

21st Century Building Science

- **Claudia Miller MD**
www.tiltresearch.org
- **Carl Grimes CIEC**
www.haywardscore.com
- **Westford Building
Science Symposium**

August 4-6, 2025



Modern Advances in Building Science

- **Should include** not just the building.
- Not just new technology.
- Not just the emerging smart buildings.
- Not even the brilliant hallucinations of Artificial Intelligence.
- It's Indoor Environmental **Quality**.
- IF it will stop ignoring the historical blind spot of IEQ...
- By excluding the missing variable
 - The individual humans who occupy the buildings
- Buildings affect people, people affect buildings.

– It's the Interactions



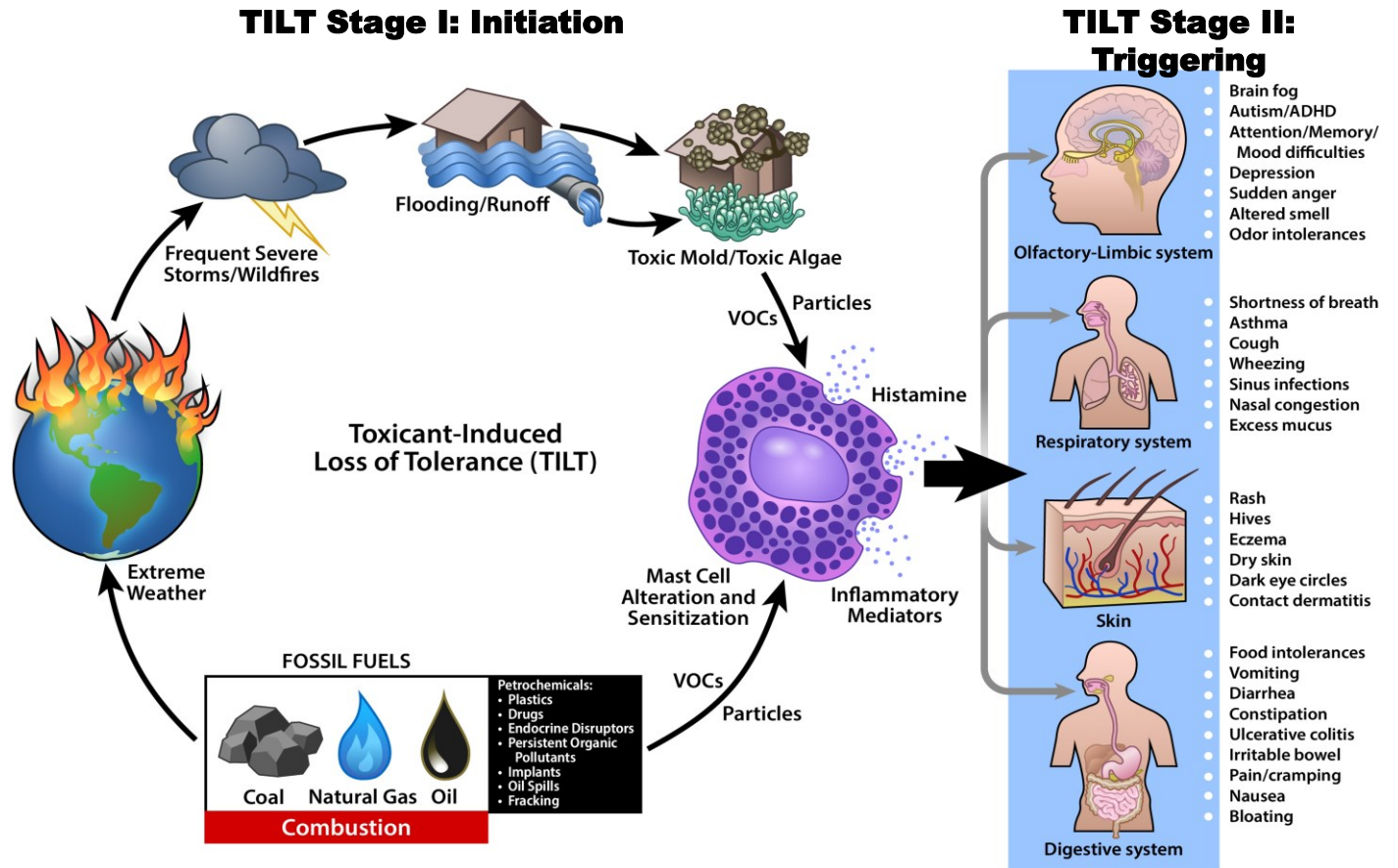
But First

- Neither Dr Miller nor I are Building Scientists. But...
- As a Certified Indoor Environmental Consultant, I need what you know so I can improve my helping individuals who leave their home and experience feeling better.
- As a former IH and now MD/Allergist Immunologist, Dr Miller needs what you know so she can better study the relationship between environmental exposures and health outcomes.
- We hope this presentation will help us both better serve our clients and patients who are sick from the buildings they occupy.

Dr Miller's brief CV

- 1996 journal *Toxicology*, proposed a unifying theory of disease *Toxicant-Induced Loss of Tolerance (TILT)*.
- 1999 in *Quick Environmental Exposure and Sensitivity Inventory (QEESI)*.
- 2021 Identified mast cell mechanism underlying TILT.
- 2023 Identified TILT initiators to include pesticides, indoor air VOCs, Gulf War exposures, implants and mold.
- 2024 *Environmental house calls can reduce symptoms of chemical intolerance: a demonstration of personalized exposure medicine.*
- 2024 Parents with high chemical intolerance score had 5.7 times an increased risk of having a child with autism/ADHD.

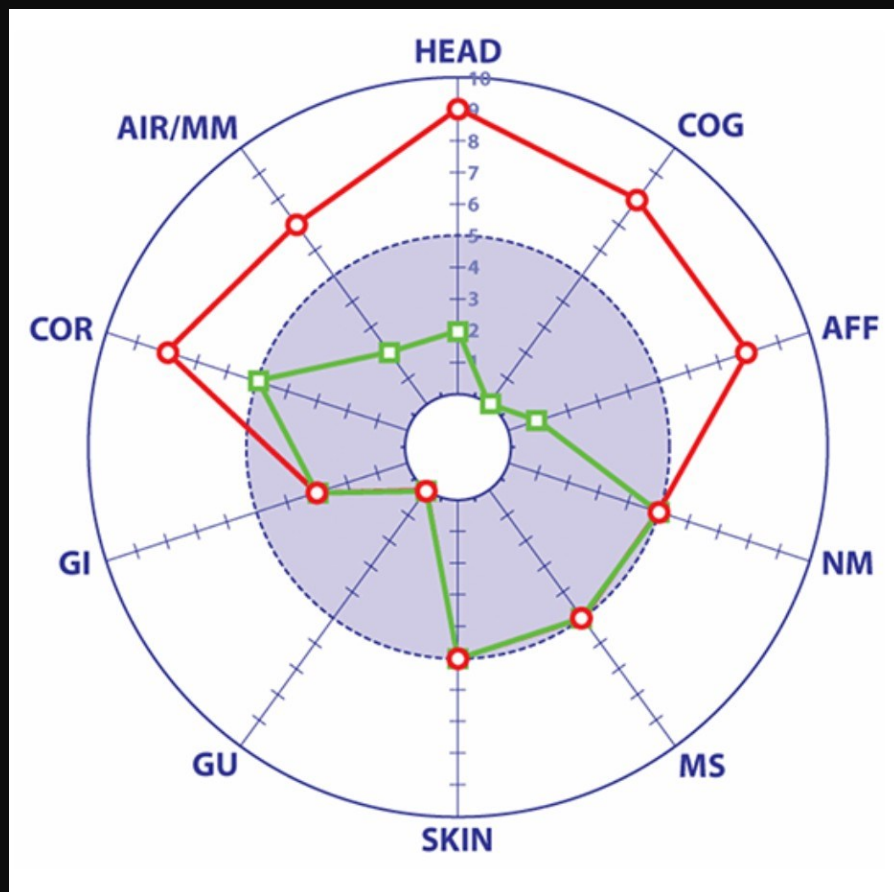
The two stages of TILT



What is YOUR experience?

- Not just the regulatory hazards, or even the fundamental factors of the indoor environment.
 - Thermal, IAQ contaminants, Noise, Illumination.
- Let's explore, as a group exercise, some of the common and ordinary exposures we all experience...
- What if we could now explore this range and variability with a consistent set of questions with an observable outcome?

QEESI Symptom Star



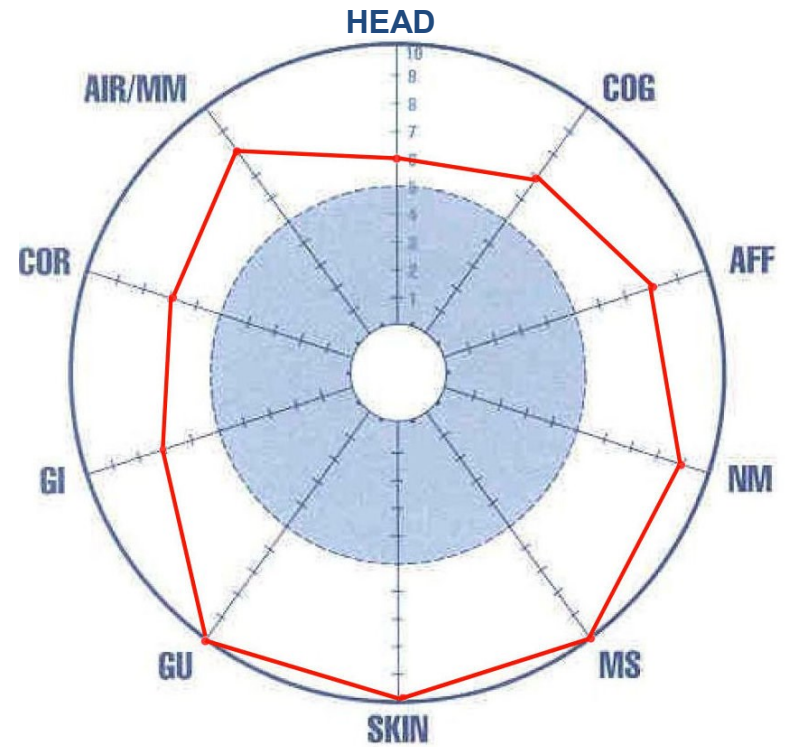
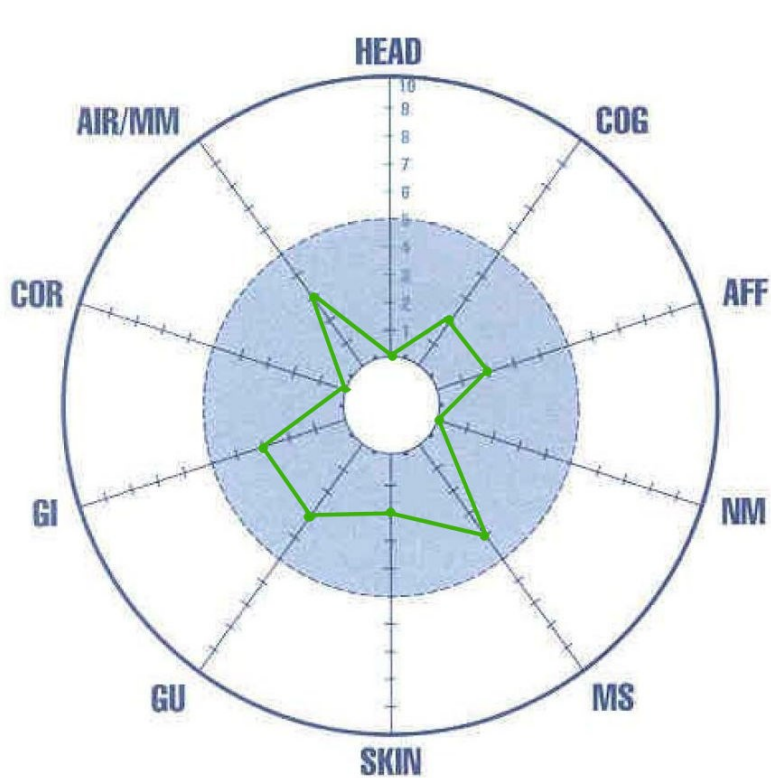
— Symptoms —

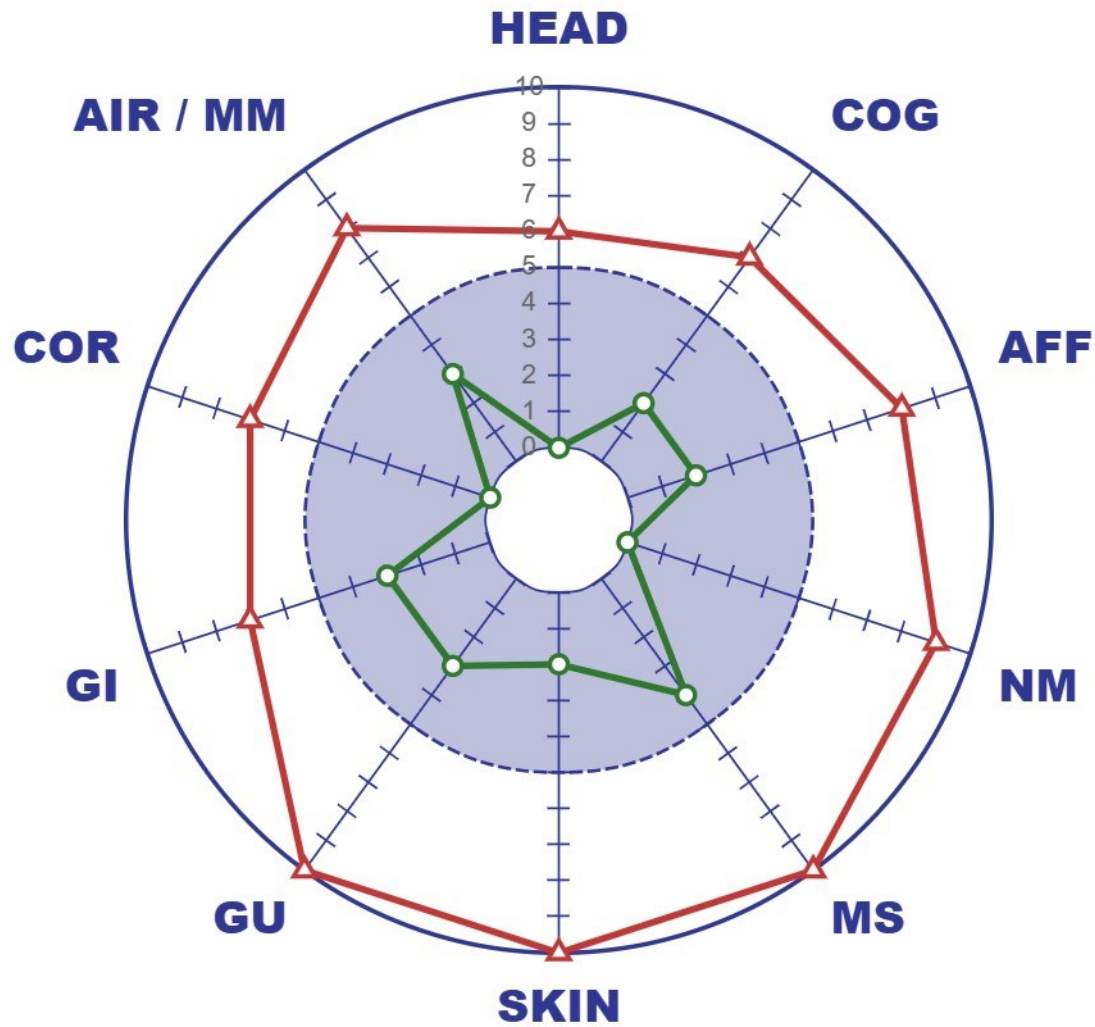
The following questions ask about symptoms you may have experienced commonly. Rate the severity of your symptoms on a 0-10 scale. Do not leave any items blank.

For each item, circle one number only:
[0 = not at all a problem] [5 = moderate symptoms]
[10 = disabling symptoms]

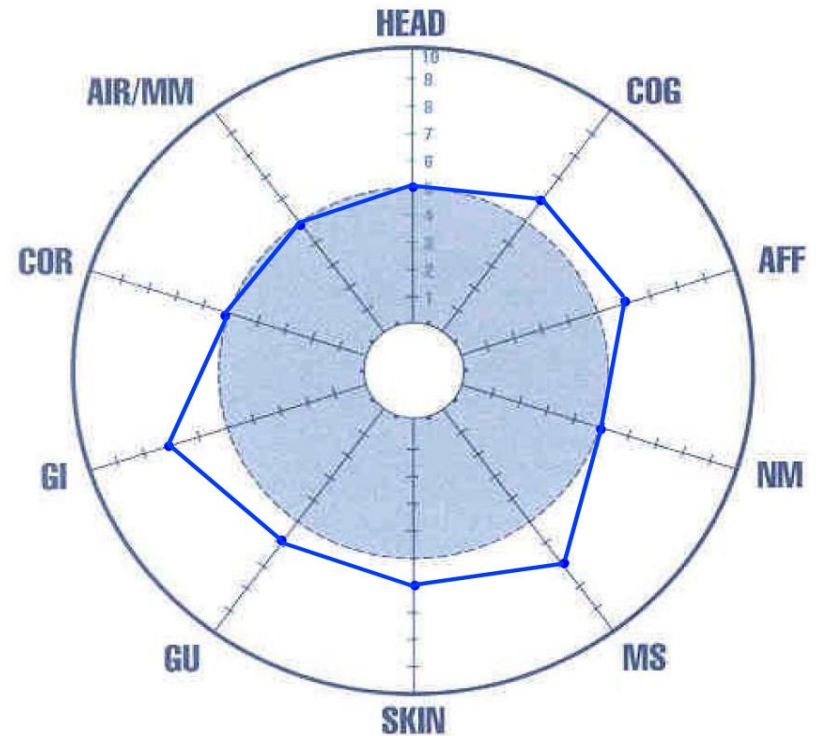
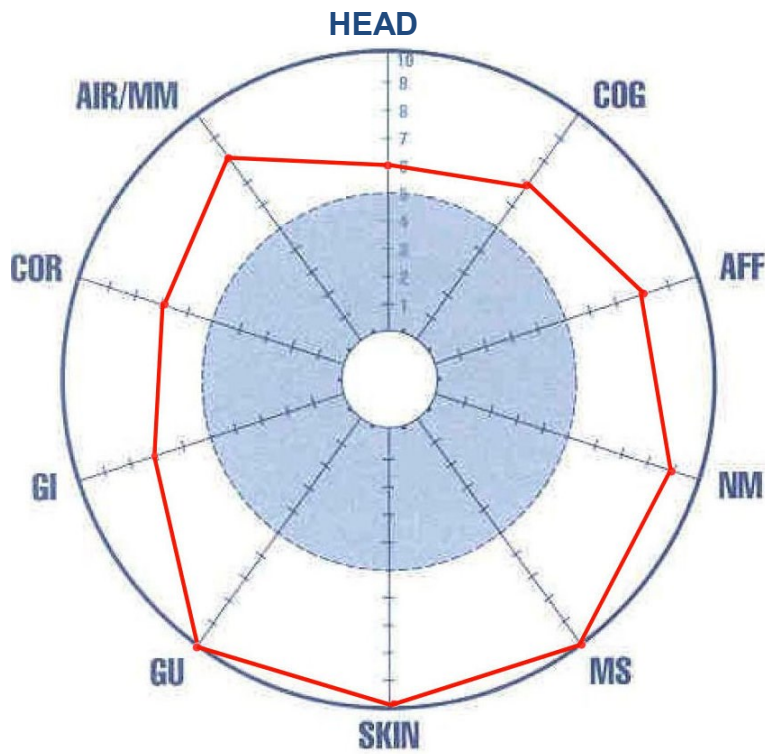
1.	Problems with your muscles or joints, such as pain, aching, cramping, stiffness or weakness?	MS 0 1 2 3 4 5 6 7 8 9 10
2.	Problems with burning or irritation of your eyes, or problems with your airway or breathing, such as feeling short of breath, coughing, or having a lot of mucus, post-nasal drainage, or respiratory infections?	AIR/MM 0 1 2 3 4 5 6 7 8 9 10
3.	Problems with your heart or chest, such as a fast or irregular heart rate, skipped beats, your heart pounding, or chest discomfort?	COR 0 1 2 3 4 5 6 7 8 9 10
4.	Problems with your stomach or digestive tract, such as abdominal pain or cramping, abdominal swelling or bloating, nausea, diarrhea, or constipation?	GI 0 1 2 3 4 5 6 7 8 9 10
5.	Problems with your ability to think, such as difficulty concentrating or remembering things, feeling spacey, or having trouble making decisions?	COG 0 1 2 3 4 5 6 7 8 9 10
6.	Problems with your mood, such as feeling tense or nervous, irritable, depressed, having spells of crying or rage, or loss of motivation to do things that used to interest you?	AFF 0 1 2 3 4 5 6 7 8 9 10
7.	Problems with balance or coordination, with numbness or tingling in your extremities, or with focusing your eyes?	NM 0 1 2 3 4 5 6 7 8 9 10
8.	Problems with your head, such as headaches or a feeling of pressure or fullness in your face or head?	HEAD 0 1 2 3 4 5 6 7 8 9 10
9.	Problems with your skin, such as a rash, hives or dry skin?	SKIN 0 1 2 3 4 5 6 7 8 9 10
10.	Problems with your urinary tract or genitals, such as pelvic pain or frequent or urgent urination? (For women: or discomfort or other problems with your menstrual period?)	GU 0 1 2 3 4 5 6 7 8 9 10

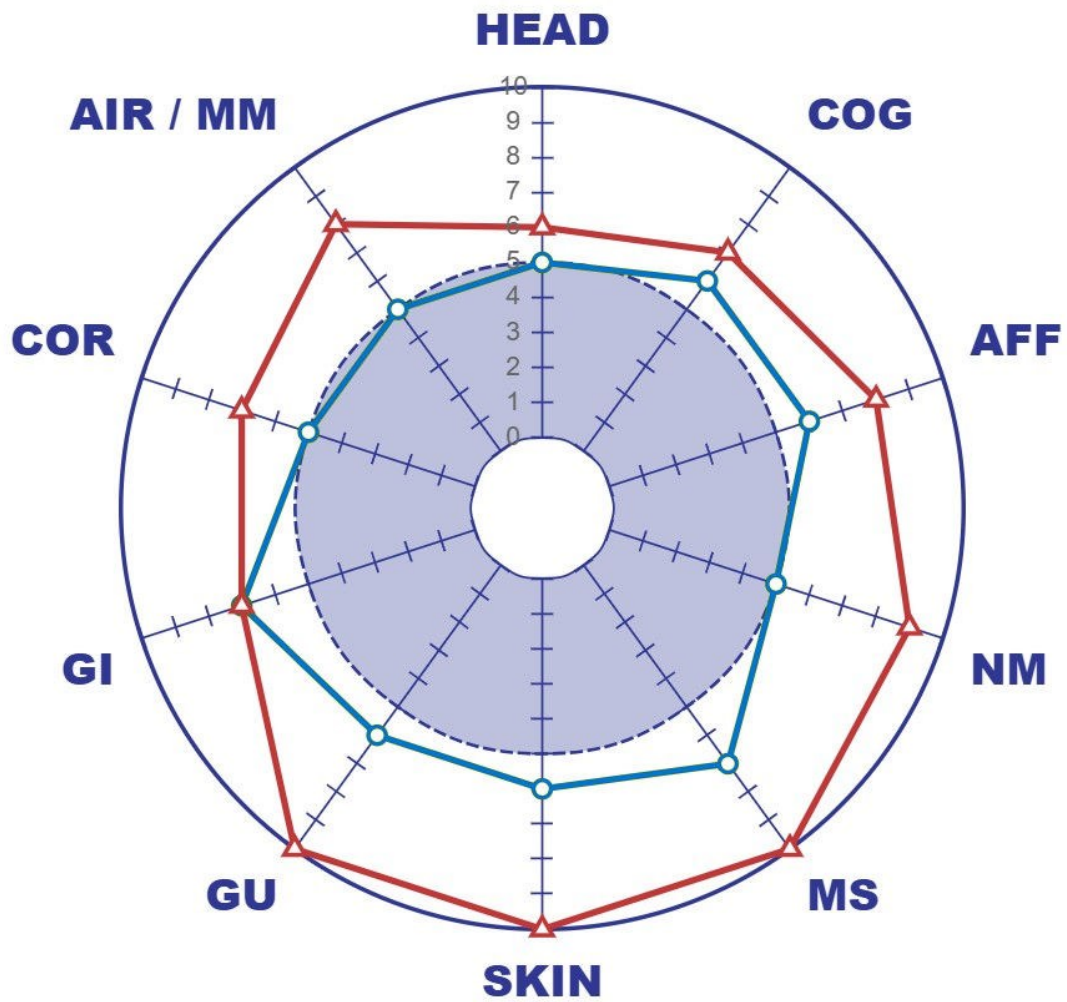
Before Exposure vs After Exposure



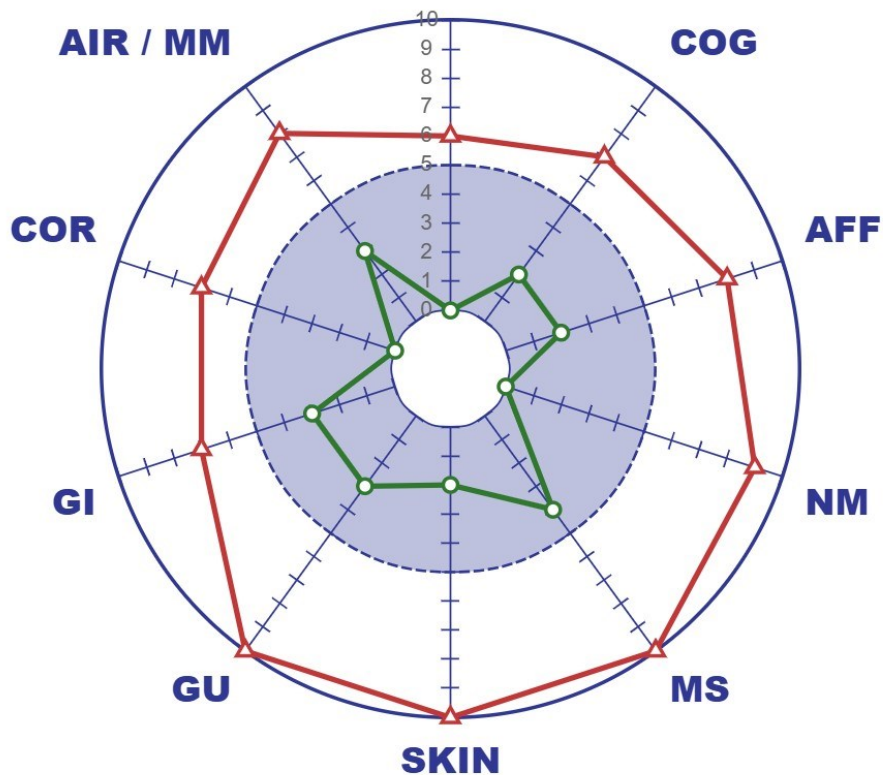


After Exposure vs After Intervention

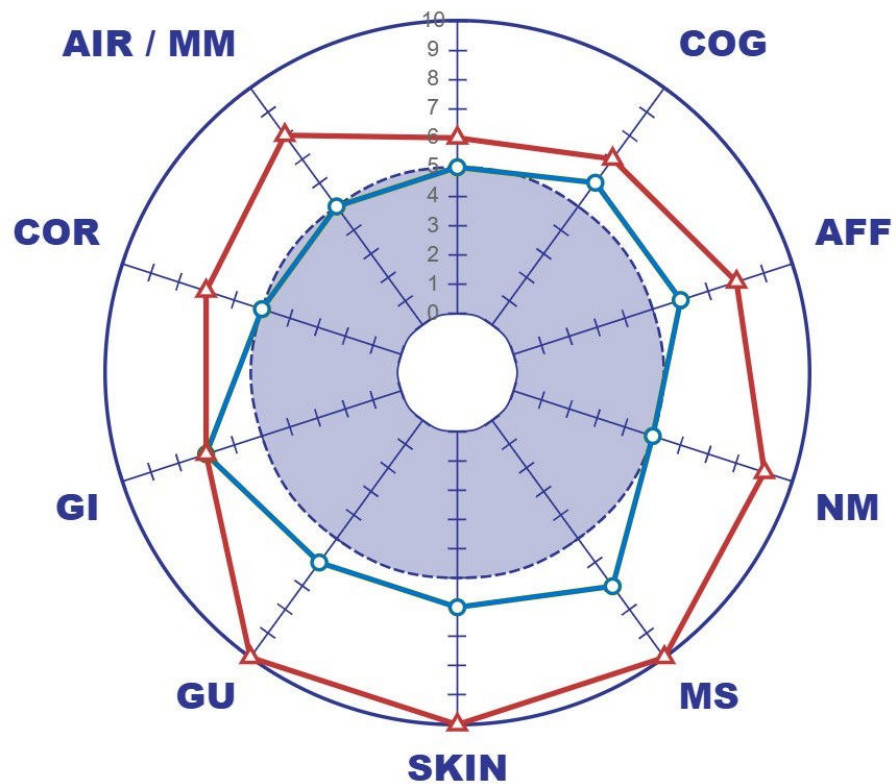




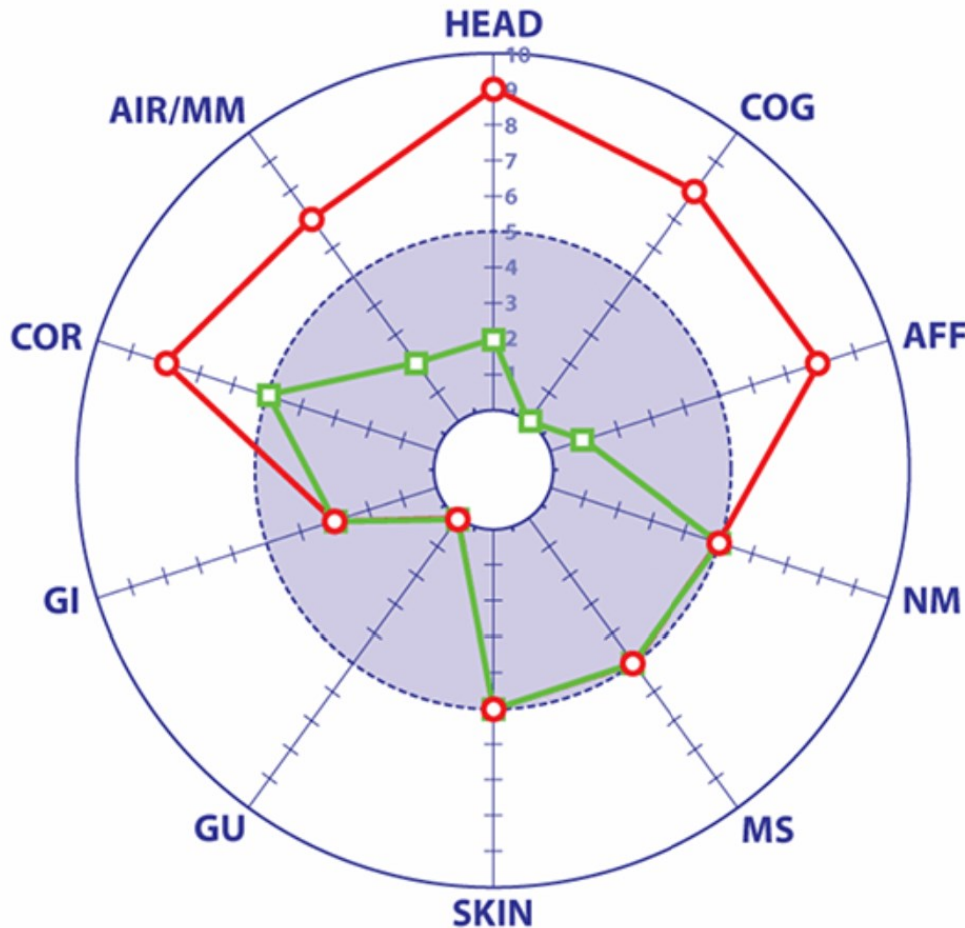
HEAD



HEAD



Some Symptoms May Not Change



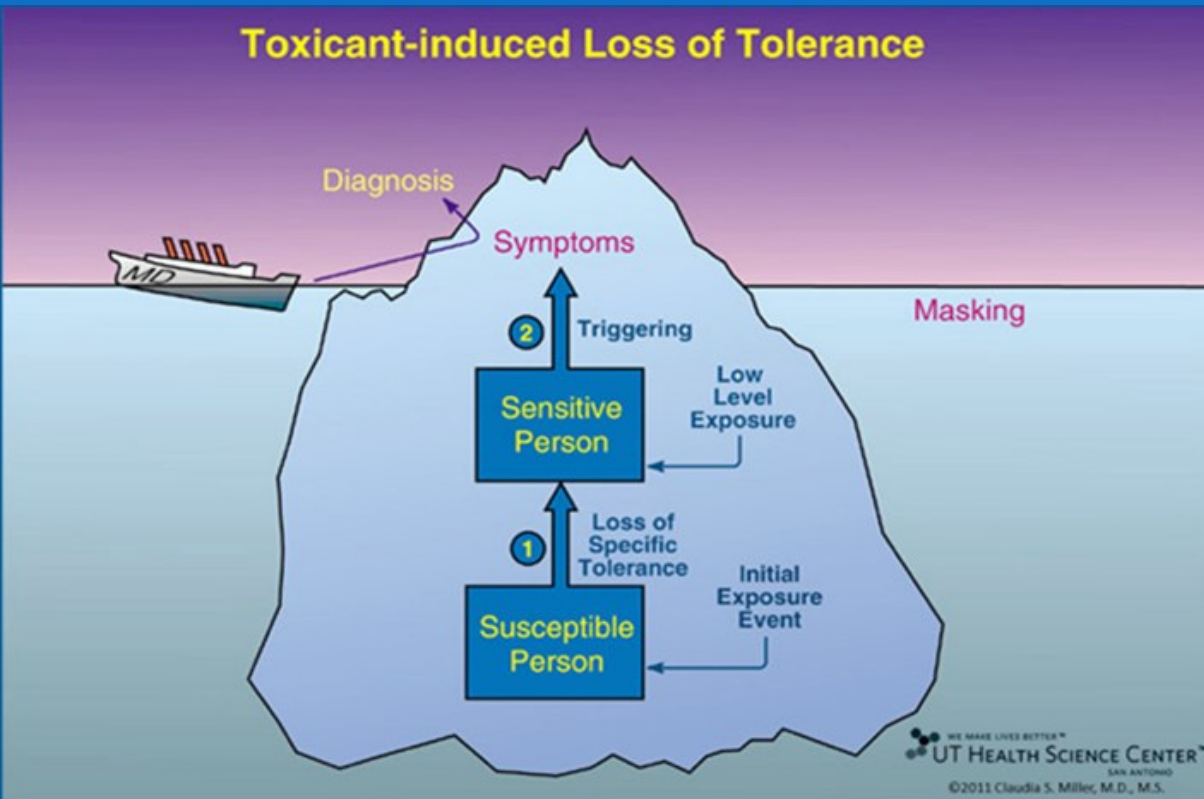
- In this case, certain symptom severities did not change: GI, GU, SKIN, MS, and NM before and after the exposure event or intervention.
- This suggests that these symptoms were not affected by the house or the intervention.
- Clients/patients feel better understood and can readily communicate this visual information to their families, doctors, and contractors.

TILT = Toxicant-Induced Loss of Tolerance

TILT has two stages

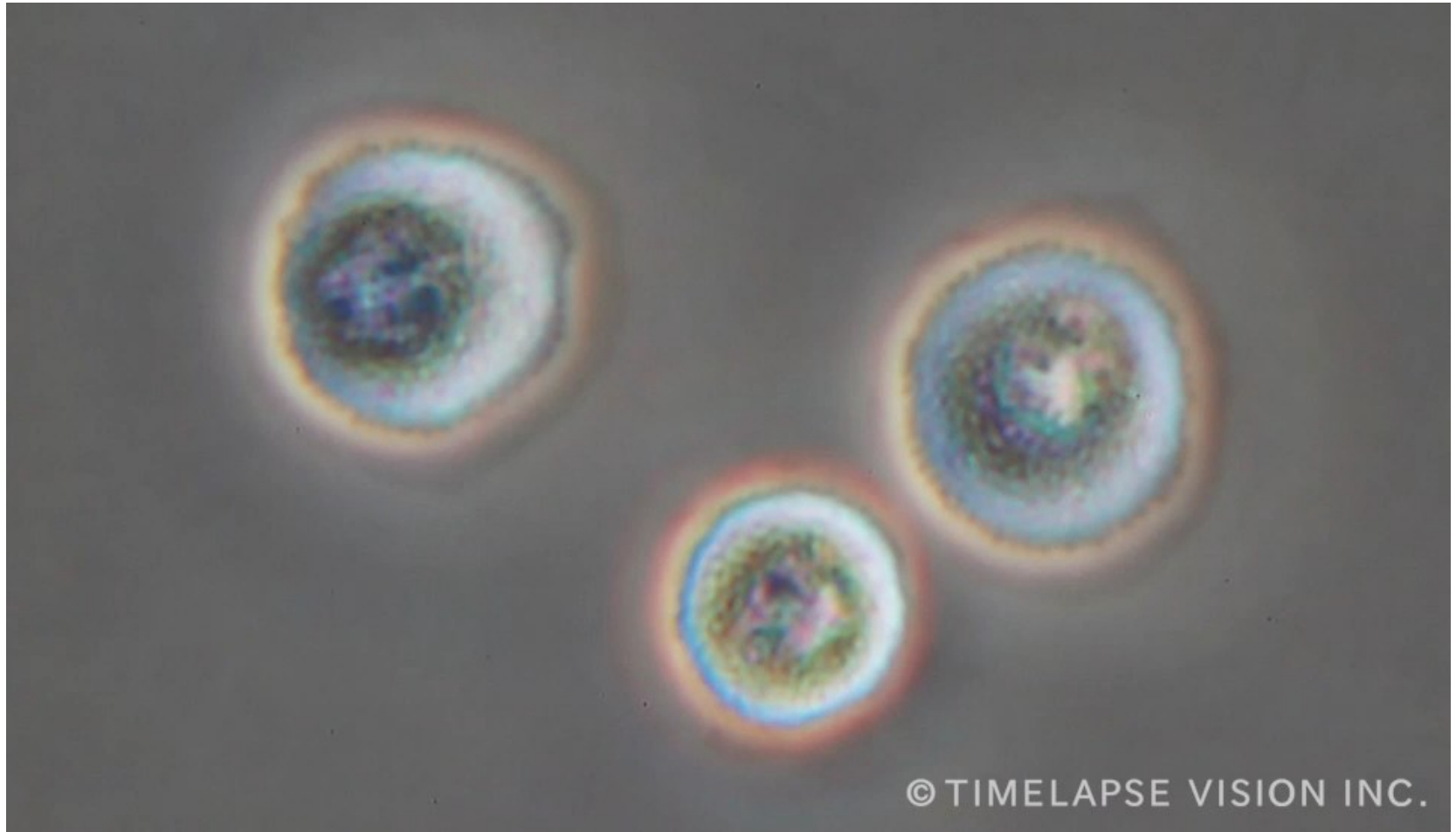
1. **Initiation** by acute exposure or repeated lower-level exposures
2. **Triggering** by previously tolerated chemicals, foods, or drugs

“Masking” hides the relationship between exposures and symptoms



**Next, Dr. Miller will discuss the
biological mechanism underlying
Toxicant-Induced Loss of Tolerance
(TILT)**

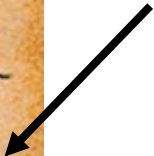
Mast Cell Degranulation



Paul Ehrlich



A couple of
“mast cells”
as described
by Ehrlich



Evolution of Mast Cells and TILT

Years Ago	Event
500,000,000	Mast cells developed in vertebrate fish.
250,000,000	Olfactory-limbic system evolved in first mammals.
300,000	<i>Homo sapiens</i> appeared.
300	Industrial Revolution (1760-1840) coal, natural gas, oil
150	Freud diagnosed “hysteria.”
<100	Synthetic organic chemical production began and grew exponentially after WWII (1939-1945): pesticides, plastics, synthetic drugs (including psychiatric medications), and food additives.

A controlled comparison of symptoms and chemical intolerances reported by Gulf War veterans, implant recipients and controls

(After Miller & Prihoda, Tox Ind Health (1999b) 15:386-397)

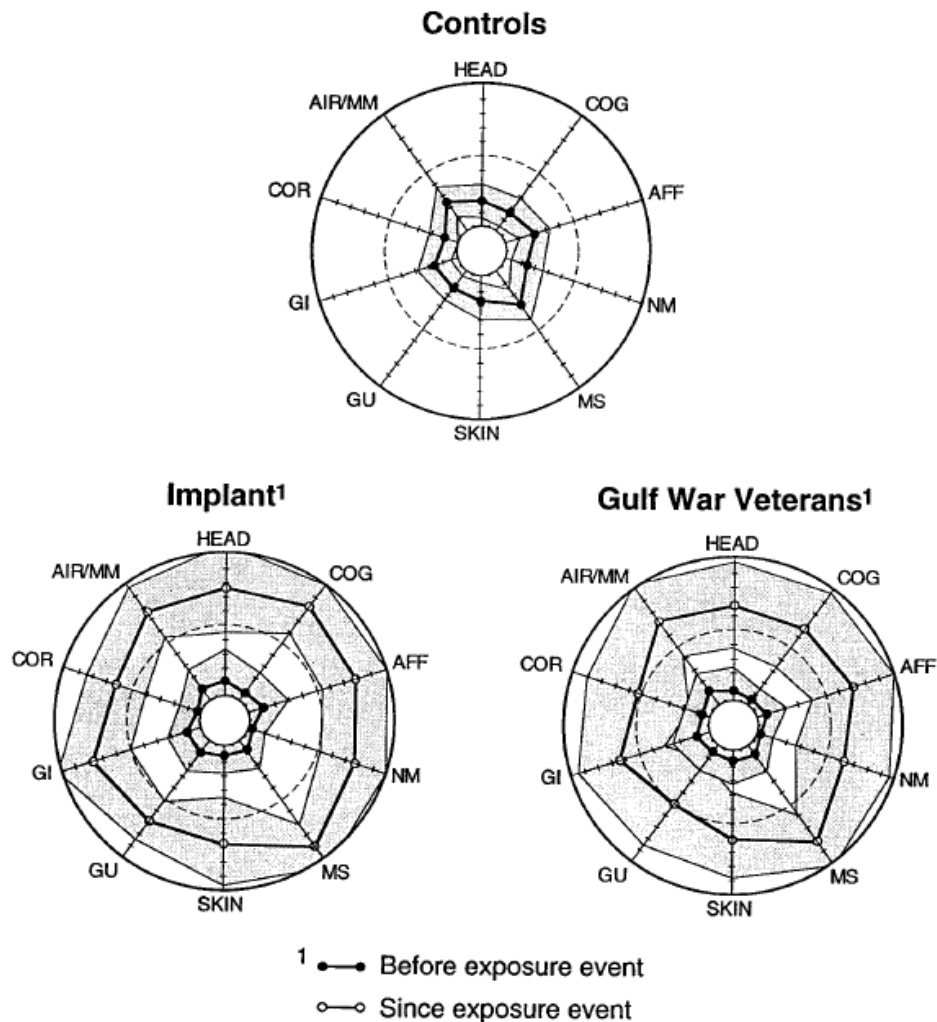


Figure 1. Mean scores on symptom items for each group plotted on the QEESI target diagram. Shaded areas depict ± 1 standard deviation for each symptom measured. HEAD=head-related symptoms, COG=cognitive symptoms, AFF= affective symptoms, NM=neuromuscular symptoms, MS=musculoskeletal symptoms, SKIN=skin-related symptoms, GU=genitourinary symptoms, GI=gastrointestinal symptoms, COR=heart/chest-related symptoms, AIR/MM=airway or mucous membrane-related symptoms.

Chemical Intolerances Attributed to Pesticide Exposure Versus Remodeling

(After Miller & Mitzel March/April 1995 Vol. 50 No.2)

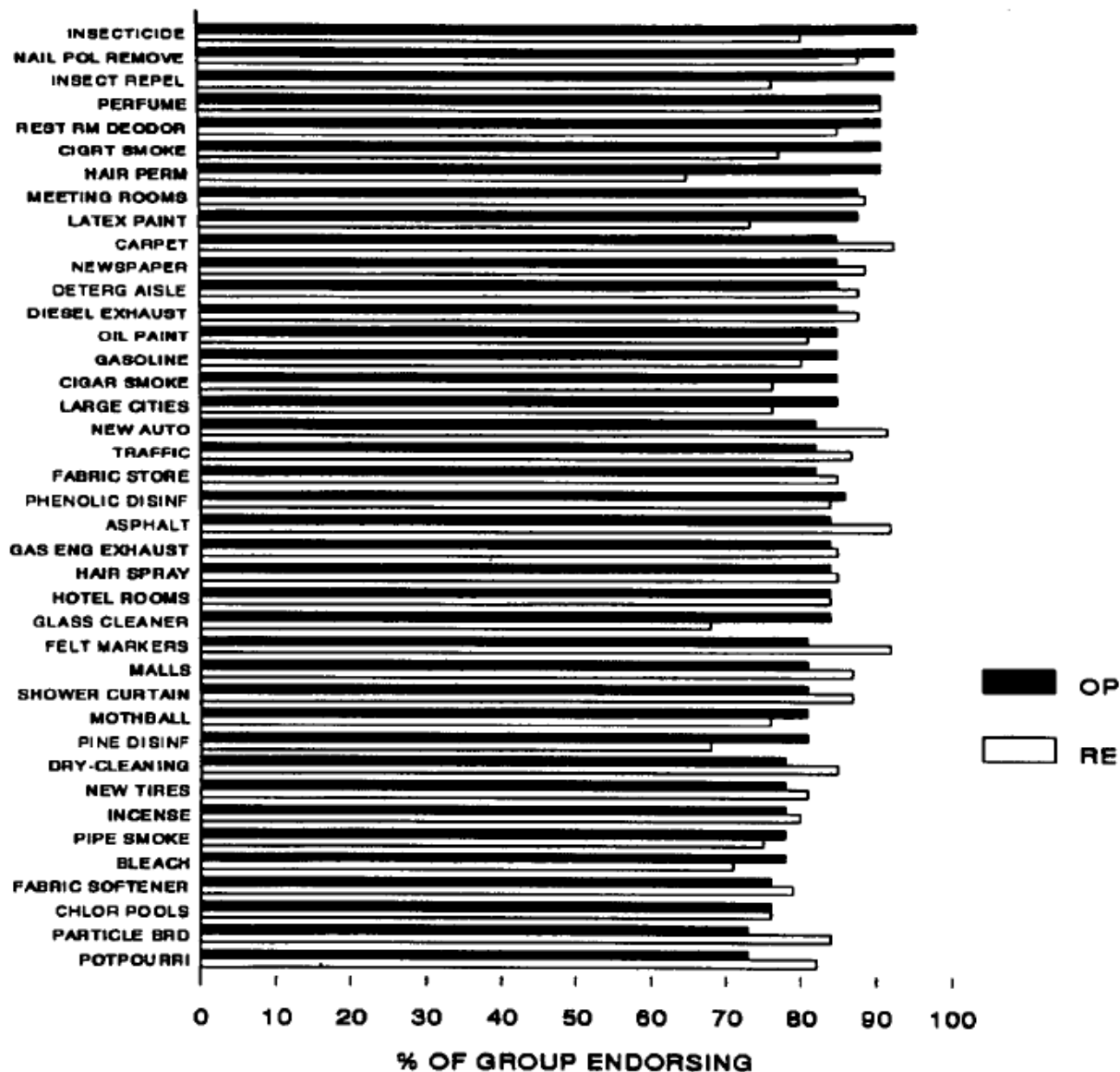


Fig. 1. Organophosphate-exposed (OP) versus remodeling-exposed (RE): comparison of endorsement rates for inhalant items. Items shown were endorsed by more than 75% of the 112 survey respondents.

Food/Ingestant Intolerances Attributed to Pesticide Exposure Versus Remodeling

(After Miller & Mitzel March/April 1995 Vol. 50 No.2)

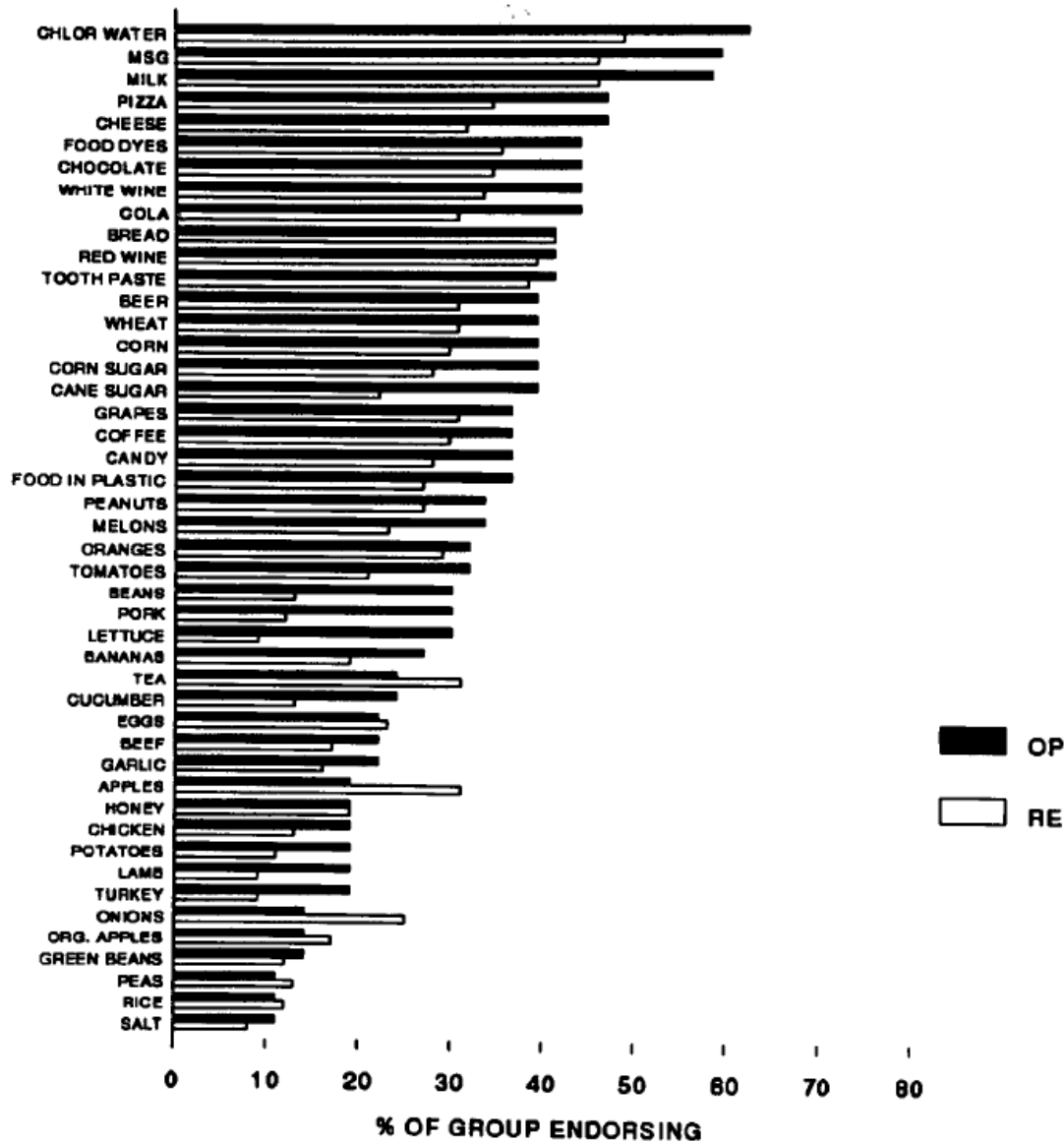
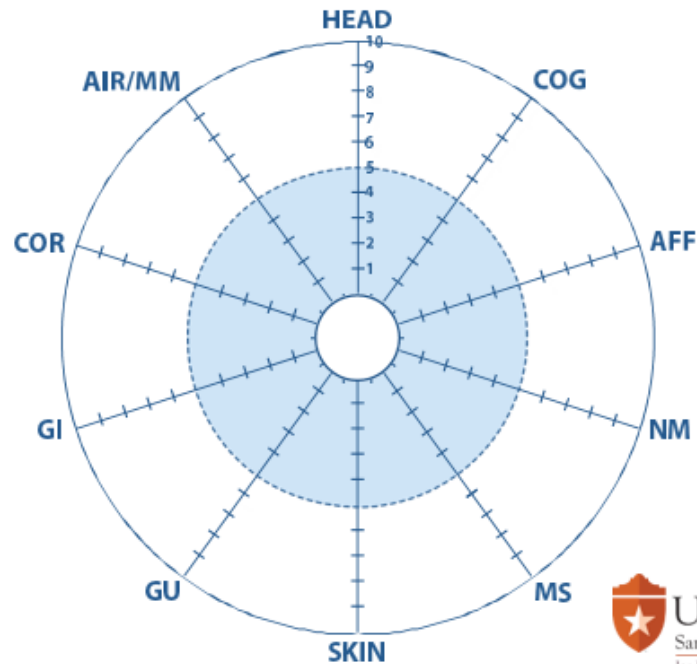


Fig. 2. Organophosphate-exposed (OP) versus remodeling-exposed (RE): comparison of endorsement rates for all ingestant items.

TILT Self-Assessment

TILT (Toxicant-Induced Loss of Tolerance) Self-Assessment[©]

1. The QEESI (Quick Environmental Exposure and Sensitivity Inventory) and Symptom Star
2. Brief Exposure History



For individual use, the TILT Self-Assessment is available at TILTResearch.org at no cost.

For commercial use, contact:
Claudia S. Miller, MD, MS
President and Founder
The TILT Research Foundation
MillerCS1212@gmail.com

Chemical, Food, and Drug Intolerances: Self-Assessment

Over the last decade, peer-reviewed research has linked a wide variety of medically unexplained symptoms and syndromes with exposures to chemicals, foods, and drugs. Identifying and understanding potential connections between symptoms and exposures are crucial for diagnosis, prevention, and treatment. We encourage you to print and complete this Self-Assessment, share it with your doctors, and ask that it be placed in your medical record.

- The **QEESI** (Quick Environmental Exposure and Sensitivity Inventory) is an internationally validated questionnaire with 50 questions to identify specific chemical, food, and drug intolerances as well as symptoms and life impact. The purpose of this questionnaire is to help identify health problems you may be having and to understand your responses to various exposures.
- The **QEESI Symptom Star** is a useful visual diagram that shows how your symptoms may have changed over time.
- The **Brief Exposure History** includes 7 questions to help document specific exposures that may have initiated or may trigger your symptoms.

Instructions:

- First, fill out the QEESI. This may take you 10 to 20 minutes.
- Next, plot your symptom severity scores on the QEESI Symptom Star. Instructions will be provided.
- Complete the Brief Exposure History.

1. Quick Environmental Exposure and Sensitivity Inventory (QEESI)[®]

Answer all questions in each section: Chemical Exposures, Other Exposures, Symptoms, Masking Index, and Impact of Sensitivities. Then total your scores. Finally, plot your symptom severity scores on the QEESI Symptom Star (example and worksheet provided).

Chemical Exposures

The following items ask about your responses to various odors or chemical exposures. Please indicate whether or not these odors or exposures would make you feel sick, for example, you would get a headache, have difficulty thinking, feel weak, have trouble breathing, get an upset stomach, feel dizzy, or something like that. For any exposure that makes you feel sick, on a 0-10 scale rate the severity of your symptoms with that exposure. For exposures that do not bother you, answer "0." Do not leave any items blank.

For each item, circle one number only:

[0 = not at all a problem] [5 = moderate symptoms] [10 = disabling symptoms]

1.	Diesel or gas engine exhaust	0 1 2 3 4 5 6 7 8 9 10
2.	Tobacco smoke	0 1 2 3 4 5 6 7 8 9 10
3.	Insecticide	0 1 2 3 4 5 6 7 8 9 10
4.	Gasoline, for example at a service station while filling the gas tank	0 1 2 3 4 5 6 7 8 9 10
5.	Paint or paint thinner	0 1 2 3 4 5 6 7 8 9 10
6.	Cleaning products such as disinfectants, bleach, bathroom cleansers or floor cleaners	0 1 2 3 4 5 6 7 8 9 10
7.	Certain perfumes, air fresheners or other fragrances	0 1 2 3 4 5 6 7 8 9 10
8.	Fresh tar or asphalt	0 1 2 3 4 5 6 7 8 9 10
9.	Nailpolish, nailpolish remover, or hairspray	0 1 2 3 4 5 6 7 8 9 10
10.	New furnishings such as new carpeting, a new soft plastic shower curtain or the interior of a new car	0 1 2 3 4 5 6 7 8 9 10

Total Chemical Intolerance Score (0-100):

Name any additional chemical exposures that make you feel ill and score them from 0 to 10:

Other Exposures

The following items ask about your responses to a variety of other exposures. As before, please indicate whether these exposures would make you feel sick. Rate the severity of your symptoms on a 0-10 scale. Do not leave any items blank.

For each item, circle one number only:

[0 = not at all a problem] [5 = moderate symptoms] [10 = disabling symptoms]

1.	Chlorinated tap water	0 1 2 3 4 5 6 7 8 9 10
2.	Particular foods, such as candy, pizza, milk, fatty foods, meats, barbecue, onions, garlic, spicy foods, or food additives such as MSG	0 1 2 3 4 5 6 7 8 9 10
3.	Unusual cravings, or eating any foods as though you were addicted to them; or feeling ill if you miss a meal	0 1 2 3 4 5 6 7 8 9 10
4.	Feeling ill after meals	0 1 2 3 4 5 6 7 8 9 10
5.	Caffeine, such as coffee, tea, Snapple, cola drinks, Big Red, Dr. Pepper or Mountain Dew, or chocolate	0 1 2 3 4 5 6 7 8 9 10
6.	Feeling ill if you drink or eat less than your usual amount of coffee, tea, caffeinated soda or chocolate, or miss it altogether	0 1 2 3 4 5 6 7 8 9 10
7.	Alcoholic beverages in small amounts such as one beer or a glass of wine	0 1 2 3 4 5 6 7 8 9 10
8.	Fabrics, metal jewelry, creams, cosmetics, or other items that touch your skin	0 1 2 3 4 5 6 7 8 9 10
9.	Being unable to tolerate or having adverse or allergic reactions to any drugs or medications (such as antibiotics, anesthetics, pain relievers, x-ray contrast dye, vaccines or birth control pills), or to an implant, prosthesis, contraceptive chemical or device, or other medical, surgical or dental material or procedure	0 1 2 3 4 5 6 7 8 9 10
10.	Problems with any classical allergic reactions (asthma, nasal symptoms, hives, anaphylaxis or eczema) when exposed to allergens such as: tree, grass or weed pollen, dust, mold, animal dander, insect stings or particular foods	0 1 2 3 4 5 6 7 8 9 10

Total Other Intolerance Score (0-100):

Symptoms

The following questions ask about symptoms you may have experienced commonly. Rate the severity of your symptoms on a 0-10 scale. Do not leave any items blank.

For each item, circle one number only:

[0 = not at all a problem] [5 = moderate symptoms] [10 = disabling symptoms]

1.	Problems with your muscles or joints such as pain, aching, cramping, stiffness or weakness?	MS 0 1 2 3 4 5 6 7 8 9 10
2.	Problems with burning or irritation of your eyes, or problems with your airway or breathing, such as feeling short of breath, coughing, or having a lot of mucus, post-nasal drainage, or respiratory infections?	AIR/MM 0 1 2 3 4 5 6 7 8 9 10
3.	Problems with your heart or chest, such as a fast or irregular heart rate, skipped beats, your heart pounding, or chest discomfort?	COR 0 1 2 3 4 5 6 7 8 9 10
4.	Problems with your stomach or digestive tract, such as abdominal pain or cramping, abdominal swelling or bloating, nausea, diarrhea, or constipation?	GI 0 1 2 3 4 5 6 7 8 9 10
5.	Problems with your ability to think, such as difficulty concentrating or remembering things, feeling spacey, or having trouble making decisions?	COG 0 1 2 3 4 5 6 7 8 9 10
6.	Problems with your mood, such as feeling tense or nervous, irritable, depressed, having spells of crying or rage, or loss of motivation to do things that used to interest you?	AFF 0 1 2 3 4 5 6 7 8 9 10
7.	Problems with balance or coordination, with numbness or tingling in your extremities, or with focusing your eyes?	NM 0 1 2 3 4 5 6 7 8 9 10
8.	Problems with your head, such as headaches or feeling pressure or fullness in your face or head?	HEAD 0 1 2 3 4 5 6 7 8 9 10
9.	Problems with your skin, such as rash, itching, or dry skin?	SKIN 0 1 2 3 4 5 6 7 8 9 10
10.	Problems with your urinary tract or genitals, such as pelvic pain or frequent or urgent urination? (For women: or discomfort or other problems with your menstrual period?)	GU 0 1 2 3 4 5 6 7 8 9 10

Total Symptom Score (0-100):

Masking Index

The following items refer to ongoing exposures you may be having. Circle "0" if the answer is "NO," or if you don't know whether you have the exposure. Circle "1" if the answer is "YES," you do have the exposure. Do not leave any items blank.

Circle "0" or "1" only:

1.	Do you smoke, vape, or dip tobacco once a week or more often?	NO=0 YES=1
2.	Do you drink any alcoholic beverages, beer, or wine once a week or more often?	NO=0 YES=1
3.	Do you consume any caffeinated beverages once a week or more often?	NO=0 YES=1
4.	Are you routinely (once a week or more often) exposed to perfume, hairspray, "air fresheners," or other scented products?	NO=0 YES=1
5.	Has either your home or your workplace been sprayed for insects or fumigated in the past year?	NO=0 YES=1
6.	In your current job or hobby, are you routinely (once a week or more often) exposed to any chemicals, smoke or fumes?	NO=0 YES=1
7.	Other than yourself, does anyone routinely smoke inside your home?	NO=0 YES=1
8.	Is either a gas or propane stove used for cooking in your home?	NO=0 YES=1
9.	Is a scented fabric softener (liquid or dryer sheet) routinely used in laundering your clothes or bedding?	NO=0 YES=1
10.	Do you routinely (once a week or more often) take any of the following: steroid pills, such as prednisone; pain medications requiring a prescription; medications for depression, anxiety, or mood disorders; medications for sleep; or recreational or street drugs?	NO=0 YES=1

Masking Index (0-10): (Total number of YES answers)

Impact of Sensitivities

If you are sensitive to certain chemicals or foods, on a scale of 0-10 rate the degree to which your sensitivities have affected various aspects of your life. If you are not sensitive or if your sensitivities do not affect these aspects of your life, answer "0." Do not leave any items blank.

How much have your sensitivities affected:

[0 = not at all] [5 = moderately] [10 = severely]

1.	Your diet?	0	1	2	3	4	5	6	7	8	9	10
2.	Your ability to work or go to school?	0	1	2	3	4	5	6	7	8	9	10
3.	How you furnish your home?	0	1	2	3	4	5	6	7	8	9	10
4.	Your choice of clothing?	0	1	2	3	4	5	6	7	8	9	10
5.	Your ability to travel to other cities or drive a car?	0	1	2	3	4	5	6	7	8	9	10
6.	Your choice of personal care products, such as deodorants or makeup?	0	1	2	3	4	5	6	7	8	9	10
7.	Your ability to be around others and enjoy social activities, for example, going to meetings, church, restaurants, etc.?	0	1	2	3	4	5	6	7	8	9	10
8.	Your choice of hobbies or recreation?	0	1	2	3	4	5	6	7	8	9	10
9.	Your relationship with your spouse or family?	0	1	2	3	4	5	6	7	8	9	10
10.	Your ability to clean your home, iron, mow the lawn, or perform other routine chores?	0	1	2	3	4	5	6	7	8	9	10

Total Life Impact Score (0-100):

Symptom Star Worksheet

Now take time to plot your QEESI Symptom Star(s). The Symptom Star(s) provide a useful visual diagram showing how your symptoms may have changed over time. We recommend plotting your symptoms 1) before any major exposure event you may have had, and 2) when your symptoms were at their worst or how they are now. You may choose to add any other time points such as the severity of your symptoms following a medical, dietary, or environmental intervention (such as prescribed steroids, chemotherapy, military service, an environmental disaster, changing jobs or residences, mold remediation, or stopping smoking).

Symptom severity is rated for each body system on a 0 to 10 scale, with 10 being severe or disabling symptoms.

The example below shows one individual's symptoms before and after a mold exposure.

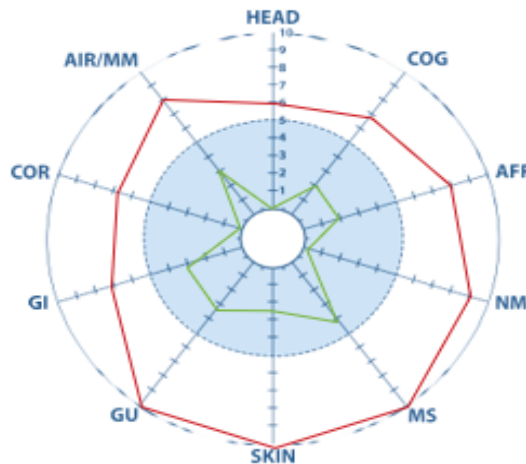
Prior to the exposure (green line), this person recalled having very few symptoms.

After the exposure (red line), he reported severe symptoms in multiple organ systems.

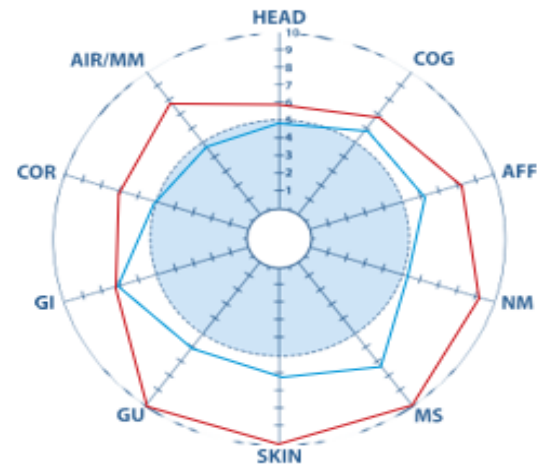
After mold remediation (blue line), symptoms decreased significantly.

Instructions:

Plot the severity of your symptoms on the target diagram by placing a dot on the corresponding line for each symptom item. Connect these dots. Indicate "before" and "after" scores by using different colors or dotted versus solid lines.



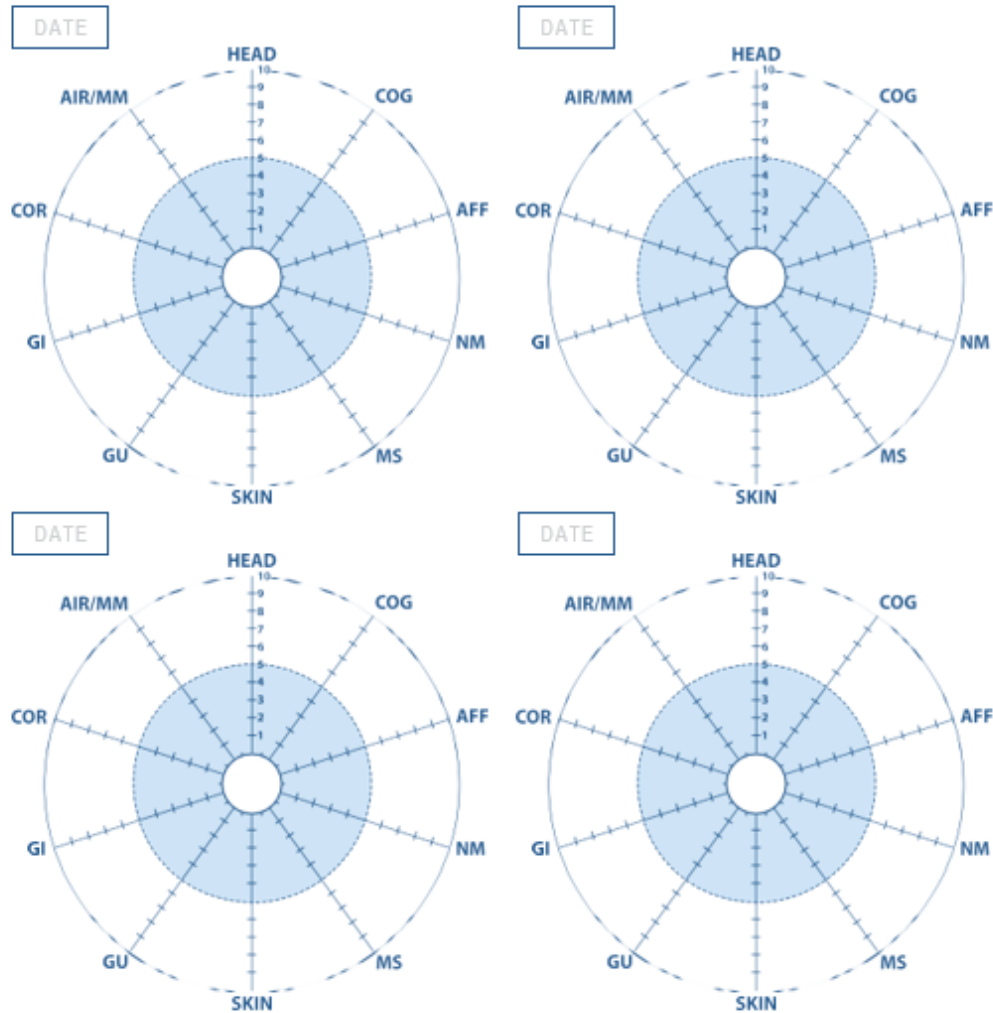
HEAD = Head-related symptoms
COG = Cognitive symptoms
AFF = Affective symptoms
NM = Neuromuscular symptoms
MS = Musculoskeletal symptoms



SKIN = Skin-related symptoms
GU = Genitourinary symptoms
GI = Gastrointestinal symptoms
COR = Heart/chest-related symptoms
AIR/MM = Airway or mucous membrane symptoms

How to create your own QEESI Symptom Stars:

- For best results, we recommend completing the QEESI at least twice. First, document your symptoms when they were at their worst, and then document your symptoms before the exposure event if there was one. Don't forget to provide copies to your doctors for their records.
- You can create additional QEESI Symptom Stars by repeating these steps, for example, if your symptoms have improved due to avoidance or taking medications or if you are feeling better now.



HEAD = Head-related symptoms
COG = Cognitive symptoms
AFF = Affective symptoms
NM = Neuromuscular symptoms
MS = Musculoskeletal symptoms

SKIN = Skin-related symptoms
GU = Genitourinary symptoms
GI = Gastrointestinal symptoms
COR = Heart/chest-related symptoms
AIR/MM = Airway or mucous membrane symptoms

Interpreting the QEESI®

The first criterion to consider is a person's masking index. If it is low—around 0, 1, 2, or 3—that person is chemically susceptible until proven otherwise. They may have been avoiding problem exposures for a long time. In such individuals, special attention should be paid to all remaining masking items such as gas stoves or heaters, caffeine, alcohol, or medications that may be masking their symptoms. The higher an individual's total masking index (0 to 10), the less able they are to identify symptom triggers.

Table 1. Criteria for low, medium, and high scores

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

How to calculate the Total Chemical Intolerance Score (0-100)

The Chemical Exposures Scale consists of ten structurally diverse substances for which individuals rate the severity of their symptoms with each exposure on a 0 to 10 scale. The **Total Chemical Intolerance Score** is the sum of the severities for all ten items.

For example, this individual's Total Chemical Intolerance Score is 55.

1.	Diesel or gas engine exhaust	0	1	2	3	4	5	6	7	8	9	10
2.	Tobacco smoke	0	1	2	3	4	5	6	7	8	9	10
3.	Insecticide	0	1	2	3	4	5	6	7	8	9	10
4.	Gasoline, for example at a service station while filling the gas tank	0	1	2	3	4	5	6	7	8	9	10
5.	Paint or paint thinner	0	1	2	3	4	5	6	7	8	9	10
6.	Cleaning products such as disinfectants, bleach, bathroom cleansers or floor cleaners	0	1	2	3	4	5	6	7	8	9	10
7.	Certain perfumes, air fresheners or other fragrances	0	1	2	3	4	5	6	7	8	9	10
8.	Fresh tar or asphalt	0	1	2	3	4	5	6	7	8	9	10
9.	Nailpolish, nailpolish remover, or hairspray	0	1	2	3	4	5	6	7	8	9	10
10.	New furnishings such as new carpeting, a new soft plastic shower curtain or the interior of a new car	0	1	2	3	4	5	6	7	8	9	10

Total Chemical Intolerance Score (0-100):

55

2. Brief Exposure History

Doctors have limited time to spend with each patient, so it is helpful to keep your history concise but complete.

1. Did you become ill after a particular exposure event?

Yes No ----> skip to question #7

2. If yes, what was the exposure(s)?

3. When did the exposure occur?

4. What symptoms did you experience at that time?

5. Were any other people or animals exposed?

a) If so, who?

b) What symptoms or problems, if any, did they develop?

6. Describe how your symptoms have changed since the exposure (if at all).

7. Do your symptoms change (get better or get worse) when you are away from your usual environment, for example, you go on vacation, stay in a different house, or work at a different job?

Are there other details you think are important? (Complete on additional page, if necessary.)

Research

Cite this article: Perales RB, Palmer RF, Rincon R, Viramontes JN, Walker T, Jaén CR, Miller CS. (2022) Does improving indoor air quality lessen symptoms associated with chemical intolerance? *Primary Health Care Research & Development* **23**(e3): 1–12. doi: [10.1017/S1463423621000864](https://doi.org/10.1017/S1463423621000864)

Received: 10 August 2021

Revised: 12 October 2021

Accepted: 22 November 2021


Key words:

chemical intolerance; environmental house calls; indoor air quality; volatile organic compounds

Author for correspondence:

Dr Raymond F. Palmer, Department of Family and Community Medicine, Hoffman TILT Program, University of Texas Health Science Center, San Antonio, USA.
E-mail: palmerr@uthscsa.edu

Does improving indoor air quality lessen symptoms associated with chemical intolerance?

Roger B. Perales, Raymond F. Palmer , Rudy Rincon, Jacqueline N. Viramontes, Tatjana Walker, Carlos R. Jaén and Claudia S. Miller

Department of Family and Community Medicine, Hoffman TILT Program, University of Texas Health Science Center, San Antonio, USA

Abstract

Aim: To determine whether environmental house calls that improved indoor air quality (IAQ) is effective in reducing symptoms of chemical intolerance (CI). **Background:** Prevalence of CI is increasing worldwide. Those affected typically report symptoms such as headaches, fatigue, ‘brain fog’, and gastrointestinal problems – common primary care complaints. Substantial evidence suggests that improving IAQ may be helpful in reducing symptoms associated with CI. **Methods:** Primary care clinic patients were invited to participate in a series of structured environmental house calls (EHCs). To qualify, participants were assessed for CI with the Quick Environmental Exposure and Sensitivity Inventory. Those with CI volunteered to allow the EHC team to visit their homes to collect air samples for volatile organic compounds (VOCs). Initial and post-intervention IAQ sampling was analyzed by an independent lab to determine VOC levels (ng/L). The team discussed indoor air exposures, their health effects, and provided guidance for reducing exposures. **Findings:** Homes where recommendations were followed showed the greatest improvements in IAQ. The improvements were based upon decreased airborne VOCs associated with reduced use of cleaning chemicals, personal care products, and fragrances, and reduction in the index patients’ symptoms. Symptom improvement generally was not reported among those whose homes showed no VOC improvement.

Research

Cite this article: Rincón R, Perales R, Palmer RF, Forster JF, Hernandez JF, Bayles B, Grimes C, Jaén CR, Miller CS. (2024) Environmental house calls can reduce symptoms of chemical intolerance: a demonstration of personalized exposure medicine. *Primary Health Care Research & Development* 00(00): xx. doi: [10.1017/S146342362400046X](https://doi.org/10.1017/S146342362400046X)

Received: 16 February 2023
Revised: 30 January 2024
Accepted: 1 August 2024






Keywords:

Fragrances; mast cells; mould; indoor air; volatile organic compounds; toxicant-induced loss of tolerance; sick building syndrome; medically unexplained symptoms; quick environmental exposure and sensitivity inventory; natural gas

Abbreviations:

Quick Environmental Exposure and Sensitivity Inventory, QEESI; Volatile Organic Compounds (VOCs); Indoor Air Quality (IAQ); Toxicant-Induced Loss of Tolerance (TILT); Medically Unexplained Symptoms (MUS); Sick Building Syndrome (SBS)

Environmental house calls can reduce symptoms of chemical intolerance: a demonstration of personalized exposure medicine

Rodolfo Rincón¹, Roger Perales¹, Raymond F. Palmer¹ , Jackie F. Forster¹, Jessica F. Hernandez¹ , Bryan Bayles² , Carl Grimes³ , Carlos R. Jaén¹  and Claudia S. Miller¹

¹Department of Family and Community Medicine, University of Texas Health Science Center San Antonio, San Antonio, TX, USA; ²Department of Life Sciences, Texas A&M University-San Antonio, San Antonio, TX, USA and ³Hayward Score, Carmel, CA 93921, USA

Abstract

Aim: The goals of this investigation were to 1) identify and measure exposures inside homes of individuals with chemical intolerance (CI), 2) provide guidance for reducing these exposures, and 3) determine whether our environmental house calls (EHCs) intervention could reduce both symptoms and measured levels of indoor air contaminants. **Background:** CI is an international public health and clinical concern, but few resources are available to address patients' often disabling symptoms. Numerous studies show that levels of indoor air pollutants can be two to five (or more) times higher than outdoor levels. Fragranced consumer products, including cleaning supplies, air fresheners, and personal care products, are symptom triggers commonly reported by susceptible individuals. **Methods:** A team of professionals trained and led by a physician/industrial hygienist and a certified indoor air quality specialist conducted a series of 5 structured EHCs in 37 homes of patients reporting CI. **Results:** We report three case studies demonstrating that an appropriately structured home intervention can teach occupants how to reduce indoor air exposures and associated symptoms. Symptom improvement, documented using the Quick Environmental Exposure and Sensitivity Inventory Symptom Star, corresponded with the reduction of indoor air volatile organic compounds, most notably

Case #1

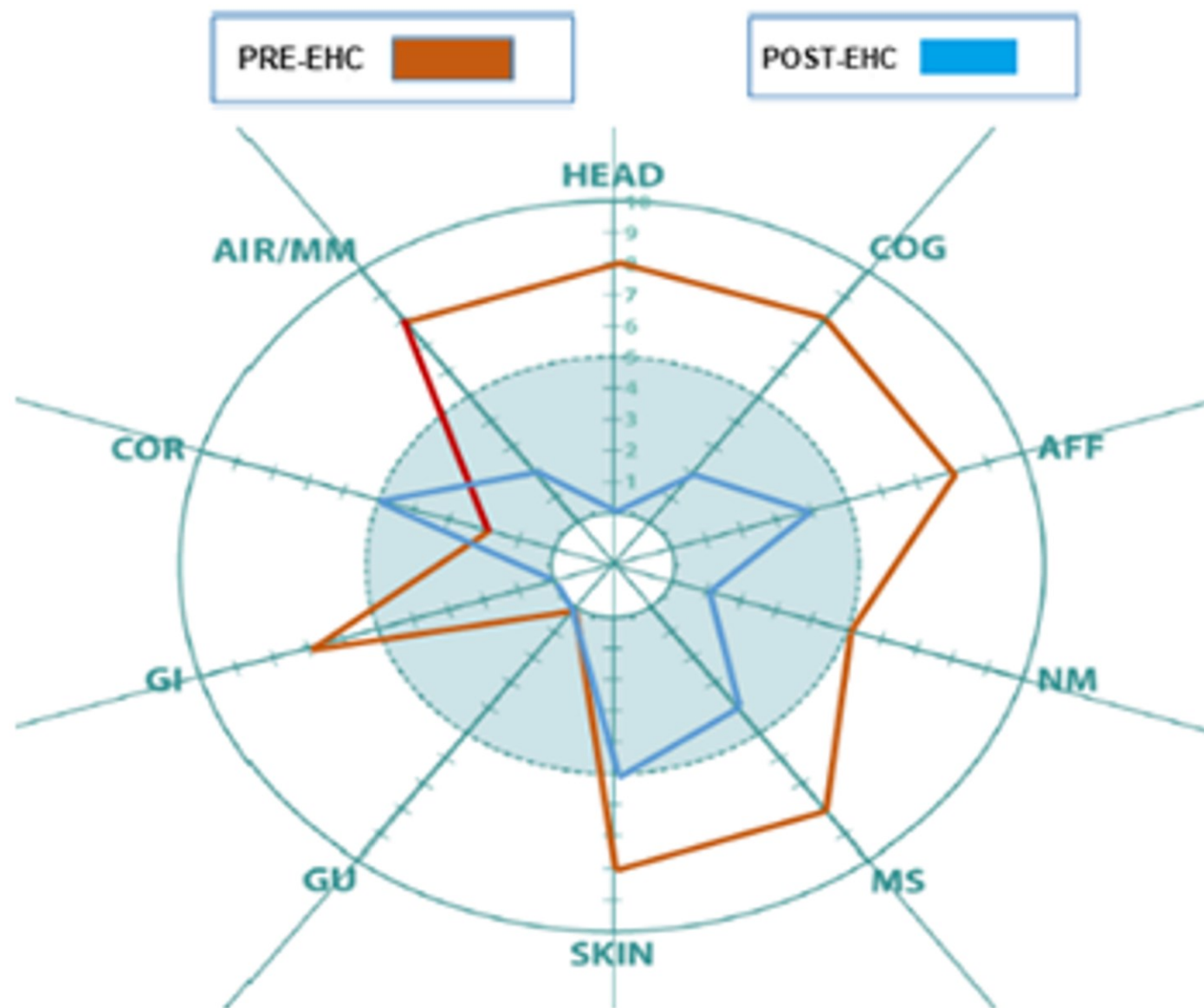
A 68-year-old female who worked as a house cleaner for 16 years reported progressively worsening symptoms, including headaches, abdominal pain and cramping, memory difficulties, fatigue, coughing spells, throat irritation, watery eyes, and joint and muscle pains when exposed to multiple scented cleaners she used at work. She also developed intolerances for combustion products including smoke from cigarettes and from cooking and grilling. She said that her exposures led to depression, irritability, and worsening headaches, cognitive, and respiratory symptoms. Ultimately, her symptoms forced her to leave her job.

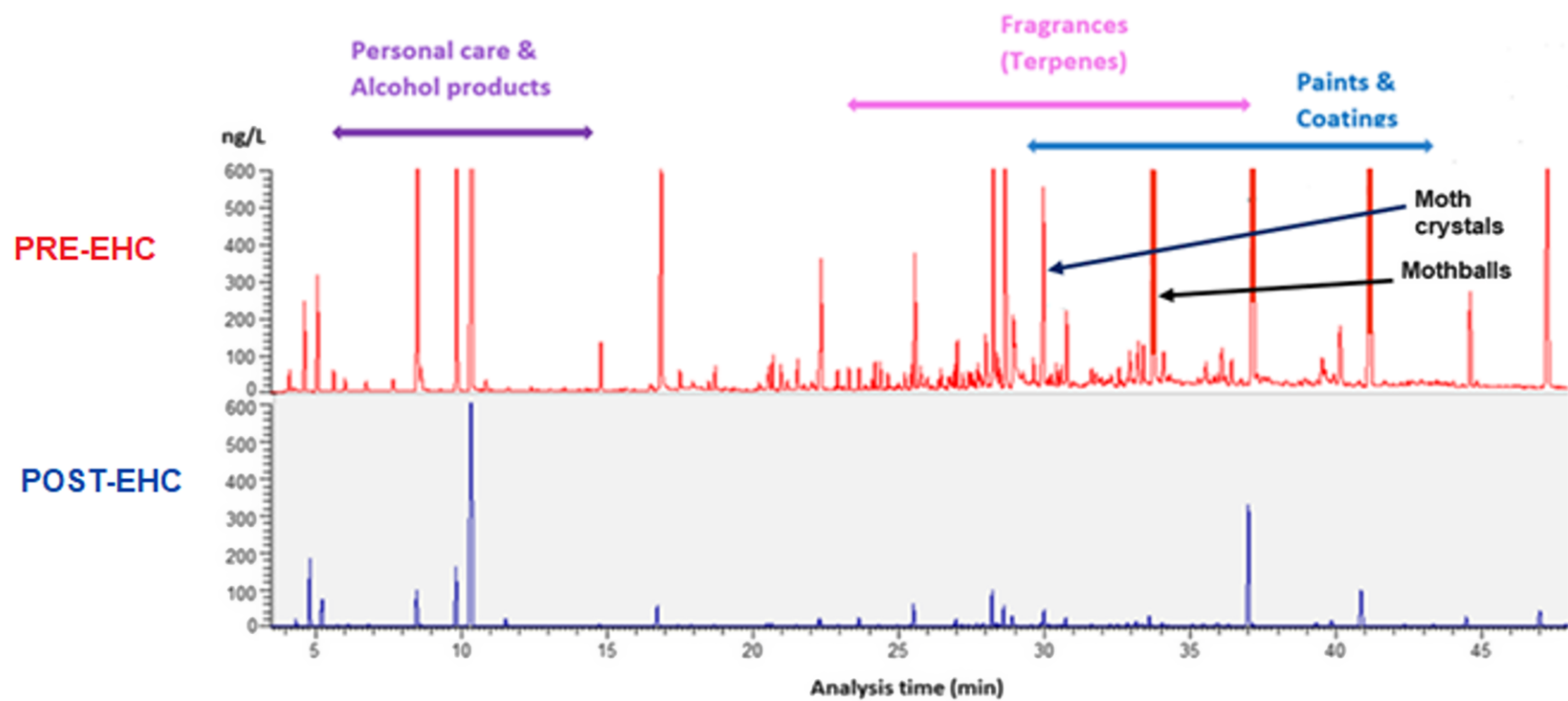
Pre-EHC observations

Multiple scented cleaning and personal care products were observed throughout the home. Candles were present in the bedrooms and living room. Mothballs were found in a closet.

Intervention

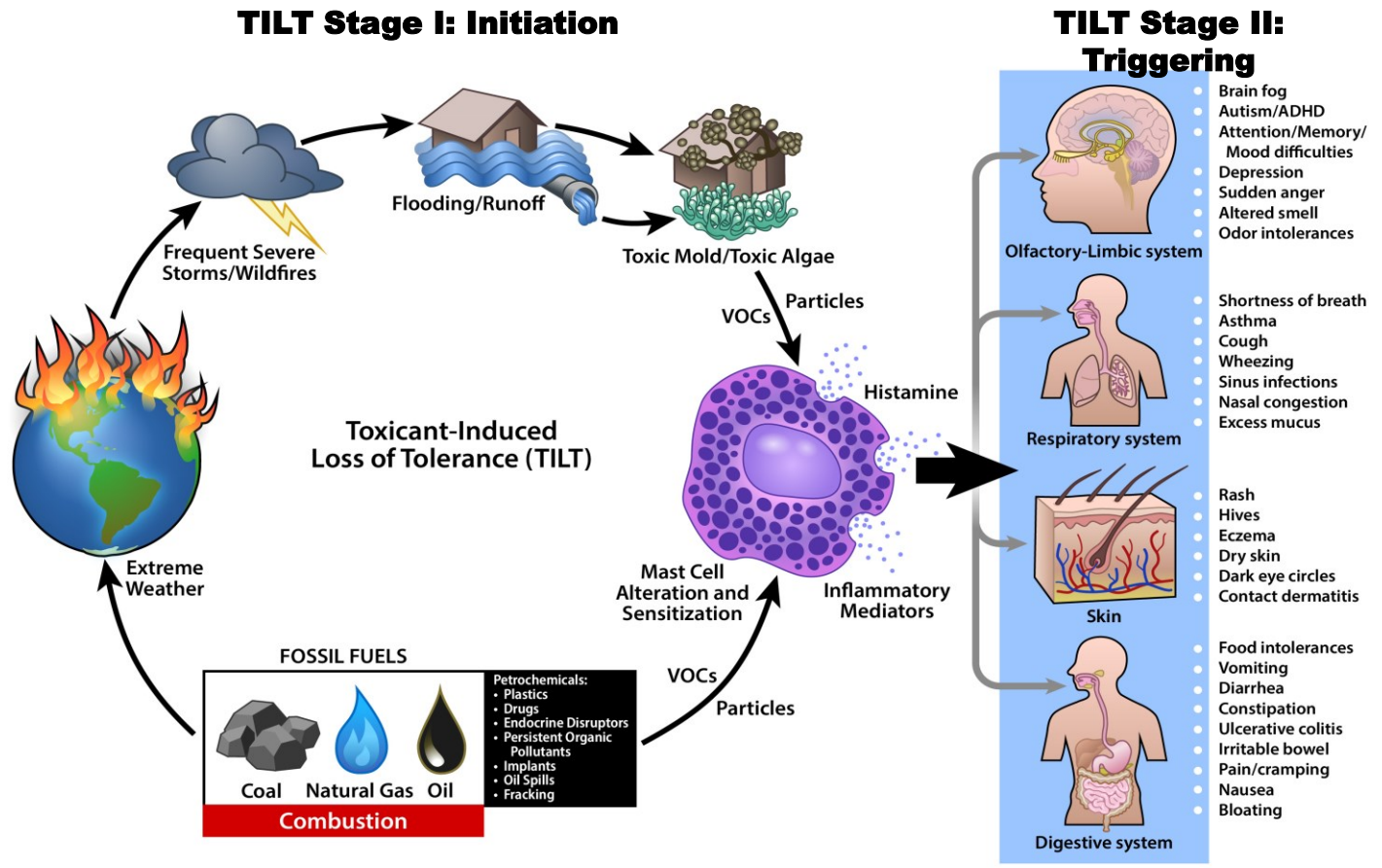
A detailed action plan was developed and discussed during the third visit, which included a targeted education session designed to help reduce sources of VOCs and eliminate mothballs. During the fourth visit, a second walkthrough and follow-up air sampling were conducted. The QEESI was also re-administered in order to document any changes in symptom severity.





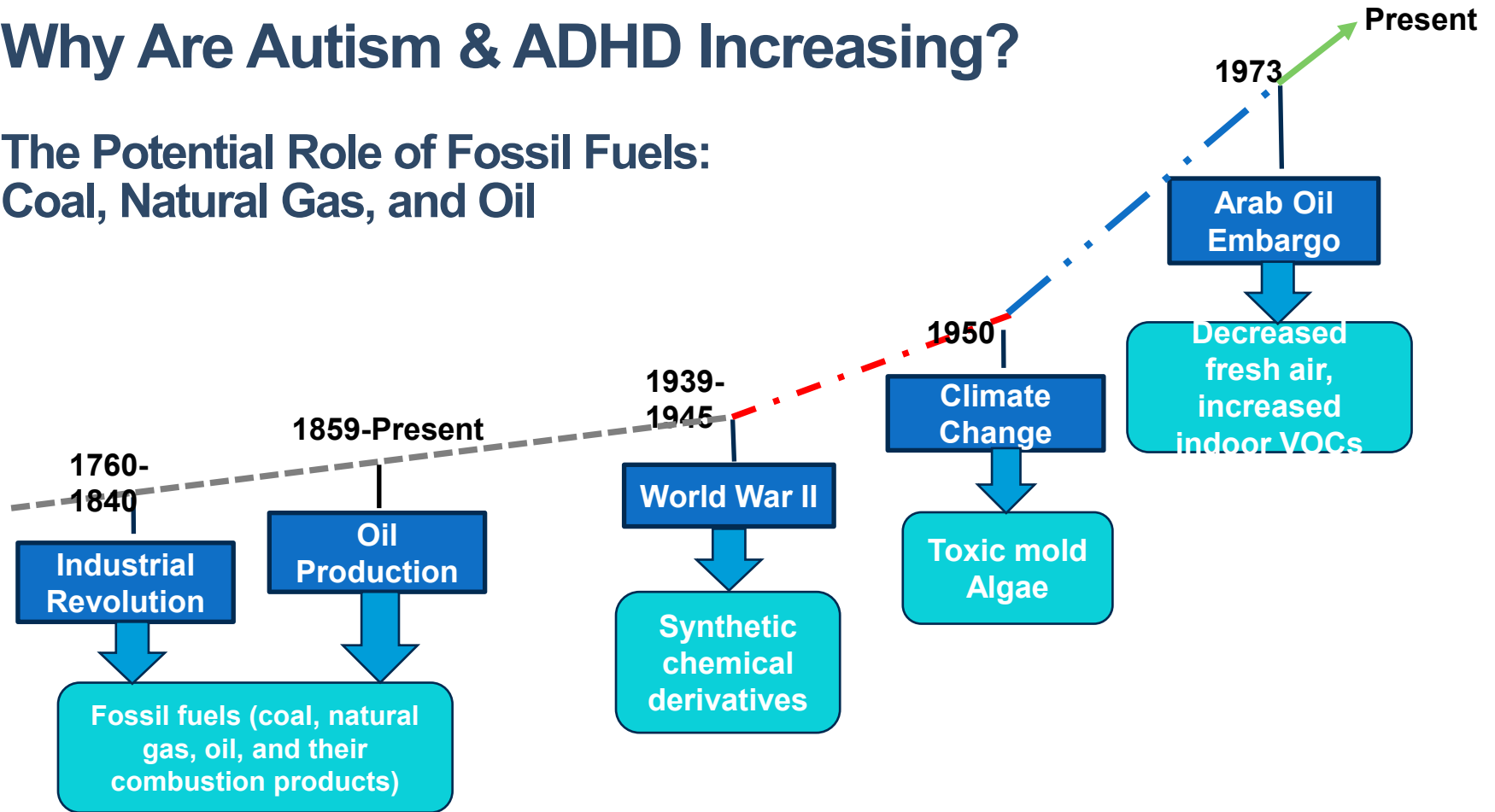


The two stages of TILT



Why Are Autism & ADHD Increasing?

The Potential Role of Fossil Fuels: Coal, Natural Gas, and Oil



This illustration is copyrighted and available at: TILTResearch.org

REFERENCES

SLIDE 11

Miller, C.S. (1996). Chemical sensitivity: symptom, syndrome or mechanism for disease? *Toxicology* 111, 69–86.
[https://doi.org/10.1016/0300-483X\(96\)03393-8](https://doi.org/10.1016/0300-483X(96)03393-8)

Miller, C.S. (1997). Toxicant-induced loss of tolerance—an emerging theory of disease? *Environmental Health Perspectives* 105, 445–453.
<https://doi.org/10.1289/ehp.97105s24>

SLIDES 13

Miller, C.S., Palmer, R.F., Dempsey, T.T. et al. (2021). Mast cell activation may explain many cases of chemical intolerance. *Environ Sci Eur* 33, 129 <https://doi.org/10.1186/s12302-021-00570-3>

SLIDES 16-18 & 21-28

Miller, C.S. and Mitzel, H.C. (1995). Chemical sensitivity attributed to pesticide exposure versus remodeling. *Archives of Environmental Health* 50, 119–129. <https://doi.org/10.1080/00039896.1995.9940889>

Miller, C.S., & Prihoda, T.J. (1999a). The Environmental Exposure and Sensitivity Inventory (EESI): a standardized approach for measuring chemical intolerances for research and clinical applications. *Toxicology and Industrial Health*, 15(3-4), 370-385.
<https://doi.org/10.1177/074823379901500311>

Miller, C.S., & Prihoda, T.J. (1999b). A controlled comparison of symptoms and chemical intolerances reported by Gulf War veterans, implant recipients and persons with multiple chemical sensitivity. *Toxicology and Industrial Health*, 15(3-4), 386-397.
<https://doi.org/10.1177/074823379901500312>

SLIDE 30

Perales, R.B., Palmer, R.F., Rincon, R., Viramontes, J.N., Walker, T., Jaén, C.R., Miller, C.S. (2022). Does improving indoor air quality lessen symptoms associated with chemical intolerance? *Primary Health Care Research & Development* 23(e3): 1–12.
[doi: https://doi.org/10.1017/S1463423621000864](https://doi.org/10.1017/S1463423621000864)

SLIDE 31

Rincón, R., Perales, R., Palmer, R.F., Forster, J.F., Hernandez, J.F., Bayles, B., Grimes, C., Jaén, C.R., Miller, C.S. (2024). Environmental house calls can reduce symptoms of chemical intolerance: a demonstration of personalized exposure medicine. *Primary Health Care Research & Development* [doi: 10.1017/S146342362400046X](https://doi.org/10.1017/S146342362400046X)

RESOURCES

Hayward Score QEESY & Symptom Star QR



Link: <https://www.haywardscore.com/qeesi-symptom-star/landing-beta>

TILT Self-Assessment QR



Link: <https://tiltresearch.org/wp-content/uploads/sites/231/2025/07/TILT-Self-Assessment-12-4-2024.pdf>

TILT Tutorial for Chemical Intolerance, Autism/ADHD:

<https://tiltresearch.org/wp-content/uploads/sites/231/2024/10/TILT-Tutorial-Autism-ADHD-9-11-2024.pdf>

TILT Tutorial for Exposed Communities and Individuals, Their Doctors, and Public Health Professionals:

<https://tiltresearch.org/wp-content/uploads/sites/231/2024/10/Tutorial-for-Exposed-Communities-and-Individuals-9-11-2024.pdf>

21st Century Building Science

- **Claudia Miller MD**
www.tiltresearch.org
- **Carl Grimes CIEC**
www.haywardscore.com
- **Westford Building
Science Symposium**

August 4-6, 2025

