

## The Relationship of Environment and Human Health



Tieraona Low Dog, MD

Author of  
"Fortify Your Life", "Healthy At Home",  
And "Life Is Your Best Medicine"

[www.DrLowDog.com](http://www.DrLowDog.com)

*Tieraona Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Environmental Toxins Impact Us All



- Environmental toxicants are industrial or naturally occurring, organic or inorganic, chemicals that harm human health across the lifespan and more so during critical developmental windows.

*Tieraona Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.



*"All substances are poisons; there is none which is not a poison. The dose differentiates a poison and a remedy."*

Paracelsus (1490-1541)

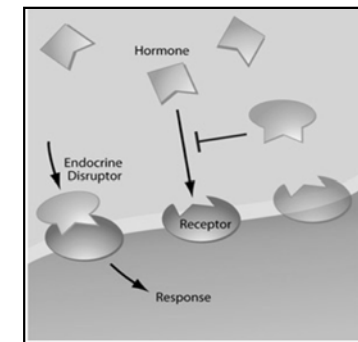
*Tieraona Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

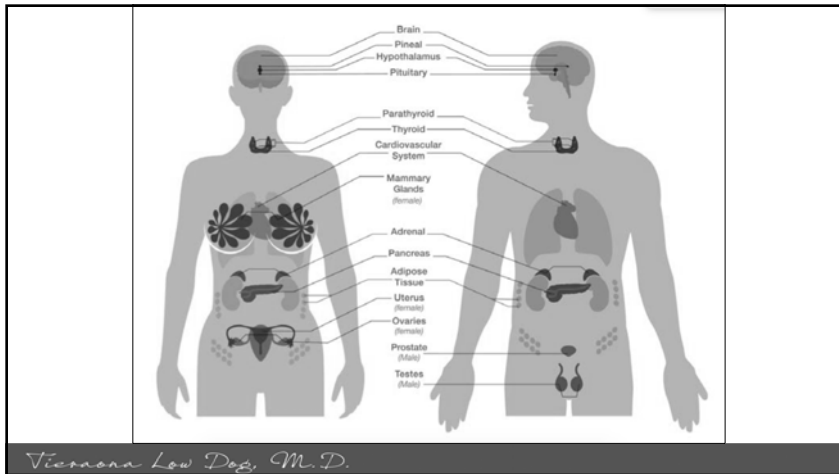
## Endocrine Disruptors

Endocrine Society defines as ***an exogenous chemical, or mixture of chemicals, that interferes with any aspect of hormone action.***

<https://www.endocrine.org/media/endosociety/files/advocacy-and-outreach/important-documents/introduction-to-endocrine-disrupting-chemicals.pdf?la=en>



*Tieraona Low Dog, M.D.*



## Endocrine Society Second Scientific Statement

“Endocrine disrupting compounds contribute to **outcomes related to impaired reproduction, neurodevelopment, thyroid function, metabolism, and increased propensity for hormone-sensitive cancers.**

Unfortunately, it is difficult to directly relate chronic disease burden to exposures in humans. The **increased prevalence of such diseases underscores the need to invoke precaution in introducing new (and usually untested) chemicals into the environment.”**

Gore AC, et al. *Endocr Rev* 2015; 36(6):E1-E150.

*Victoriana Low Dog, M.D.*

## Assessment of Risk Complex

- Exposed to many EDCs in environment - understanding how they **act alone and together** is crucial but difficult to study.
- Lifelong exposures to EDCs, particularly during critical windows may lead to considerable adverse consequences to human health.
- One of most sensitive stages in human development takes **place in-utero and first 3 years of a child's life.**
- **While limits/restrictions for some EDCs have been made for children's products** – there is still considerable exposure and little focus on limits during pregnancy.

*Victoriana Low Dog, M.D.*

*"In our every deliberation, we must consider the impact of our decisions on the next seven generations."*

*Iroquois Confederacy*



*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## EDC and Reproduction

- Increased prevalence of **hormone-sensitive cancers** (e.g. breast, prostate), impaired fertility, **early puberty**, **decreased sperm counts**, **genital malformations**, and **unbalanced sex ratios** at least partially attributable to increased EDC exposures.



Crain DA, et al. Female reproductive disorders: the roles of endocrine-disrupting compounds and developmental timing. *Fertility and Sterility* 2008; 90:911-940.

*Victoriana Low Dog, M.D.*

## EDC and Reproduction

Epidemiological prospective cohorts using biomarkers for exposures over past 16 years: EDC exposures **impact reproductive potential in women**. Exposure to EDCs decrease:

1. Estradiol levels (BPA)
2. Antral follicle count (BPA, phthalates, parabens)
3. Oocyte quality (BPA, phthalates, PCBs, triclosan\*)
4. Implantation (BPA, phthalates, PCBs)
5. Embryo quality (BPA, PCBs, triclosan\*)
6. Rate of clinical pregnancy and live births (phthalates, parabens).

Triclosan banned by FDA in antibacterial hand soaps in 2017

- Karwacka A, et al. Exposure to modern, widespread environmental endocrine disrupting chemicals and their effect on the reproductive potential of women: an overview of current epidemiological evidence. *Human Fertility*, 2019; 22:1, 2-25, DOI: [10.1080/14647273.2017.1358828](https://doi.org/10.1080/14647273.2017.1358828)

*Victoriana Low Dog, M.D.*

## Premature Ovarian Insufficiency



- 25% of premature ovarian insufficiency cases have unknown etiology.
- Review 97 relevant human and animal studies: **phthalates, BPA, pesticides and tobacco** most reported substances having **negative impact on ovarian function** with increased follicular depletion leading to an earlier age of menopause onset.

Vabre P, et al. Environmental pollutants, a possible etiology for premature ovarian insufficiency: a narrative review of animal and human data. *Environ Health* 2017; 16(1):37. doi: 10.1186/s12940-017-0242-4.

*Victoriana Low Dog, M.D.*



## Bisphenol A

- First synthesized 1891, known to mimic estrogen since 1930's.
- In hard, rigid plastics, metal food cans; plastic water pipes, thermal receipts, etc.
- Banned in baby bottles and cups in 2012.
- Reproductive toxicity category 1B ("May damage fertility") in EU.
- Associated with disruption of: **female reproduction** (cystic ovaries, altered uterine morphology, fertility), **mammary gland development, cognitive function and metabolism (increased insulin resistance)**
- Mechanism of action is complex but available evidence shows that *disruption of estrogenic pathway is central and consistently involved in these four effects.*
- [echa.europa.eu/documents/10162/908badc9-e65d-3bae-933a-3512a9262e59](http://echa.europa.eu/documents/10162/908badc9-e65d-3bae-933a-3512a9262e59) Accessed October 6, 2019.

*Victoriana Low Dog, M.D.*

## Prenatal Exposure BPA

Endocrinology, 2019, Jan 1, 180(5): 1421-1435. doi: 10.1210/en.2019-00034.

**Transgenerational Effects of Endocrine-Disrupting Chemicals on Male and Female Reproduction.**

Braten JE, Flaws JA<sup>1</sup>.

**Author information**

<sup>1</sup> Department of Comparative Biosciences, University of Illinois, Urbana, Illinois 61802.

**Abstract**

Endocrine-disrupting chemicals are known to interfere with normal reproductive function and hormone signaling. Phthalates, bisphenol A, pesticides, and environmental contaminants such as polychlorinated biphenyls and dioxins are known endocrine-disrupting chemicals that have been shown to negatively affect both male and female reproduction. Exposure to these chemicals occurs on a daily basis owing to these compounds being found in plastics, personal care products, and pesticides. Recently, studies have shown that these chemicals may cause transgenerational effects on reproduction in both males and females. This is of concern because exposure to

- Chemical signaling (hormone) vitally important in fetal development.
- Fetus likely exposed to free BPA, readily crosses placenta.
- Fetal sex determined genetically but gonadal hormones important for differentiation of male/female phenotypes. **EDCs mimicking or blocking natural sexual hormones may interfere with development.**
- Exert epigenetic effects that may be passed to subsequent generations.

Kolatorova L, et al. *Physiol. Res.* 2017; 66 (Suppl. 3): S305-S315; Brehm E, et al. *Endocrinology* 2019; 160(6):1421-1435

*Victoriana Low Dog, M.D.*

## Canned Foods

- Randomized crossover study 20 healthy volunteers given **canned or fresh food**. One day wash out and then interventions reversed.
- Urine samples collected immediately before meals and then 2 h, 4 h, and 6 h after meals.
- **Mean BPA concentrations** at 2 h, 4 h, and 6 h after meals were **152%, 206%, and 79% higher**, respectively, than mean BPA concentrations before meals. Returned to baseline by 24 hours.



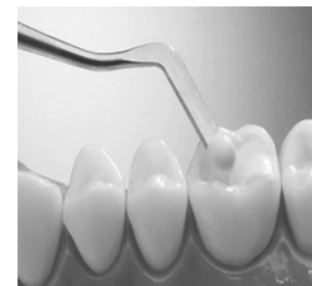
Peng CY, et al. *Environ Sci Pollut Res Int* 2019 Jul 27

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

*Victoriana Low Dog, M.D.*

## BPA and Dental Restorations

- Systematic review **20 studies** show that **BPA levels increase in saliva** one hour after composite resins and dental sealants.
- **One week after treatment, level in saliva only marginally higher than before treatment and no statistically significant level in urine.**



Paula AB, et al. Once Resin Composites and Dental Sealants Release Bisphenol-A, How Might This Affect Our Clinical Management?—A Systematic Review. *Int J Environ Res Public Health* 2019 May 9;16(9).

Berge TLL, et al. Bisphenol A in human saliva and urine before and after treatment with dental polymer-based restorative materials. *Eur J Oral Sci* 2019 Oct;127(5):435-444.

*Victoriana Low Dog, M.D.*

## Controversy Exists

- **High levels in urine, blood, umbilical cord blood, amniotic fluid in US.**
- National Toxicology Program CLARITY-BPA study in rats failed to find any significant adverse effects even at high exposure to BPA.
- However, NIEHS funded studies show **BPA exposure in pregnancy can increase risk of obesity and behavioral problems in child, and increase asthma with early childhood exposure.**
- Discrepancies in outcomes may be due to differences in animal models, labs using different experimental designs, different measurements (HPLC, GC-MS or LC-MS/MS), route and window of exposure, and experimental targets.

NTP Research Report: The CLARITY-BPA CORE STUDY: A PERINATAL AND CHRONIC EXTENDED DOSE RANGE STUDY OF BISPHENOL A IN RATS. [https://ntp.niehs.nih.gov/ntp/results/pubs/rtr/reports/rtr09\\_508.pdf](https://ntp.niehs.nih.gov/ntp/results/pubs/rtr/reports/rtr09_508.pdf). Accessed October 4, 2019  
Columbia Center for Children's Environmental Health <https://cccch.org/?s=BPA&submit=Search>. Accessed October 6, 2019

*Victoriana Low Dog, M.D.*

## BPA Analogues



- Research shows **BP-B, BP-F, BP-S** also act as endocrine disruptors.
- **National Toxicology Program:** “Our results add to a growing literature indicating that risk characterizations of BPA need to expand and should begin to consider BPA structural and functional analogues. This is especially important given that the evidence....**that many of the BPA analogues are active at concentrations similar to or lower than BPA.**”

Usman A, et al. Occurrence, toxicity and endocrine disrupting potential of Bisphenol-B and Bisphenol-F: A mini-review. *Toxicol Lett* 2019 Sep 15;312:222-227. AND [https://ntp.niehs.nih.gov/ntp/results/pubs/rtr/reports/rtr09\\_508.pdf](https://ntp.niehs.nih.gov/ntp/results/pubs/rtr/reports/rtr09_508.pdf). Accessed October 2, 2019

*Victoriana Low Dog, M.D.*

## Strategies for Patients

- Eat **fresh or frozen foods**
- **Do not microwave foods/beverages in plastic containers or with plastic cling-wraps**
- **Hand wash** plastic containers
- **Use glass, porcelain and/or stainless steel containers**
- **Avoid cans** when possible, especially acidic, salty or fatty foods (purchase in glass or cartons). Be cautious with “BPA-free”
- Use **filter for tap water** and carry stainless steel water bottle
- Say **no to thermal paper** receipts.
- Avoid plastics with **recycling #3 and 7**

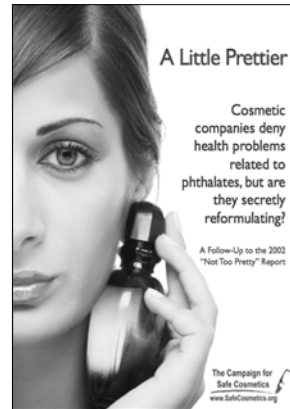
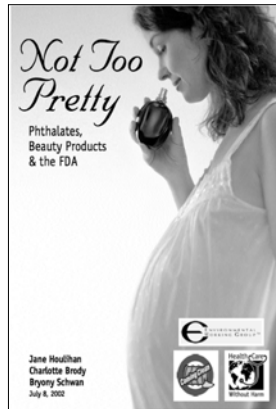
*Victoriana Low Dog, M.D.*

## Phthalates

- Human made chemicals used in **toys, vinyl floor and wall coverings, detergents, lubricating oils, food packaging, pharmaceuticals, blood bags/tubing, and personal care products.**
- From 2008-2017, numerous phthalates banned in children's products. Labs must test for prohibited phthalates.
- CDC: **84% population have >six phthalates in system. Women higher levels of urinary metabolites than men** for those phthalates that are used in soaps, body washes, shampoos, cosmetics, and similar personal care products.
- **SYNTHETIC fragrances** are a significant source of exposure.

<https://www.fda.gov/cosmetics/cosmetic-ingredients/phthalates>. Accessed October 6, 2019

*Victoriana Low Dog, M.D.*



*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Phthalates and Motor Skills

- NIEHS Study: researchers measured 6 phthalate metabolites in urine from **209 women late in their pregnancy and children at 3, 5, and 7 years.**
- **Age 11, administered motor proficiency screening test to children.**
- Higher exposure to phthalates *before birth* associated with **lower motor function among girls; higher exposure in childhood** associated with lower scores in boys.
- Balalian AA, et al. Prenatal and childhood exposure to phthalates and motor skills at age 11 years. *Environ Res* 2019. 171:416–427.



*Victoriana Low Dog, M.D.*

## Phthalates and Cognition

- NIEHS study **328 inner-city mothers and their children:** urinary metabolites of phthalates in late pregnancy. Cognition evaluated age 3 and at age 7 Wechsler Intelligence Scale for Children.
- Significant **inverse associations** seen between various maternal prenatal metabolite concentrations and **child processing speed, perceptual reasoning working memory; child verbal comprehension; child perceptual reasoning.**
- Among children of mothers with **highest versus lowest quartile DnBP and DiBP** metabolite concentrations, **IQ was 6.7 and 7.6 points lower, respectively.**

Factor-Litvak P, et al. Persistent Associations between Maternal Prenatal Exposure to Phthalates on Child IQ at Age 7 Years. *PLoS One*. 2014 Dec 10;9(12):e114003.

*Victoriana Low Dog, M.D.*

## Phthalates

- Data from Swedish Environmental Longitudinal Mother and Child, Asthma, Allergy and the Infant Development and Environment Study (TIDES): found **prenatal exposure** to specific phthalates **statistically significantly associated with language delay in children.**
- **TIDES study:** 3 DEHP metabolites during 1<sup>st</sup> trimester significantly and inversely associated with **shortened anogenital distance** in male newborns.

Grindler NM, et al. *Scientific Reports* 2018; 8:6086; Bornchag CG, et al. *JAMA Pediatr* 2018; Dec 1;172(12):1169-1176; Swan SH, et al., *Hum Reprod* 2015; 30(4):963-72.



*Victoriana Low Dog, M.D.*

## Diet and EDC Levels



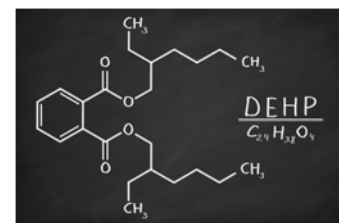
- Use of **plastic containers** associated with **higher urinary phthalate metabolites**, **canned food consumption** associated with **higher urinary BPA concentrations**.
- Foods/dietary patterns associated with **healthier food choices** (e.g., organic/grown/raised/caught foods, folic acid supplements, vegetarianism) associated with **lower urinary phthalate metabolite and BPA concentrations**.
- Dietary intervention: exclusive consumption **organic foods for 3 days**: urinary DEHP metabolite concentrations **decreased 53–56%** and **urinary BPA concentrations by 66%**. Foods provided and prepared from plastic-free packaging and containers.

Pacyga DC, et al. Dietary Predictors of Phthalate and Bisphenol Exposures in Pregnant Women. *Adv Nutr* 2019 Sep; 10(5): 803–815.

*Victoriana Low Dog, M.D.*

## Phthalates Insulin Resistance

- Systematic review by EPA researchers: phthalate exposure at levels seen in human populations may have metabolic effects.
- Association between **phthalate exposure and diabetes** should be considered.
- Other EDC implicated in type-2 DM include **BPA, PCBs, and organochlorine pesticides**.



Radke EG, et al. *Environ Int* 2019 Nov;132:104768  
Sarfis RM, et al. *Diabetologia* 2019 Oct;62(10):1811-1822.

*Victoriana Low Dog, M.D.*

## Some EDCs Act As obesogens

- **Can cause weight gain** via exposure to pesticides/herbicides, industrial/household products, plastics, and personal care products.
- **Highly lipophilic**, increases fat deposition that increases capacity for own retention.
- Vicious cycle of increasing obesity and retention of other lipophilic chemicals with broader range of adverse actions.
- **Animal models and epidemiological studies show especially sensitive time for exposure is *in utero* and neonatal period.**



Darbore PD. Endocrine Disruptors and Obesity. *Curr Obes Rep* 2017 Mar;6(1):18-27.

*Victoriana Low Dog, M.D.*

## Reducing Exposure



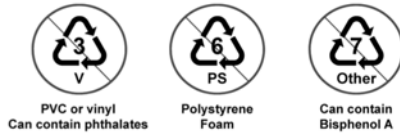
- Avoid plastics with **recycling #3** on package
- Avoid foods with **plastic wrap/packaging**.
- **Don't heat food in plastic.**
- Read labels of personal care products, **avoid those with phthalates or "fragrance"**
- If water is from a well, **test for phthalates** and contact state health dept. if levels are high
- Use **activated carbon filtration system** or **reverse osmosis**

*Victoriana Low Dog, M.D.*

Choose safer plastics:<sup>1</sup>



Plastics to avoid:<sup>2,3</sup>



Luz Claudio and Reeve Chace. Quick Guide to Plastics. Staying Healthy in a Changing Environment #3. Mount Sinai Community Health Bulletin.

*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC. All Rights Reserved.

## Parabens

- **Antimicrobial and preservative**, commonly used in personal care products: **methylparaben (MP)** **propylparaben (PP)**, ethylparaben (EP), butylparaben (BP) and benzylparaben (BenzylP).
- **Estrogenic/anti-androgenic potential**: EU/USA/Canada limits amounts in cosmetics (0.4% single paraben and 0.8% mixtures).
- Studies in mother-infant pairs find that median concentrations of parabens *similar in both maternal blood and amniotic fluid*.

Jorgensen N et al. *BMJ Open* 2012; 2: 1197; Towers CV, et al. *J Expo Sci Environ Epidemiol* 2015; 25: 604-607

Shekhar S, et al. *Gen Comp Endocrinol* 2017; 241: 100-107

*Victoriana Low Dog, M.D.*

## Parabens and Puberty

- Center Health Assessment of Mothers and Children of Salinas: 338 children in Salinas Valley, CA followed birth to adolescence.
- **In girls: peripubertal concentrations associated with earlier breast and pubic hair development, and menarche with MP; earlier menarche with PP.**
- **In boys: peripubertal concentrations associated with earlier genital development with PP.**
- Note: study found **prenatal diethyl phthalate and triclosan exposures associated with earlier menarche in girls.**

Harley KG, et al. Association of phthalates, parabens and phenols found in personal care products with pubertal timing in girls and boys. *Hum Reprod* 2019 Jan 1;34(1):109-117

*Victoriana Low Dog, M.D.*

## Reduce Exposure

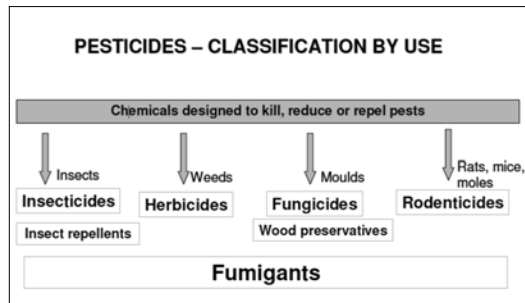
- **Read labels** for anything containing - **paraben.**
- Use **paraben-free products.**
- Consider **homemade** products to soothe skin: **shea butter, organic sunflower seed oil**, etc.
- There are “certifying” seals that consumers can also look for (e.g., Safer Choice, EWG)



*Victoriana Low Dog, M.D.*



## Pesticides



*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Organophosphate Pesticides

- First synthesized and used as **nerve gas** in World War II.
- Their chemical structures and properties significantly modified to alter their toxicity and other physical/chemical properties but they are all neurotoxic. That's how they **work as insecticides**.
- **Neurological and/or cognitive deficits** described and experimental and epidemiological relationships found between **pesticide exposure and Alzheimer's, Parkinson's, and amyotrophic lateral sclerosis diseases**.

Baltazar MI, et al. *Toxicol Lett* 2014; 230(2):85-103.

Sanchez-Santed F, et al. Organophosphate pesticide exposure and neurodegeneration. *Cortex* 2016; Jan;74:417-26.

*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Organophosphate Pesticides

- Systematic reviews and epidemiologic studies, in urban and agricultural settings, linked OP exposures during fetal development with **poorer cognitive, behavioral, and social development in children**.
- Higher likelihood of **autistic spectrum disorder** diagnosis for children born to women residing within (versus beyond) 1.5 km of OP pesticide applications on agricultural fields; **strongest for chlorpyrifos**.
- July 2019, EU decided against renewing chlorpyrifos license in 2020 after evaluating for neurodevelopmental effects in children and genotoxic effects.
- Germany, Ireland, Latvia, Lithuania, Slovenia Sweden never allowed. UK banned in 2016.

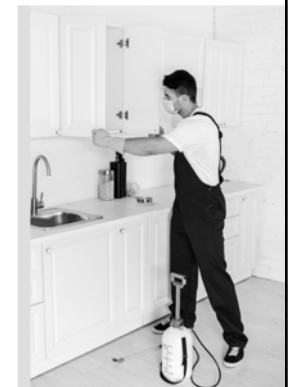
Hertz-Picciotto I, et al. Organophosphate exposures during pregnancy and child neurodevelopment: Recommendations for essential policy reforms. *PLoS Med* 2018 Oct; 15(10): e1002671.

<https://cen.acs.org/environment/pesticides/safe-exposure-chlorpyrifos/EU-regulators/97/web/2019/08> Accessed 10/02/19

*Victoriana Low Dog, M.D.*


## Chlorpyrifos

- Organophosphate pesticide used to **control household pests** (e.g., cockroaches, termites, fire ants).
- **Used agriculturally** to combat pests on cotton, grain, seed, nut, fruit, wine, and vegetable crops.
- Used in nurseries, food processing plants, on golf courses, and in water supplies to **combat mosquito larvae**.
- Acutely toxic to earthworms and honeybees.
- Study of indoor air and dust samples collected in homes and day cares in US found many had chlorpyrifos present, even though most had not used pesticides for one week or longer.




*Victoriana Low Dog, M.D.*

*The New York Times*  
**E.P.A. Won't Ban Chlorpyrifos, Pesticide Tied to Children's Health Problems**  
 July 19, 2019



"The E.P.A. may argue that the science showing chlorpyrifos is unsafe is unclear..... (but) under the Food Quality Protection Act, the E.P.A. must prove that there was a reasonable certainty that the pesticide would not cause harm."

*Victoriana Low Dog, M.D.*



## Pesticide Exposure: ADHD

- Prenatal OP exposure **observed a negative effect on mental development and increase in attention problems in preschool and school children.**
- Children: higher urinary levels of dimethyl phosphate twice or pyrethroid metabolites were **two times more likely to have ADHD, compared to children with low or undetectable levels.**

Kuehn BM. JAMA. 2010 Jul 7;304(1):27-8. Bouchard, et al. *Pediatrics*. 2010 Jun;125(6):e1270-7.  
 Gonzalez-Alzaga B, et al. *Toxicol Lett* 2014; 230(2):104-21 Wagner-Schuman M, et al. *Environ Health* 2015; May 28;14:44.

*Victoriana Low Dog, M.D.*

EWG'S 2019 DIRTY 12 <sup>TM</sup>	EWG'S 2019 CLEAN 15 <sup>TM</sup>
1. STRAWBERRIES	1. AVOCADOS
2. SPINACH	2. SWEET CORN
3. KALE	3. PINEAPPLES
4. NECTARINES	4. SWEET PEAS FROZEN
5. APPLES	5. ONIONS
6. GRAPES	6. PAPAYAS
7. PEACHES	7. EGGPLANTS
8. CHERRIES	8. ASPARAGUS
9. PEARS	9. KIWIS
10. TOMATOES	10. CABBAGE
11. CELERY	11. CAULIFLOWER
12. POTATOES	12. CANTALOUPE
• HOT PEPPERS	13. BROCCOLI
	14. MUSHROOMS
	15. HONEYDEW MELONS

[www.ewg.org](http://www.ewg.org)

*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC. All Rights Reserved.



*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC. All Rights Reserved.

"If we are going to live so intimately with these [agricultural] chemicals--eating and drinking them--taking them into the very marrow of our bones--we had better know something about their nature and their power."



Rachel Carson,  
*Silent Spring*

*Victoriana Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

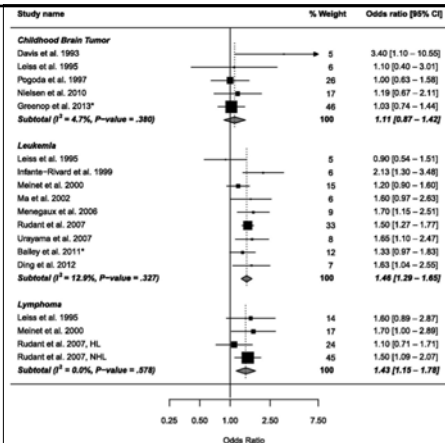
## Insecticides and Cancer

- Meta-analysis of 16 studies found childhood exposure to **indoor residential insecticides** (nonoccupational and nonagricultural) is **associated with a significant increased risk of childhood leukemia and lymphomas**.
- Positive but not statistically significant association found for **brain tumors**.
- **Integrated pest management** recommended by **USDA, EPA, American Public Health Association, and National PTA**.



Chen M, et al. Residential Exposure to Pesticide During Childhood and Childhood Cancers: A Meta-Analysis. *Pediatrics* 2015; 136(4):719-29.

*Victoriana Low Dog, M.D.*

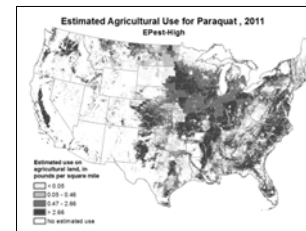


Meta-analysis of the association between childhood cancers and exposure to home pesticides during childhood. \*Professional home treatments.

In: Chen M, et al. Residential Exposure to Pesticide During Childhood and Childhood Cancers: A Meta-Analysis. *Pediatrics* 2015; 136(4):719-29.

*Victoriana Low Dog, M.D.*

## Paraquat Dichloride Herbicide



Gatto, NM, et al. "Well-Water Consumption and Parkinson's Disease in Rural California." *Environmental Health Perspectives* 117:12 (2009): 1912-1918.  
Zhang XF, *Lab Invest* 2016; May;96(5):496-507.

- Widely used soy, corn, cotton, peanuts and alternative for weeds **resistant to GLY**.
- Repeated exposure in animal models induces pathological features of **Parkinson's**, loss of **dopaminergic neurons** in **nigrostriatal dopamine system**.
- Exposures during teen or young adult years in California-- **increased Parkinson's risk of 200-600%**, depending on overall years of exposure.
- **Banned in 32 countries**.

*Victoriana Low Dog, M.D.*

## Glyphosate

- Introduced as **broad-spectrum herbicide** 1974.
- Glyphosate and glyphosate based herbicides have **endocrine-disrupting** effects on **male reproduction** at low doses.
- Two recent reviews of glyphosate's health hazards report conflicting results:
  - Review by International Agency for Research on Cancer (IARC) found glyphosate is a **"probable human carcinogen"**.
  - Review by the European Food Safety Agency (EFSA) **found no evidence of carcinogenic hazard**.



Pham TH, et al. Perinatal exposure to glyphosate and a glyphosate-based herbicide affect spermatogenesis in mice. *Toxicol Sci* 2019 Feb 20. pii: ktz039.

Landrigan PJ, et al. The need for independent research on the health effects of glyphosate-based herbicides. *Environ Health* 2018 May 29;17(1):51.

*Viviana Low Dog, M.D.*

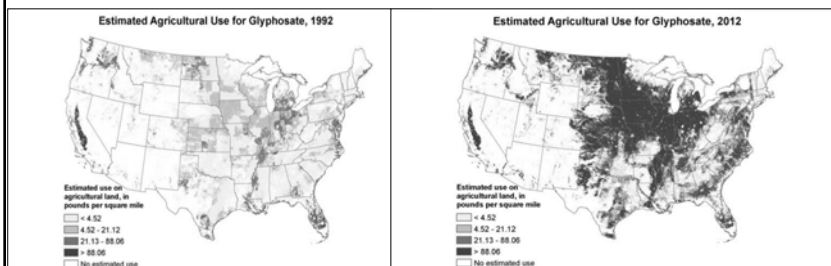
## Glyphosate and Cancer

- Agricultural Health Study:** prospective cohort of **54,251 licensed pesticide applicators** from North Carolina and Iowa, of which **44,932 (82.8%) used glyphosate**, including 5779 incident cancer cases (79.3% of all cases).
- Glyphosate was not statistically significantly associated with cancer at any site in this study.** Applicators in *highest exposure quartile had increased risk of acute myeloid leukemia*, though didn't reach statistical significance.

Amdreotti G, et al. Glyphosate Use and Cancer Incidence in the Agricultural Health Study. *J Natl Cancer Inst* 2018; 1;110(5):509-516.

*Viviana Low Dog, M.D.*

## Glyphosate Use Dramatically Increased



*Viviana Low Dog, M.D.*

## Glyphosate and Pregnancy



- Pregnant women in Indiana: those with **highest urinary GLY levels had shorter gestational lengths** ( $p = 0.02$ ).
- Animal data suggest **high exposures to GLY in pregnancy are associated with birth defects**.
- Study in N. Carolina found increased risk of **atrial septal defects in children** born to mothers with higher GLY exposures.

Parvez S, et al. Glyphosate exposure in pregnancy and shortened gestational length: a prospective Indiana birth cohort study. *Environ Health* 2018; 17: 23.  
Rappazzo KM, et al. Maternal residential exposure to specific agricultural pesticide active ingredients and birth defects in a 2003-2005 North Carolina birth cohort. *Birth Def Res* 2018 Dec 28. doi: 10.1002/bdr2.1448.

*Viviana Low Dog, M.D.*

## Foods with Glyphosate Residues



EFSA. The 2014 European Union report on pesticide residues in food. *EFSA J* 2016;14(10):1–139.  
 CFIA. Safeguarding with science: glyphosate testing in 2015–2016. in Canada: Canadian Food Inspection Agency; 2016. pp. 1–5.

- EFSA database: **soybeans, corn, barley, lentils, linseed, mustard seed, oats, sorghum, wheat, coffee beans, tea, beet root, and mushroom** with GLY residues.
- Canada: highest levels of GLY in **beans, peas, lentils, grains, infant cereal and baby food**, followed by **juice and other processed forms of fruits and vegetables**.
- GMO soy has high residues.

*Victoriana Low Dog, M.D.*

## Pollinators: The Honey Bee



Motta EVS, et al. Glyphosate perturbs the gut microbiota of honey bees. *Proc Natl Acad Sci USA* 2018 Oct 9;115(41):10305–10310.

- Honey bee gut microbiota dominated by **eight bacterial species** that promote weight gain and reduce pathogen susceptibility.
- Gene encoding EPSs in almost all sequenced genomes of bee gut bacteria, **indicating susceptible to glyphosate**.
- Relative and absolute abundances of dominant gut microbiota species are **decreased in bees exposed to glyphosate at concentrations documented in the environment**.

*Victoriana Low Dog, M.D.*

## Atrazine

- Second most widely used herbicide in US and most commonly detected pesticide in surface water: **it is a pervasive water contaminant**.
- **Endocrine disruptor, inhibiting luteinizing hormone production, increasing aromatase production**. Can feminize male frogs.
- **Immunotoxic effects and potential link to lymphoma**.
- **Banned by EU in 2004**.

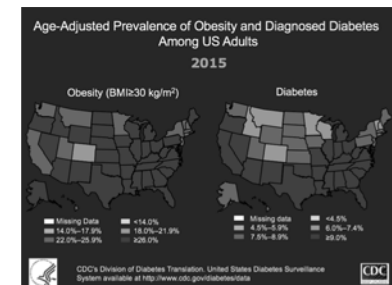


Thompson PA, et al. Environmental immune disruptors, inflammation and cancer risk. *Carcinogenesis* 2015; 36(Suppl 1): S232–S253.

*Victoriana Low Dog, M.D.*

## Atrazine and Obesity

- **Agricultural Health Study: exposure during pregnancy increases risk for gestational DM**.
- Chronic administration of **low concentrations of atrazine** in drinking water of rats decreased basal metabolic rate, and increased body weight, intra-abdominal fat and insulin resistance without changing food intake or physical activity level.



Lim S, et al. Chronic exposure to the herbicide, atrazine, causes mitochondrial dysfunction and insulin resistance. *PLoS One* 2009;4(4):e5186.

Saldana TM, et al. Pesticide exposure and self-reported gestational diabetes mellitus in the Agricultural Health Study. *Diabetes Care* 2007; 30(3):529–34

*Victoriana Low Dog, M.D.*

## Lymphoma and Drinking Water

- Incidence of non-Hodgkin lymphoma increased rapidly in rural areas and has been consistently higher in Nebraska than US as a whole.
- **Nebraska water high nitrate AND atrazine.**
- Drinking water containing nitrate was associated with a *nearly three-fold increase in risk for developing NHL if atrazine* was also present.
- Example of difficulty in predicting cumulative effect of multiple chemical exposures..



Rhoades MG, et al. *Environ Health Insights* 2013; 7:15-27

*Victoria Low Dog, M.D.*

## Atrazine and Low Birth Weight

- **2017 study:** association between **atrazine and preterm and very preterm birth** in Midwestern counties in which <10% of population uses well water.
- **14,445 live births in Ohio** communities enrolled in **EPA Atrazine Monitoring Program: significantly increased odds of low birth weight** associated with atrazine exposure, particularly during 1<sup>st</sup> and 2<sup>nd</sup> trimesters.



Stayner LT, et al. Atrazine and nitrate in drinking water and the risk of preterm delivery and low birth weight in four Midwestern states. *Environ. Res.* 2017;152:294-303.  
Almberg KS, et al. Atrazine Contamination of Drinking Water and Adverse Birth Outcomes in Community Water Systems with Elevated Atrazine in Ohio, 2006-2008. *Int J Environ Res Public Health* 2018 Aug 31;15(9): pii: E1889.

*Victoria Low Dog, M.D.*



## EWG's Tap Water Database

Since 2010, water utilities' testing has found pollutants in Americans' tap water, according to an EWG drinking water quality analysis of 30 million state water records.

[www.ewg.org/tapwater/](http://www.ewg.org/tapwater/)

Enter your zipcode

GO

or find your state

advanced search

*Victoria Low Dog, M.D.*

<https://www.ewg.org/tapwater/water-filter-guide.php>



## EWG's Updated Water Filter Buying Guide

Find the right filter for your water - and budget

What's most important to you in a water filter?

Whether you want the least expensive or most effective filter, a filter to soften hard water or one to remove specific

*Victoria Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Water

- One billion people lack access to potable water.
- Two billion lack access to adequate sanitation, over 3 billion people suffer from waterborne disease annually, many of whom die.
- The earth's water supply is shared, and finite.
- No pollution or contamination takes place in isolation, and the health of the world's waters has an enormous impact on the health of people everywhere.

*Vianna Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Mercury

- Bacteria in water can transform inorganic mercury into bio-active, organic form, called methylmercury, which concentrates to very high levels in fish.
- US Geological Survey of 291 freshwater streams between 1998-2005 found 100% of the larger fish tested positive for significant mercury exposure.
- Majority of mercury entering US rivers stems from emissions from coal mining. The emissions enter the air and then are precipitated back into water systems.

Scudder BC, et al. U.S. Geological Survey Scientific Investigations Report 2009-5109, 74 p.

*Vianna Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## FDA Advice



- Women of childbearing age and young children:
  - NO swordfish, shark, king mackerel, or tilefish.
  - Eat 12 ounces (340 g) fish and shellfish low in mercury per week.
  - Omega 3 crucial for optimal neurological development in the fetus and infant.
  - Take a prenatal vitamin with DHA.

*Vianna Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Seafood Calculator

[www.ewg.org/research/ewg-s-consumer-guide-seafood/seafood-calculator](http://www.ewg.org/research/ewg-s-consumer-guide-seafood/seafood-calculator)

Calculations are based on 4 oz. serving size

CATEGORY	SPECIES	WEEKLY MERCURY	SUSTAINABILITY	CONCLUSION
<b>EWG'S BEST BETS!</b> Very High Omega-3s, Low Mercury, Sustainable	SALMON	NuNu	Best Choice: Wild Alaska	⚖️ⓧ⚖️
	SARDINES	NuNu	Best Choice: Pacific	⚖️ⓧ⚖️
	MUSSELS	NuNu	Best Choice: Farmed	⚖️ⓧ⚖️
	RAINBOW TROUT	NuNu	Best Choice: Farmed	⚖️ⓧ⚖️
	ATLANTIC MACKEREL	NuNu	Best Choice: Not Trawled	⚖️ⓧ⚖️

*Vianna Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## To Reduce Exposure

- What is water source (may contain pesticide from shallow groundwater)? Recommend granulated active carbon filtration (or reverse osmosis)
- Know if your community has implemented a registry or alert system to notify individuals when planned pesticide applications are being done.
- Be an advocate for integrated pest management in homes, schools, day care center and businesses. Know how to recommend to patients.
- Dust, vacuum, and ventilate home often.
- Counsel patients about dietary modifications: purchase organic, wash produce, peel off outer layers leafy veggies, remove peels, trim fat/skin from meat/poultry/fish.

*Vianna Low Dog, M.D.*

*Knowing is not enough, we must apply.*

*Willing is not enough, we must do.*

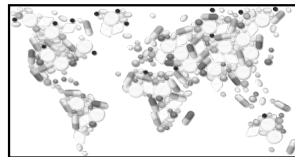
*Goethe*

*Vianna Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Pharmaceuticals in the Environment

Over 200 different pharmaceutical agents, including antibiotics, NSAIDs, analgesics, lipid-lowering drugs, estrogens, anti-depressants and others, have been detected in aquatic and terrestrial environments around the world, including areas as remote as the Antarctic.



Murdoch K. [www.ntn.org.au/wp/wp-content/uploads/2015/05/NTN-Pharmaceutical-Pollution-in-the-Environment-2015-05.pdf](http://www.ntn.org.au/wp/wp-content/uploads/2015/05/NTN-Pharmaceutical-Pollution-in-the-Environment-2015-05.pdf) Accessed September 12, 2016

*Vianna Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

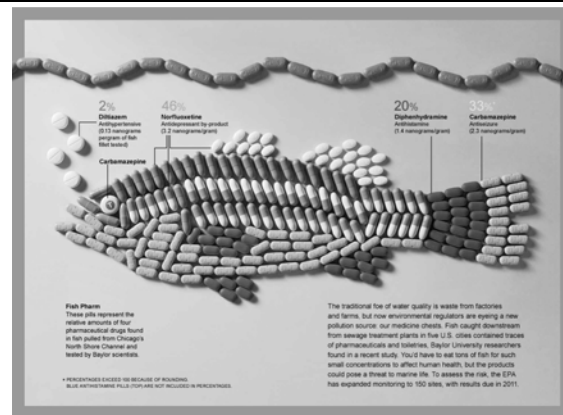
## Pharmaceuticals in Water and Soil

- Over four billion pharmaceutical prescriptions filled last year in US and is expected to increase in coming years.
- Continually increasing trends in prescription usage means that active pharmaceutical ingredients have an ever-growing presence in the natural environment.
- Pharmaceuticals are nearly ubiquitous in most environmental media as a result of improper disposal and normal human excretion.

• Suchomel A, et al. A Method for Developing Rapid Screening Values for Active Pharmaceutical Ingredients (APIs) in Water and Results of Initial Application for 119 APIs. *Int J Environ Res Public Health* 2018 Jul; 15(7): 1308.

*Vianna Low Dog, M.D.*





Source: National Geographic Magazine

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

Victoria Low Dog, M.D.

## Antibiotics in the Environment

- Antibiotics highly successful pharmaceuticals used in human and veterinary therapy.
- Large amounts wind up in municipal wastewater due to human excretion or improper disposal.
- Run off sludge and water from animal feedlots contribute large amounts into ecosystem.
- US: 2 million people infected with antibiotic resistant organisms and 23,000 people die each year as a direct result (CDC)

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

Victoria Low Dog, M.D.

## Multi-Antibiotic Resistance in Streams

- Screening **427 *Escherichia coli* strains** isolated from **11 locations on nine streams** draining into Savannah River against panel of antibiotics.
- **>40 % of strains demonstrated resistance to 10 or more antimicrobials**, suggesting environmental **multi-antibiotic resistance**.
- Among multi-antibiotic-resistant isolates, several demonstrated resistance to **all structural classes of antimicrobial agents tested**, including frontline antibiotics such as gatifloxacin and ciprofloxacin.

McArthur JV, et al. Patterns of Multi-Antibiotic-Resistant *Escherichia Coli* from Streams with No History of Antimicrobial Inputs.  
*Microb Ecol* 2016 Nov;72(4):840-850.

Victoria Low Dog, M.D.

*"(Our bodies) are not distinct from the bodies of plants and animals, with which we are involved in the cycles of feeding and in the intricate companionships of ecological systems and of the spirit.... It is therefore absurd to approach the subject of health piecemeal with a departmentalized band of specialists... Our fragmentation of this subject cannot be our cure, because it is our disease."*

Wendell Berry, *The Unsettling of America*Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

Victoria Low Dog, M.D.

# And Another Way of Thinking About Environmental Health



*Victoria Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Where Would You Want to Play?



*Victoria Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.



## Where Would You Want to Learn?



*Victoria Low Dog, M.D.*

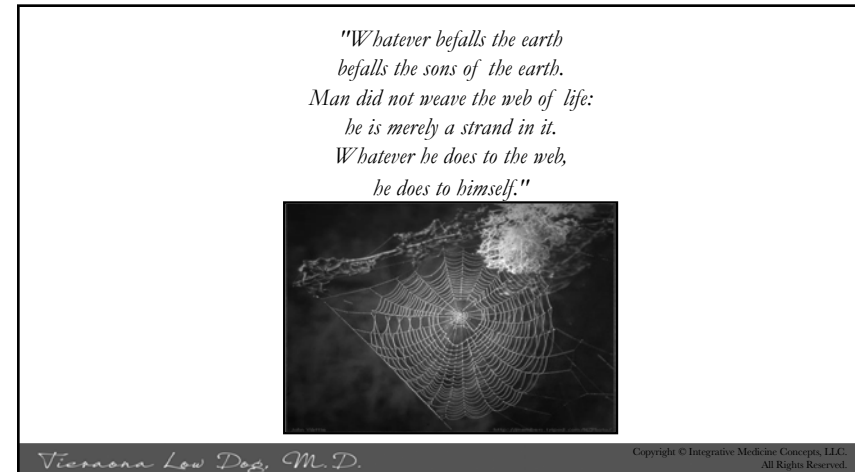
Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.

## Where would you want to heal?



*Victoria Low Dog, M.D.*

Copyright © Integrative Medicine Concepts, LLC.  
All Rights Reserved.



## Resources

- ToxTown: <https://toxtown.nlm.nih.gov/>
- Pesticides Matter from UCSF: downloadable brochure for patients [https://prhe.ucsf.edu/sites/g/files/tksra341/f/PM\\_Brochure\\_en\\_pr\\_int.pdf](https://prhe.ucsf.edu/sites/g/files/tksra341/f/PM_Brochure_en_pr_int.pdf)
- Consumer Guide: Phthalates and Bisphenol A by PEHSU [https://www.pehsu.net/Library/facts/bpapatients\\_factsheet03-2014.pdf](https://www.pehsu.net/Library/facts/bpapatients_factsheet03-2014.pdf)
- National Institute of Environmental Health Sciences Brochures and Fact Sheets: <https://www.niehs.nih.gov/health/materials/index.cfm>

Viviana Low Dog, M.D.

## Resources

- Environmental Working Group [www.ewg.org](http://www.ewg.org)
- Integrated Pest Management [www.beyondpesticides.org](http://www.beyondpesticides.org)
- National Pesticide Information Center <http://www.npic.orst.edu/factsheets/MinimizingExposure.html>
- Organic Store Locator [www.organicstorelocator.com](http://www.organicstorelocator.com)
- Farmer's Markets/Organic Farms [www.localharvest.org](http://www.localharvest.org)

Viviana Low Dog, M.D.