Qualifying Patients for TPE

Dr. Paul Savage
Founder, MDLifeSpan

DISCLOSURE

Dr. Savage does not have any relevant financial relationships to disclose during the last 24 months with ineligible companies whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.

Today’s Hidden Health Crisis

The NEW ENGLAND JOURNAL of MEDICINE

This landmark study raises concerns about microplastics and cardiovascular health. A study of 304 patients undergoing plaque removal surgery found over half had microplastics in their arteries. These common plastics were linked to more than a fourfold increase in heart attack, stroke, or death risk over nearly three years, underscoring significant cardiovascular dangers.

Mar 7, 2024

Journal of Exposure Science & Environmental Epidemiology

A new study shows that chemicals called PFAS in U.S. drinking water are linked to higher cancer rates. By comparing water quality and cancer data from 2016–2021, researchers estimate thousands of cancer cases may be due to these “forever chemicals.” The findings underscore the need for stricter water safety regulations.

Jan 9, 2025

NIH National Library of Medicine
National Center for Biotechnology Information

This study examines how environmental pollutants—such as heavy metals, pesticides, and plastic additives—infiltrate our air, water, and soil, ultimately harming human health. It discusses pollutant exposure routes, quantifies associated disease risks (e.g., respiratory, reproductive, cardiovascular issues, and cancer), and highlights the urgent need for better monitoring and preventive measures.

Aug 25, 2023

Toxins

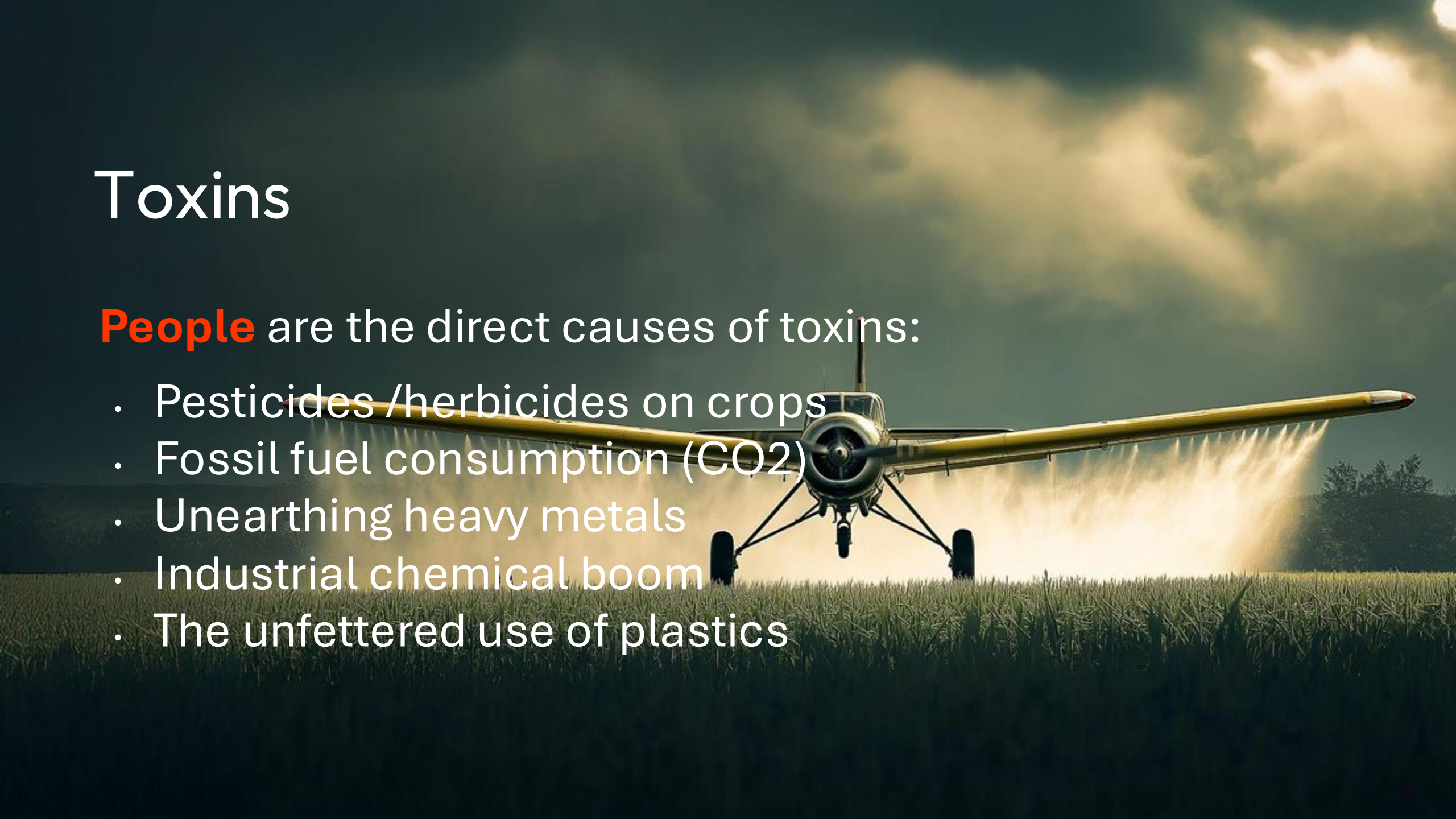
People are the direct causes of toxins:

- Pesticides /herbicides on crops
- Fossil fuel consumption (CO2)
- Unearthing heavy metals
- Industrial chemical boom
- The unfettered use of plastics

Toxins

People are the direct causes of toxins:

- Pesticides /herbicides on crops
- Fossil fuel consumption (CO_2)
- Unearthing heavy metals
- Industrial chemical boom
- The unfettered use of plastics



An increasingly toxic present

- In the words of a 2015 study, **Persistent Organic Pollutants (POPs)**: A Global Issue, A Global Challenge:

- Since the Second World War, scientists have identified certain chemical contaminants that exhibit toxic characteristics and are persistent in the environment, bioaccumulative, prone to long-range atmospheric transboundary migration and deposition, and expected to impose serious health effects on humans, wildlife, and marine biota adjacent to and distant from their origin.

There's a spoonful of plastic in our brains

Humans inhale **roughly 7,000 microplastics per day.**

Brain samples have **7–30x more plastic than those from the liver or kidneys.**

Cardiovascular patients with microplastics in their blood are **4x likelier to experience heart attack, stroke or death.**

Microplastics are suspected of links to **colon cancer and certain lung cancers.**

New York Magazine, Feb 25, 2025

The situation is not improving

"The production and use of chemicals continue to grow worldwide, particularly in developing countries. This is likely to result in greater negative effects on health."

"Chemicals of public health concern,"
World Health Organization, June 1, 2020.

There are more than 150,000 man-made chemicals in existence.

Phys.org

We can test of 150 of those 150,000 toxins = 0.1%

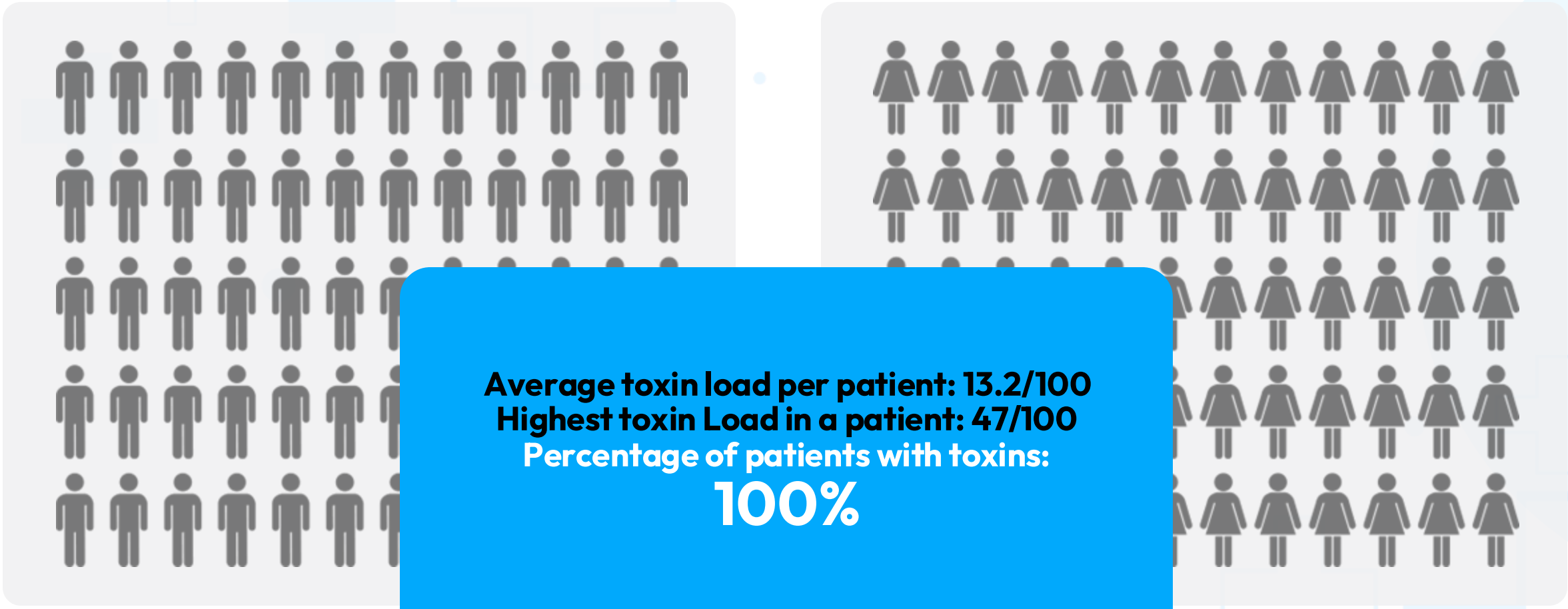
Compared to a mountain that is 7,200 ft tall

Types of Toxins Tested

- ✓ Microplastics
- ✓ PFAS
- ✓ Heavy Metals
- ✓ Pesticides
- ✓ Herbicides
- ✓ Mycotoxins
- ✓ Phthalates
- ✓ Phenols
- ✓ Volatile Organic Chemicals

Toxin Detection Research

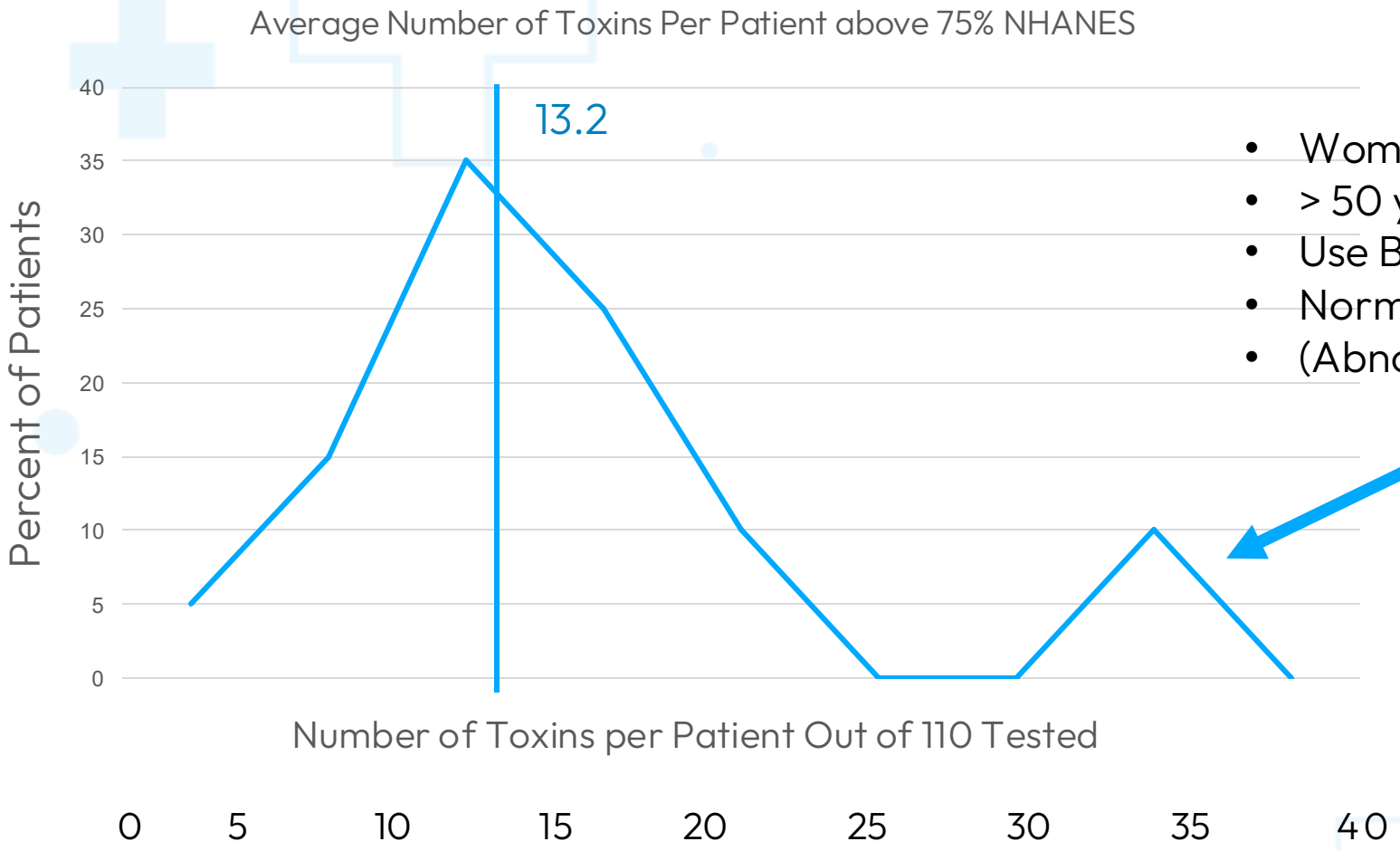
Everyone is highly toxic! Toxicity levels in **“healthy”** people in 2023.



Average toxin load per patient: 13.2/100
Highest toxin Load in a patient: 47/100
Percentage of patients with toxins:
100%

MDLifespan 2023: Internal Observational data on 237 healthy patient seen in outpatient

Toxin Detection Research



- Women
- > 50 years
- Use Beauty Products
- Normal or Below Average BMI
- (Abnormal Detox Genes)

MDLifespan 2023: Internal Observational data on 237 healthy patient seen in outpatient

Toxin Detection Research

Microplastics were detected in 100% of subjects
PFAS were detected in 99% of subjects
Pesticides were detected in 99% of subjects

Toxin	Total		Toxin	Total		Toxin	Total		Toxin	Total
Bisphenol A (BPA)	54		2-Hydroxyisobutyric Acid (2HIB)	17		Diethyldithiophosphate (DEDTP)	7		N-Acetyl (3,4-Dihydroxybutyl) Cysteine (NADB)	2
Mercury	42		Aflatoxin G2	17		Methylparaben	7		2-Hydroxyethyl Mercapturic Acid (HEMA)	2
Lead	41		Beryllium	16		Roridin L2	7		N-Acetyl Propyl Cysteine (NAPR)	2
Ochratoxin A	37		Citrinin	15		Uranium	6		Diphenyl Phosphate (DPP)	2
Arsenic	35		Antimony	14		DDA	6		Enniatin B1	2
Glyphosate	32		Tin	14		Roridin A	6		Satratoxin H	2
Thallium	30		Tungsten	14		Thorium	5		Sterigmatocystin	2
Butylparaben	30		Aflatoxin M1	14		Propylparaben	5		Verrucarin A	2
Cadmium	28		Perfluorobutanoic acid (PFBA)	14		N-acetyl-S-(2-carbamoylethyl)-cysteine (NAE)	5		Platinum	1
Dimethylphosphate (DMP)	28		Perfluorooctanoic acid (PFOA)	14		Perfluoro-n-[1,2-13C2] decanoic acid (MPFDA)	5		Diethylphosphate (DEP)	1
Fumonisins B1	27		Fumonisins B3	13		Perfluoroheptanoic acid (PFHpA)	5		Atrazine	1
Triclosan	26		mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)	12		Perchlorate	4		3-Methylhippuric Acid (3MHA)	1
Zearalenone	25		Aflatoxin G1	12		Monoethyl phthalate (MEtP)	4		mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)	1
Aflatoxin B1	24		Perfluorohexane Sulfonic Acid (PFHxS)	12		Roridin E	4		N-Acetyl (2-Cyanoethyl) Cysteine (NACE)	1
Tiglylglycine (TG)	23		Aluminum	11		Satratoxin G	4		N-Acetyl (2,Hydroxypropl) Cysteine (NAHP)	1
Gliotoxin	23		Gadolinium	11		Perfluoro-n-[1,2-13C2] hexanoic acid	4		Mycophenolic Acid	1
Dimethylthiophosphate (DMTP)	22		Bismuth	11		Palladium	3		Dodecafluoro-3H-4,8- dioxanoate (NaDONA)	1
Barium	21		Chaetoglobosin A	11		Aflatoxin B2	3		Perfluoro-1-heptane sulfonic acid (PFHpS)	1
Perfluorohexanoic acid (PFHxA)	21		Fumonisins B2	11		T-2 toxin	3		Perfluorooctane sulfonic acid (PFOS)	1
Perfluoropentanoic acid (PFPeA)	21		4-Nonylphenol	10		9-chlorohexadecafluoro-3- oxanonane-1-sulfonate	3		Perfluorotridecanoic acid (PFTrDA)	1
Dimethyldithiophosphate (DMDTP)	20		Atrazine mercapturate	10		Perfluoro-1-[1,2,3,4-13C4] octanesulfonic acid	3		Diethylthiophosphate (DETP)	0
Dihydrocitrinone	20		Perfluorododecanoic acid (PFDoA)	10		Perfluorodecanoic acid (PFDeA)	3		2-Methylhippuric Acid (2MHA)	0
Diacetoxyscirpenol	19		Phenylglyoxylic Acid (PGO)	9		Perfluoroundecanoic acid (PFUnA)	3		N-acetyl phenyl cysteine (NAP)	0
Nickel	18		Deoxynivalenol	9		2,4-Dichlorophenoxyacetic Acid (2,4-D)	2		Monoethyl Phthalate (MEP)	0
Cesium	18		Nivalenol	9		4-Methylhippuric Acid (4MHA)	2		Ethylparaben	0
GenX/HPFO-DA	18		Patulin	8		3-Phenoxybenzoic Acid (3PBA)	2		Perfluoro-[1,2-13C2] octanoic acid (M2PFOA)	0
Tellurium	17		Verrucarin J	8		mono-2-ethylhexyl phthalate (MEHP)	2		Perfluorononanoic acid (PFNA)	0
									Perfluorotetradecanoic acid (PFTeDA)	0

Most Commonly Detected Toxins

MDLifespan 2023: Internal Observational data on 237 healthy patient seen in outpatient

Toxins

How toxins kill

- Cripple enzymes
- Interfere with hormones
- Damage organs
- Damage cell membranes
- Modify gene expression
- Damage DNA

What toxins cause:

- Birth defects
- Certain cancers
- Tumors at multiple sites
- Immune-system disorders
- Reproductive problems
- Stunted growth
- Permanent impairment of brain function

Toxins are the primary cause of autism, ADHD, and obesity affecting the unborn child.

In short, toxins are the primary cause of inflammation.

Inflammation is the primary cause of disease.

Leading causes of death

1. **Toxins**
2. **Heart disease**
3. **Cancer**
4. **Covid-19**
5. **Alzheimer’s**

24% of all estimated global deaths are linked to the environment.

Toxins and a few Human Diseases

Autoimmune Diseases
Rheumatoid Arthritis, Multiple Sclerosis

Cancers
Leukemia, Lymphoma, Lung Cancer, Bladder Cancer, Breast Cancer, Kidney Cancer, Skin Cancer, many more

Cardiovascular Diseases
Coronary Heart Disease, Congestive Heart Failure, Hypertension, Stroke

Dermatological Conditions
Skin Irritations and Allergies

Endocrine Disruption
Reproductive, Thyroid, Obesity

Gastrointestinal Diseases
Liver Disease, Pancreatitis

Infectious Diseases
Vector Borne Diseases

Kidney Diseases
Chronic Kidney Disease

Neurological Disorders
Parkinson's Disease, Alzheimer's Disease, Amyotrophic Lateral Sclerosis

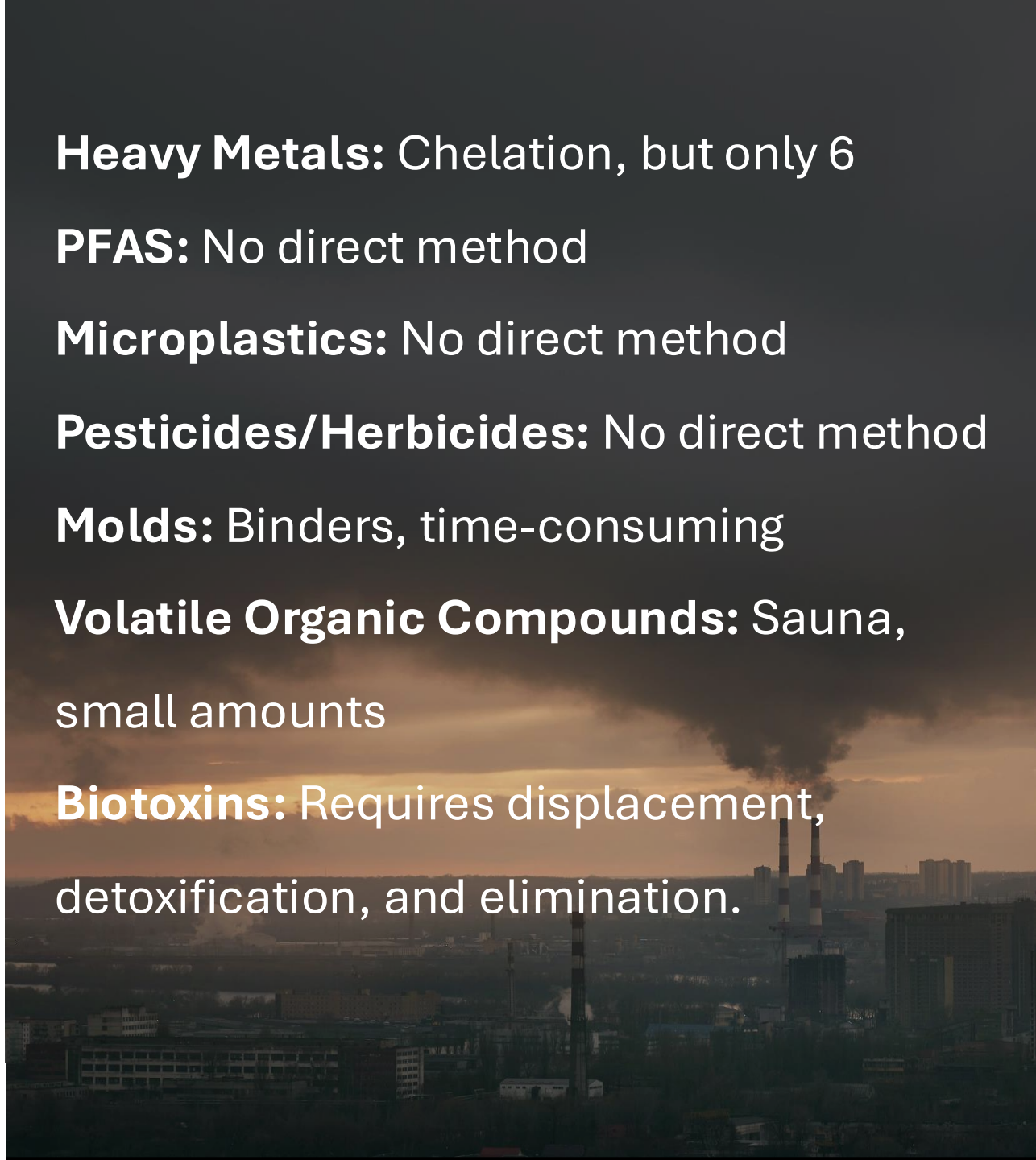
Respiratory Diseases
Asthma, Chronic Obstructive Pulmonary Disease (COPD)

Neurodevelopmental Disorders
Autism spectrum disorders, Childhood ADHD

Reproductive Health Issues
Birth Defects, Low Birth Weight and Preterm Birth

"Toxins are notoriously difficult, and incredibly slow, to get out of the body."

Dr. Paul Anderson DNM



Heavy Metals: Chelation, but only 6

PFAS: No direct method

Microplastics: No direct method

Pesticides/Herbicides: No direct method

Molds: Binders, time-consuming

Volatile Organic Compounds: Sauna, small amounts

Biotoxins: Requires displacement, detoxification, and elimination.

Idiopathic Environmental Intolerances

Idiopathic Environmental Intolerances (IEI)

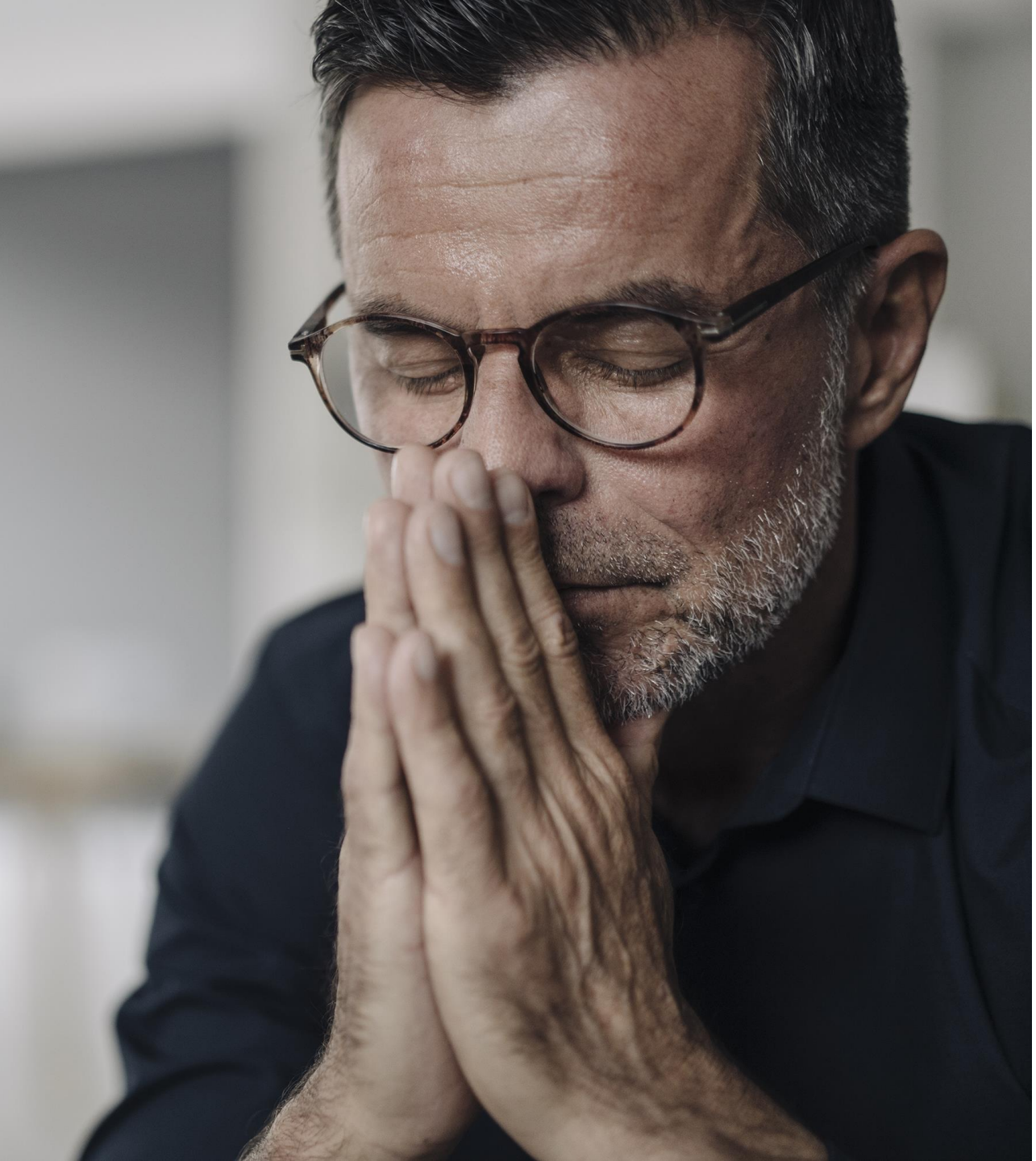
Known as **Multiple Chemical Sensitivity** (**MCS**), also known as **Multiple Chemical Intolerances** (**MCI**), is an acquired, chronic, multi-system illness, in which people experience a range of symptoms in response to exposure to multiple chemicals.

https://pmc.ncbi.nlm.nih.gov/articles/PMC5794238/

Multiple Chemical Sensitivities (MCS)

The first reports about sensitization and allergies to chemical substances date back to 1956 when allergist Dr. Theron G. Randolph defined "environmental disease" as a group of disorders observed in some of his patients after the exposure to various chemical compounds, not related to each other.

In 1987 Dr. MR Cullen used the definition of **"Multiple Chemical Sensitivity" (MCS)** to define an "acquired disorder characterized by recurrent symptoms, affecting multiple organs and systems, which arise in response to a demonstrable exposure to chemicals, even for low doses, much lower than those causing reactions in the general population."



Signs and Symptoms

A 2010 review of IEI research said that the following symptoms, in this order, were the most reported in IEI: headache, fatigue, depression, shortness of breath, arthralgia, myalgia, nausea, dizziness, neurocognitive deficits, gastrointestinal symptoms, respiratory symptoms, and cardiovascular symptoms.

A 2017 review of IEI studies said that “IEI is a syndrome that progresses to increasingly serious stages, with the gradual onset of multiple pathologies." It can be associated with very high levels of disability.

Idiopathic Environmental Intolerances

Stage 0 – Tolerance

In this stage, the individual is normally able to adapt to the environment

Stage 1 – Sensitization.

Present with dermal, ocular and respiratory tract irritation, itching, fatigue, muscle and joint pain, headache, nausea, tachycardia, changes in blood pressure, balance problems, sensations of cold or fever, dyspnea, cognitive problems, asthma, insufficient peripheral circulation, immune disorders and gastrointestinal diseases.

Multiple Chemical Sensitivity by Sabrina Rossi, Alessio Pitidis 2018 https://pmc.ncbi.nlm.nih.gov/articles/PMC5794238/

Idiopathic Environmental Intolerances

Stage 2 – Inflammation

Chronic inflammation in load of different tissues, organs, and systems. Various disorders development, detectable through specialist examination: dermatitis, vasculitis, immune, endocrine, metabolic diseases, food and environmental allergies (dust, pollen, etc), arthritis, colitis, rhinitis, dyspnea, asthma, muscle fatigue, fainting, cognitive delays, poor peripheral circulation, bleeding, etc.

Stage 3 – Deterioration

Chronic inflammation produces damage to tissues and organs. central nervous system, kidneys, liver, lungs, immune system, circulatory, vascular, dermal are affected. Lupus, ischemia, heart failure, cancer, autoimmunity, neurodegenerative and psychiatric syndromes, hemorrhagic forms, porphyria are the most common diseases in this stage.

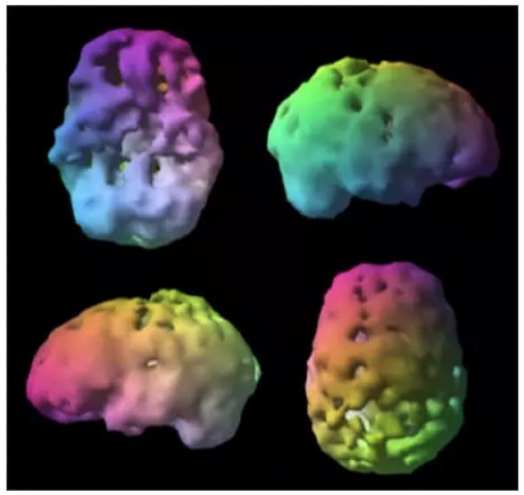
Idiopathic Environmental Intolerances - Neurologic

- Many common symptoms of IEI are neurological (for example, "dizziness, seizures, head pain, fainting, loss of coordination").

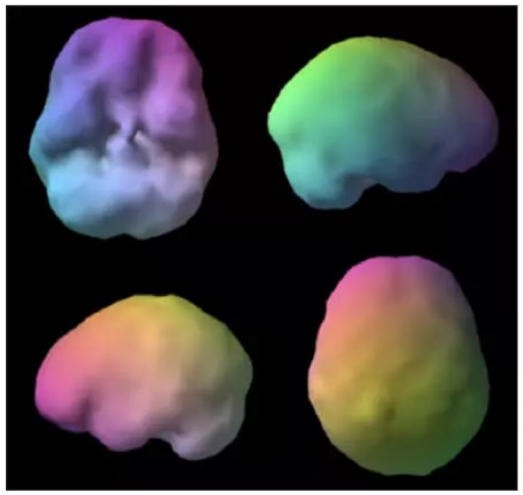
- And neurogenic inflammation and a central sensitization syndrome have been thought to be mechanisms involved in causing, perpetuating and worsening IEI.

Idiopathic Environmental Intolerances - Neurologic

Multiple neuro-imaging studies have shown that people with MCS often have other neurological abnormalities, including abnormal cerebral perfusion patterns, especially in the autonomic nervous system areas. These abnormalities have been documented both in studies using Positron emission tomography (PET) and Single-photon emission computed tomography (SPECT) scans.



Unhealthy SPECT Brain Scan

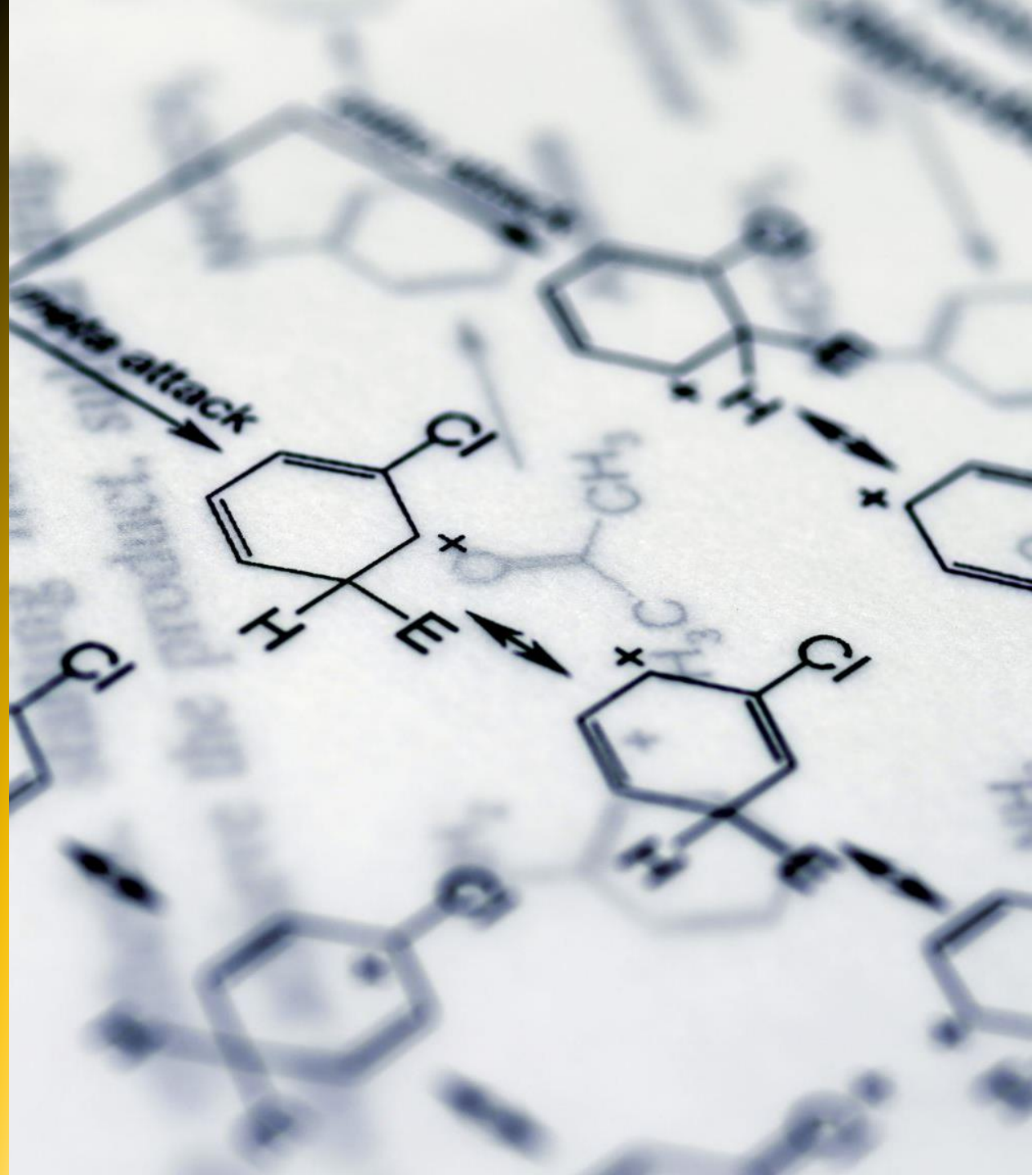


Healthy SPECT Brain Scan

Idiopathic Environmental Intolerances - Immunologic

- MCS is not an allergy, and subjects with MCS having adverse reactions do not routinely exhibit the immune markers associated with allergies.

- Nevertheless, certain immune irregularities have been identified in subjects with MCS in a range of studies.



Idiopathic Environmental Intolerances - Immunologic

- In the 1980s and 1990s, some researchers hypothesized that these immune irregularities suggested that MCS was caused by a chemically induced disturbance of the immune system, which resulted in chronic immune dysfunction.

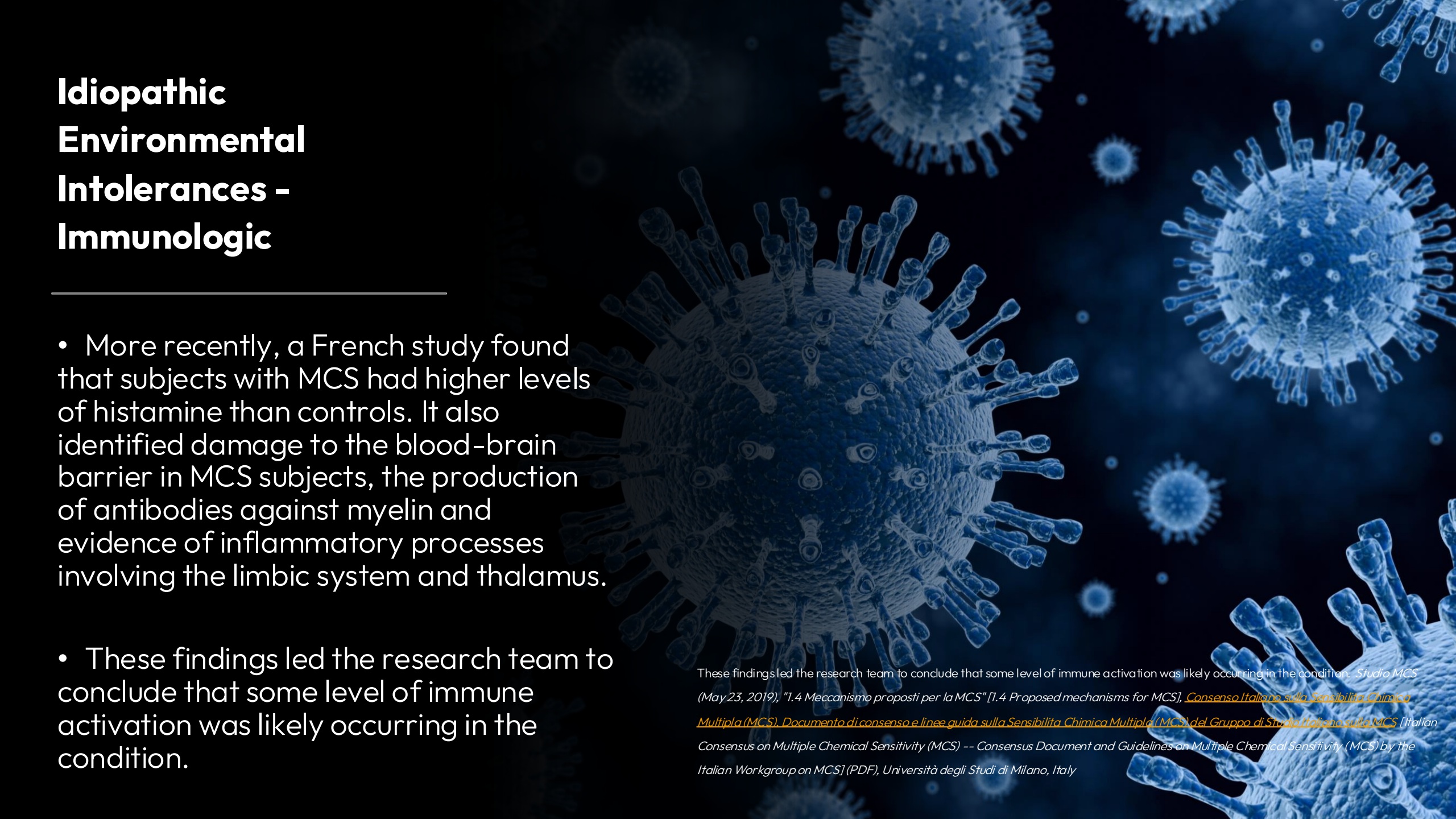
- While others concluded that allergic or immunotoxicological reactions could be contributing factors in at least a subset of MCS patients.

- As more studies were conducted, however, some argued that there was no consistent pattern of immunological reactivity or abnormality in MCS.

Idiopathic Environmental Intolerances - Immunologic

- More recently, a French study found that subjects with MCS had higher levels of histamine than controls. It also identified damage to the blood-brain barrier in MCS subjects, the production of antibodies against myelin and evidence of inflammatory processes involving the limbic system and thalamus.

- These findings led the research team to conclude that some level of immune activation was likely occurring in the condition.

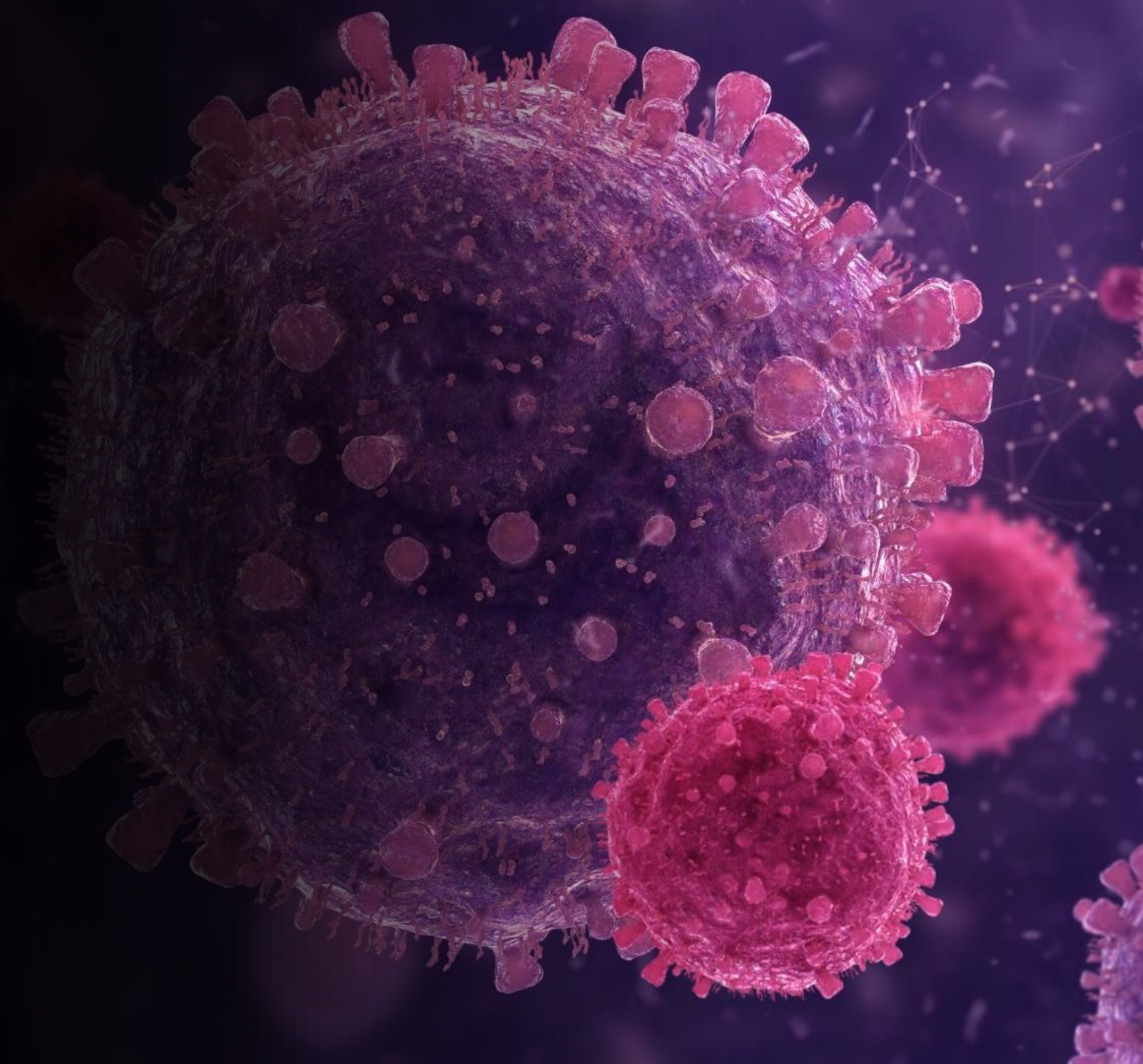


These findings led the research team to conclude that some level of immune activation was likely occurring in the condition. *Studio MCS (May 23, 2019), "1.4 Meccanismo proposti per la MCS" [1.4 Proposed mechanisms for MCS], Consenso Italiano sulla Sensibilità Chimica Multipla (MCS), Documento di consenso e linee guida sulla Sensibilità Chimica Multipla (MCS) del Gruppo di Studio Italiano sulla MCS [Italian Consensus on Multiple Chemical Sensitivity (MCS) -- Consensus Document and Guidelines on Multiple Chemical Sensitivity (MCS) by the Italian Workgroup on MCS] (PDF), Università degli Studi di Milano, Italy*

Idiopathic Environmental Intolerances - Immunologic

- There is also evidence that subjects with MCS are more likely than controls to have real allergies and autoimmune diseases.

- And the 2019 consensus on MCS notes an association between the condition and Hashimoto's thyroiditis, Systemic Lupus Erythematosus (SLE), psoriasis and atopic eczema.



Idiopathic Environmental Intolerances - Psychologic

It has also been hypothesized that multiple chemical sensitivity is a psychological disorder.

Psychosomatic, psychiatric and psychological theories of MCS, however, have not been accepted by the most recent medical consensus document on MCS, and the hypothesis that MCS has psychological causes has flaws.

Idiopathic Environmental Intolerances - Psychologic

The 2019 Italian consensus on MCS concluded that the studies that hypothesize that the condition has a psychological cause "have been the object of strong criticism, both for methodological deficiencies as well as for the conflict of interests of the scientists who propose this thesis.“

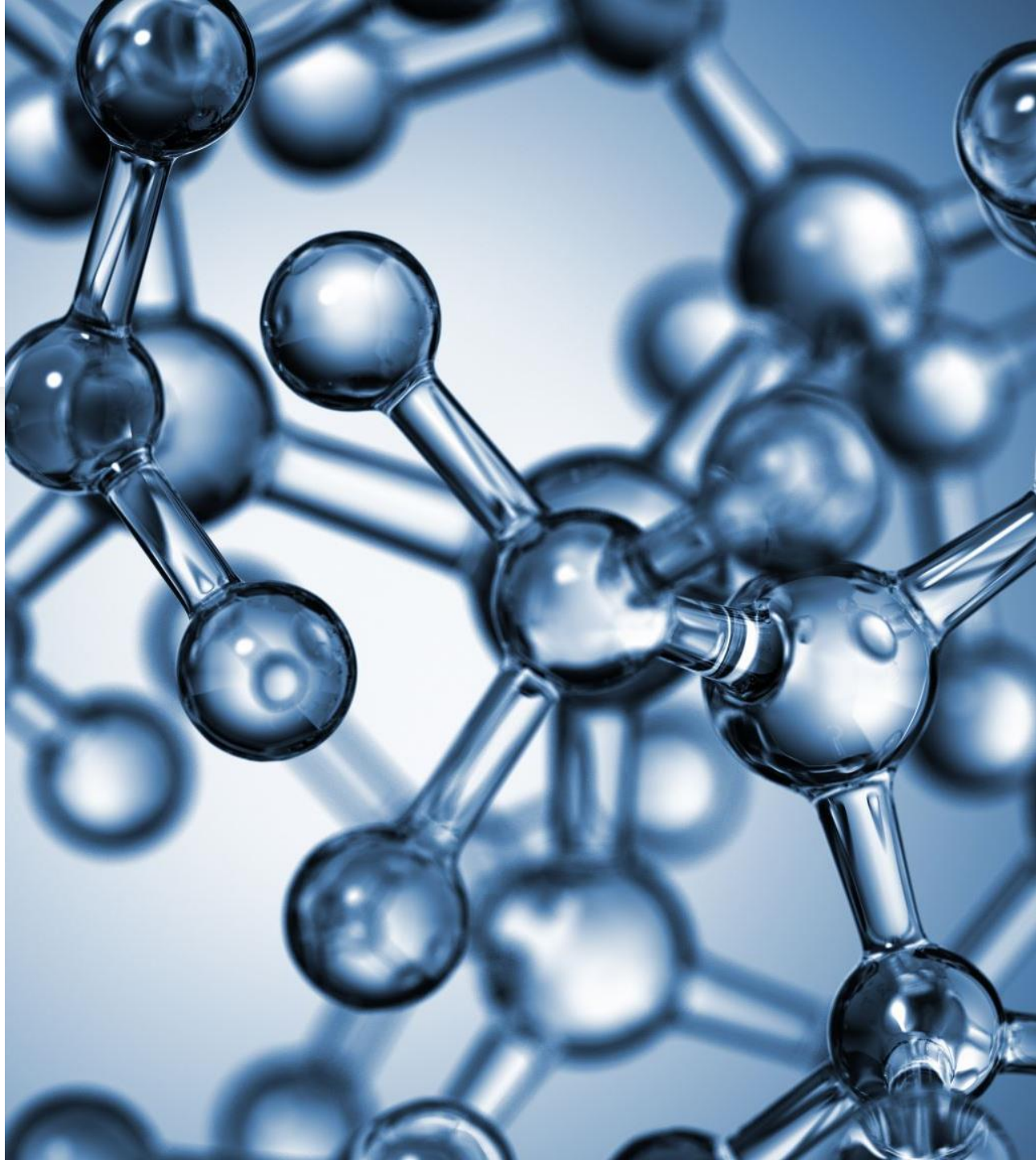
It said there was consensus that MCS reactions could cause psychiatric symptoms through biological processes (e.g. neurogenic inflammation) and that symptoms of the condition should not be mistaken for the cause.

Idiopathic Environmental Intolerances - Genetic

- The 2019 consensus on MCS said that the condition could, at least in part, be caused by genetic alterations affecting detoxification pathways—something which in combination with toxin exposures could make some people more vulnerable to developing MCS than the rest of the population.

Idiopathic Environmental Intolerances - Immunologic Genetic

- Genetic markers known to affect detoxification pathways have been identified as being more common in subjects with MCS than controls, including polymorphisms and differences in expression of the following: CYP2D6, MTHFR, NAT1, NAT 2, GSTM1, NOS3, NOS2 and GPX1. and PON1 and PON2.



Multiple Chemical Sensitivities (MCS) - Genetic

- These findings could support the hypothesis that MCS is caused by a synergy of environmental exposures to toxic substances and the impaired ability to metabolize toxic substances, due to factors related to genetic predisposition.

Idiopathic Environmental Intolerances – Italian Workgroup

In May 2019, the Italian Workgroup on MCS, a group of physicians, research scientists and clinical staff, published a detailed, 30-page consensus paper called the *Italian Consensus on MCS.*

This document may be the most detailed scientific review of research about MCS to date. It goes into detail about ways the condition can be better managed in clinical environments.

The workgroup published their consensus in Italian and English, asking for input from MDs and other health professionals, biologists and chemists.

Idiopathic Environmental Intolerances - Signs and Symptoms

- Lacour criteria (2005)
  - Symptom duration of at least 6 months
  - Symptoms in response to at least 2 of 11 categories of chemical exposures
  - At least one central nervous system symptom is present (fatigue, headaches or neurocognitive deficits, and one symptom from another organ system)
  - Symptoms causing adjustments of personal lifestyle, or of social or occupational life
  - Symptoms occurring when exposed and improving or resolving when exposures are removed
  - Symptoms are triggered by exposure levels that do not induce symptoms in other individuals who are exposed to the same levels

Idiopathic Environmental Intolerances - Likely Toxins

- The following substances are common triggers for adverse symptoms in people with MCS:
    - Microplastics
    - PFAS
    - Pesticides (insecticides and herbicides), biocides and fungicides
    - Agricultural chemicals, notably fertilizers
    - Mold and mycotoxins
    - Synthetic fragrances and products containing fragrance (e.g. fragranced deodorant)
    - Laundry detergents and fabric softeners
    - Cigarette smoke and woodfire smoke
    - Petrochemical solvents and plastics
    - Formaldehyde
    - Some building materials
    - Preservatives, food colorings and additives
    - Some medications and anesthetics
    - Air pollution (e.g. PM2.5, black carbon, nitrogen oxide, ozone)
    - Natural essential oils.

Studio MCS (May 23, 2019), "1.4 Meccanismo proposti per la MCS" [1.4 Proposed mechanisms for MCS], Consenso Italiano sulla Sensibilita Chimica Multipla (MCS). Documento di consenso e linee guida sulla Sensibilita Chimica Multipla (MCS) del Gruppo di Studio Italiano sulla MCS [Italian Consensus on Multiple Chemical Sensitivity (MCS) -- Consensus Document and Guidelines on Multiple Chemical Sensitivity (MCS) by the Italian Workgroup on MCS] (PDF), Università degli Studi di Milano, Italy

Idiopathic Environmental Intolerances - Assessment Tools

The Quick Environmental Exposure and Sensitivity Inventory (QEESI) is a diagnostic tool that is often used to assess a patient for Idiopathic Environmental Intolerances

In a study of 421 individuals, including four exposure groups and a control group, the QEESI© provided sensitivity of 92% and specificity of 95% in differentiating between persons with Idiopathic Environmental Intolerances and the general population.

Criteria for low, medium, and high scale scores

Scale/Index	Score		
	Low	Medium	High
Symptom Severity	0-19	20-39	40-100
Chemical Intolerance	0-19	20-39	40-100
Other Intolerance	0-11	12-24	25-100
Life Impact	0-11	12-23	24-100
Masking Index	0-3	4-5	6-10

Miller CS, Prihoda TJ: The Environmental Exposure and Sensitivity Inventory (EESI): a standardized approach for measuring chemical intolerances for research and clinical applications. Toxicology and Industrial Health 15:370-385, 1999

Idiopathic Environmental Intolerances - Diagnostic Tools

Toxin Testing
- Vibrant America
- Doctor's Data

Inflammation
- CRP
- ESR
- IL-1b
- IL-6
- IL-8

Immune System
- Lymphocytes
- IgG Antibodies

Oxidation
- MPO
- TMAO
- Oxidized LDL

Genetics
SPECT

Idiopathic Environmental Intolerances - Prevalence

While prevalence rates for MCS vary according to the diagnostic criteria used, the condition is reported across industrialized countries and the data suggests it affects women more than men.

Idiopathic Environmental Intolerances - Prevalence

- The most extensive epidemiological study into MCS in the U.S. was in 2005.

- It found that the national prevalence rate for MCS diagnosed by a doctor was 2.5% and self-reported MCS was 11.2%.

- In 2018, the prevalence rate of diagnosed MCS had increased by more than 300% and self-reported chemical sensitivity by more than 200% in the previous decade.

- They found that the national prevalence rate for MCS diagnosed by a doctor was 12.8% and self-reported MCS was 25.9%.

Idiopathic Environmental Intolerances – Recognition

GMS Curr Top Otorhinolaryngol Head Neck Surg. 2004:3:Doc05. Epub 2004 Dec 28.

Multiple Chemical Sensitivity (MCS) – Scientific and Public-Health Aspects

Michael Schwenk [1]

Affiliations + expand

PMID: 22073047 PMCID: PMC3199799

In 1996, an expert panel at WHO/ICPS (International Classification for Patient Safety) was set up to examine MCS.

The panel:
1."accepted the existence of a disease of unclear pathogenesis",
2.proposed that the disease was acquired, that its symptoms were "in close relationship to multiple environmental influences, which are well tolerated by the majority of the population," and that it "could not be explained by a known clinical or psychic disorder,"
3.suggested that the broader term "idiopathic environmental intolerances" (IEI) be adopted instead of MCS, to incorporate MCS and several other conditions under a single umbrella term.

Treatment - Avoidance

- A study, which surveyed more than 900 people with IEI/MCS about their experiences managing the condition, found that 95% of respondents thought that "creating a chemical-free living space and chemical avoidance" had been the best strategy out of any management or treatment option they had tried.

Treatment – No Clinically Proven Cure to IEI/MCS

As of 2022, there was no clinically proven cure for IEI/MCS. There is also no scientific consensus on supportive therapies, "but the literature agrees on the need for patients with IEI/MCS to avoid the specific substances that trigger reactions for them and also on the avoidance of xenobiotics in general, to prevent further sensitization.“

UNTIL NOW……..

Notable studies and publications

1987, Cullen, M.R. The worker with multiple chemical sensitivities: An overview[201] - (Abstract)

1999, Multiple chemical sensitivity: a 1999 consensus[5] - (Full text)

2005, Multiple Chemical Sensitivity Syndrome (MCS) – suggestions for an extension of the US MCS-case definition[26] - (Abstract)

2014, Toxicant-Induced Loss of Tolerance: A Theory to Account for Multiple Chemical Sensitivity[99] (Full text)

2016, Association of Odor Thresholds and Responses in Cerebral Blood Flow of the Prefrontal Area during Olfactory Stimulation in Patients with Multiple Chemical Sensitivity[202] - (Full text)

2018, Multiple Chemical Sensitivity: Review of the State of the Art in Epidemiology, Diagnosis, and Future Perspectives[1] - (Full text)

2018, Perspectives on multisensory perception disruption in idiopathic environmental intolerance: a systematic review[6] - (Abstract)

2019, Italian Consensus on Multiple Chemical Sensitivity (MCS) -- Consensus Document and Guidelines on Multiple Chemical Sensitivity (MCS)[94] - (Full text - English)

Notable studies and publications

2019, International prevalence of chemical sensitivity, co-prevalences with asthma and autism, and effects from fragranced consumer products[65] - (Full text)

2019. Padmanabhan, A., Connelly-Smith, L., Aqui, N., Balogun, R. A., Klingel, R., Meyer, E., ... & Winters, J. L. Guidelines on the use of therapeutic apheresis in clinical practice.

2019. Zanatta E, Cozzi M, Marson P, Cozzi F. The role of plasma exchange in the management of autoimmune disorders. Br J Haematol. 2019 Jul;186(2):207-219. doi: 10.1111/bjh.15903. Epub 2019 Mar 28. PMID: 30924130.2021.

2020. Mehdipour, M., Mehdipour, T., Skinner, C., Wong, N., Lieb, M., Liu, C., ... & Conboy, I. M. (2020). Rejuvenation of three germ layers tissues by exchanging old blood plasma with saline-albumin. *Aging, 12*(10), 8790-8819. https://doi.org/10.18632/aging.103418

2021, Volatile organic compounds (VOCs) in exhaled breath as a marker of hypoxia in multiple chemical sensitivity[95] - (Full text)

2021, Mast cell activation may explain many cases of chemical intolerance[100] (Full text)

2021, Multiple Chemical Sensitivity[203] (Full text)

Notable studies and publications

2021. Momchilova, Albena. Plasmapheresis Affects Ophthalmological Parameters and Oxidative Stress in Patients with Multiple Sclerosis and Neuromyelitis Optica. Archives in Biomedical Engineering & Biotechnology. 5. 10.33552/ABEB.2021.05.000617.

2021. *Journal of Clinical Apheresis, 34*(3), 171-354. https://doi.org/10.1002/jca.21705
Solanki, A., Singh, A., Chauhan, A., Agarwal, D., Himanshu, D., & Chandra, T. Therapeutic plasma exchange an emerging treatment modality. *Asian journal of transfusion science*, *15*(1), 46–51.

2022. Kim, D., Kiprov, D.D., Luellen, C. *et al.* Old plasma dilution reduces human biological age: a clinical study. *GeroScience* **44**, 2701–2720 (2022). https://doi.org/10.1007/s11357-022-00645-w

2023. Terumo BCT. *Advances in apheresis technology: A look into the future of therapeutic plasma exchange* [White paper]. Terumo BCT.

2024. Khosa, N.A., Essa, S.M., Zarak, M.S., Zarkoon, A.U., Ibrahim, I.A., & Mumtaz, T. (2024). Plasma-exchange therapy in acute immune-mediated neuropathy: Effects on muscle strength and functional outcomes. *Romanian Journal of Neurology*.

2025. American Society for Apheresis. Procedure: Therapeutic Plasma Exchange (https://cdn.ymaws.com/www.apheresis.org/resources/resmgr/fact_sheets_file/therapeutic_plasma_exchange.pdf).


Thank You