Nutritional Considerations with Atrial Fibrillation

Presented By

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Credentials
Doctor of Chiropractic
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40+ Years Clinical Experience

Professional Experience
Nearly 2,000 Seminars & Lectures (U.S. & Europe)
Author of Articles & Textbooks in Clinical Nutrition
Mentor to Thousands of Practitioners in Functional Testing

Clinical Appointments
New York Hospital
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University of Texas MD Anderson Cancer Center

Areas of Expertise
Thyroid & Nutrient-Related Fatigue
Oxidative Stress & Chronic Inflammation
Fertility & Hormonal Health
Evidence-Based Supplementation
Nutrition for Athletes
Chronic Disease Support

Atrial Fibrillation Statistics

- Atrial fibrillation (AF) is the most common type of sustained arrhythmia, accounting for significant morbidity and mortality.
- According to the 2021 Global Burden of Disease (GBD) study, AF/atrial flutter affected 52.55 million individuals worldwide, a **137%** increase from 1990, and associated deaths have **doubled (2x)** since 1990.

Circulation 2024;149:e1-156.
Europace 2024;26:euae195.

- Atrial fibrillation (AF), the most common arrhythmia, impacts 33 million individuals worldwide, with an all-cause mortality rate of 63.3 per 1,000 person-years.
- The prevalence of AF has escalated in recent years, leading to a surge in mortality and morbidity. **J Am Heart Assoc. 2017 Apr;6(5):e005155.**
- AF amplifies the risk of stroke by 4-5 times. **Stroke. 2013 Nov;44(11):3103–8.**

Categorization of Atrial Fibrillation

- Risk for AF
- Pre-AF
- AF
- Permanent AF[1]
- This emphasizes the importance of prevention and risk factor management at the earliest stage.

Circulation 2024;149:e1-156.

Traditional Risk Factors for AF

- Demographic
- Anthropometric
- Cardiovascular risk factors such as lack of physical activity, smoking, and obesity; cardiovascular disease (CVD).
- Non-cardiac conditions; and genetic markers (at least 138 AF loci identified in single variant testing and causative mutations found in large families or populations such as the ion channel *KCNQ1*, the cardiac peptide *NPPA*, the transcription factor *TBX5*, and a motor protein *MYL4*).

Nat Rev Cardiol 2023;404-17.
Eur Heart J 2021;42:373-498.

HEAD-2-TOES Scheme

- **H**eart failure
- **E**xercise
- **A**rterial hypertension
- **D**iabetes mellitus (Type 2)
- **T**obacco smoking
- **O**besity
- **E**thanol consumption
- **S**leep apnea

Non-Traditional Risk Factors

- Unhealthy Lifestyle
- Novel Biomarkers
- Adverse conditions or diseases
- Natural Environmental Factors

Biological Responses and Drivers

- Microbiota changes
- Oxidative stress
- Inflammation
- Autonomic dysfunction

Sleep

- Globally, more than one-third of adults sleep less than the recommended 7 h per night advised by the American Academy of Sleep Medicine and Sleep Research Society. **Sleep 2015;38:843-4.**
- In a prospective cohort study with more than 0.4 million participants, only 21% of individuals had a healthy sleep score of 5, including chronotype, sleep duration, insomnia, snoring, and daytime sleepiness.
- They had a 29% lower risk of incident AF than those with a poor sleep pattern did. **J Am Coll Cardiol 2021;78:1197-207.**
- When assessed separately, two meta-analyses reported a 6% and 21% increased risk of AF for individuals with short sleep durations.

Eur J Intern Med 2023;114:84-92.
EPMA J 2022;13:77-86.

Mechanisms of AF and Sleep

- Sympathetic nervous system activation
- Increased blood pressure
- Chronic inflammation
- Oxidative stress
- Insomnia can activate the hypothalamic-pituitary-adrenocortical axis, especially when associated with short objective sleep duration.

J Appl Physiol (1985)2005;98:2024-32.
Nat Rev Immunol 2019;19:702-15.
Biol Psychiatry 2016;80:40-52.

Night Shift Work

- Long-term shift work, especially night shift work, may disrupt the circadian rhythms of the body and lead to abnormal sleep patterns. Sci Rep 2019;9:4635.
- A recent study revealed that a duration of more than 10 years and an average of three to eight night shifts per month were significantly associated with 22% and 37% greater risks of incident AF, respectively. Eur Heart J 2021;42:180-8.
- Shift work has been associated with a 10-year incidence of AF in individuals <40 years. Open Heart 2022;9:e002086.

Shift Work

- Night shift work can lead to long working hours, chronic fatigue, sleep disruption, and increased stress, which may negatively impact cardiovascular health and increase the risk of AF.

Health Care Manag 2020;39:122-7.
Int J Environ Res Public Health 2020;17:589.

- Shift work may affect the stability and rhythm of the cardiovascular system, influencing cardiac electrical activity.

Mechanisms of Shift Work and AF

- Activation of the sympathetic nervous system
- Excessive secretion of norepinephrine
- Inflammation
- Oxidative stress
- Changes in lifestyle behaviors such as diet and physical activity.

Hypertension 2016;68:243-50.
Ind Health 2004;42:268-76.
Ann Occup Environ Med 2016;28:48.

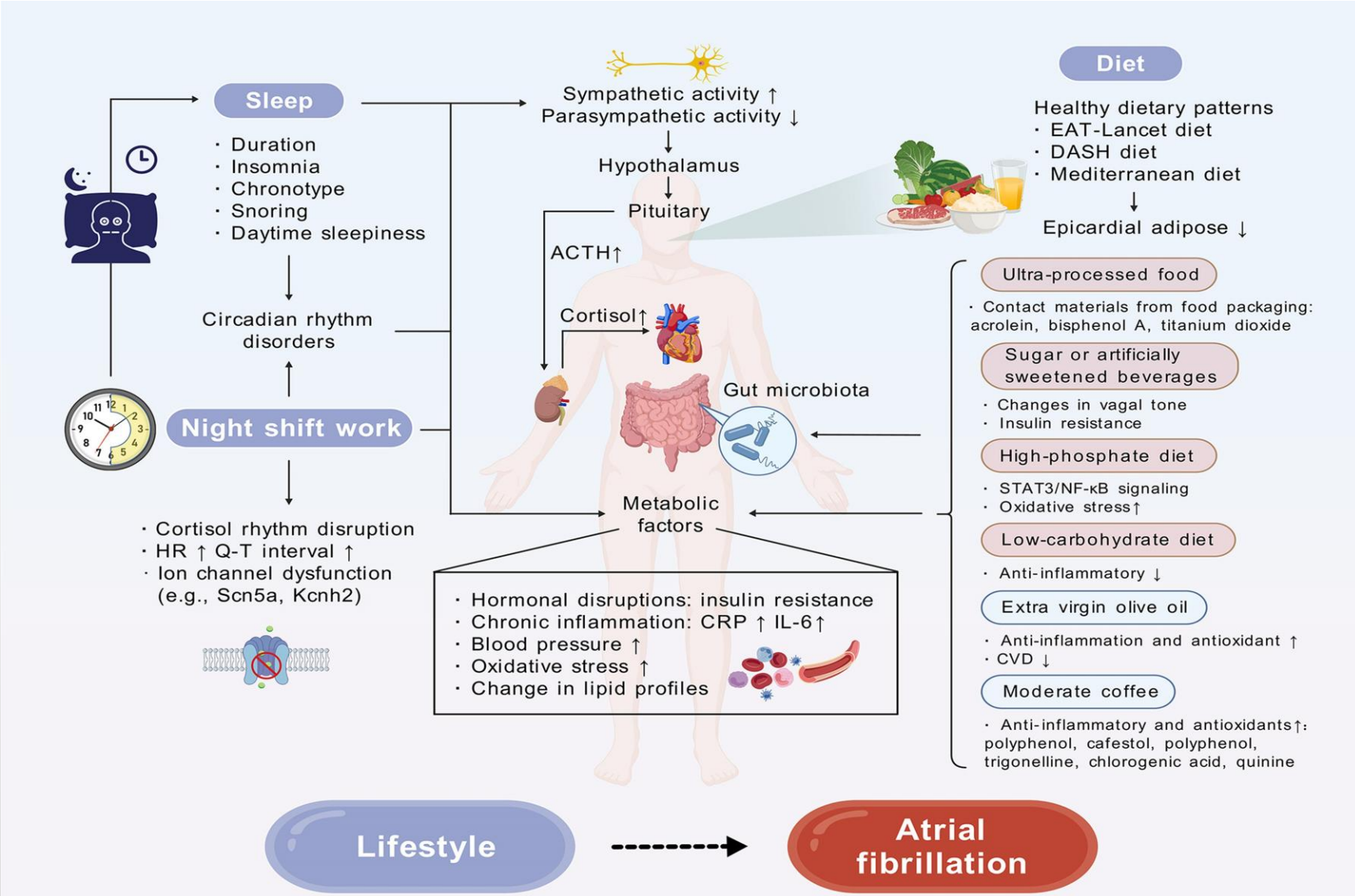
Diet and AF

- Ultra-processed food
- Sugar-sweetened or artificially sweetened beverages
- High-phosphate diet
- Low-carbohydrate diet
- Extra virgin olive oil may reduce the incidence of AF.

Heart 2023;109:1683-9.
Circ Arrhythm Electrophysiol 2024;17:e12145.
Acta Physiol 2023;238:e13964.

Mediterranean Diet and AF

- Evidence has demonstrated that greater adherence to a Mediterranean diet is associated with a significant reduction in the amount of epicardial adipose tissue in people with AF, and excess epicardial adipose tissue is strongly associated with persistent AF. **Eur J Prev Cardiol 2024;31:348-55.**



Eur Heart J, Volume 46, Issue 9, 1 March 2025, Pages 784–804.



Biomarkers and Atrial Fibrillation

Gut Microbiota

- Genetic evidence from 430 000 participants indicates a causal relationship of two specific microbial taxa with incident AF: the species *Eubacterium ramulus* and the genus *Holdemania*.

Cardiovasc Diabetol 2023;22:306.

- Trimethylamine N-oxide (TMAO), a metabolite from the gut microbiota, was found to be predictive of AF.

Int J Cardiol Heart Vasc 2020;29:100554.

Microbiota Mechanisms and AF

- The mechanisms **are not** yet fully understood.
- Metabolites produced by the gut microbiota may influence immune responses and inflammation, processes that contribute to the structural and electrical remodeling of the atria. **Mil Med Res 2023;10:51.**
- The gut–immune–heart axis shows that the gut microbiota can indirectly induce AF by modulating the immune system.
  - Recruitment and phenotypic changes of monocytes and macrophages, as well as the specific roles of cytokines released by leucocytes.
- The gut microbiota may interact with the autonomic nervous system, potentially influencing the cardiac rhythm through the production of short-chain fatty acids and other neurotransmitters. **PeerJ 2023;11:e16228.**

Hyperuricaemia

- Hyperuricemia is estimated to affect ~14.0%, 20.0%, and 24.5% of adults in China, the USA, and Ireland.

  Front Immunol 2021;12:791983.
  PeerJ 2023;11:e16228.

- Hyperuricemia may not only operate through CVD to increase the risk of AF but also has a direct influence on the development of AF via mechanisms:
  - Oxidative stress
  - Inflammation
  - Insulin resistance
  - Activation of the renin-angiotensin-aldosterone system.
    - All of which could induce electrical remodeling, autonomic nervous system changes, Ca^{2+} handling abnormalities, and atrial remodeling.

      Nutr Metab Cardiovasc Dis 2021;31:2756-65.

• High Serum Uric Acid

- High serum uric acid can increase reactive oxygen species via ERK/p38 activation and PI3K/Akt inhibition and increased reactive oxygen species interfere with the IRS1/Akt pathway to induce insulin resistance in cardiomyocytes. **Front Pharmacol 2020;11582680.**
- The urate-lowering medication febuxostat was also found to be associated with a greater risk of AF than allopurinol was, especially among patients with an 80 mg/day dose and in the first 6 months of use. **Eur Heart J 2019;40:3046-54.**

Homocysteine (Hcy)

- Elevated levels of Hcy, known as hyperhomocysteinaemia, are linked to an increased risk of cardiovascular diseases and other health issues.

Nutr Metab 2017;14:78.

- Its prevalence is highly variable worldwide, ranging from 5% to 7% in the general population to 25% among those with vascular diseases.

Nut Med 1996;2:386-9.

- A meta-analysis of five case-control studies revealed that serum or plasma Hcy levels were significantly higher in AF patients than in control subjects.

Int J Clin Pract 2021;75:e14738.

- A subsequent meta-analysis of these studies estimated a **27%** increased risk of AF for each **1-unit** increment in $\log_2$(Hcy).

Heart Lung Circ 2019;28:615-22.

Hyperhomocysteinaemia and AF

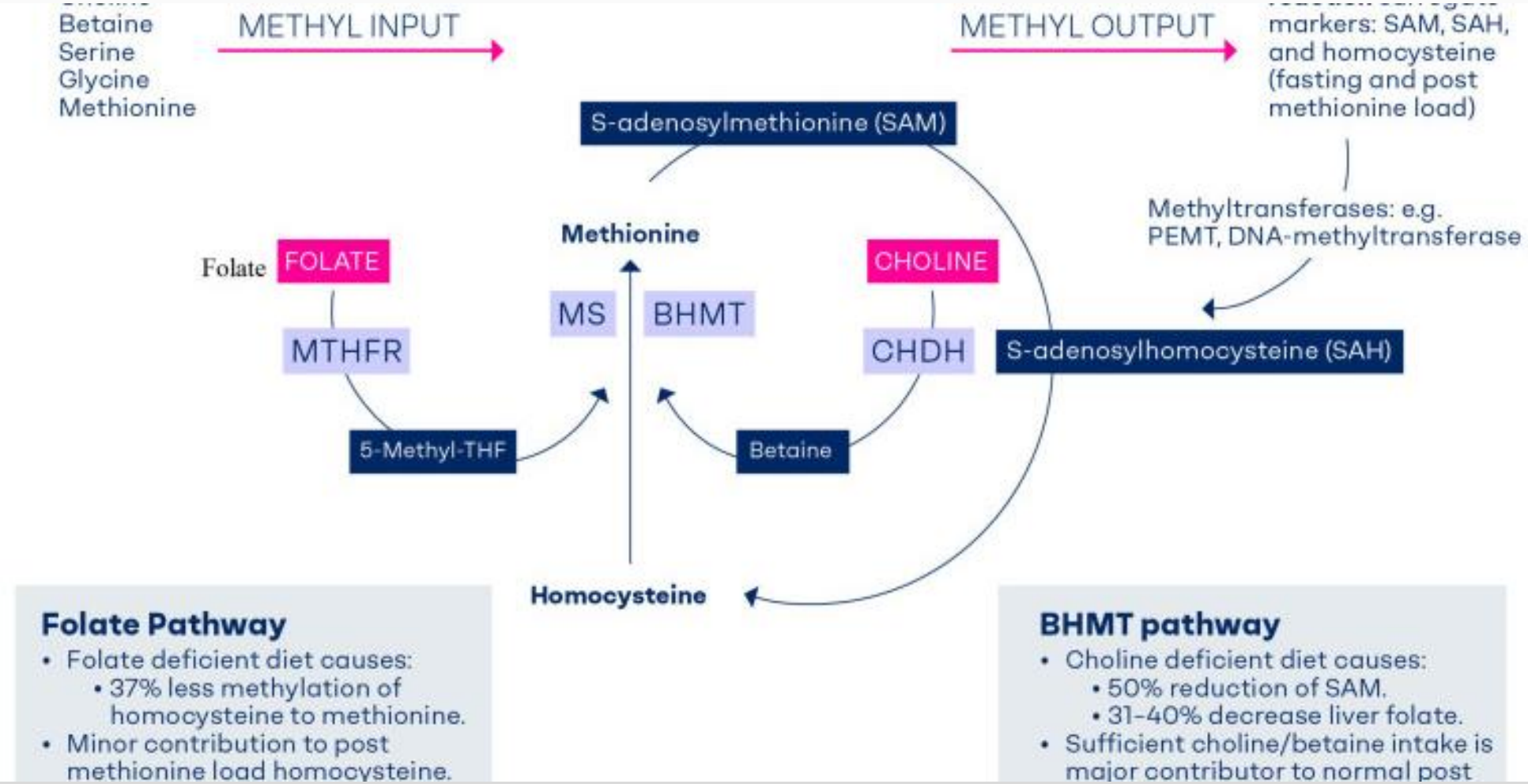
- Elevated Hcy levels are linked to atrial structural remodeling, as indicated by positive correlations with left atrial diameter and markers of collagen Type I degradation.

  Eurospace 2008;10:961-6.
  Euro Heart J 2004;25:523-30.

- Could contribute to electrical remodeling by affecting the function of various ion channels in atrial myocytes, leading to a shortened action potential duration and promoting conditions conducive to AF through pro-arrhythmic effects. **Eng Med Biol Soc 2009;2009:3936-9.**

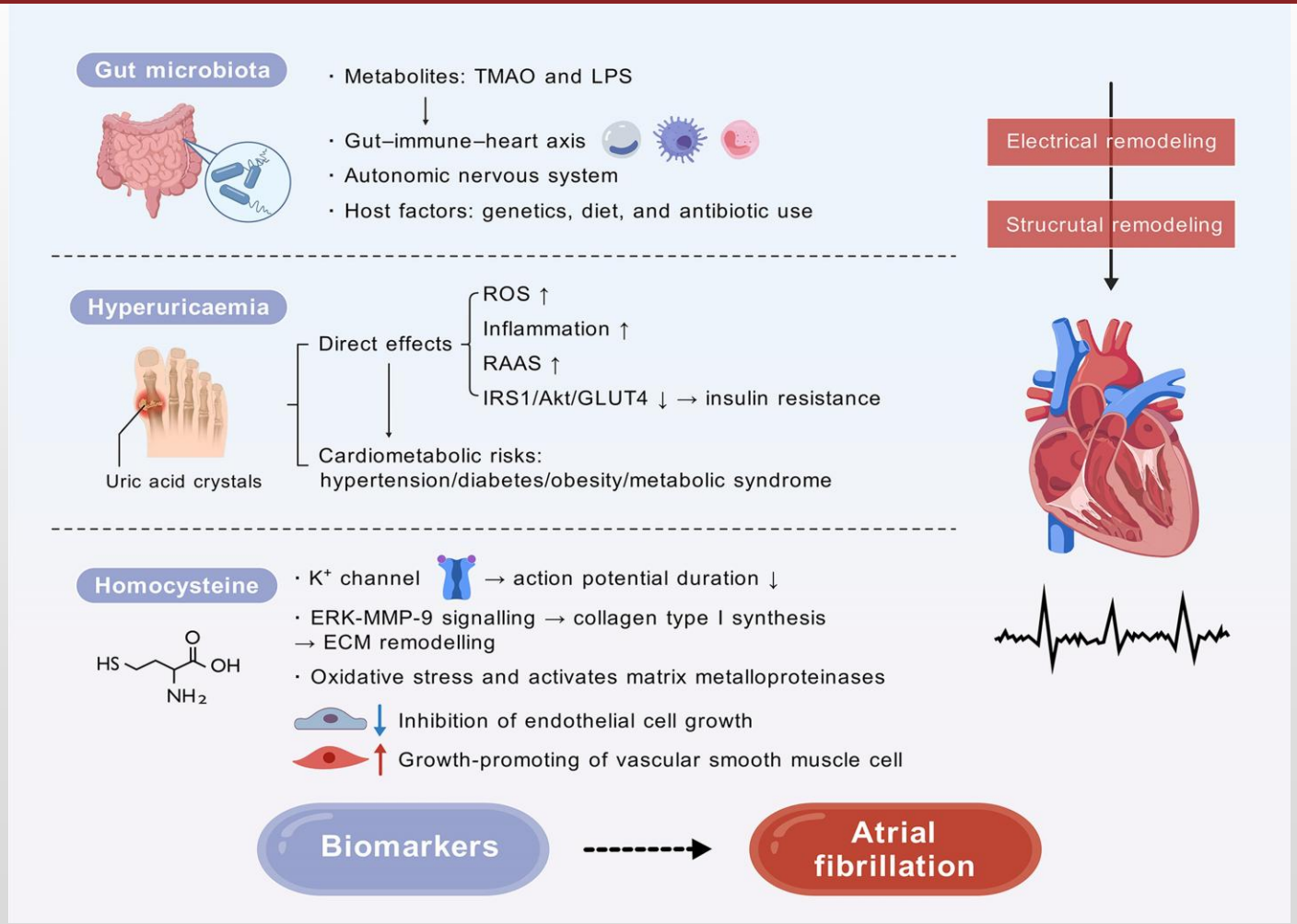
- As a proinflammatory and pro-oxidative marker, Hcy can cause direct biological damage to cardiomyocytes and trigger acute inflammatory responses within the atria. **Clin Res Cardiol 2012;101:217-25.**

Nutrients and Homocysteine Regulation



Nutrients. 2025 Jul 30;17(15):2495.

Summary of the Mechanism of Biomarkers



Eur Heart J, Volume 46, Issue 9, 1 March 2025, Pages 784–804,

Adverse Conditions and Diseases

- Depression
- Epilepsy
- Clonal Haematopoiesis
- Infections
- Asthma

Depression

- Depression is the third (3rd) leading cause of disability worldwide, and there were ~49.4 million DALYs globally in 2020 due to depression. **Lancet 2021;398:1700.**
- A Korean cohort with 5 million participants reported that depression was associated with a **25%** increased risk of new-onset AF, and those with recurrent episodes of depression had an even greater risk of incident AF (32%).

JAMA Netw Open 2022;5:e2141772.

- A study of a younger group (aged 20–39 years), which consistently indicated that individuals with depression had a 1.58-fold greater risk of AF.

Heart Rhythm 2023;20:365-73.

Mechanisms Explaining the Relationship Between Depression and AF

- Dysfunction of the autonomic nervous system is frequently observed in patients with psychiatric disorders, especially those with depression, which may be due to impaired conduction speed, aggravated cardiac burden, and cardiac electrical remodeling.

  PLOS One 2014;9:e101734.
  Psychosom Med 2013;75:42-51.

- Depression is linked to an increase in **proinflammatory cytokines**, such as interleukin-6 (IL-6) and tumor necrosis factor (TNF)-α, which alter atrial electrophysiology and structural substrates.

  Biol Psychiatry 2010;67:446-57.
  Nat Rev Cardiol 2015;12:230-43.

- Depression could exacerbate adverse metabolic health factors such as hypertension and obesity and thereby affect AF risk. **J Affect Disord 2024;349:635-45.**

Antidepressant Medication and AF

- The use of antidepressants may induce AF. **Front Cardiovasc Med 2022;9:897622.**
- The cardiovascular effect of tricyclic antidepressants may involve a decrease in intraventricular conduction speed, leading to prolonged PR, QRS, and QT intervals.

  Curr Med Chem 1999;6:469-80.
- Approximately 60% of mental health care treatment occurs in the primary care setting, and 62% of antidepressant prescriptions are written by general practitioners.

  Psychiatr Serv 2003;54:682-7.
  Psychiatr Serv 2009;60:1167.

Epilepsy

- Epilepsy is one of the most burdensome chronic neurologic disorders, directly affecting ~45.9 million people worldwide. **Lancet Neurol 2019;18:357-75.**
- Atrial fibrillation is the most common subtype of arrhythmia in people with epilepsy. **Cureus 2017;9:e1550.**
- The prevalence of AF in persons with epilepsy is nearly twice that in persons without epilepsy. **Can J Cardiol 2024;40:688-95.**
- After 329,432 individuals with a median follow-up of 12.5 years were evaluated, the risk of incident AF was found to be 1.26-fold greater in people with epilepsy.

Eur Heart J 2023;44:3374-82.

“The Epileptic Heart’

- Electrical and mechanical dysfunction of the heart and coronary vasculature caused by a chronic epilepsy-induced catecholamine surge and sustained hypoxemia. **Epilepsy Behav 2020;105:106946.**
- In addition to autonomic dysregulation, stress hormones such as adrenaline and noradrenaline are released during epileptic activity, increasing cardiac excitability.

Curr Opin Cardiol 2012;27:24-8.
Neurology 1984;34:255-7.

Epilepsy Relationships and AF

- Epilepsy induces cerebral hypoperfusion and hypoxia, resulting in neuronal injury and potential myocardial ischemia that aggravate remodeling of atrial tissue, including focal myocardial fibrosis and atrial enlargement.

  Epilepsy Behav 2020;105:106946.
  Neurology 2003;60:492-5.

- Dysfunction of K^+, Na^+, and Ca^{2+} channels may be one of the bases of abnormal cardiac electrophysiology altered by chronic epilepsy, providing potential intervention targets.

  Epilepsy Res 2016;127:19-29.
  J Neurol 2023;270:1229-48.

Anti-Seizure Medications and AF

- The pro-arrhythmic effects of some anti-seizure medications.

Expert Opin Drug Saf 2022;21:641-52.

- Medications with sodium channel-blocking properties, such as phenytoin and lamotrigine, have been implicated in QT interval prolongation and may increase the risk of arrhythmias, particularly at higher doses or in patients with pre-existing cardiac conditions. **Transl Res 2018;191:81-92.**

- **Caution:** Anti-epileptic drugs should be prescribed with caution for epilepsy patients with high-risk AF.

Clonal Haematopoiesis of Indeterminate Potential (CHIP)

- The presence of age-related pre-leukaemic mutations in healthy individuals, termed CHIP, commonly occurs in 10%–20% of people older than 70 years.

  N Engl J Med 2014;371:2488-98.

- Clonal hematopoiesis of indeterminate potential mutations are **1.4-fold** more common in AF patients than in non-AF patients. **Eur Heart J 2024;45:778-90.**

- Given that CHIP represents a heterogeneous set of mutations, certain mutations in CHIP may signify a greater risk of incident AF.

- *PPM1D* CHIP was found to be the highest-risk subtype for AF, and *TET2* and *DNMT3A* are two other driver mutations.

  Eur Heart J 2024;45:791-805.
  J Am Coll Cardiol 2023;81:1263-78.

- Inflammation is the most proposed underlying mechanism linking these CHIP mutations and AF.

Infections

- COVID-19 status was found to have the greatest association with incident AF, rather than with other CVDs, such as heart failure and coronary artery disease.

  Eur J Intern Med 2021;91:53-8.

- During COVID-19 infection, the incidence of new-onset AF ranges from 3% to 10% in non-critically ill patients and from 16% to 44% in patients hospitalized in intensive care units. **Biomedicines 2022;10:1940. and J Clin Med 2023;12:6989.**

- Patients with pneumonia were found to have the highest odds of developing AF, rather than sepsis, gastrointestinal, or urinary infections. **Eur Heart J 2020;41:1112-9.**

- Most infections trigger an immune response that leads to the release of proinflammatory cytokines such as IL-6, IL-8, TNF-α, and high-sensitivity C-reactive protein. **Eur Heart J 2020;41:1120-2.**

COVID-19

- In COVID-19 infection, pericytes in cardiac tissues are directly targeted by acute respiratory syndrome coronavirus 2 (SARS-CoV-2) through angiotensin-converting enzyme 2 receptors, leading to increased microvascular permeability, local tissue inflammation, and fibrosis. **FASEB J 2020;34:11347-54.**
- Electrolyte and autonomic nervous system imbalances caused by infections can alter cardiac electrophysiological properties and reduce variability, creating a pro-arrhythmic environment. **Circ Res 2014;114:1500-15.**
- Post-COVID-19 patients with postural orthostatic tachycardia syndrome (POTS), a post-acute sequela characterized by potential autonomic dysfunction, presented prolonged atrial electromechanical delay, which has been found to be closely associated with AF.

Heart Rhythm 2022;19:1880-9.
Indian Heart J 2023;75:292-7.

Asthma

- It is estimated to affect 262 million people and causes 455,000 deaths worldwide.

Lancet 2020;396:1204-22.

- A dose–response association was observed between levels of asthma control and risk of AF with the highest HR 1.74 in participants with uncontrolled asthma.

JAMA Cardiol 2018;3:721-8.

- Hypoxia is one major pathophysiology linking asthma and AF.
- Chronic hypoxemia alters the expression of hypoxia-inducible Factor 1, leading to increased systemic inflammation and oxidative stress. **Eur Heart J 2021;42:532-40.**
- Prominent inflammatory responses in asthma, which are shared with AF, such as the leukotriene receptor pathways, can partially account for the intrinsic interaction.

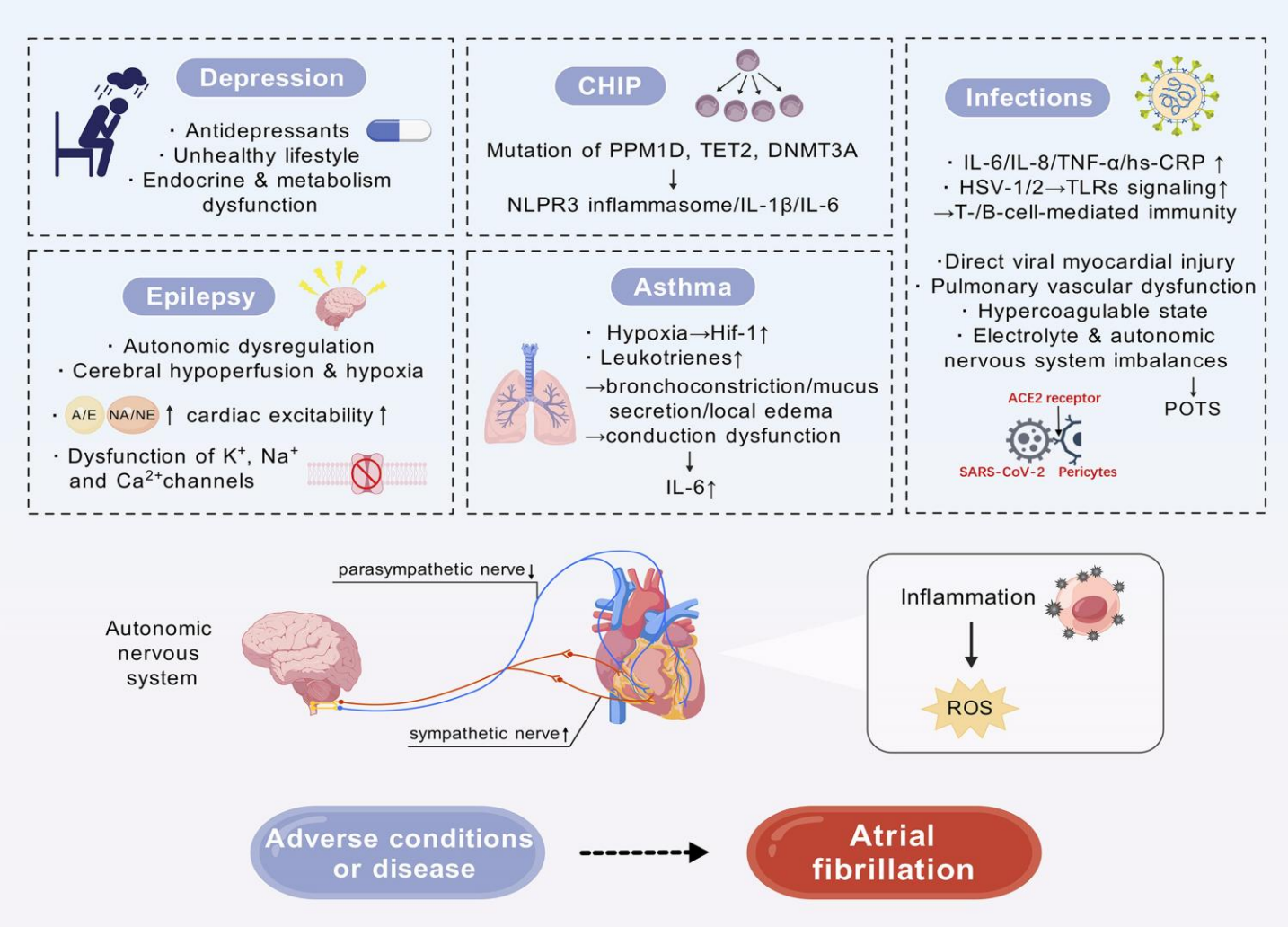
Circ Arrhythm Electrophysiol 2020;13:e007685.

β receptors and Cardiac Tissue

- Distribution of β receptors on cardiac muscle.
- Treatments such as short-acting bronchodilator β-agonists may be potential triggers of AF.
- **Goals:**
  - Correcting hypoxia
  - Achieving long-term stability
  - Reducing acute exacerbations may be the primary goals for lowering the risk of AF in patients with asthma.

Circ Arrhythm Electrophysiol 2020;13:e007685.

The Mechanism Network of the Associations Between Adverse Conditions or Diseases and Atrial Fibrillation



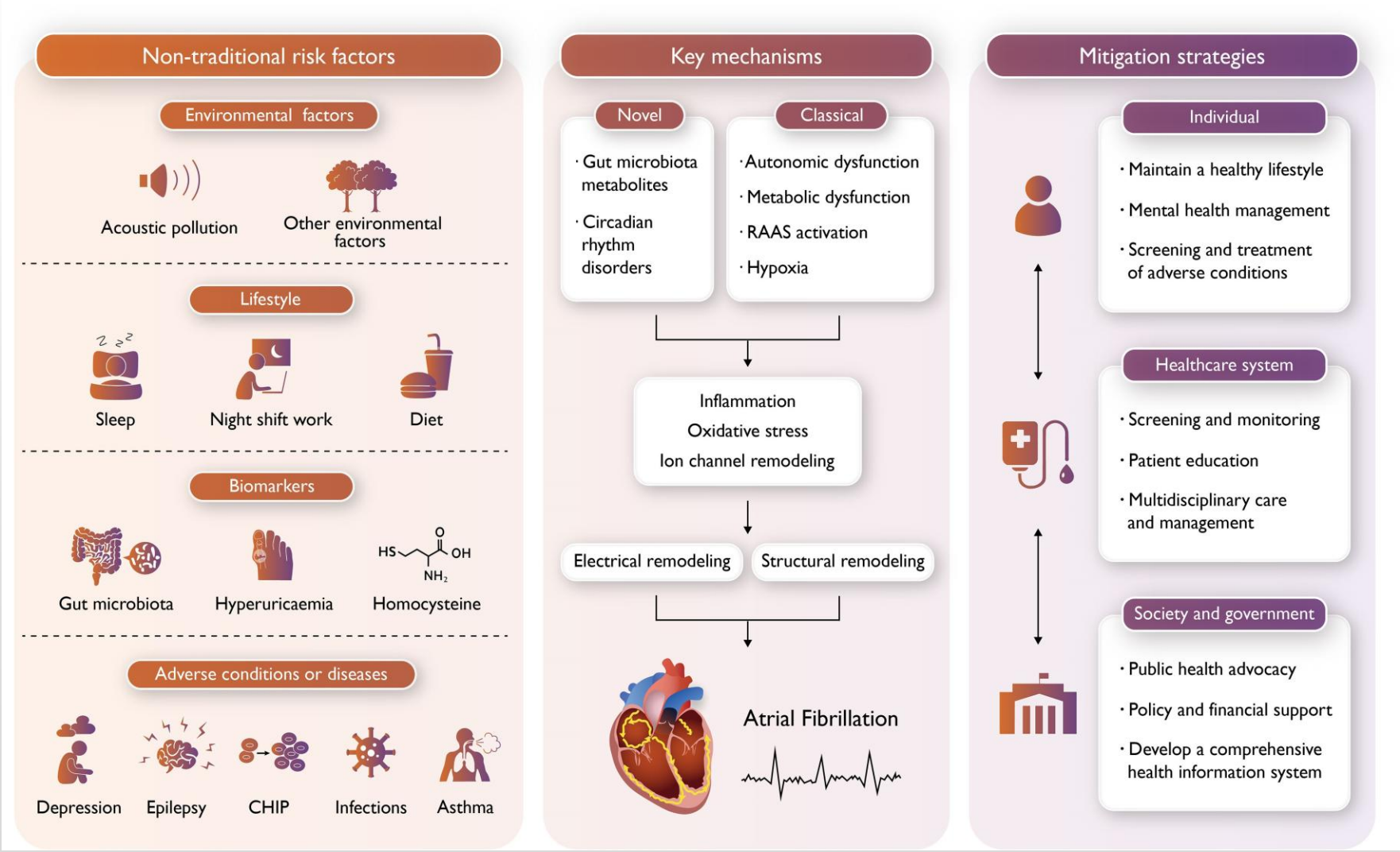
Eur Heart J, Volume 46, Issue 9, 1 March 2025, Pages 784–804.

Acoustic Pollution

- The estimated risk of AF in this study was **18% and 30%** greater in nurses exposed to high-decibel traffic noise and wind turbine noise at night, respectively. **Environ Health Perspect 2021;129:87002.**
- Monrad *et al.* also reported an association between a 6% greater risk of incident AF and 5 year mean road traffic noise levels prior to diagnosis.

  Environ Int 2016;92-93:457-63.
- Mechanistically, noise and noise disturbances act as stressors, activating the autonomic nervous system and promoting the release of stress hormones.

Non-traditional Risk Factors for Atrial Fibrillation



EPA and DHA

- Several biological actions that contribute to their cardiovascular protective effects.
  - Modulation of lipid metabolism
  - Anti-inflammatory
  - Antioxidant
  - Antiarrhythmic
  - Antithrombotic effects
  - Cell membrane effects including modulation of ion channel function and of formation of membrane domains involved in cell signaling; and endothelial function improvement.

Nutrients. 2021;13:2421.
Annu Rev Pharmacol Toxicol. 2023;63:383–406.
Curr Opin Clin Nutr Metab Care. 2022;25:436–42.

Antiarrhythmic Effects

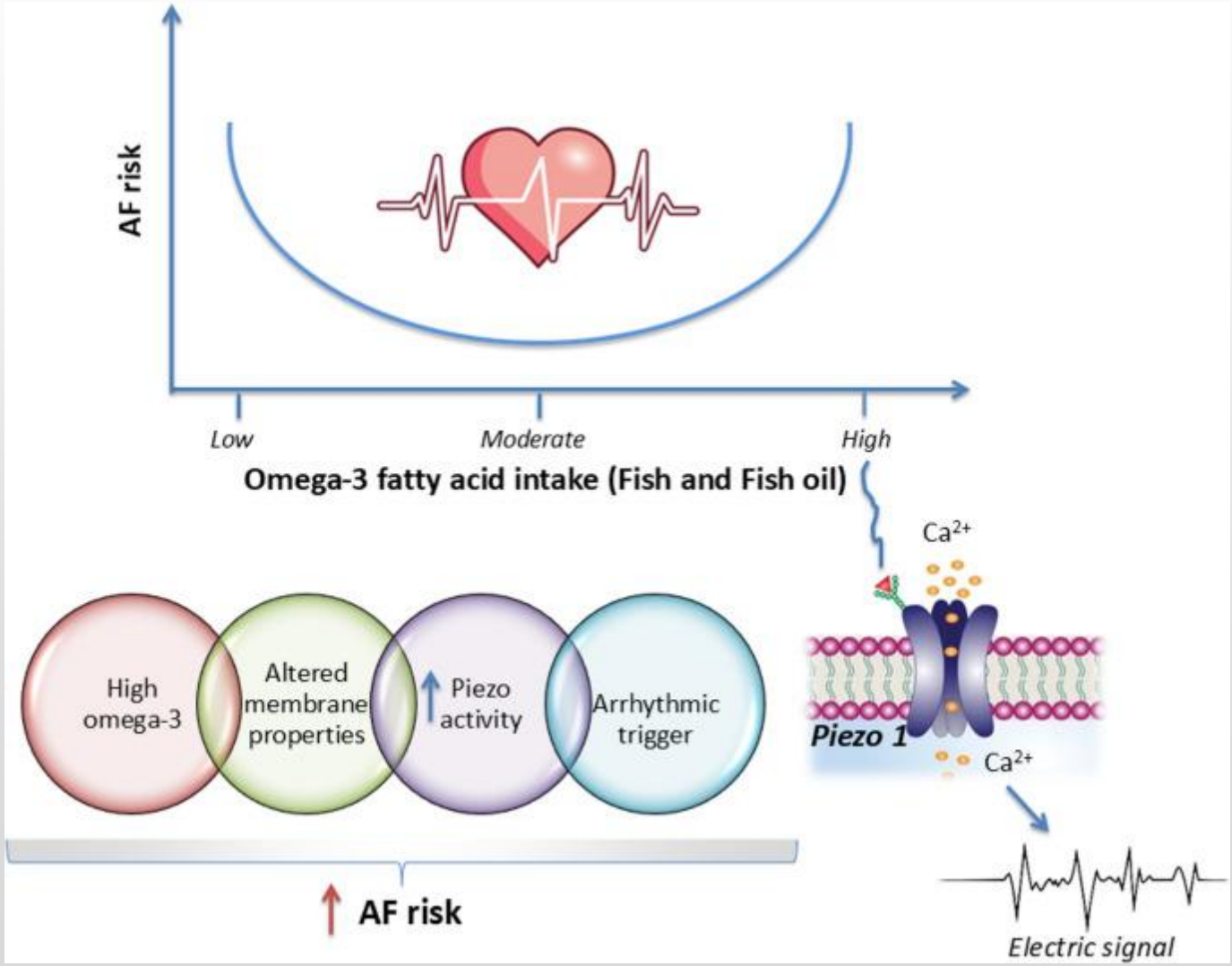
- The antiarrhythmic effects of EPA and DHA result from multiple complementary mechanisms, including modulation of ion channels and influence on the autonomic nervous system.
- EPA and DHA improve cardiac muscle cell function and alter membrane fluidity, affecting ion channel conductivity and reducing heart rate. **Circulation. 2022;145:1037–9.**
- By directly influencing calcium, sodium, and potassium currents in the heart, they can also change the duration of ventricular action potentials.

PIEZO Proteins

- PIEZO1/2 are among the largest known ion channels, comprising over 2,500 amino acids arranged into 38 transmembrane helices.
- Cell membrane lipids modulate the structural transitions that control the opening and closing of these channels.
- DHA slows PIEZO1 inactivation, while EPA accelerates it.
- DHA and EPA ratio might influence PIEZO1 activity. **Circulation. 2022;145:1037–9.**
- A predominance of DHA enhances PIEZO1-mediated calcium influx, prolonging the action potential and raising the risk of delayed after-depolarizations and AF.
- It also promotes calcium-dependent signaling pathways.
- PIEZO1 is not limited to cardiomyocytes; atrial fibroblasts also express this channel.
- Fibroblasts from patients with AF show higher PIEZO1 expression and activity compared to those with normal sinus rhythm, implicating it in atrial structural remodeling.

J Mol Cell Cardiol. 2021;158:49–62.

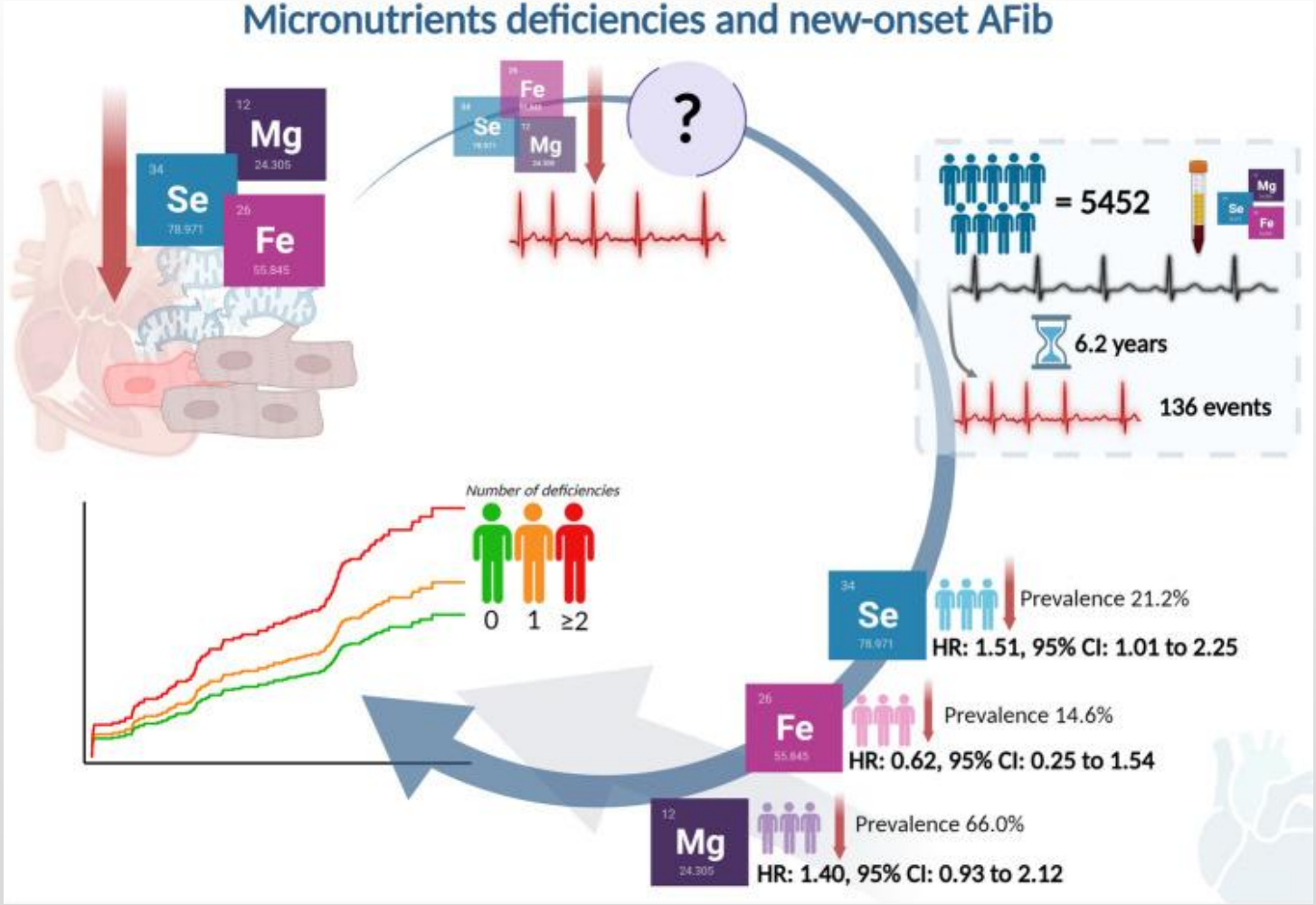
EPA and DHA Intake and Risk of Atrial Fibrillation (AF)



Dose for EPA and DHA

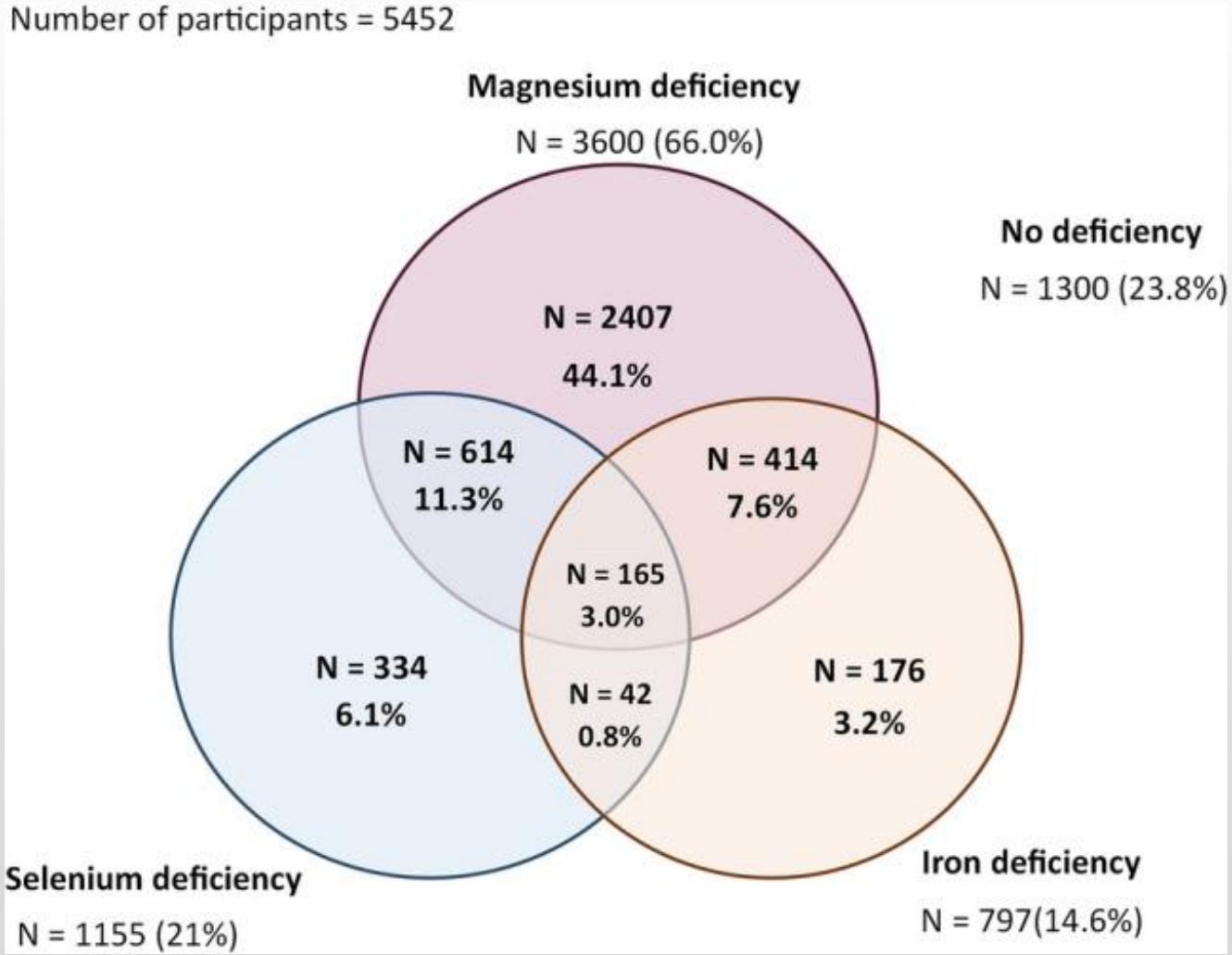
- Findings indicate that supplementation with DHA and/or EPA has been linked to a **24%** higher relative risk of developing AF (absolute risk: 4.0% vs. 3.3%; RR: 1.24, 95% CI: 1.11–1.38; p= 0.0002).
- The increase in risk appeared to be dose-related:
  - Daily doses around 1 g were associated with a **12%** rise in AF risk.
  - Higher doses ranging from **1.8 to 4 g** per day have been linked to an approximately **50%** increase.

Selenium, Iron And Magnesium



Clinical Research in Cardiology (2025) 114:41-52.

Combination Deficiencies and AF



Clinical Research in Cardiology (2025) 114:41-52.

Vitamin D Levels and AF

- In a prospective cohort study by Alonso et al., among 1866 patients who developed atrial fibrillation, 29% had a 25-hydroxyvitamin D level of less than 20 ng/ml.
- In the study by Ozcan et al., which compared 137 new-onset AF patients with 90 patients without AF, the rate of VDD (defined as 25-hydroxyvitamin D levels <20 ng/ml) in new-onset AF patients (VDD =67%) was significantly higher than the control group (VDD = 51%).

J Am Soc Hypertens. 2015;9(4):307–12.

- The prevalence of VDD in AF patients appears to be between 30% and 40%.

Vitamin D and AF

- Vitamin D plays a crucial role in multiple metabolic pathways. **Circulation. 2013 Dec;128(23):2517–31.**
- Vitamin D is a negative modulator of the renin–angiotensin–aldosterone system (RAAS).

Osteoporos Int. 2013;24:2167–80.

- RAAS and inflammation play a significant role in the pathogenesis of AF.

Am J Cardiol. 2018;122(5):780–4.
Nat Rev Cardiol. 2015;12(4):230–43.

Study – Vitamin D and AF

- Mortality was more common in patients with VDD (n = 12, 6.31%) than in those with VDI (n = 4, 2.10%) and VDS (n = 2, 1.05%) groups (p = 0.03).
- Prior electrical cardioversion was observed in 12 (15.58%), 5 (10.86%), and 11 (16.41%) patients from the VDD, VDI, and VDS groups, respectively, without a significant statistical difference (p-value = 0.69).
- The success rate of electrical cardioversion was significantly higher in the VDS group than in the VDI and VDD groups (p = 0.03): 16.6%, 50%, and 81.8% in the VDD, VDI, and VDS groups, respectively.
- The need for anticoagulant therapy was significantly higher in the VDD group (p = 0.02).

Vitamin D Deficiency and AF

- In conclusion, not only may VDD induce atherosclerosis, but lower levels of vitamin D are also associated with more severe coronary involvements.
- Interestingly, successful electrical cardioversion was more prevalent in the VDS group than in the VDD and VDI groups.
- Some studies suggest a link between vitamin D deficiency and AF recurrence after electrical cardioversion. **Braz J Cardiovasc Surg. 2020;35:191–7.**
- VDD was associated with AF cardioversion failure.

Herzschrittmacherther Elektrophysiol. 2022;33(2):209–16.

- Vitamin D deficiency has been associated with left atrial fibrosis and an increased risk of AF recurrence after ablation. **J Cardiol. 2017;69(1):16–23.**

Fatigue and Syncope

- Syncope was more prevalent in the VDD group than in the VDI and VDS groups.
  - **VDD** – Vitamin D Deficiency
  - **VDI** – Vitamin D Insufficiency
  - **VDS** – Vitamin D Supplementation
- Low vitamin D levels decrease serotonin production and release, decrease autonomic cardiac activity, and increase inflammation, leading to gastrointestinal dysfunction.
- All three (3) mechanisms affect the brain, cardiac, and gastrointestinal autonomic systems. **J Pediatr Neurosci. 2017;12(2):119–23.**
- VDD is associated with orthostatic hypotension in older adults. **Age Ageing. 2020;50(1):198–204.**
- In a study by Songül Usalp et al., VDD levels were significantly lower in patients with vasovagal syncope. **J Arrhythm. 2020;36(2):371–6.**



Thank you!

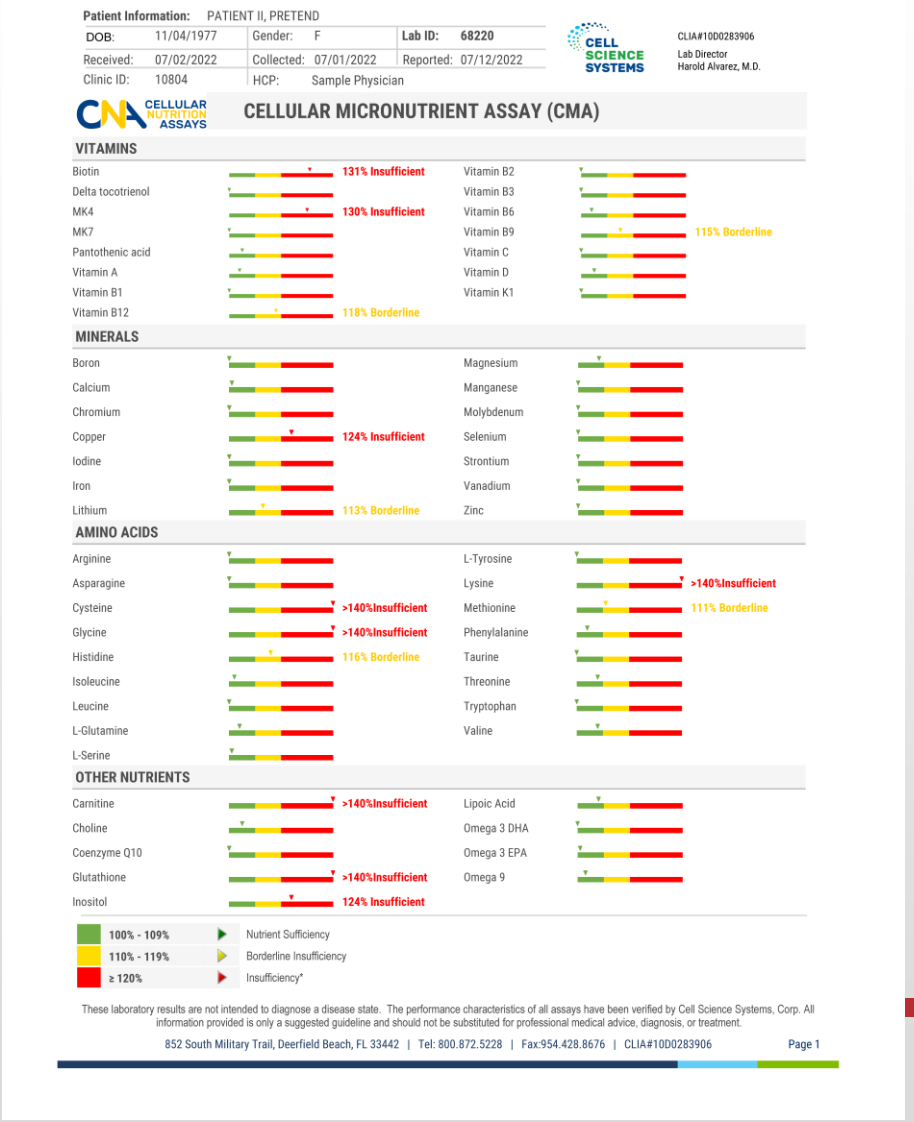
Practitioner Support

- **To open a CSS/Genova Diagnostics account:**

  https://www.gdx.net/

- **CSS customer service:** csscustomerservice@gdx.net

- **To schedule a complimentary 30-minute educational session:** www.cellsciencesystems.com/resultsreview



Patient Information: PATIENT II, PRETEND

DOB:	11/04/1977	Gender:	F	Lab ID:	68220
Received:	07/02/2022	Collected:	07/01/2022	Reported:	07/12/2022
Clinic ID:	10804	HCP:	Sample Physician		

CELL SCIENCE SYSTEMS
CLIA#10D0283906
Lab Director
Harold Alvarez, M.D.

CNA CELLULAR NUTRITION ASSAYS

CELLULAR MICRONUTRIENT ASSAY (CMA)

VITAMINS

Biotin	131% Insufficient	Vitamin B2	
Delta tocotrienol		Vitamin B3	
MK4	130% Insufficient	Vitamin B6	
MK7		Vitamin B9	115% Borderline
Pantothenic acid		Vitamin C	
Vitamin A		Vitamin D	
Vitamin B1		Vitamin K1	
Vitamin B12	118% Borderline		

MINERALS

Boron		Magnesium	
Calcium		Manganese	
Chromium		Molybdenum	
Copper	124% Insufficient	Selenium	
Iodine		Strontium	
Iron		Vanadium	
Lithium	113% Borderline	Zinc	

AMINO ACIDS

Arginine		L-Tyrosine	
Asparagine		Lysine	>140%Insufficient
Cysteine	>140%Insufficient	Methionine	111% Borderline
Glycine	>140%Insufficient	Phenylalanine	
Histidine	116% Borderline	Taurine	
Isoleucine		Threonine	
Leucine		Tryptophan	
L-Glutamine		Valine	
L-Serine			

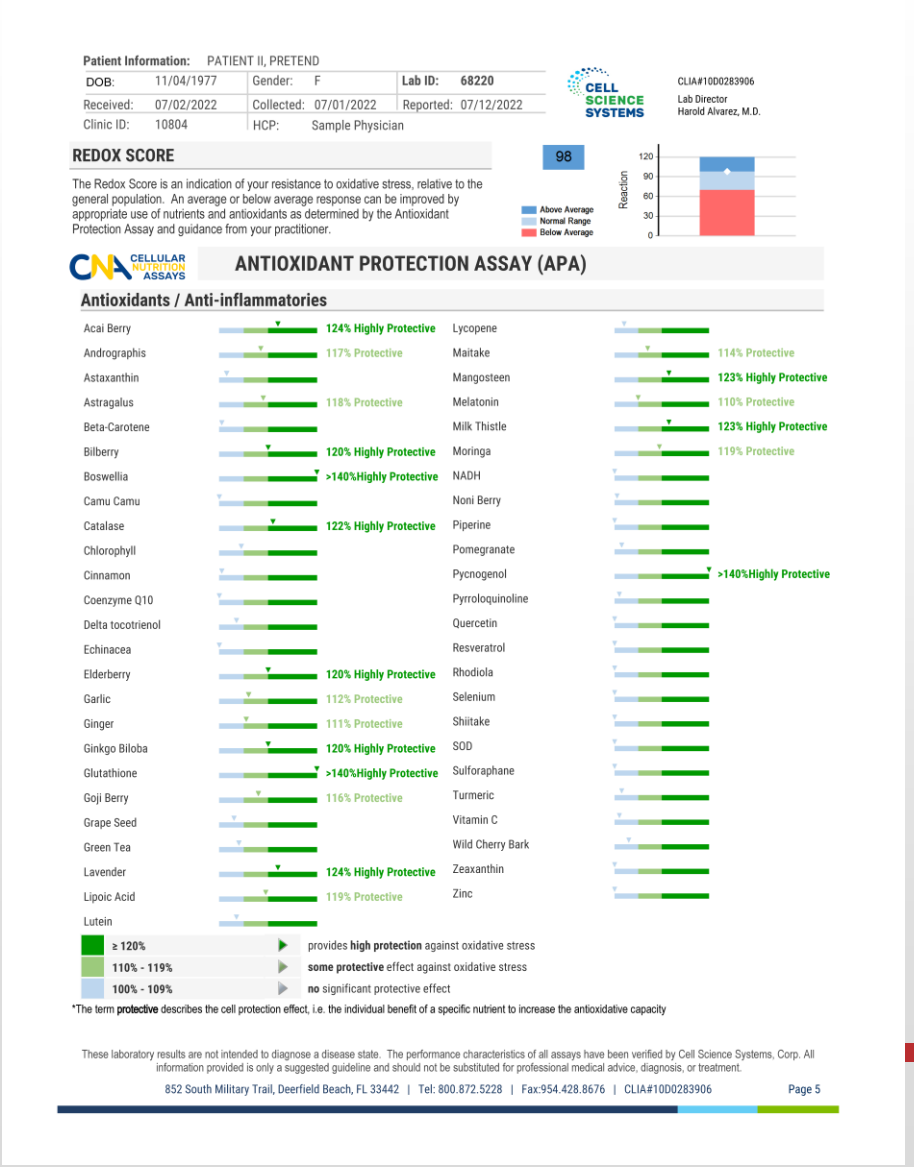
OTHER NUTRIENTS

Carnitine	>140%Insufficient	Lipoic Acid	
Choline		Omega 3 DHA	
Coenzyme Q10		Omega 3 EPA	
Glutathione	>140%Insufficient	Omega 9	
Inositol	124% Insufficient		

100% - 109%	Nutrient Sufficiency
110% - 119%	Borderline Insufficiency
≥ 120%	Insufficiency*

These laboratory results are not intended to diagnose a disease state. The performance characteristics of all assays have been verified by Cell Science Systems, Corp. All information provided is only a suggested guideline and should not be substituted for professional medical advice, diagnosis, or treatment.

Cellular Micronutrient Assay



Patient Information: PATIENT II, PRETEND

DOB:	11/04/1977	Gender:	F	**Lab ID:**	**68220**
Received:	07/02/2022	Collected:	07/01/2022	Reported:	07/12/2022
Clinic ID:	10804	HCP:	Sample Physician		

CELL SCIENCE SYSTEMS
CLIA#10D0283906
Lab Director
Harold Alvarez, M.D.

REDOX SCORE

98

The Redox Score is an indication of your resistance to oxidative stress, relative to the general population. An average or below average response can be improved by appropriate use of nutrients and antioxidants as determined by the Antioxidant Protection Assay and guidance from your practitioner.

Above Average
Normal Range
Below Average

Reaction: 120, 90, 60, 30, 0

CELLULAR NUTRITION ASSAYS

ANTIOXIDANT PROTECTION ASSAY (APA)

Antioxidants / Anti-inflammatories

Acai Berry	124% Highly Protective	Lycopene	
Andrographis	117% Protective	Maitake	114% Protective
Astaxanthin		Mangosteen	123% Highly Protective
Astragalus	118% Protective	Melatonin	110% Protective
Beta-Carotene		Milk Thistle	123% Highly Protective
Bilberry	120% Highly Protective	Moringa	119% Protective
Boswellia	>140%Highly Protective	NADH	
Camu Camu		Noni Berry	
Catalase	122% Highly Protective	Piperine	
Chlorophyll		Pomegranate	
Cinnamon		Pycnogenol	>140%Highly Protective
Coenzyme Q10		Pyrroloquinoline	
Delta tocotrienol		Quercetin	
Echinacea		Resveratrol	
Elderberry	120% Highly Protective	Rhodiola	
Garlic	112% Protective	Selenium	
Ginger	111% Protective	Shiitake	
Ginkgo Biloba	120% Highly Protective	SOD	
Glutathione	>140%Highly Protective	Sulforaphane	
Goji Berry	116% Protective	Turmeric	
Grape Seed		Vitamin C	
Green Tea		Wild Cherry Bark	
Lavender	124% Highly Protective	Zeaxanthin	
Lipoic Acid	119% Protective	Zinc	
Lutein			

≥ 120%	provides **high protection** against oxidative stress
110% - 119%	**some protective** effect against oxidative stress
100% - 109%	**no** significant protective effect

*The term **protective** describes the cell protection effect, i.e. the individual benefit of a specific nutrient to increase the antioxidative capacity

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Redox Assay & Antioxidant Protection Assay