
Time & Lifestyle Management
Manual vs Passive tracking
Exercise programming
Habit tracking, goal setting, and scheduling
Digital Logs & Integration
Food, fitness, mood, etc.
Medication & Supplement Tracking
Integrated Portal & Timeline
Notes, appointments, labs
Files & Media
Texts, videos, photos, call summaries, documents

Sensors & Devices

Wearables (smart watches, rings)
Environmental Sensors (e.g., air quality, light exposure)
Continuous Glucose Monitoring
Sleep-specific devices
Performance training monitors
Wearable EKG
Neurofeedback

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RC's Vast Data Ecosystem

- 1,098,237 Lab Data Points
- 55,575 Brain imaging data points
- 35,388 CTA imaging data points
- 3,571 DXA imaging data points
- 94,534 Total Diagnostic Imaging data points
- >6,000 Neuromechanical data points
- >4,500 Locomotion & Vestibular data points
- >1,022 Daily readiness & physiological data points
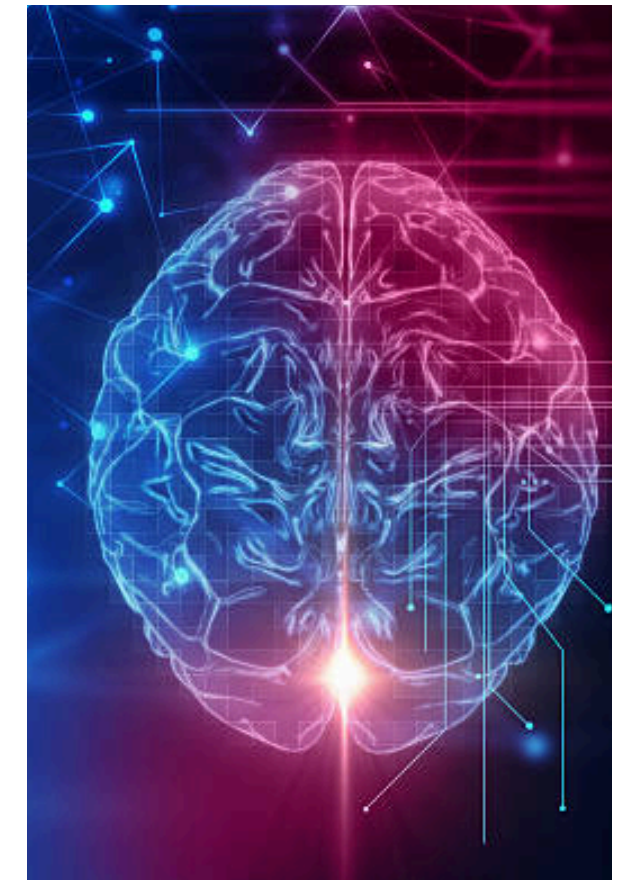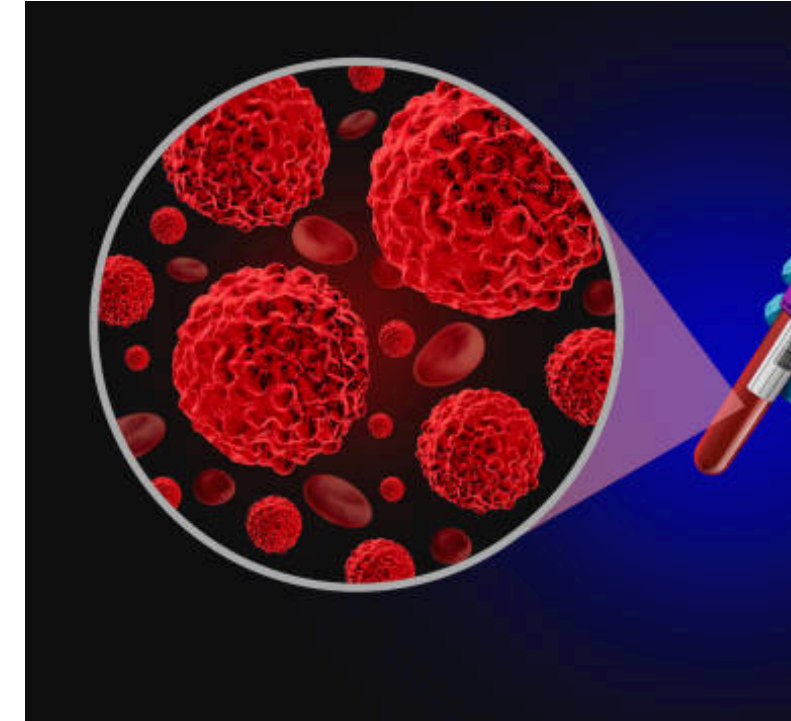
Core Metrics

- RC measures millions of biomarkers to predict longevity
  - NAD+ levels
  - Mitochondrial strength
  - Glucose / HbA1c
  - Insulin / HOMA-IR
  - CRP (C-reactive protein)
  - Tau protein
  - Amyloid β plaques
  - Physical strength
  - HRV
  - Sleep
  - Etc.
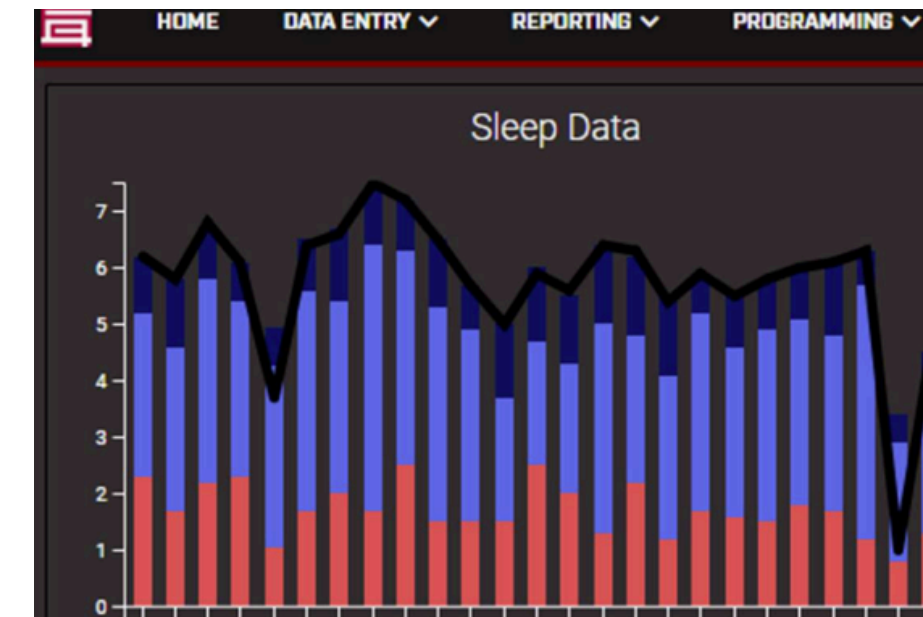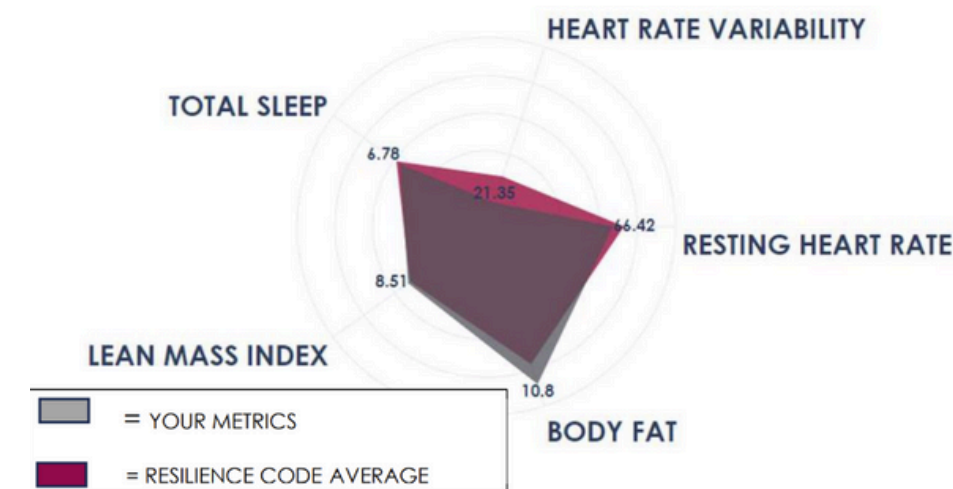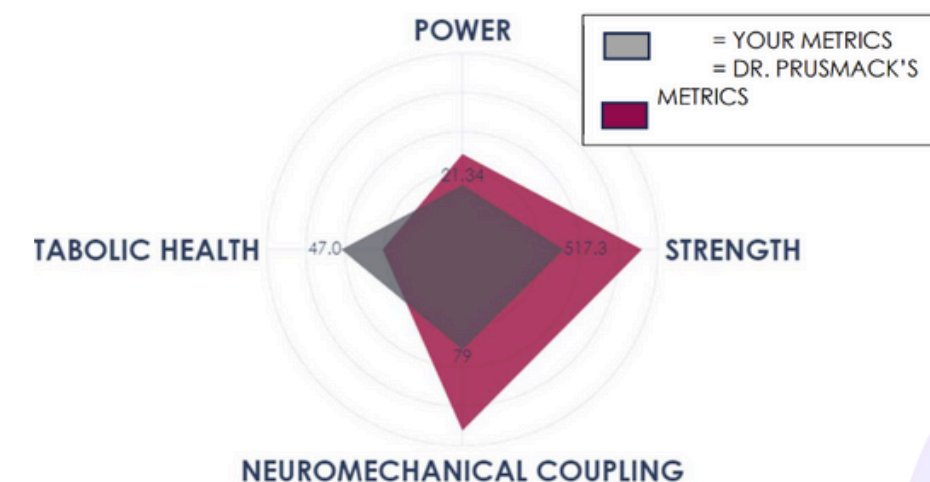
Data Driven Imaging

- Neuroimaging (MRI, MRA, qEEG) assesses early signs of neurodegeneration or structural anomalies.
- Cognitive stress testing, balance, eye tracking, and olfaction testing identify subtle deficits.
- Labs include neuroinflammation panels, neurotransmitter metabolites, and BDNF levels.

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Our Clinical Teams: Medical + Performance

- Our medical team manages diagnostics, pharmacology, fluidly adapting care plans, and disease prevention.
- Performance coaches, movement specialists, data coordinators, and physical therapists implement holistic plans.
- Integrated teams round bi-weekly and communicate daily.

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Infinite Health: Brain-First Model

- The brain regulates mood, movement, hormonal rhythms, and stress responses.
- Cognitive resilience enhances compliance with health routines and reduces reactivity to stressors.
- Neurological deterioration is often the first sign of systemic dysfunction — we intervene early.
- Brain is the central node in the ecosystem, influencing gut, hormones, immune function, and movement.

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The Brain as a Biomarker

- Neuromechanical Testing: Prioprio, Dynavision, Senaptec, Vestibulo-ocular Testing
- Electrophysiology: qEEG
- Neuropsychological Testing
- Radiology: NeuroQuant + LesionQuant for structural MRI analysis, 3T MRI with DTI, tractography, fMRI
- Brain Biomarkers: Neurohormomes, Neural Autoantibodies, Ptau, Amyloid beta 42/40, s100, NFL, Exosomes

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The Body as a Biomarker: Performance vs Fitness

PHYSICAL PERFORMANCE RELIES ON:

- MOBILITY—For sport & everyday movement
- STRENGTH-SPEED (Strength)—How <u>much</u> force can be produced
- SPEED-STRENGTH (Power)—How <u>fast</u> that force can be produced
- SPEED—The ability to apply force quickly in a technical way
- SPORT-SPECIFIC ENERGY SYSTEM DEVELOPMENT
  - Aerobic
  - Lactic
  - Alactic

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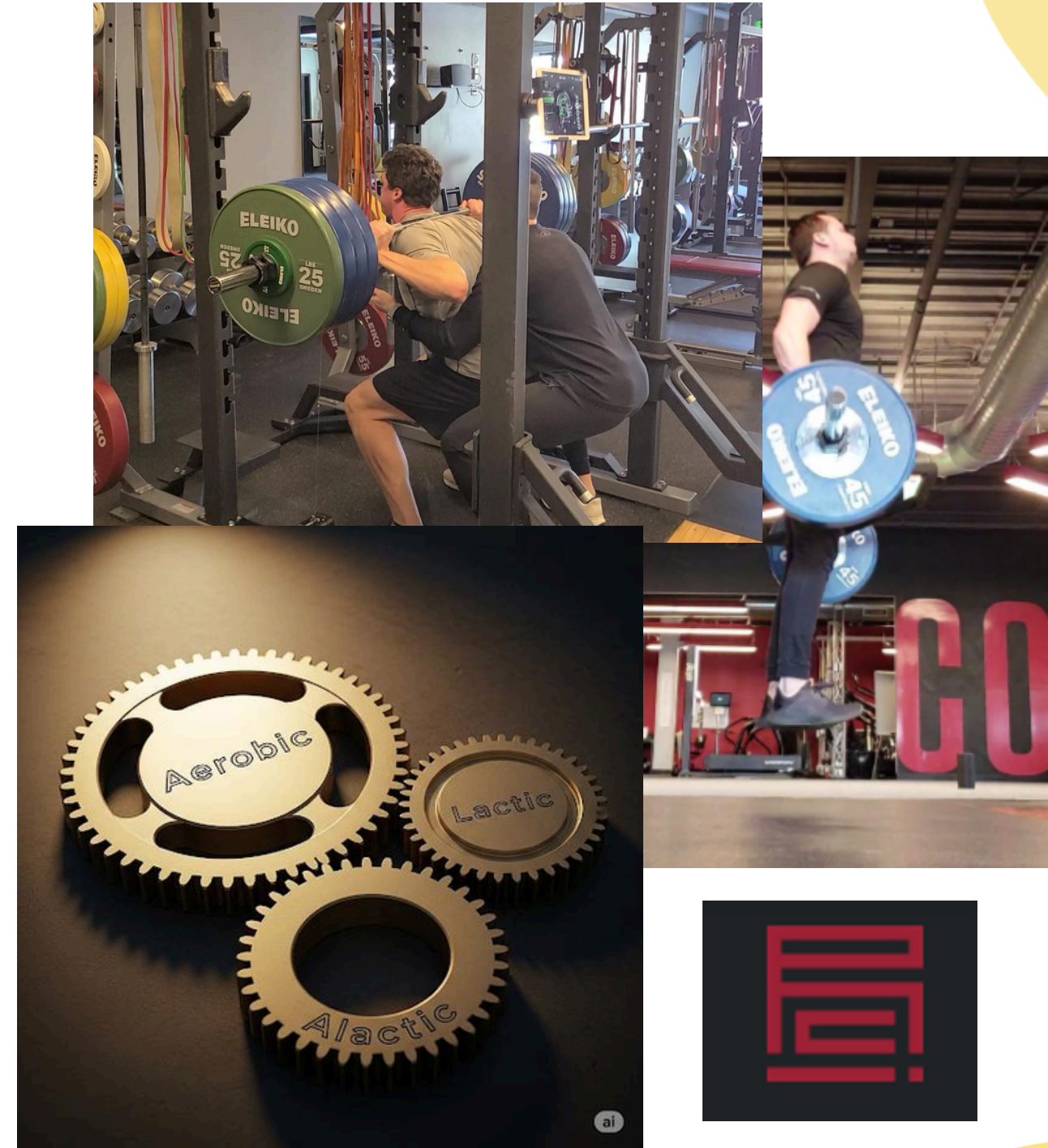
FORCE-VELOCITY PROFILING: Vertical Jump

What is Force-Velocity Profiling?
- Assesses ability to generate force at varying velocities by measuring jump height with ascending load (Example: Bodyweight, 60lbs, 110lbs, 160lbs)
- Plots force (high load, low speed) vs. velocity (low load, high speed)
- Identifies strength of speed deficits

How the Profile Guides Training:
- Force-Deficient: Focus on max strength work (slow bar speed, heavy load)
- Velocity-Deficient: Focus on speed and power (fast bar speed, lighter load)
- Balanced: Concurrent strength and power training, adjust by sport-specific need

Force-Dominant vs. Velocity-Dominant

Shift in the Force-Velocity Curve after an effective training program

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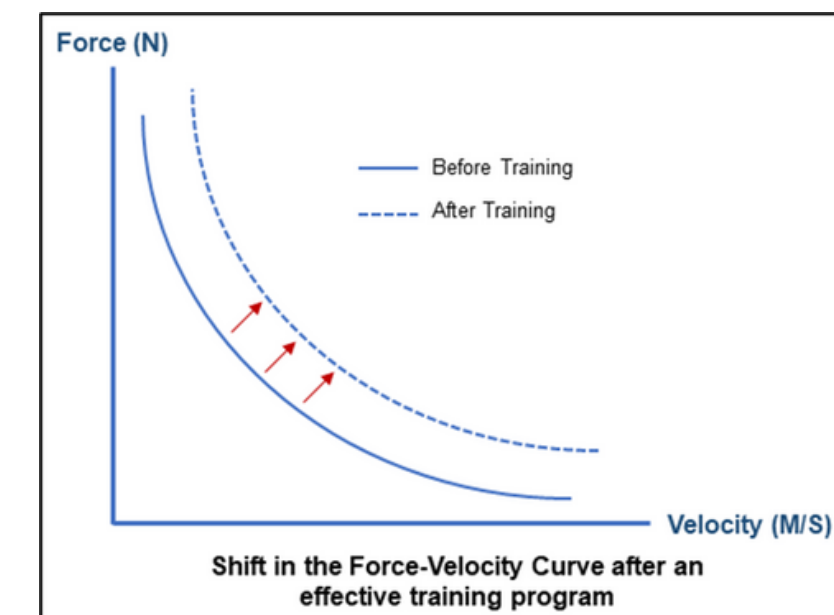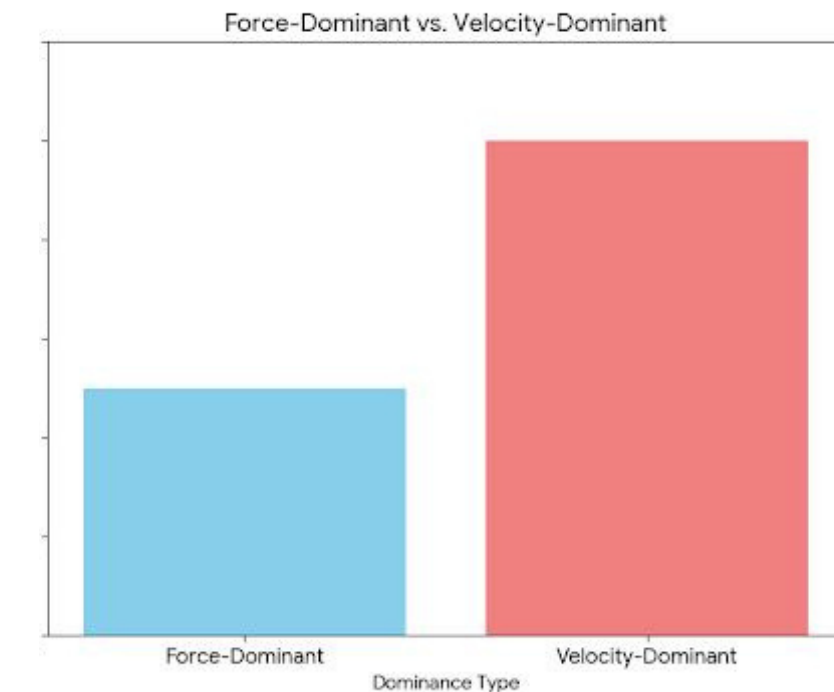
FORCE–VELOCITY PROFILING: Vertical Jump

Performing the Force-Velocity Profiling Test
- Record jump heights at different loads
  - Bodyweight (BW)
  - Empty Trap Bar (60lbs)
  - 110lbs
  - 160lb

- Using an equation developed by Carmelo Bosco, the athlete can be determined as optimal or suboptimal in two categories:

  - Strength-Speed
    - If jump height with BW + 100% of BW in additional load = 35% ± 5% of Bodyweight Jump Height, the athlete would be optimal for strength-speed

  - Speed-Strength
    - If jump height with BW + 50% of BW in additional load = 65% ± 5% of Bodyweight Jump Height, the athlete would be optimal for speed-strength

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FORCE-VELOCITY PROFILING: Vertical Jump

Bosco Calculator

	Speed-Strength	Strength-Speed
Optimal	65%	35%
You	58.71%	17.43%

Bosco FV Profile

Optimal — You
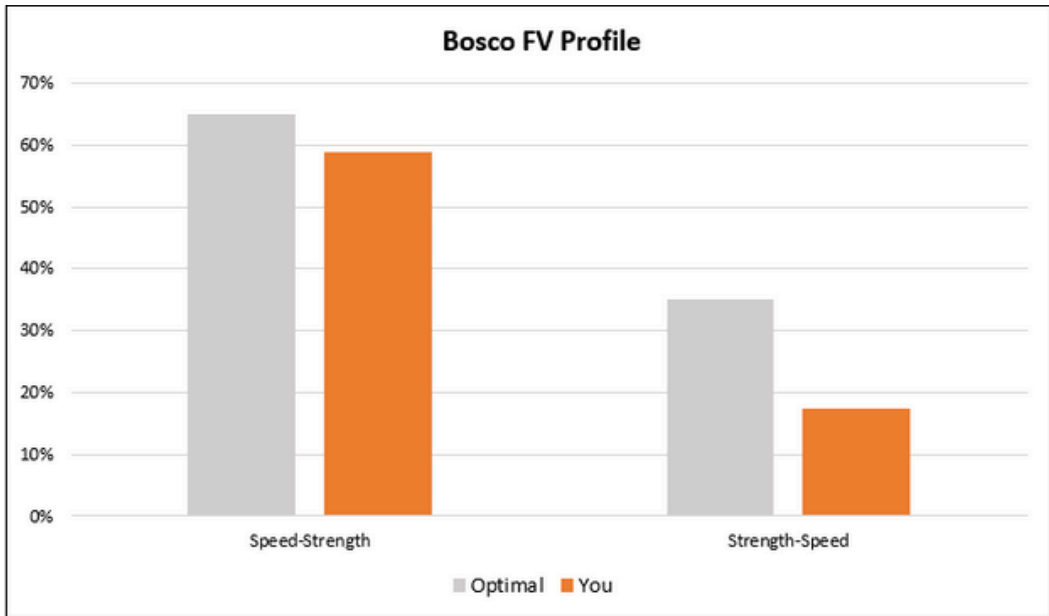
INITIAL RESULTS
- Slight velocity deficiency
- Large force deficiency

TRAINING INTERVENTION
- 16 Week (Four 4-week blocks)
- Concurrent strength & power training

The Goal Is To Be Within ± 5% Of "Optimal" Value

Re-Testing

Bosco Calculator

	Speed-Strength	Strength-Speed
Optimal	65%	35%
You	63.60%	27.21%

Bosco FV Profile

Optimal — You
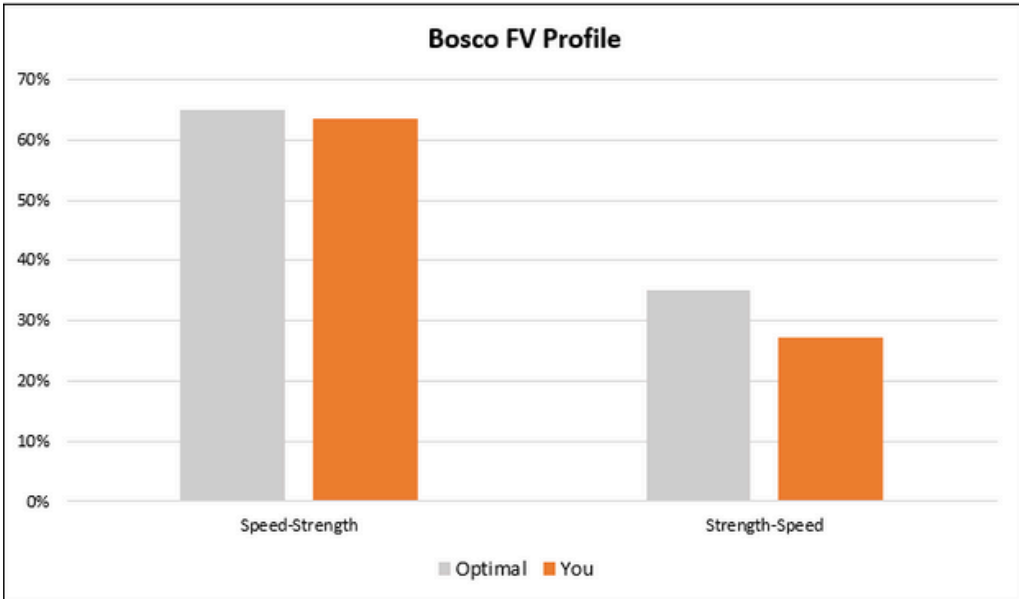
RE-TESTING RESULTS
- Optimal velocity output
- Much improved force output- only slight deficiency

TRAINING INTERVENTION ADJUSTMENT
- 16 Week (Four 4 week blocks)
- Maximal strength training

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FORCE-VELOCITY PROFILING: Exercise Specific

Pre-Training Load & Velocity Testing:
- Obtain 3 velocity measurements with increasing weight
- Mathematically project workload goal

Velocity-Based Load Prescription:
- Select the desired training intensity for the desired goal (e.g. 85% of 1 Rep Maximum for Strength Development) and the corresponding velocity that the weight should be moved
- Enables autoregulation and real-time performance feedback

Training Implications:
- Personalized loading based on bar speed
- Fatigue monitoring via velocity drop-off
- Each rep trains the intended quality (strength, power, speed)

BENCH PRESS FORCE-VELOCITY PROFILE

Minimum Velocity Threshold (1RM): 0.15 m/s

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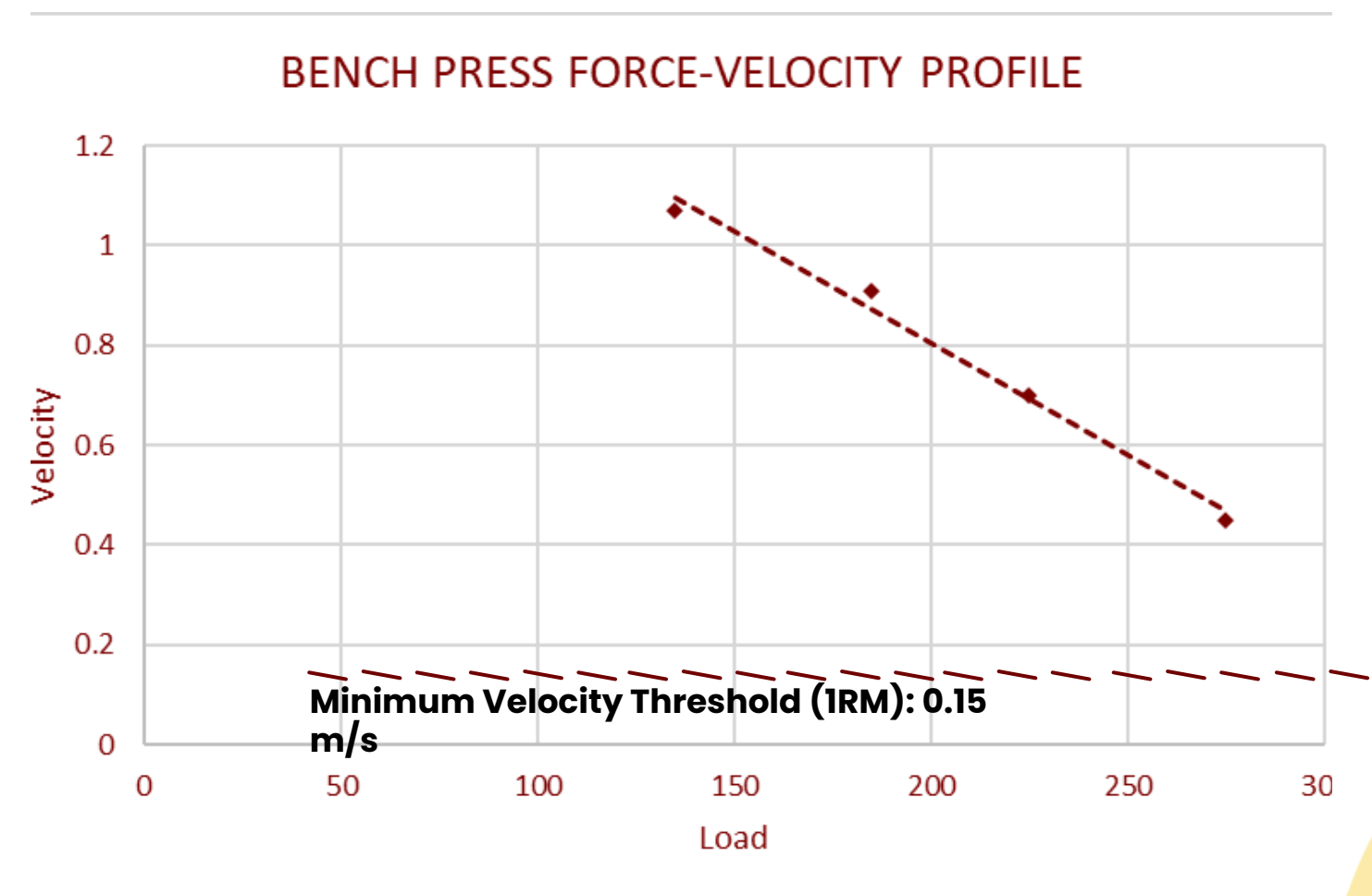
FORCE-VELOCITY PROFILING: Exercise Specific

Training Example—Bench Press:
- Pre-training velocity data collected during each bench press session
  - Speed at 135 LBS (blue line)
  - Speed at 225 LBS (green line)

- Training Goal
  - Maximal Strength Development (high load/low speed)

- Interpretation
  - January-July 2025: upward trends in speeds at 225LBS
  - During the focus on strength-speed, power (speed-strength) might see a slight decrease as seen in the graph by the blue line

Bench Press Velocity over Time

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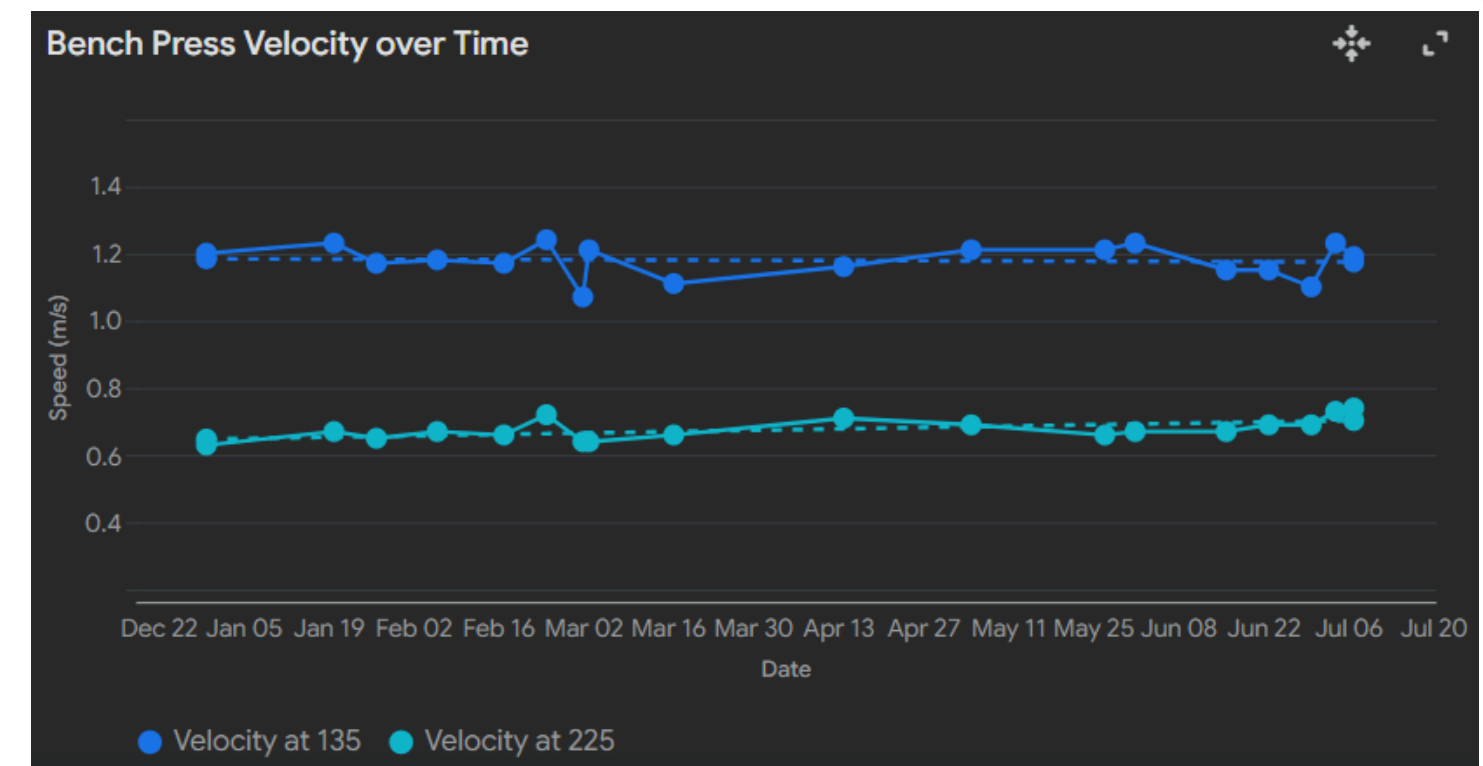
Case Study: Concussion Code

- **CONCUSSION HX:**
  - 12y/o first concussion back of head door frame + vominting , vertigo – LOC
  - 13 y/o hyperextended neck in football, ambulance of field. neck pain + concussion
  - High school: 1 concussion every year --> brief LOC , increased emotions, headache, vertigo , resolve in 1-2 weeks --> no ongoing problems
  - College 2018 --> drinking heavily at a frat party --> high velocity head into another person on slip and slide + concussion , regained consciousness at bottom of slide --> increased emotions, brain fog ,much more cognitive issues --> couldn't spell, remember instructions , hot flashes, panic attacks, then progressed to headaches, tingling of scalp , involuntary muscle jerks , got worse and worse
- **Environmental Exposure HX:**
  - summer prior to college white river hiking in tenesseee --> lower body "black specks" on legs --> all tics (100 of them)

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Case Study: ConcussionCode

26 y/o male with chronic complex persistent post concussive syndrome a[nd] probable chronic Tickborne illness . Patient has sustained significant concussions (+ LOC + Vestibular issues + amnesia + > 3) In the setting of a single high risk tick bite episode of 100+ nymphs) His main complaints are:

1. Severe muscle pain and joint popping, involuntary muscle contractions in neck resulting in small amplitude functional motor tics of neck
2. Exercise intolerance and PPPD associated with walking outside
3. Lack of Cognitive endurance with daily tasks and work
4. Waking up feeling hungover
5. Fatigue Brain Fog
6. Dysautonomia : POTS
7. Anxiety depression
8. Gut issues,

Case Study: ConcussionCode

RESILIENCE CODE

INFINITE HEALTH

YOUR HEALTH, REWRITTEN.

John Doe · ConcussionCode · 2025-07-03

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Case Study: Concussion Code

- Zooming out, our patients on average see an average of
  - Increase in HRV
  - Increase in deep sleep
  - Increase in recovery
  - Increase in overall energy
  - Increase in motivation
  - Decrease in stress
  - Improvement in strength and speed
- The 26-year-old male saw the same

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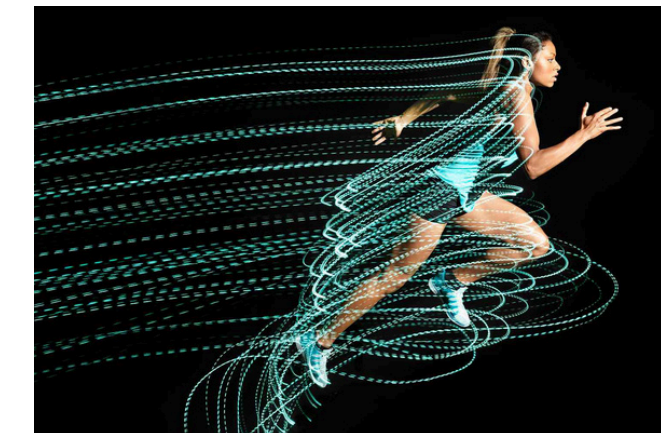
Programs in Action

- Targeted plans for brain fog, sleep disruption, memory decline, Lyme disease, ADHD symptoms, and many more.
- Combine cognitive training, nootropics, nutraceuticals, and neuroplasticity techniques.
- Adjusted weekly based on iCode data and real-time wearable inputs.

-14,8%

39.00 PRE   33.21 POST
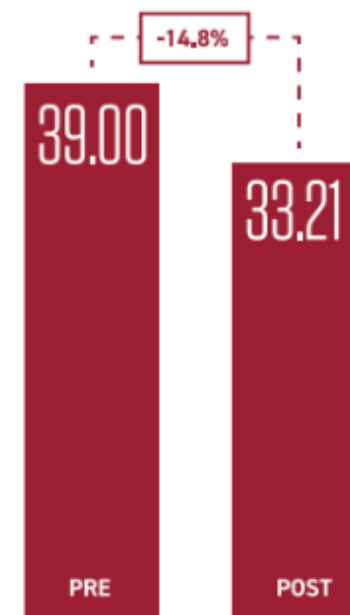
MSQ

All time 13.4% decrease in symptoms
- 9 mon timespan
- n=58
- 267 results (23% compliance)

-38,3%

39.69 PRE   24.50 POST
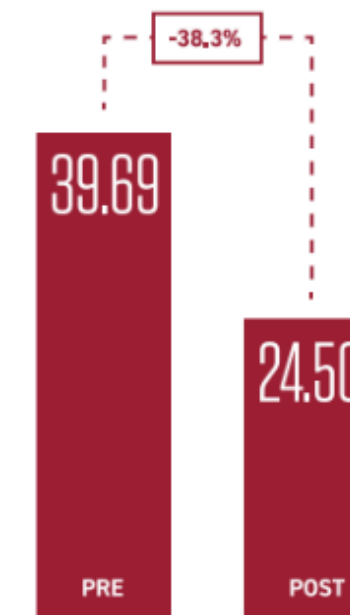
MSIDS

38.3% decrease in Average Horowitz MSIDS Scores through Lyme Treatment

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Case Study: Executive with Burnout

- 42-year-old with declining performance and mood.
- iCode data flagged REM drop, rising evening cortisol, lowered verbal memory.
- Introduced mitochondrial support, breath training, and nootropic rotation.
- Full recovery of executive function within 6 weeks.

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Sleep Efficiency

- **Data Sources**:
- **AM questionnaire**: Captures daily sleep aid usage
- **WHOOP device**: Provides sleep and recovery metrics (HRV, RHR, deep sleep)
- **Methods**:
- Matched sleep aid usage to sleep metrics **by date**
- Aggregated data **monthly**:
  - Summed number of days each sleep aid was used
  - Averaged sleep metrics per month
- Calculated **Pearson correlations** between sleep aid frequency and recovery metrics (e.g., HRV, RHR)

- Sleep efficiency was seen to have a positive trend seen with sleep efficiency in first graph
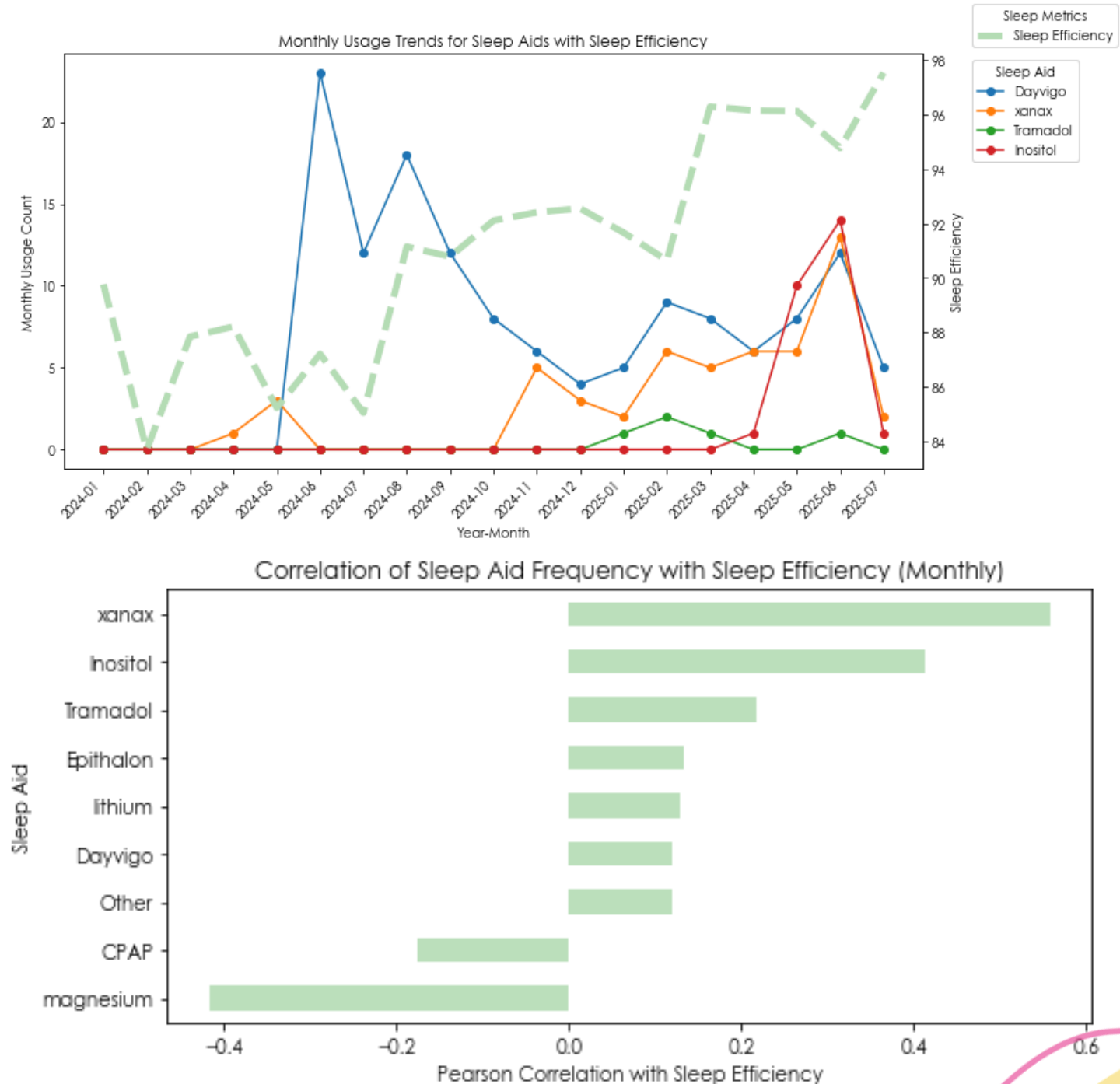
Sleep Aides & Recovery Metrics

- We integrated sleep aid data from AM questionnaires with WHOOP sleep and recovery metrics by aligning records by date. For each month, we:
- **Summed the usage** of each specific sleep aid.
- **Averaged sleep metrics** such as deep sleep hours, resting heart rate (RHR), and heart rate variability (HRV).
- **Calculated Pearson correlations** between sleep aid frequency and sleep metrics.
- **Key Insight:**
- **Dayvigo** usage showed notable associations:
  - **July 2024**: Taken on 10+ days, with HRV averaging around **35**.

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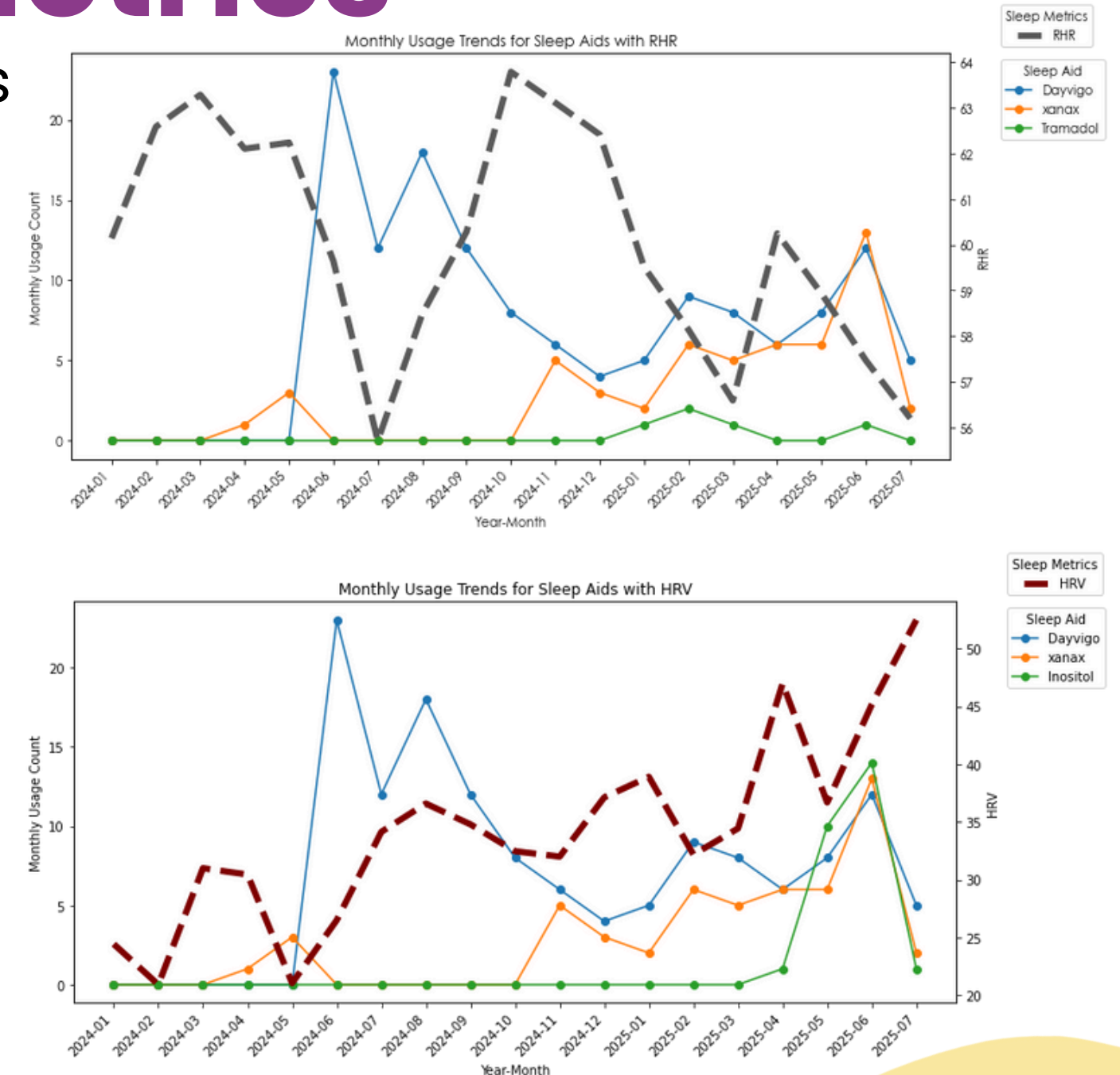
Sleep Aides & Recovery Metrics

Correlations:
- **RHR**: Moderate negative correlation *(r > –0.4)* — suggestive of a potential lowering effect.
- **HRV**: Positive correlation *(r > 0.2)* — indicating a potential improving effect.
- We visualized these relationships by plotting sleep aid frequency against corresponding sleep metrics to highlight potential patterns of impact.
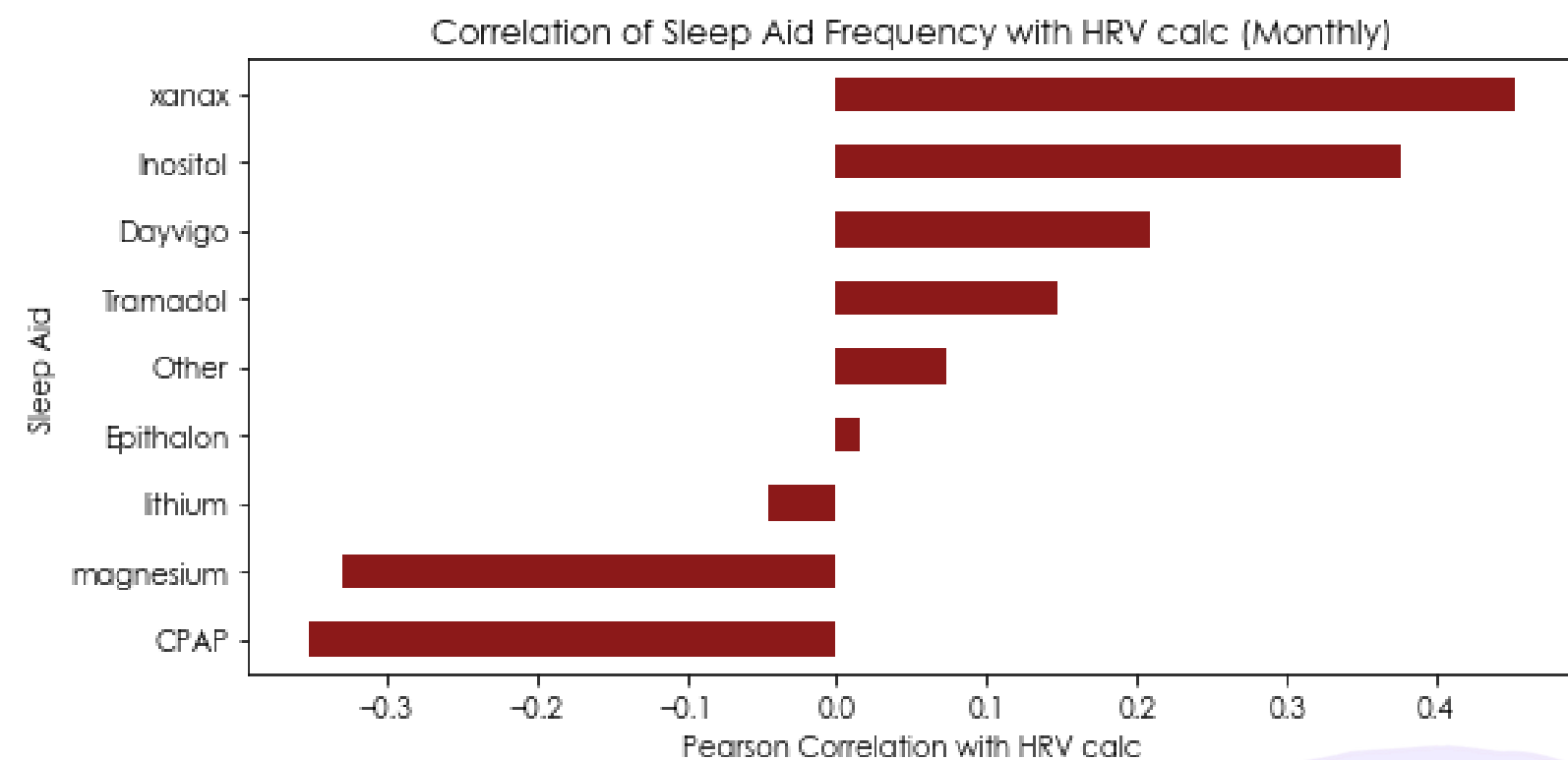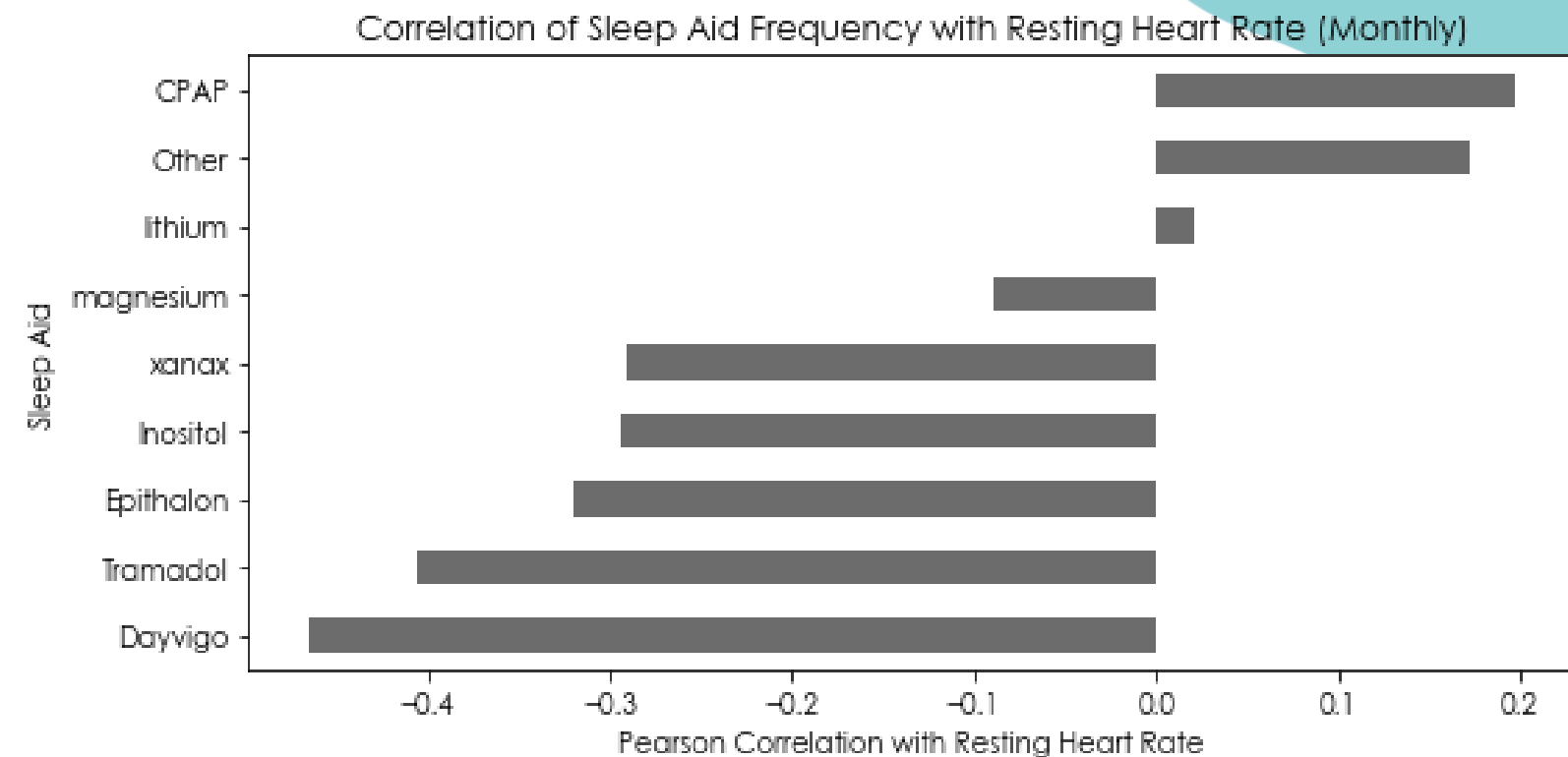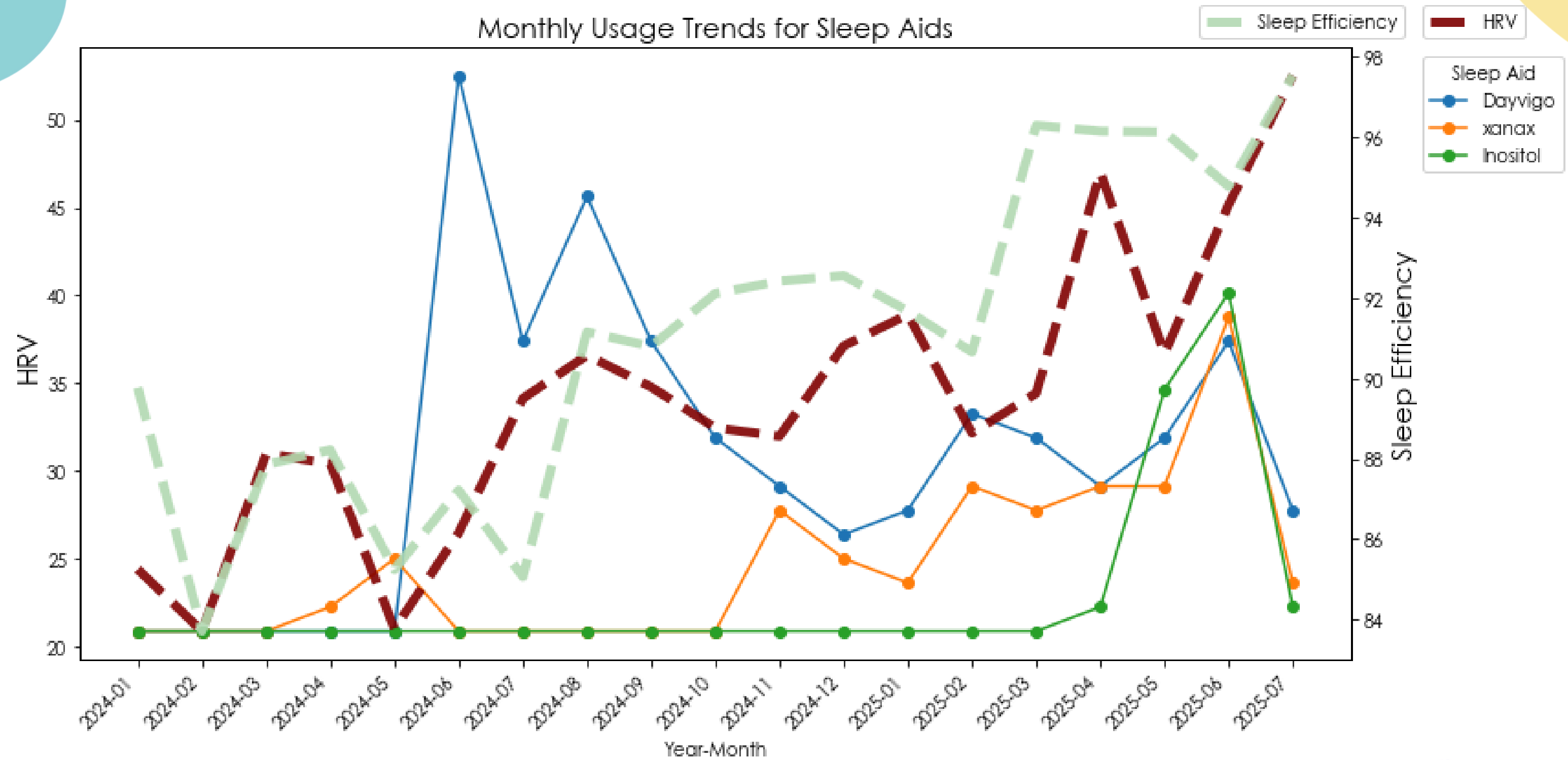
Correlation of Sleep Aid Frequency with Resting Heart Rate (Monthly)

Correlation of Sleep Aid Frequency with HRV calc (Monthly)

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Monthly Usage Trends for Sleep Aids

Comprehensive Testing done at Resilience Code

Micronutrient

Candida +IBS

Organic Acids

Resilience Code Lab Workup

Gut Zoomer

Viral Infections
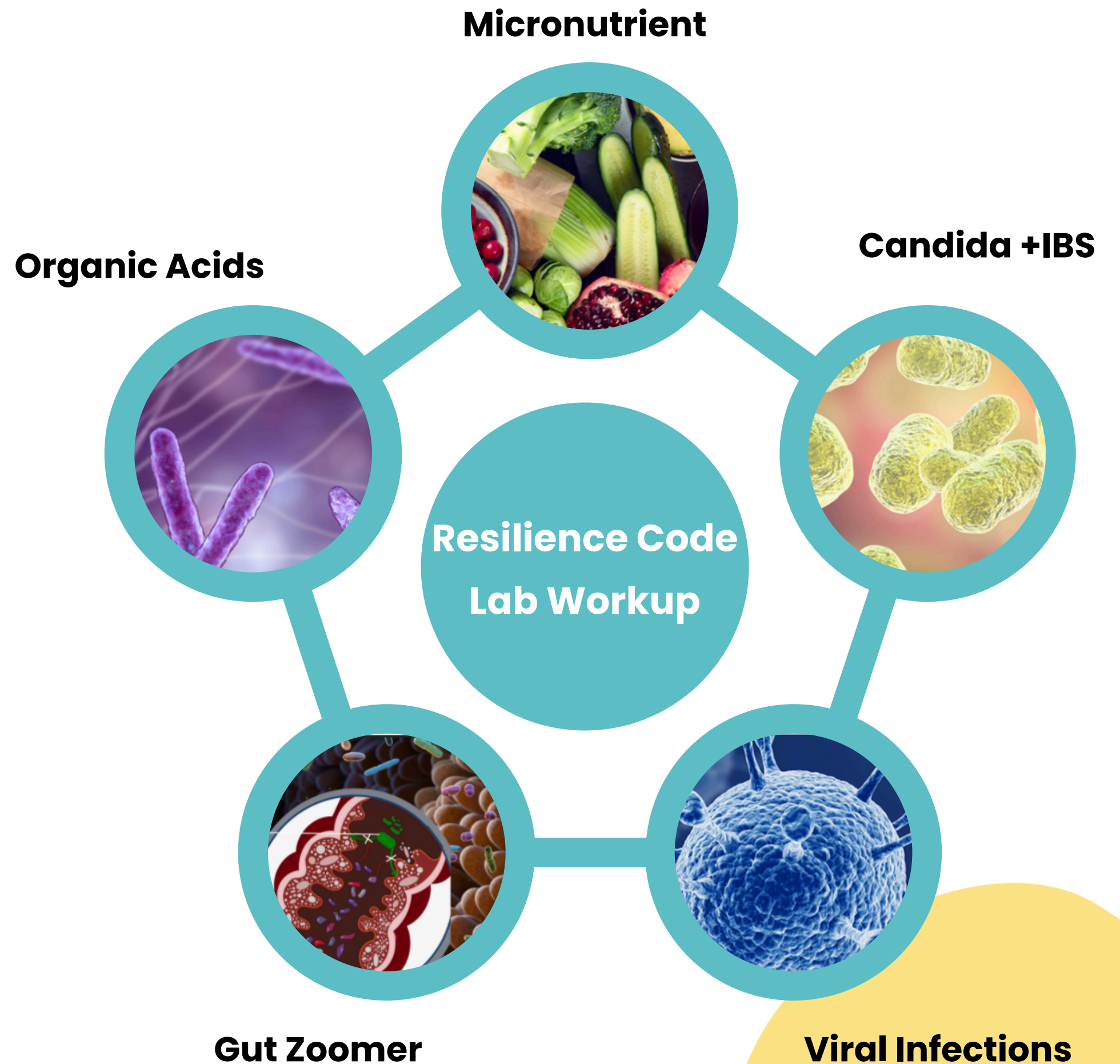
Comprehensive Testing done at Resilience Code

Cardiac Health Panel

Hormones

Total Tox Burden

Resilience Code Lab Workup

AutoImmune

Thyroid Panel

Case Study: Toxins

- 55 y/o female from Sonoma
- Referred for: Weight Gain, Migraines, Chronic lower back and neck pain, constant hand numbness
- MRI of cervical and lumbar spine Normal
- Background: Active in Pilates, sports medicine/nutrition background
- Goals: Address pain and numbness, support active lifestyle, modest weight loss

Case Study:

TOXINS				
ENVIRONMENTAL TOXINS	**01/26/23**	**MIN**	**MAX**	
DIMETHYLPHOSPHATE (DMP)	73.52	0.01	9.1	**3 HIGH ENVIRONMENTAL TOXINS**
GLYPHOSATE	28.53	0.01	1.65	
MONO-ETHYL PHTHALATE (METP)	1869.75	0.01	94.2	
BISPHENOL A (BPA)	2.71	0.01	2.12	**4 MODERATELY ELEVATED ENVIRONMENTAL TOXINS**
N-ACETYL PROPYL CYSTEINE (NAPR)	29.94	0.01	11.3	
N-ACETYL-S-(2-CARBAMOYLETHYL)-CYSTEINE (NAE)	187.35	0.01	82	
PHENYLGLYOXYLIC ACID (PGO)	494.26	0.01	285	
GUT	**01/26/23**	**MIN**	**MAX**	
GUT DYSBIOSIS - FUNGAL ANTIBODIES				
CANDIDA GUILLIERMONDII (IGG + IGA)	17.6	0.0	10.0	**FUNGAL COLONIZATION**
GUT DYSBIOSIS - FUNGUS/YEAST				
3-OXOGLUTARIC ACID	0.40	0.0	0.31	**HIGH FUNGUS/YEAST DYSBIOSIS**
ARABINOSE	85.47	0.0	30.0	
GUT DYSBIOSIS – H PYLORI				
H PYLORI, IGM ABS	12.0	0.0	9.0	**POSSIBLE H PYLORI**
HEAVY METALS	**01/26/23**	**MIN**	**MAX**	
THORIUM	0.08	0.01	0.02	**2 HIGH HEAVY METALS**
TUNGSTEN	1.01	0.04	0.12	
BARIUM	3.25	1	2.33	**3 MODERATELY ELEVATED HEAVY METALS**
CADMIUM	0.31	0.1	0.29	
MERCURY	0.85	0.1	0.57	
MOLD TOXINS	**01/26/23**	**MIN**	**MAX**	
ENNIATIN B1 (ENN B1)	0.15	0.05	0.13	**3 MODERATELY ELEVATED MOLD TOXINS**
SATRATOXIN H	0.11	0.05	0.1	
OCHRATOXIN A (OTA)	4.24	0.05	3.83	
OXALATE METABOLITES	**01/26/23**	**MIN**	**MAX**	
GLYCERATE	22.1	3.5	16.4	**2 HIGH OXALATE METABOLITES**
GLYCOLATE	68	0.0	67.0	

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Case Study:

PROGRAM — **RESTORE** — **PHASE #1**

DETOX, DIET, NUTRIENT & HORMONE BALANCE — 6 WEEKS

DIET:

DIET:	ORGANIC, HIGH PROTEIN (2.0 G/KG/DAY), ANTI CANDIDA DIET X 12 WEEKS
LINK:	https://www.thecandidadiet.com
AVOID SENSITIVITIES:	ALL DAIRY, ALL 3+, 2+ FOOD SENSITIVITIES
AVOID PTHALATES:	PLASTIC FOOD AND BEVERAGE CONTAINERS, PLASTIC WRAP, PERFUME, "FRAGRACE" NAIL POLISH
LINK:	https://www.ewg.org/news-insights/news/2021/10/six-tips-avoid-phthalates-after-study-highlights-health-harms-billion
AVOID PESTICIDES:	https://www.downtoearth.org/health/nutrition/how-to-avoid-pesticides-your-diet
AVOID PESTICIDES (WINE):	http://organicvineyardalliance.com/pesticide-fact-sheet/
DRINK GLYPHOSATE FREE WINE:	https://yoursustainableguide.com/organic-wines-with-least-pesticides/

POWDER:

SUPPLEMENTS	DOSAGE	FREQUENCY	PURPOSE	NOTES
OPTICLEANSE GHI	1 PACKET	DAILY	DETOX/PROTEIN	WHOLESCRIPTS.COM

AM + PM :

SUPPLEMENTS	DOSAGE	FREQUENCY	PURPOSE	NOTES
ALLERGY RESEARCH: CURCUWIN	2 CAP	AM + PM	INFLAMMATION/CURCUMIN	FULLSCRIPT.COM
DESIGNS FOR HEALTH: OMEGAVAIL HI-PO*	1 GEL	AM + PM	INFLAMMATION/SKIN	FULLSCRIPT.COM
DESIGNS FOR HEALTH: FLORAMYCES	1 CAP	AM + PM	PROBIOTIC #1	FULLSCRIPT.COM
DESIGNS FOR HEALTH: PREBIOMED XOS	1 CAP	AM + PM	PROBIOTIC #2	FULLSCRIPT.COM
DESIGNS FOR HEALTH: NAC 900MG	1 CAP	AM + PM	DETOX	FULLSCRIPT.COM
DESIGNS FOR HEALTH: MITOCHONDRIAL NRG	2 CAP	AM + PM	COQ10/ALA/ENERGY	FULLSCRIPT.COM
DESIGNS FOR HEALTH: L-ARGININE	1 CAP	AM + PM	DEFICIECNY	FULLSCRIPT.COM
DESIGNS FOR HEALTH: COMPLETE MINERAL COMPLEX	1 CAP	AM + PM	MINERAL DEFICIECNY	FULLSCRIPT.COM

MEDS - PEPTIDES

	DOSAGE	FREQUENCY	PURPOSE	NOTES
BCP 157	500MCG	AM + PM DAILY	JOINT REPAIR/INFLAMMATION	VPI/INEGRATIVE
5-AMINO -1MQ	1 CAP (50MG)	AM	ENERGY/FAT LOSS/NAD+	VPI COMPOUNDING
NAD+ IM INJECTIONS	0.5ML	WEEKLY	MITOCHONDRIA/ANTIOXIDANT	VPI COMPOUNDING
ULTRALIPO MIC B INJECTIONS	1ML	WEEKLY	FAT BURNING	VPI COMPOUNDING

MEDS

	DOSAGE	FREQUENCY	PURPOSE	NOTES
LOW DOSE NALTREXONE	1 CAP (4.5MG)	AM	INFLAMMATION	VPI COMPOUNDING
METFORMIN ER	500MG	AM + PM	ANTIAGING/INSULIN SENSITIVITY	PHARMACY

BEDTIME:

MEDS

	DOSAGE	FREQUENCY	PURPOSE	NOTES
TESTIM (TESTOSTERONE) GEL	0.5ML	PM	SEX DRIVE/OSTEOPENIA	PHARMACY

SUPPLEMENTS	DOSAGE	FREQUENCY	PURPOSE	NOTES
GI DETOX	2 CAP	BED	DETOX/BINDER	FULLSCRIPT.COM

LIFESTYLE:

IV	FREQUENCY		PURPOSE	NOTES
OZONE	1-2X MONTHLY		ANTIOXIDANT	
PHOSPHATYDAL CHOLINE			DETOX/NERVE HEALTH	
ALPHA LIPOIC ACID			ANTIOXIDANT/NEUROPATHY	
GLUTATHIONE			DETOX	

BRAIN	FREQUENCY		PURPOSE	NOTES
NEUROFEEDBACK	AS PER SARAH		SLEEP/ MINDFULNESS	SARAH M.
INFRARED SAUNA				
MOLKULE HEPA FILTER				

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Case Study:

TOXINS						
ENVIRONMENTAL TOXINS	01/26/23	07/03/23	08/24/23	MIN	MAX	
HERBICIDES						
GLYPHOSATE_VA	28.53		12.98		<1.65	SIGNIFICANTLY IMPROVED BUT STILL HIGH PESITICIDE "ROUND UP"
OTHER TOXINS						
N-ACETYL-S-(2-CARBAMOYLETHYL)-CYSTEINE (NAE)_VA	187.35		181.61		<82	IMPROVED BUT STILL MODERATELY ELEVATED "ACRYLAMIDE" TOXINS FOUND IN COFFEE, HIGH TEMPERATURE COOKED FOODS , PLASTICS
PESTICIDES						
DIMETHYLPHOSPHATE (DMP)_VA	73.52		14.31		<9.1	SIGNIFICANTLY IMPROVED BUT STILL HIGH "DMP" PESTICIDES
PHENOLS						
BISPHENOL A (BPA)_VA	2.71		2.23		<2.12	SIGNIFICANTLY IMPROVED TOXIN FOUND IN PLASTICS
PHTHALATES						
MONO-ETHYL PHTHALATE (METP)_VA	1869.75		330.88		<94.2	SIGNIFICANTLY IMPROVED BUT STILL HIGH PHTHALATES (PLASITICIZER) IN COSEMETICS
VOLATILE ORGANIC COMPOUNDS						
N-ACETYL PROPYL CYSTEINE (NAPR)_VA	29.94		6.98		<11.3	IMPROVED VOLATILE ORGANIC COMPOUND
PHENYLGLYOXYLIC ACID (PGO)_VA	494.26		368.19		<285	SIGNIFICANTLY IMPROVED BUT STILL MODERATELY ELEVATED VOLATILE ORGANIC COMPOWNDS
GUT	01/26/23	07/03/23	08/24/23	MIN	MAX	
GUT DYSBIOSIS - BACTERIAL						
M-HYDROXYPHENYLACETATE (ION)	5.8		9.3		<=8.1	MILD BACTERIAL DYSBIOSIS
PHENYLACETATE (ION)	0.09		0.16		<=0.12	
GUT DYSBIOSIS - FUNGAL ANTIBODIES						
GUT DYSBIOSIS - FUNGUS/YEAST						
3-OXOGLUTARIC ACID	0.40		.2		<=0.31	MUCH IMPROVED FUNGAL DYSBIOSIS
ARABINOSE	85.47		18		<=30.00	

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What will our clients have in the near future?

- **Personalized Chatbot Support**
  - 24/7 guidance for symptoms, next steps, and basic health questions
  - Integrated with your data for context-aware recommendations
  - Wild work to ADD to doctor-patient relationship
- **Seamless App Communication**
  - Direct messaging with your care team
  - Appointment reminders, updates, and shared documents
- **AI-Enhanced Decision Support**
  - Intelligent triage and data interpretation
  - Helps patients understand results and take action
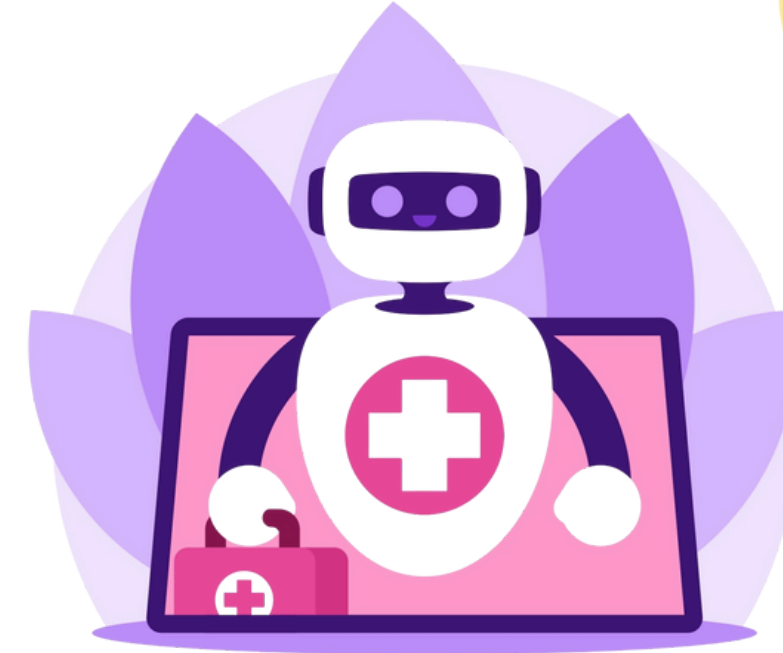
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What do all Clients Have in Common Today?

- Continuous adaptation through personalized data
- Motivated integrative medical team
- Holistic, tailored plans
- Weekly interdisciplinary reviews
- Advanced diagnostics are tested regularly
- Personalized nutrition and supplements
- Mental and neurological optimization Concierge-level support: 24/7 access to care team for seamless, one-on-one guidance

Infinite Health: The Future of Longevity

- Resilience Code is uniquely positioned to be a global leader in AI Driven Human Optimization
- With the foundation in precision medicine, elite athletic performance and deep diagnostic data Resilience Code possesses the raw data inputs and services ready for world class machine learning
- RC is now heavily focused on investing in AI infrastructure and personnel not only to enhance the client experience and clinical efficiency but also create accurate actionable interventions in real time that optimize outcomes and "performance-span"
- We unlock your code. You own your outcome !!

INFINITE HEALTH

TEST · LEARN · TRAIN · ADAPT

RESILIENCE

DATA

The Vibrant
Longevity
Summit