Chemical Exposures and the Elimination of Toxic Metals from the Human Body

SHEICON 2016
Seeking Health Education Institute
Scottsdale Arizona

Stephen J. Genuis
MD FRCSC DABOG DABEM FAAEM
Clinical Professor
Faculty of Medicine
University of Alberta
Faculty Disclosure

Dr. Stephen J Genuis

- Relationship with commercial interests - None
- Disclosure of Commercial Support – None
- Mitigating Potential Bias – None
- Conflict of interest – None
DISCLAIMER: THIS PRESENTATION DOES NOT PROVIDE MEDICAL ADVICE

The information, including but not limited to, text, graphics, images and other material contained in this presentation is for informational purposes only. The purpose of this conference is to provide an understanding and knowledge of various health topics. It is not intended to be a substitute for professional medical advice, diagnosis or treatment. Always seek the advice of your physician or other qualified health care provider with any questions you may have regarding a medical condition or treatment and before undertaking a new health care regimen, and never disregard professional medical advice or delay in seeking it because of something you have encountered in this presentation.

SHEI does not recommend or endorse any specific tests, physicians, products, procedures, opinions or other information that may be mentioned in this presentation. Reliance on any information appearing in this presentation is solely at your own risk.
Chemical Exposures and the Elimination of Toxic Metals

Thesis:

The totality of evidence strongly suggests that bio-accumulated chemical toxicants including toxic elements are the cause of many chronic diseases and immune problems.

Clinical Relevance:

Eliminating the underlying burden of chemical toxicants including toxic metals may prevent adverse health outcomes and restore health in those with chronic afflictions.
Chemical Exposures & Elimination of Toxic Metals from the Human Body

I. Background – Chemical exposures in context

II. What can you do clinically?
   ♦ Elimination of Toxic Metals from the Body
   ♦ Case Reports
I. Background – Chemical exposure in context

- Unparalleled rates of chronic mental and physical illness

- Toxic chemical exposures and bioaccumulation: major determinant of the escalating prevalence of chronic disease
The Problem: *America*  
(2015 figures)

- Chronic diseases accounts for 86% of health care costs
- Half of all American adults have at least one chronic condition
- Almost one in three Americans has multiple chronic conditions
- Of the 2 Trillion dollars spent annually on healthcare, 75% of it goes to treating chronic disease
- Chronic disease accounts for 81% of hospital admissions

---

"The number of people affected by Alzheimer's and dementia is growing at an epidemic pace, and the skyrocketing financial and personal costs will devastate the world's economies and healthcare systems, and far too many families."

William Thies, Ph.D.,
Chief Medical & Scientific Officer
Alzheimer's Association.
Inflammatory Bowel Disease in Children

- 10-fold increase over 10 years.
Every year, more than 670,000 women in the USA have a hysterectomy.

24% increase between 1996-2002.

In USA: 30-40% of women <65 have had a hysterectomy (2009)

75% increase in prostate cancer between 1977 – 2006!

Canadian Cancer Society/National Cancer Institute of Canada (2006, April) Table 7.1 & Table 8.1
2008 Study: Increasing number of people living with chronic pain
- 70 Million Americans live with chronic pain
- Chronic pain affects ~ 4/10 seniors in institutions

- Waiting lists often >1 year for consultation at pain clinics
- 2009 Report – significant adverse effect on productivity and economy
- Escalating problem with adolescents living with chronic pain

Rates of Mental Illness

- An estimated 26.2 percent of Americans ages 18 and older — about one in four adults — suffer from a diagnosable mental disorder in a given year.

- Leading cause of disability in the U.S.A. and Canada.

- Recent talk...25% of reproductive aged woman in the USA are on antidepressants


Half of all pediatric hospital beds in Canada filled to treat serious mental health problems

Across Canada, child and youth emergency room visits for mental health issues increased 45 per cent from 2007 to 2014.
Tidal Wave of Cancer

U.S. Lifetime Cancer Rates:
1923 – 3% of the population
2010 – Women: 1 in 3
Men: 1 in 2

- Significant increase in cancer in young as well as mature individuals
- Rates will continue to increase
- Anticipate 50% increase in rates of cancer over the next 15 years
“Health and social welfare systems are unprepared for the rapid growth in demands that will arise from these epidemics.”

The increase in childhood chronic conditions in the United States.
Query:

- Does exposure to toxic chemicals including heavy metals have anything to do with widespread erosion of personal and public health in adults and children?
Ludwig van Beethoven (1770-1827)

Lived in turmoil suffering from both acquired deafness and mania and depression

Crashed and banged his piano, dousing his head with copious amounts of water while scribbling his melodies and harmonies on walls and shutters

Oft thought to be related to syphilis

Recent study from hair and bone analysis: Lead poisoning
- received from doctor in treatment for health complaints
Vincent Van Gogh (1853-1890)

- The Starry Night – lead poisoning – causes swelling of retina causing light circles like halos around objects
- Nibbled at his paints – heavily contaminated with lead
- Had classic symptoms of lead poisoning
- Acute exposures upon painting
- Serious psychiatric illness

CIGARETTE SMOKING

- Dr. Norm Delarue, thoracic surgeon at TGH: in 1947 recognized the relationship between smoking and lung cancer.

- Info on smoking & mortality published in 1954 BMJ & still ignored

- Took the usual 30-40 years before widely accepted
- Recognized as a determinant of many illnesses
- Plethora of vocal programs to diminish rates of smoking

Now we have a plethora of other chemical exposures that people are routinely exposed to.
(some of which are at least as toxic as smoking)

75 years ago, synthetic chemicals were a futuristic idea.

Chemical Revolution: since then, more than 90,000 anthropogenic compounds have been created and many released into the environment.

Majority have not been tested for their impact on human health.

Exposure is now a routine part of daily life for most people – beauty, safety, convenience, efficiency, etc…
## Chemical Pollutants

<table>
<thead>
<tr>
<th>Toxic Elements</th>
<th>Organic Pollutants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>Synthetics</td>
</tr>
<tr>
<td>Lead</td>
<td>Petrochemicals</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Biological agents</td>
</tr>
<tr>
<td>Aluminum</td>
<td>Byproducts &amp; metabolites</td>
</tr>
<tr>
<td>Arsenic</td>
<td></td>
</tr>
<tr>
<td>etc</td>
<td></td>
</tr>
</tbody>
</table>

- Nanotoxicology: Nanoscale Pollutants (Organic & Inorganic)
People are routinely exposed...

1) Breathe
2) Smell
3) Absorb through skin or mucous membranes
4) Ingest
5) Vertical transmission
6) Implanted or injected

After exposure, what happens?

Depending on

i) properties of the chemical

ii) detoxification abilities of the individual

Some chemicals are eliminated

Some chemicals persist – why?

- Enterohepatic circulation (EHC)
- Renal tubular reabsorption
- Affinity to tissues – e.g. lipophilic
- Impaired detoxification mechanisms

Organ dysfunction – e.g. liver, kidney
Deficient in nutrients for elimination
Polymorphisms
Toxicants interfering with elimination

Toxic metals interfere with all stages of liver detoxification

Phase I – Activation of Xenobiotic
- via cytochrome P450 enzymes
- Impaired by Hg, Pb, As, Cd

Phase II – Conjugation of activated xenobiotic
- via mechanisms including GSH-S-Transferase
- Impaired by Hg, Pb, As, Cd

Phase III – Elimination of xenobiotic complex –
- Various toxic metals alter microbiome which is intimately involved in elimination

Result – facilitates bioaccumulation of all xenobiotics

- Moore M. A commentary on the impacts of metals and metalloids in the environment upon the metabolism of drugs and chemicals. Toxicol Letters, 148, 2004, 153-158
Is chemical exposure & bio-accumulation a common problem?

- Most American adults and children have bio-accumulated numerous potentially toxic chemicals
American Red Cross collected Cord Blood Samples:

What is the impact of toxic chemical exposure?

- **No sustained damage evident**
- **Irreversible damage after exposure**
- **Persistent exposure continually disrupting physiology as a result of bio-accumulated toxicants**

- Chronic illness (modifiable)
Impact of Some Persistent Chemicals

Chronic presence of toxicants

↓

Chronic disruption of human biology

↓

Chronic illness

Just as chemical pharmaceuticals alter physiology...
An internal dose of other biologically active foreign chemicals may disrupt physiology
Clinical Observation: Mounting Evidence

Remove presence of toxicants in many cases

No longer chronic metabolic disruption of human biology

Clinical improvement or resolution

<table>
<thead>
<tr>
<th>Chemical Toxicants</th>
<th>Pathophysiology</th>
<th>Clinical Manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>Mechanism of illness</td>
<td>Indirect (secondary impact)</td>
</tr>
<tr>
<td>Cytotoxic Damage</td>
<td></td>
<td>Immune Dysfunction</td>
</tr>
<tr>
<td>Dys. GABA, Glutamate, Glutathione</td>
<td></td>
<td>- Suppression</td>
</tr>
<tr>
<td>Endocrine Disruption</td>
<td></td>
<td>- Autoimmunity</td>
</tr>
<tr>
<td>Epigenetic Displacement</td>
<td></td>
<td>- Hypersensitivity</td>
</tr>
<tr>
<td>Oxidative Stress</td>
<td></td>
<td>Nutritional compromise</td>
</tr>
<tr>
<td>Inflammatory</td>
<td></td>
<td>Impair detoxification pathways</td>
</tr>
<tr>
<td>Plaque formation</td>
<td></td>
<td>Microbiome damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ANS dysregulation</td>
</tr>
</tbody>
</table>
Endocrine Disruption

- Many toxicant compounds distort endocrine function
- May interfere with synthesis, transport, action, or excretion of hormones
- May mimic hormones, block hormone receptors, act synergistically with hormones, have anti-hormonal action, etc.
Many chemicals are endocrine disruptors, including several pesticides and various heavy metals (xenoestrogens).

Can affect fertility, thyroid function, puberty, sexual development, and hormone sensitive organs such as prostate, breast, endometrium, etc. etc.

Microbiome damage

What is germ ecosystem responsible for?

- Detoxification
- Involved in neurotransmitter release
- Breakdown of foods
- Absorption
- Production of required nutrients etc. etc – e.g. vitamin K2
- etc

Alteration of microbiome impairs its ability to carry out normal biology

Ursell LK, Knight R . Xenobiotic and the human gut microbiome: metatranscriptomics reveal the active players. Cell Metab. 2013 Mar 5;17(3):317-8
Toxicants can interfere with microbiome viability and function

Disturbance of the microbiome by environmental chemicals can result in functional changes that lead to disease

chlorine, heavy metals, some pesticides, antibiotics, etc


• Samsel et al. Glyphosate’s Suppression of Cytochrome P450 Enzymes and Amino Acid Biosynthesis by the Gut Microbiome: Pathways to Modern Diseases Entropy 2013, 15(4), 1416-1463
By various recognized pathophysiological mechanisms, chemical toxicant exposure and bioaccumulation cause harm.
What kind of disease processes may result from chemical toxicant exposure?

Damaging human health in many ways:

- Carcinogenic
- Hepatotoxic
- Neurotoxic
- Immunotoxic
- Developmental toxicity
- etc. etc

Toxicity linked with all kinds of illness

- Dementia
- Widespread autism
- Infertility
- Cancer
- Mental health problems
- Autoimmune illness
- Allergies
- Skin Disorders
- Etc, etc, etc
Enormous attention in the literature exploring potential causal connections

- Many scientific and public health journals: *Environmental Health Perspectives; Environmental Research, Science of the Total Environment; J Environ & Public Health, myriad Toxicology journals, etc…*

- NIH recently begun funding studies exploring elimination of persistent toxicants

- Extensive research on persistent EDCs & Epigenetics

- etc…

---

- National Institutes of Health (NIH) Grant Proposal (NIH K99/R00) on 'Biomonitoring for and detoxification of environmental chemicals in humans.' (2010)
Pronouncements from medical bodies

Pediatric Academic Societies 2001 Annual Meeting:

“Low level exposure to environmental toxicity may be impacting the functioning of the current generation”

World Health Organization:

“Acute and chronic, high and low-level exposures to chemicals in the environments of children may cause functional and organic damage.”

etc. etc…

Common retort – No impact at low doses!

- Inherent physiology occurring as a result of biochemical reactions involving ppb & ppt

- Endocrine disruption with equally low doses of xenobiotics

“If we drained the blood of 250,000 pre-menopausal women, we’d get one teaspoon of the active estrogen – estradiol.”

Natalie Angier (Pulitzer Prize winning author of Woman: An Intimate Geography)


Kenneth A. Cook, Environmental Working Group Subcommittee on Superfund, Toxics, and, Environmental Health. Presentation to Senate Environment & Public Works Committee (Feb. 4, 2010)
Metabolic Impact at low doses

- Serum PFOS change of 5 ppbs made significant changes in SUA (source - stain resistance in clothes, furniture and carpets)

| NHANES (CDC) 2004 average level | PFOS | 20.7 |

- “Our results indicate that bisGMA at concentrations less than 0.1 micromolar cause an extreme depletion of intracellular glutathione as well as increasing apoptosis.” (bis-GMA – typically used in dental restorations)

- Steenland K. et al. Association of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) with uric acid among adults with elevated community exposure to PFOA. Environ Health Perspect. 2010 Feb;118(2):229-33.
Another retort: NOAEL safety testing

No observed adverse effect level
  - the level of exposure of an organism to a chemical or agent (e.g. radiation), at which no such adverse effect is found in exposed test organisms

i. Most compounds not tested
ii. Testing is one time exposure – real life is persistent ongoing exposure of bioaccumulated toxicants
iii. Only looking at short term outcomes
iv. Detoxification mechanisms different in rats - cannot extrapolate findings to people

Mounting evidence that ubiquitous chemical toxicant exposure of the late 20th and early 21st century is a major determinant of the profound decline of individual and public health.
The Chemical Erosion of Human Health

- Exposure to myriad chemical substances
- Persistence & accumulation of some
- Individual & synergistic toxicity recognized
- Adverse health effects documented
- Individuals & populations affected
- Managing the Problem

Adverse health effects documented

Individuals & populations affected

Managing the Problem

Persistence & accumulation of some

Individual & synergistic toxicity recognized

Exposure to myriad chemical substances
II. What can you do clinically to address the chemical erosion of health?

i. Prevent further exposure to individuals and population groups

ii. Get the stuff out of people already with an internal dose
Detoxification - flourishing

Spectrum of therapies used:

- Medications – e.g. bile acid sequestrants
- Blood filtration – e.g. hemodialysis
- Plasma exchange or removal – e.g. therapeutic apheresis, phlebotomy
- Binding therapies – e.g. chelation
- Physical therapies – e.g. transdermal depuration, various types of baths, foot pads, constitutional hydrotherapy, etc
- Microbiome enhancement – selected probiotics
- Enterohepatic interruption – e.g. Olestra
- Colonic therapies – e.g. oil enemas, coffee enemas, etc
- Energy therapies
- Liver/Gallbladder flushes
- Food therapies – e.g. fibre, chlorella, broccoli sprouts (e.g. benzene)
- Etc, etc

Detoxification schools of thought
(editor of journal edition on detoxification – researchers, clinicians, organizations, programs, etc)

➢ Panchakarma – Ayurvedic medicine
➢ Scientology approach
➢ Gerson technique
➢ ‘Experts’
➢ Energy-related detox strategies
➢ Etc.

Many claims
Lots of anecdotal reporting
Limited evidence-based research in the scientific literature
Some techniques based on science
Many lack scientific credibility
Focus on what has scientific evidence

Clinical Detoxification
- elimination of persistent toxic substances from the body

I. Avoidance
II. Intrinsic Detoxification
III. Extrinsic Detoxification

I. Precautionary Avoidance

Single Most Important: *Avoid, Avoid, Avoid!*

Personal Inventory

- Breathe
- Ingest
- Dermal Application
- Smell
- Implanted or injected
- Vertical Transmission
e.g. Some Unrecognized Common Sources

- Emissions from computers – Hg, Pb, As, Be, PBDEs, etc
- Airplane travel – compressed air in engine – metals, petro,
- Some candles – wicks to slow rate of burning – e.g. Pb, etc
- Vehicle emissions – engine compartment
- Some supplements – some sourced from polluted areas
- etc. etc…
II. Intrinsic Detoxification

- Optimizing inherent function of the body to detoxify
- Raw materials required for biochemical processes (e.g. glutathione)
- Minimize obstructing features (e.g. EtOH, meds, etc)
Intrinsic Detoxification - Limitations

- Intrinsic detoxification cannot effectively remove all compounds
  - Enterohepatic circulation
  - Renal tubular reabsorption (pH dependent)

** Need other mechanisms to remove some bioaccumulated agents
III. Extrinsic Detoxification

Targeted Interventions to facilitate removal of accrued toxins

1) Endeavor to identify the burden of persistent toxicants – toxicological testing

2) Intervene with appropriate therapy
Identify what the total burden is

**Chemical Pollutants**

- **Toxic Elements**
- Organic Pollutants
Challenges of assessing and managing toxic element contamination

1. Toxic element chemistry is complex
2. Each toxic element has specific properties - they do not all behave the same
3. Synergy and interactions with other pollutants not completely understood
4. Testing is imprecise

Explore some fundamentals of toxic elements…
Multiple toxic elements

In addition to Hg, Pb, As, Cd, Al, also...

- **Gadolinium** - MRIs
- **Platinum** – post-chemo
- **Thallium** – electronics and glass industry – has seeped into kale and cruciferous veggies – cabbage, broccoli, cauliflower, collard, etc
  - found in regions of California lately - pilot studies in 2014 and 2015
- **Nickel** – occupational, proximity to industrial sources, food processing  industry
- **Antimony** – used in some materials as a flame retardant
- etc
Exposure and accrual of toxic agents such as metals and metalloids can occur in different forms:
- e.g. Hg: Organic – methylmercury, ethyl Hg, dimethyl Hg, Hg-oxalate, etc
  Inorganic – elemental mercury, mercuric chloride, divalent Hg, etc.
- e.g. Pb – Organic – tetra-ethyl Pb, tetra-methyl Pb
  Inorganic - lead oxide, lead sulphate (most cases)
- Can exist in different forms in the body

Marked Variability in toxicity and behavior of different species of same element:
- Different forms metabolized by the body in different ways
- Can interact with body biochemistry and change speciation state
- Assessing speciation state – can be complicated and expensive
Arsenic – Organic vs. Inorganic

Arsenic:
- Can exist in several ways: elemental, organic, inorganic, and gaseous
- Inorganic – very serious acute and chronic toxicity
- Organic – much less toxic – founds in many foods

Organic Arsenobetaine is a common constituent of seafood and is considered nontoxic.
Organic arsenic compounds in most seaweed are arsenosugars, mildly toxic
Inorganic arsenic was > 600 times more toxic than the arsenosugar typically found in seafood.

Organic vs inorganic metabolized totally differently
Organic As can be trivalent or pentavalent.

- ATSDR (Agency for Toxic Substances and Disease Registry) Toxicological Profile for Arsenic (Update) (Draft for Public Comment) 2007b.
- Lewis AS Organic versus Inorganic Arsenic in Herbal Kelp Supplements. Environ Health Perspect. 2007 Dec; 115(12): A575
Properties of each element varies
(between and within families)

How each toxic element behaves

- storage
- distribution
- toxicology & mechanisms of damage
- elimination
  etc

varies between toxic elements and
different species of one element
Storage varies (where we live varies)

- Cadmium – widely distributed - mainly kidney then liver
- Lead – stores primarily in bones, teeth and brain
- Mercury – stores in brain and kidneys
- Aluminum – mainly in brain; some in bones
- Etc

Storage also depends on speciation for some elements
- e.g. Organic methy-Hg targets brain
  Elemental Hg targets lungs, brain and kidney
e.g. Rate of spontaneous elimination

- Completely different in blood than in tissues
- Can shift between compartments
- Individual variation - nutritional status, genetics, total load, detoxification status, etc

Lead
- Half-life of about 30 days in blood
- Half-life of 25-30 years in bone

Huge implications for testing
e.g. Mode of Excretion varies

- Between elements
- Between species of element
  - many toxic element species – excretion primarily through renal mechanisms
  - Thallium – primarily fecal with EHC recycling

What we do know

➢ Exposure and bioaccumulation of toxic heavy metals in some forms is very harmful to the body

➢ Can cause profound damage in many different ways (EDC, enzyme dysfunction, mitochondrial damage, epigenetic change, etc) resulting in myriad and serious clinical problems

➢ Elimination of these toxic agents can result in remarkable clinical improvement
Clinical Approach

1. Secure Avoidance*
2. Facilitate intrinsic decorporation*
3. Test
4. Treat
Testing for toxic element body burden - challenging

- Hair testing
  - DN show very recent exposure
  - DN show bioaccumulated burden
  - Subject to external contamination – hair dyes, etc
- Blood testing – recent exposure – depending on half-life
  - May vary with caloric state
- Sweat testing
  - some metals show that are not present in blood
  - some metals not excreted well in sweat
- Biopsy
  - Metals deposit differently
  - Differential findings at sites of same tissue
- Fingernail testing
- Energy Testing, etc – no published evidence seen
- etc…
Porphyrin Profiles – shows outcomes

- Some toxic metals affect metabolic pathway of porphyrin production
- Porphyrins in the urine, can be an indicator of heavy metal poisoning - e.g. Pb, Hg

Porphyrisns are naturally occurring proteins essential for the production and function of heme – a component of hemoglobin

- Benefits: Can show extent of damage at cellular level and improvement with treatment

Drawbacks:
- Non-specific: potentially the result of other toxicants or other processes
- Does not give quantitative assessment of body burden
Many approaches – will discuss my approach

➢ No perfect approach – otherwise all would be using same
➢ Use least invasive & least potential for toxicity
➢ Respect and recognize that other approaches can work very well

1. Consider overall plan to assess & manage patient
   - toxic element approach one part of whole picture
2. Know what toxic elements you are dealing with
3. Look for source - avoidance of exposure is crucial
4. Facilitate natural mechanisms of detoxification as much as possible to allow the body to do what it was designed to do – heal and protect itself.
5. Use selected interventions to remove
Testing: My preference – minimally invasive and safe as out-pt

1. Whole blood toxic elements as part of nutritional screen – post L-GSH – indication of Cd, As, Al

2. Provoked DMSA urine (oral) – reflection of body burden of selected agents – Pb, Hg
   - mobilize and bind – L-GSH
   - cautious trial of components

3. Develop plan for removal

   Drawbacks – Provoked DMSA does not adequately show Cd, As, Al
   Better response to DMPS – more expensive and potentially more reactions
   IV single or combined – e.g. EDTA & DMSA – more invasive
Extrinsic Detoxification of toxic elements: Strategies
Strategy #1: Transdermal Depuration

- Induced perspiration with excretion of toxicants through the skin
History of Therapeutic Sweating

Various cultures have used sweating techniques

- Aboriginal sweat lodges
- Finnish cultural practice
- Japanese Onsen
- Steam rooms
- etc
Sauna/hot yoga/steam bath/exercise/ etc

- Increases the thermal load to the body
- Body temperature rises (39°C = 102+°F), hypothalamus detects rise and initiates an ANS thermoregulatory heat-loss response
- Body responds by directing cardiac output to skin.
- Enhanced circulation to the skin from a baseline of 5–10% to a maximum of 60–70% of cardiac output.
- Perspiration ensues, with an excreted volume of up to 2 litres/h in some individuals.

Evidence for elimination of toxicants??
Sauna associated with

Short- and long-term amelioration of various cardiovascular, rheumatologic, and respiratory afflictions.

Contraindications to sauna use:
- high-risk pregnancy
- severe aortic stenosis
- recent cardiovascular events
- unstable angina

Extrinsic Detoxification through Induced Sweating

- Numerous studies have confirmed clinical benefit and release of selected toxicants into sweat
Published Sauna Research to Date

Actual analysis of perspiration:

- Methadone
- Cocaine
- Amphetamines
- Crystal meth
- Morphine

Sauna therapy can diminish the body burden of assorted bioaccumulated toxicants:

- Polychlorinated biphenyls (PCBs)
- Polybrominated biphenyls
- Chlorinated pesticides
- Hexachlorobenzene
Toxic Element Excretion

Lead & nickel appear in analytical studies on sweat.

But lack of evidence for other toxic elements…


- Principal Investigator – Stephen Genuis MD
- Associates – Deib Birkholz PhD
  (toxicological advice & testing)
  – Sanjay Beesoon PhD candidate
    (stats and analysis)

Approval from Health & Ethics Research Board, University of Alberta
BUS Study Protocol

- Collected Blood, Urine & Sweat from 20 participants
- Tested for the presence of various (120) chemicals
- Compared the Blood : Urine : Sweat ratios for each compound
- Looked for differences in excretion rates based on
  - age
  - gender
  - health status
  - type of sauna used
BUS Study: Induced Sweating
– tested for 120 chemicals

Chemical groups studied:

1. **Toxic Elements** – heavy metals & metalloids
2. **Plasticizers** – phthalates & bisphenol A
3. **Solvents** – benzene, xylene, etc
4. **OC Pesticides** – DDT, DDE, etc
5. **PCBs** – many congeners
6. **PFCs** – PFHxS, PFOS, PFOA, etc
7. **PBDEs**
Variables in BUS Study

- 10 chronically ill vs. 10 healthy controls
- Varied ages – youth to senior
- Both genders
- 10 with infra-red sauna; 7 regular sauna; 3 exercise sweat
Results: Toxic Elements

Toxic elements come out to varying degrees in sweat

Required minerals also come out to varying degrees in sweat
Comparison of elimination of metals through urine and sweat.
Cadmium

- 50% of participants had no detectable cadmium in their blood or urine.

- Of these, 80% had notable levels in sweat

- Cadmium can be stored in tissues with no evidence in blood or urine

- Sweat can release stored cadmium
15% of participants had no detectable levels of Hg in blood.

All of these had Hg in sweat.

Mercury can be stored in tissues and excreted via sweat with no evidence of Hg in blood.
Sauna Use – also removes various POPs

- Facilitation of perspiration
  - Preheat, exercise, hot fluids, clothing, etc
- Frequency
- Preparation
- Length
- Controversies – e.g. best type for efficacy, safety, etc
- Cautions
  - Mineral depletion
  - Type of sauna
  - Offgassing
  - EMFs
  - Toxicant mobilization – S & S
Strategy #2:

**Foods and nutrients that may help eliminate toxic elements**

- Garlic
- Chlorella
- Apple/Citrus Pectin – dietary fibre esp in peel of citrus
- Fermented foods and probiotics

-----------------------------

- Folate - Rx As
- Selenium (e.g. Brazil nuts) – Rx Hg
- Malic acid (e.g. apples) – Rx Al

-----------------------------
Comparison of therapeutic effects of garlic and d-Penicillamine in patients with chronic occupational lead poisoning.


Blood lead concentrations were reduced significantly in the garlic and d-penicillamine groups, respectively, with no significant difference between the two groups.

Insufficient testing regarding allicin from garlic & other toxic elements
Chlorella

- Numerous papers in the literature confirming ability of certain chlorella species to facilitate binding and elimination of heavy metals

- Caution vs. contamination
Emerging evidence of inorganic element removal
Success with radioactive elements in Chernobyl

Fermented foods & Probiotics

- Emerging evidence of organisms involved in elimination of toxic elements
  - Pb – *L. rhamnosus GG*
  - Cd – *L. plantarum*
  - As (V) – *L. casei*

Zoghby A et al. Surface Binding of Toxins and Heavy Metals by Probiotics. Mini-Reviews in Medicinal Chemistry, 2014 14:84-98
Folate and As


- Folic acid supplementation lowers blood arsenic. Gamble et al.
Selenium

Biometals. 2015 Aug;28(4):605-14

- Selenium as an antidote in the treatment of mercury intoxication.
- Bjorklund G.

- Secure adequacy
Malic acid and Aluminum

- Comparative effects of several chelating agents on the toxicity, distribution and excretion of aluminium.
- Domingo JL et al.
Insufficient study to provide solid evidence

- Cilantro (Coriander) – mobilizes from CNS but insufficient direct evidence on toxic element removal
- Alfalfa (high fiber – able to bind some chemicals in colon) insufficient direct evidence on toxic element removal
- Rutin – phytoextract from buckwheat, black tea, insufficient direct evidence on toxic element removal
- etc, etc
Strategy #3: Natural Agents for eliminating toxic elements

Natural Occurring Zeolites – from volcanic ash & seawater
- Through cation exchange, toxins are allegedly absorbed into the zeolite cage and then excreted - prevent reabsorption in the EHC
- Confirmed to work in wastewater – insufficient evidence in literature in humans
- Unpublished data from colleagues – unsuccessful work in humans
- May have some toxicity – with contamination

Bentonite Clay & Charcoal
- Toxicant uptake - Works in environmental and industrial settings e.g. water purification - lacks human evidence
- Interrupt EHC e.g. thallium absorbed by activated charcoal in vitro

Saponins - Originating from soy or the yucca plant
- Alleged to bind some toxicants in bile to prevent reabsorption in the EHC – lack of evidence in human work for toxic elements
- etc

Agents that bind or ‘chelate’ metals

i) Dimercaprol (BAL – British anti-Lewisite).
   - Previously used for metal poisoning – As, Hg, Pb, Antimony, Ni, Cobalt, etc
   - Effective vs. inorganic Hg, not against phenyl- or alkyl Hg.
   - Potentially toxic with multiple side effects

ii) d- Penicillamine – was used for Pb, As, Hg, Cd
   - Lot of side effects, potentially toxic

Flora, S; Pachauri, V (2010), "Chelation in metal intoxication", Int J Research & Public health 7 (7): 2745–2788,
Beattie et al. WHJ Rheumatol Suppl. 1981 Jan-Feb;7:96-9Penicillamine in metal poisoning
Many Rx approaches – workshops available

- **DMSA** – (oral, transdermal) effective against many toxic elements – but not all
  Hg, Pd, Gd, Tl, Ni, etc

- **DMPS** – (oral or IV) **much better** vs. As, Cd (prohibitively expensive
  $900/month; less well tolerated; more potentially toxic; concern re nephrotoxicity
  of rapid Cd release)

- **calcium EDTA** (oral, sublingual, transdermal, and rectal, IV) – **better**
  vs. As, Cd, Al; Poor affinity for Hg

  Oral EDTA is only about 5% absorbed. Rectal EDTA might be absorbed as much as
  35% to 37%
Toxic element consideration

- DMSA nor DMPS do not generally cross the blood brain barrier on their own in humans

- EDTA does cross blood brain barrier

- We do not completely understand redistribution of toxicants
Efficacy with brain mercury

- Animal work: DMSA and DMPS diminish brain and kidney concentrations of Hg

- Incidentally, Lipoic acid did not reduce Hg brain concentrations

DMSA in children with ASD

Evidence for sustained improvement with interventions to diminish the load of toxic elements
- oral DMSA in children with autism

Propensity to lose minerals
Must replete minerals on ongoing basis
Nutrient flooding
  Juicing
  Smoothies
  Bone broth
  Supplements
Strategy #5: Physical Interventions & Energy Rx

- Massage – anecdotal
- Epsom salt baths
- Energy - Qi Gong
- Energy machines
- Etc.

Insufficient direct evidence on toxic element removal
Have seen many people who have had these treatments
Extrinsic Detoxification

**Ionic Foot Baths**: Sends a current into the body to generate positively charged ions which allegedly attach to negatively charged toxins and discards bound toxicants through foot pores.


**Energy treatments**: Techniques which purport to enhance the biophysical energy of the body (e.g. Qi Gong) to stimulate detoxification pathways.
Strategy 6 – Colonic therapies

Colon Hydrotherapy
Enemas

Panchakarma (multi-therapy program) – Pb exposure (Anecdotal)

No scientific evidence for removal of toxic elements found in scientific literature via colonic therapy
Review: My Approach – well tolerated and effective

i) Take history

ii) Testing

iii) Avoidance***

iv) Rx:

• Thermal Depuration
• Detox Foods and supplements – chlorella, garlic, pectin, etc
• DMSA 1-2/week po
• EDTA 1/week p.r.
• Probiotics and fermented foods

v) f/u testing Q 6 months
Clinical Outcomes

- Case Histories...
Case: Man with Bipolar Disease & Progressive Dementia

- 62 year old with 33 year history of bipolar illness. Recent development of progressive dementia.

- Memory, comprehension, communication and reasoning - rapidly declining.

- “Irreversible, degenerative condition.”

- Recommendation: chronic care placement.
Case 2 cont: Heavy Metal Exposure

- Assessment: History of work with stained glass in confined space – lead exposure

- Massive amounts of lead on challenge test; minimal levels on blood testing

- Pb detoxification: use over 9 months, astonishing recovery in mentation & mood

- Good sense of humor

- “Great to have the man I married back in my life.”
Case: Young man with depression & intrusive thoughts

- Teacher with escalating thoughts of hurting young children
- Increasing depressed with inclination toward self-harm
- Marked elevation of Hg – blood and provoked urine
- Likely source – daily consumption of tuna fish
- Pursuing health and consumption of omega-3 fatty acids
- Avoidance
- Sauna/chlorella/probiotics/DMSA
- Complete resolution in few months
Bio-accumulated chemical toxicants, often from repeated low-level exposures, are the cause of many chronic mental and physical health problems.

Eliminating the underlying burden of chemical toxicants including toxic elements may prevent adverse health outcomes and restore health in those with chronic afflictions.
References and papers:
Researchgate