

Roundup and GMOs: Are we gambling with the future of food?

Stephanie Seneff

MIT CSAIL

July 29, 2014

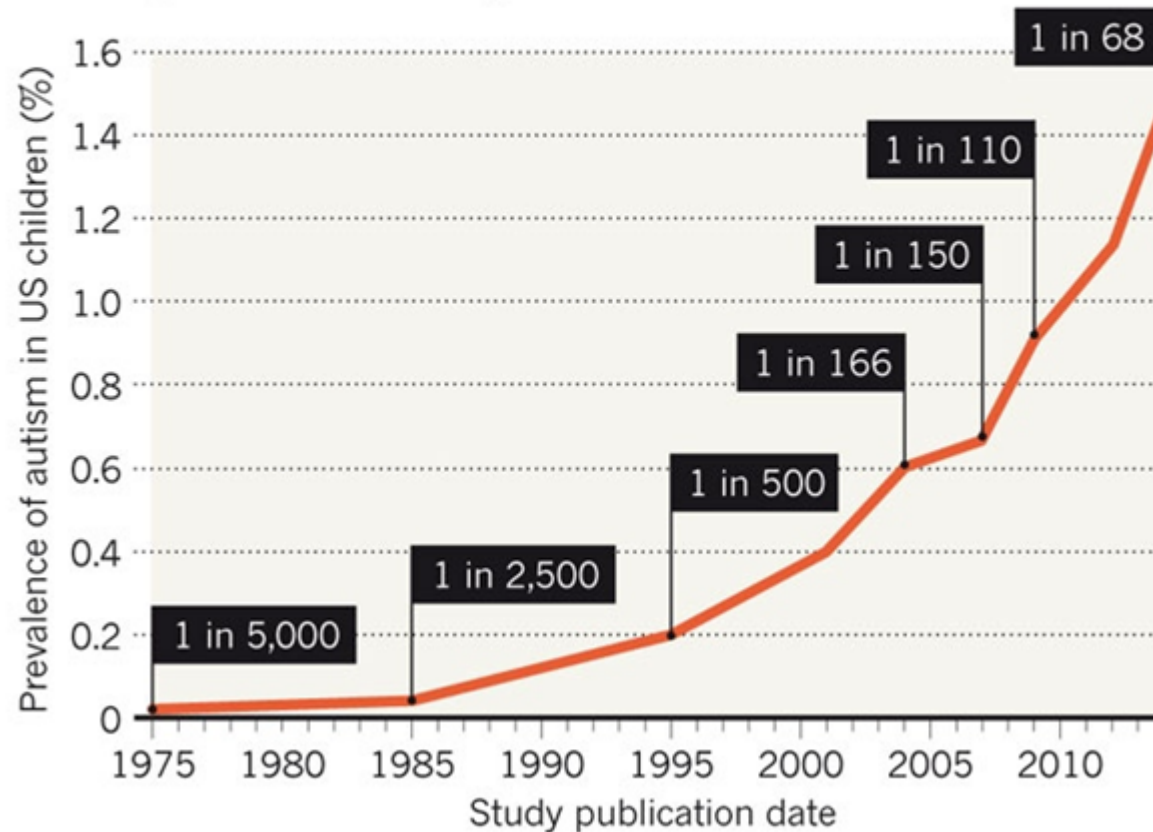


**“There are three things that
can’t be long hidden:
the sun, the moon and the truth”
--Buddha**

A Frightening Trend*

AUTISM DIAGNOSES RISING

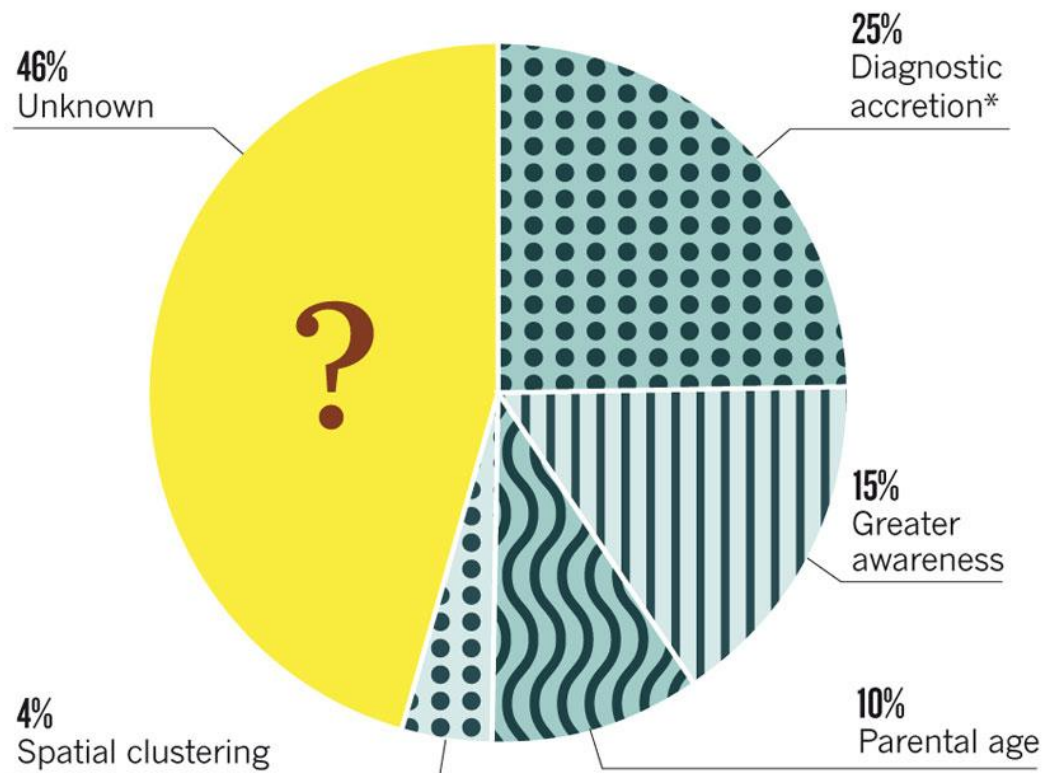
Almost 1.5% of US children are now diagnosed with autism, according to data from 11 regions in the United States.



*K. Weintraub, Nature 479, Nov. 3 2011, 22-24.

“If it is an environmental cause contributing to an increase, we certainly want to find it.”*

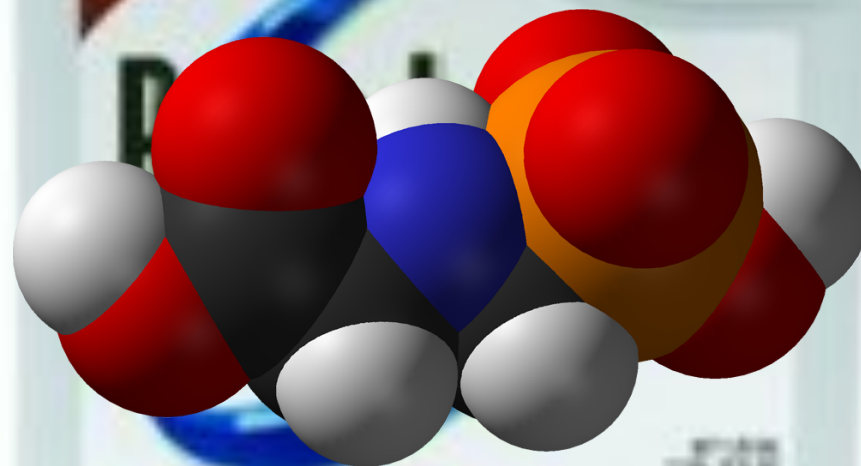
Reasons: unclear



*Children who formerly would have been diagnosed solely with mental retardation

*K. Weintraub, Nature 479, Nov. 3 2011, 22-24.

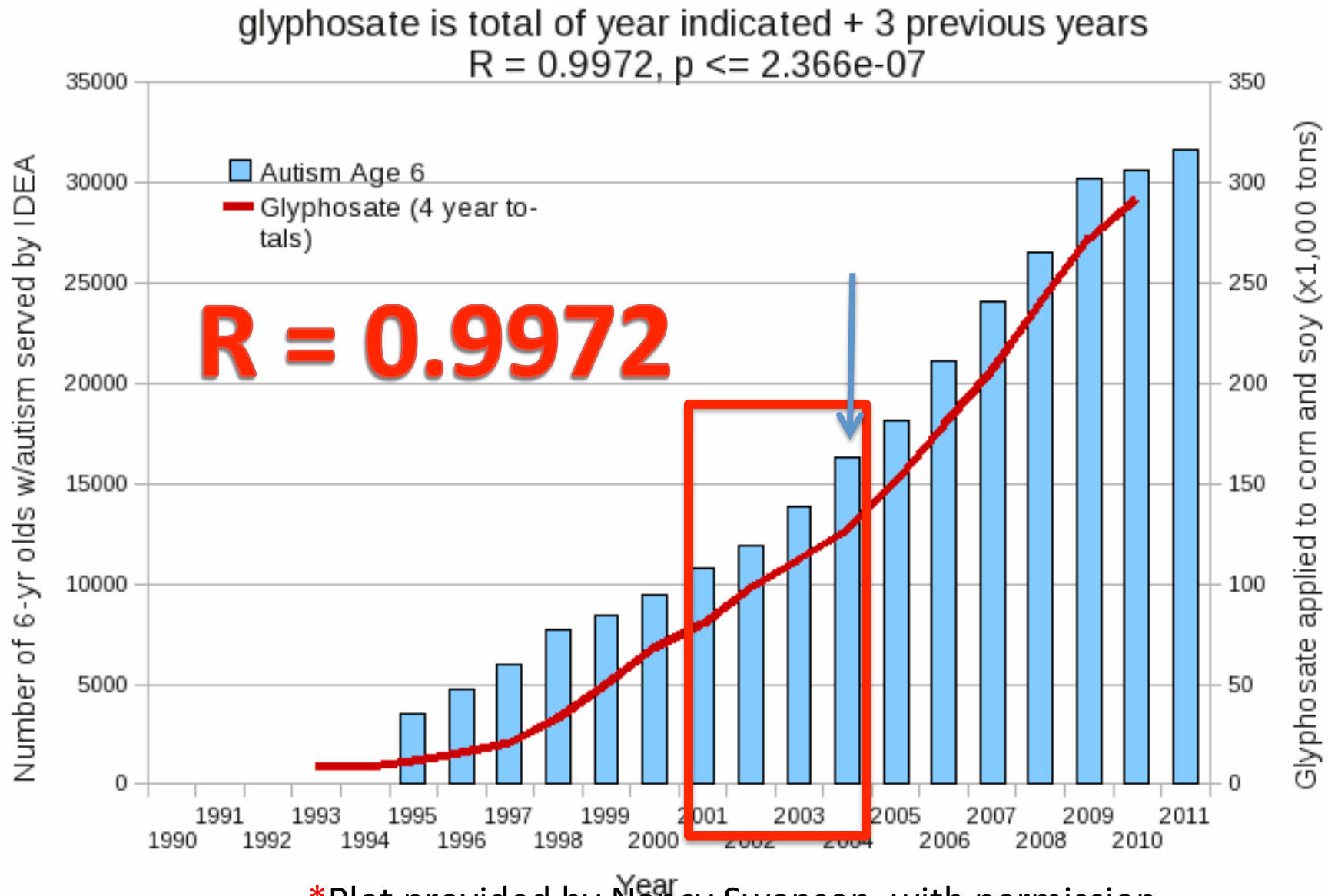
GLYPHOSATE



Glyphosate and Autism

草甘膦和自閉症

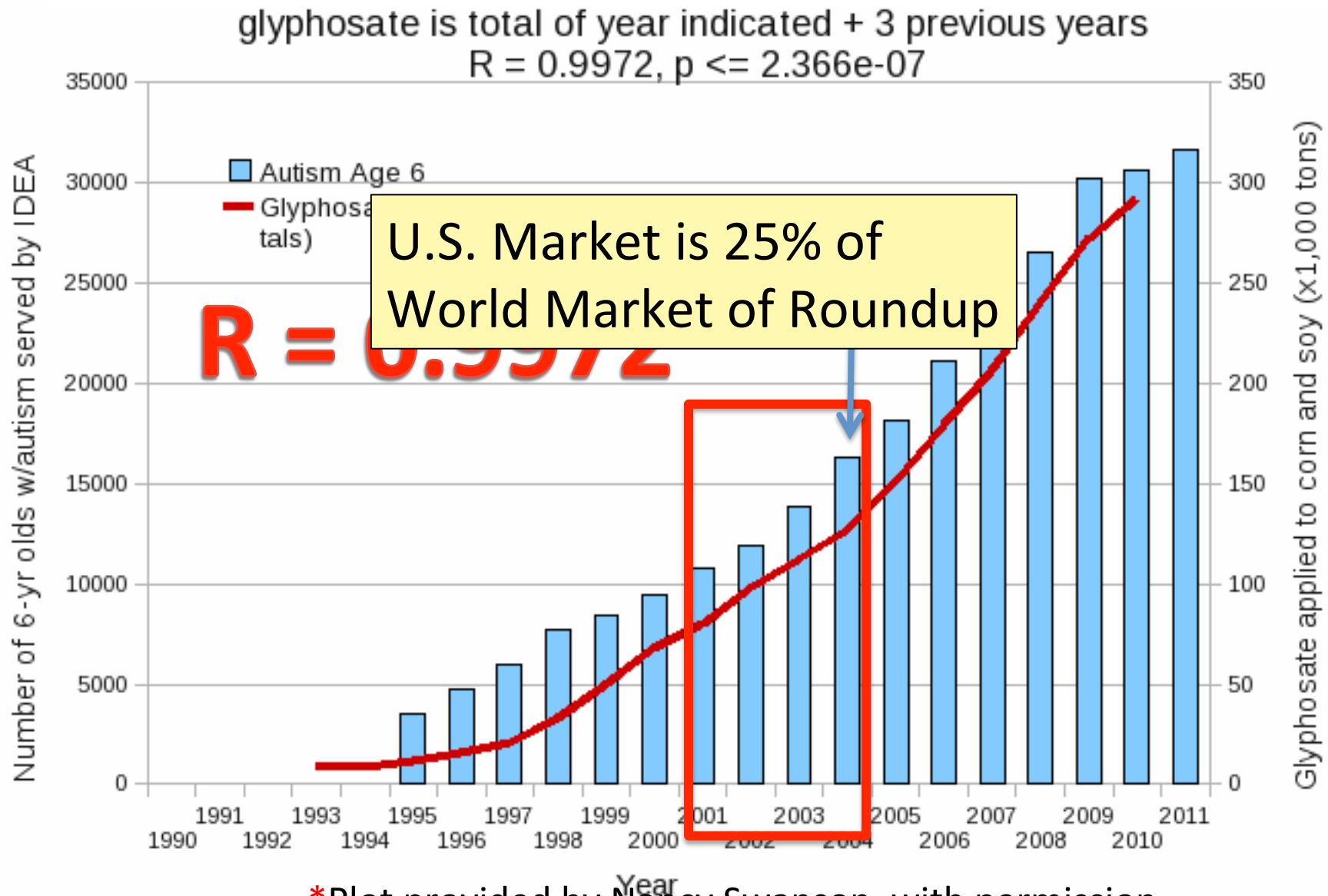
Autism Prevalence: 6 year olds



* Plot provided by Nancy Swanson, with permission

Data sources: autism: US Department of Education; Glyphosate: US Department of Agriculture

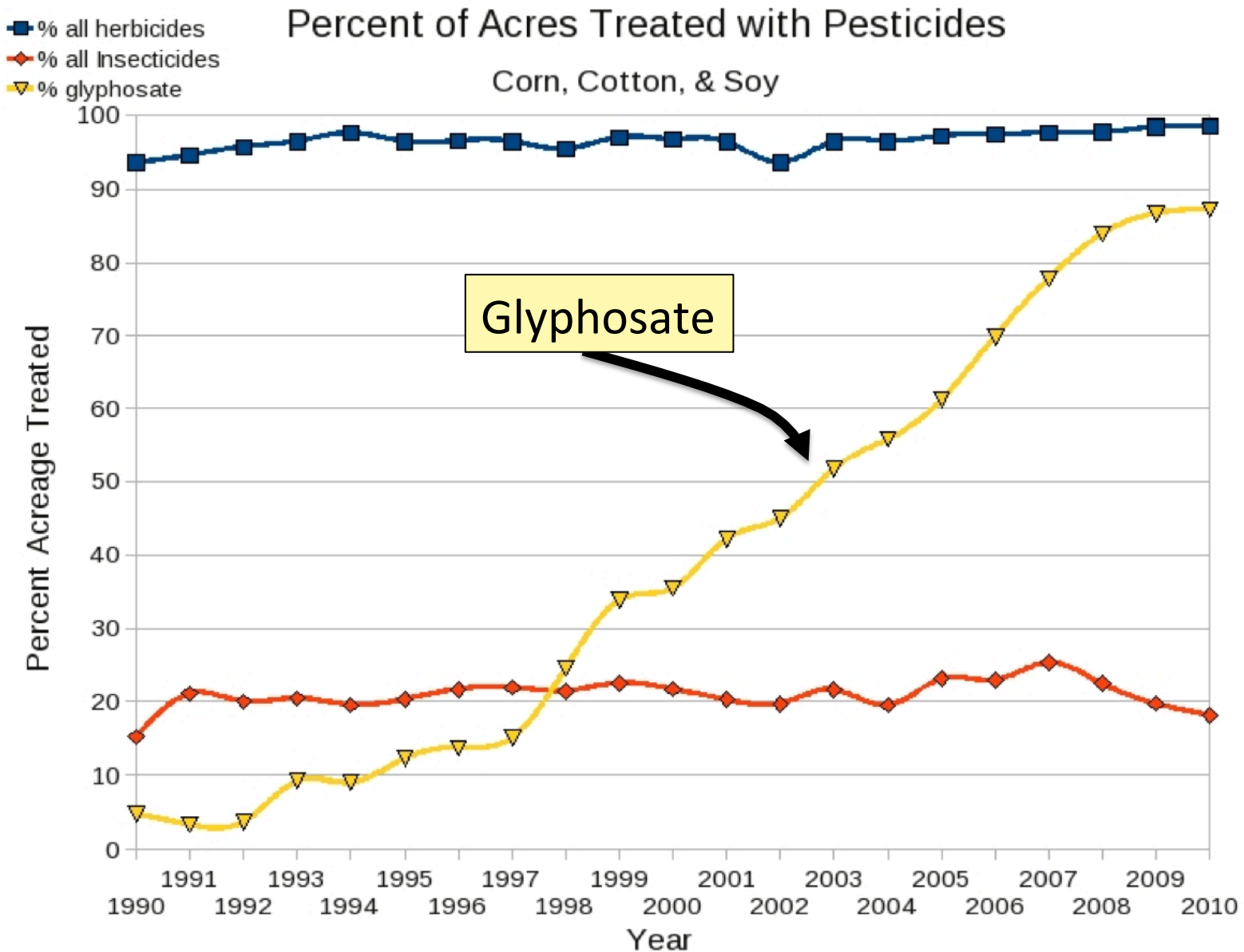
Autism Prevalence: 6 year olds



* Plot provided by Nancy Swanson, with permission

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Glyphosate vs. Other Pesticides*

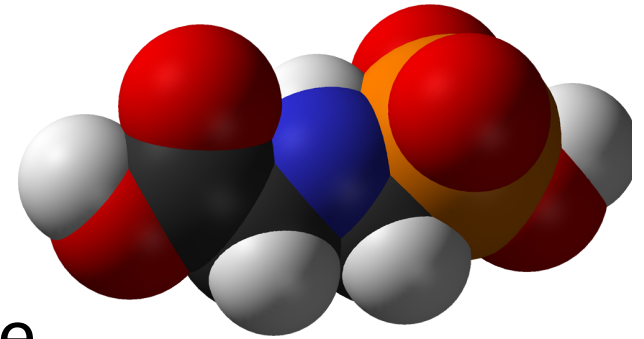


*<http://sustainablepulse.com/wp-content/uploads/GMO-health.pdf>

A Brief History of Glyphosate

- Glyphosate is the active ingredient in the pervasive herbicide, Roundup[®]
- GMO “Roundup Ready” soy, corn, canola, sugar beets, cotton, tobacco and alfalfa
 - Plants soak up the glyphosate and don’t die
- Roundup-Ready crops → Roundup-Ready weeds
- Monsanto assures regulatory bodies that glyphosate is practically nontoxic to humans
 - Disrupts shikimate pathway which our cells don’t have
- Very little monitoring of glyphosate levels in food

Is Glyphosate Toxic?



- Monsanto has argued that glyphosate is harmless to humans because our cells don't have the shikimate pathway, which it inhibits
- However, our gut bacteria DO have this pathway
 - We depend upon them to supply us with essential amino acids (among many other things)
- Other ingredients in Roundup greatly increase glyphosate's toxic effects
- Insidious effects of glyphosate accumulate over time
 - Most studies are too short to detect damage

Main Toxic Effects of Glyphosate*

- Kills beneficial gut bacteria and allows pathogens to overgrow
- Interferes with function of cytochrome P450 (CYP) enzymes
- Chelates important minerals (iron, cobalt, manganese, etc.)
- Interferes with synthesis of aromatic amino acids and methionine
 - Leads to shortages in critical neurotransmitters and folate
- Disrupts sulfate synthesis and sulfate transport

**Samsel and Seneff, Entropy 2013, 15, 1416-1463*

The Enhancing Effect of Adjuvants*

“Adjuvants in pesticides are generally declared as inerts, and for this reason they are not tested in long-term regulatory experiments. It is thus very surprising that they amplify *up to 1000 times* the toxicity of their APs [Active Principles] in 100% of the cases where they are indicated to be present by the manufacturer.”

*R. Mesnage et al. BioMed Research International 2014; Article ID:179691.

Roundup Safety Claims Disputed*

“It is commonly believed that Roundup is among the safest pesticides. ... Despite its reputation, *Roundup was by far the most toxic among the herbicides and insecticides tested.* This inconsistency between scientific fact and industrial claim may be attributed to huge economic interests, which have been found to falsify health risk assessments and *delay health policy decisions.*”

*R. Mesnage et al., Biomed Research International, Volume 2014 (2014), Article ID 179691

Okay, It's toxic!
But are we exposed?

Very little data!

Autism and Pesticide Exposure during Pregnancy*

“In general, exposure during the *third trimester* appeared to be riskiest, and odds of having a child with autism went up the closer the family had been living to the pesticide application, suggesting that doses got higher the nearer women were to the chemicals.”

*[cbsnews.com/news/pesticide-exposure-in-pregnancy-linked-to-autism-risk-in-kids](https://www.cbsnews.com/news/pesticide-exposure-in-pregnancy-linked-to-autism-risk-in-kids)

Glyphosate in Air and Rain*

- Study conducted by the US Geological Survey in Mississippi
- 18-fold increase in glyphosate application since 1995



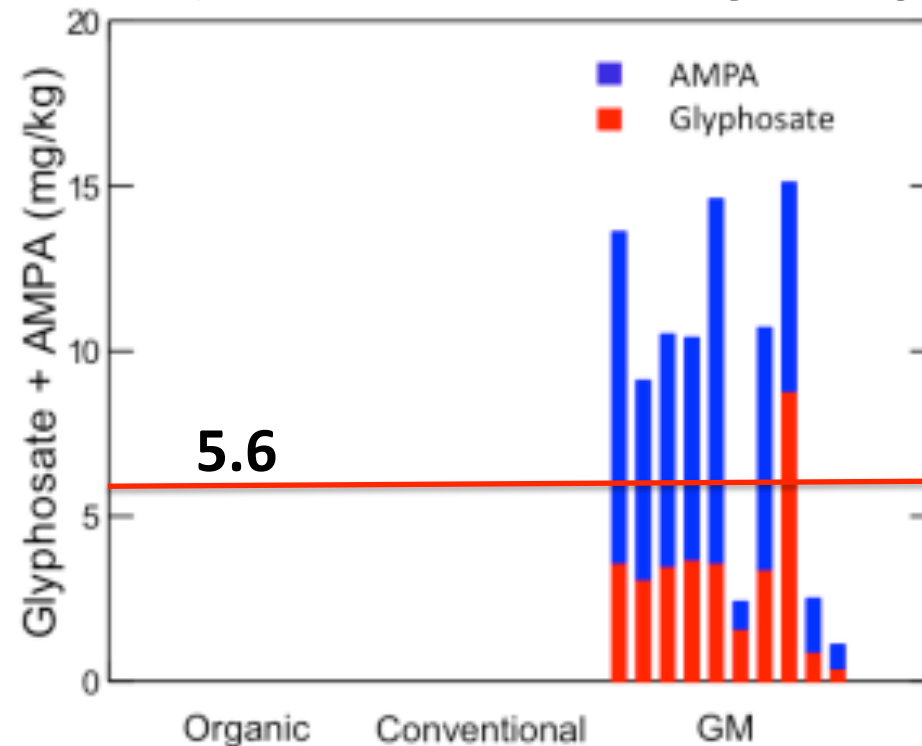
Glyphosate was the predominant new herbicide detected in both air (86%) and rain (77%) in 2007 (not measured in 1995)

*M.S Majewski et al., Environ Toxicol Chem. 2014 Feb 19. Epub ahead of print.

Glyphosate Test Report: Findings in American Mother's Breast milk, urine and water*

- ***Moms Across America*** initiative!
- Breast milk levels ranging from 76 ug/l to 166 ug/l are 760 to 1600 times higher than the European Drinking Water Directive allows
- Urine testing shows glyphosate levels over 10 times higher than in Europe
- Monsanto is wrong regarding bioaccumulation

Study of glyphosate and AMPA (breakdown product) residues in soy crops*



“Another claim of Monsanto's has been that residue levels of up to **5.6** mg/kg in GM-soy represent “...*extreme levels*, and far higher than those typically found” (Monsanto 1999).

Soy Formula Linked to Seizures in Autism*

"There was a 2.6-fold higher rate of febrile seizures, a 2.1-fold higher rate of epilepsy comorbidity and a 4-fold higher rate of simple partial seizures in the autistic children fed soy-based formula"



*CJ Westmark, PLOSOne March 12, 2014, DOI: [10.1371/journal.pone.0080488](https://doi.org/10.1371/journal.pone.0080488).

Some Biomarkers for Autism

- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate
- Methionine deficiency
- Serotonin and melatonin deficiency
- Defective aromatase
- Zinc and iron deficiency
- Urinary p-cresol
- Mitochondrial disorder
- Seizures; Glutamate toxicity in the brain

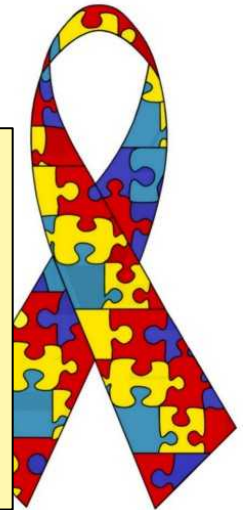


Some Biomarkers for Autism

- Disrupted gut bacteria; inflammatory bowel
- Low serum sulfate

These can all be explained as potential effects of glyphosate on biological systems*

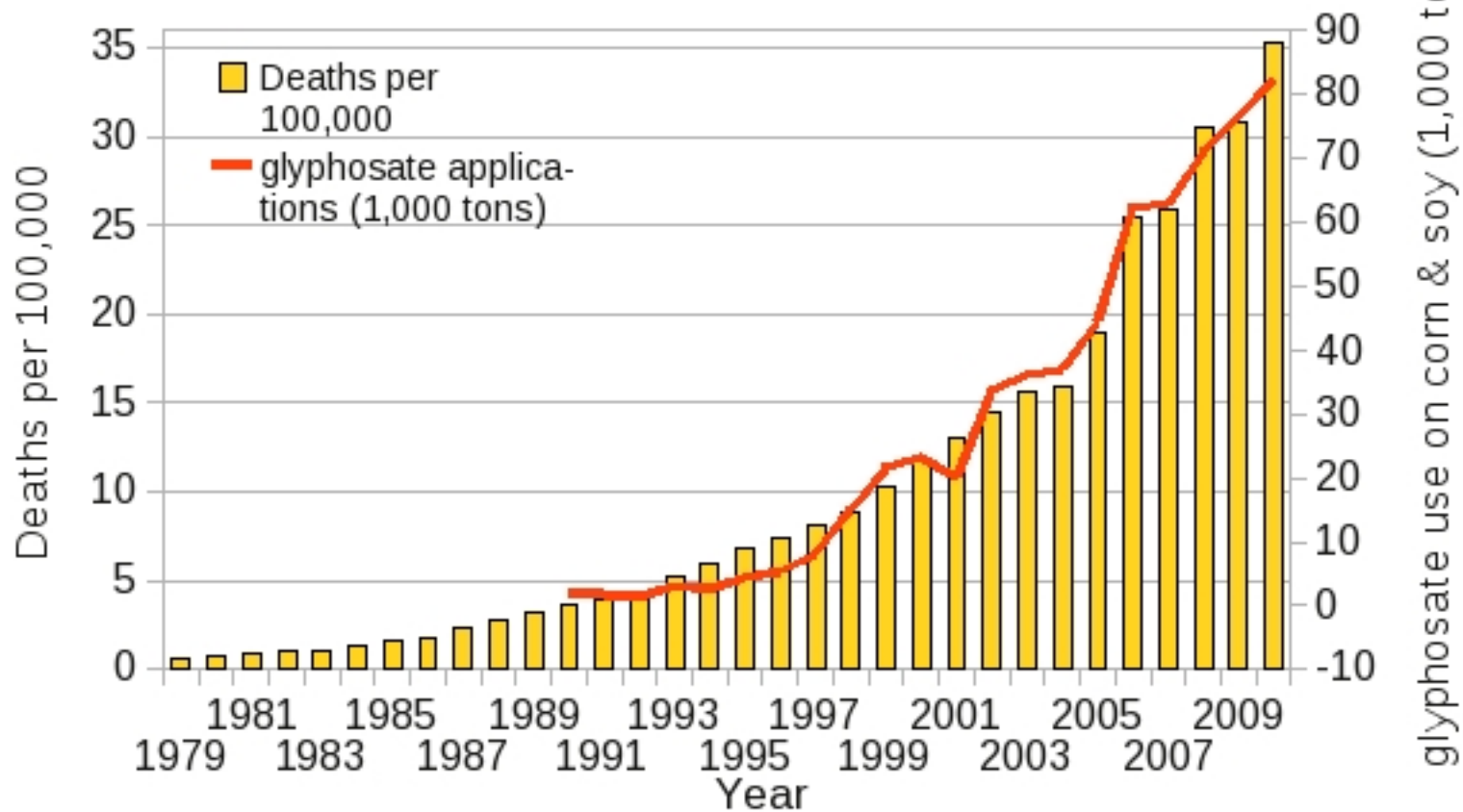
- Zinc and iron deficiency
- Urinary p-cresol
- Mitochondrial disorder
- Seizures; Glutamate toxicity in the brain



*A Samsel and S Seneff, Entropy 2013, 15, 1416-1463

Dementia (癡呆症) and Autism Have Much in Common

Deaths from Senile Dementia (ICD F01, F03 & 290)
plotted against glyphosate applications on corn & soy
($R = 0.9933$, $p \leq 1.947e-09$) sources: USDA:NASS; CDC



Plot kindly provided by Nancy Swanson

Digestive System Disorders

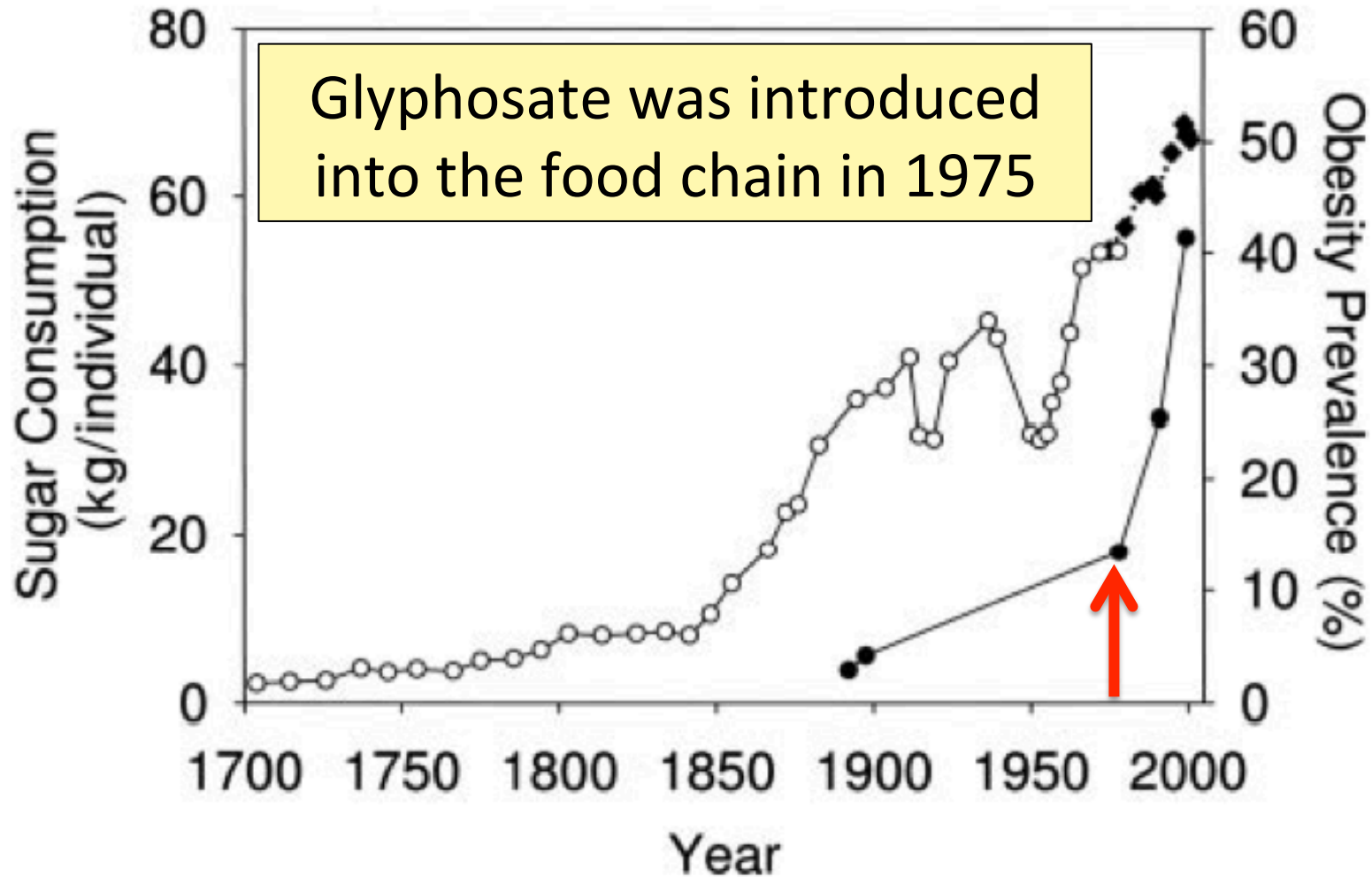
Gut Microbes and Obesity

- Our microbes outnumber our own cells 10 to 1
- There are between 200 and 300 different species in a typical person.
- Glyphosate causes a loss of beneficial bacteria and an overgrowth of pathogens in the gut
 - Pathogens release toxic phenols (e.g., p-cresol)
 - This can lead to inflammatory bowel disease
 - And a direct path to obesity!
- Gut microbes from an obese person induced obesity in mice*

*N. Fei and L. Zhao, The ISME Journal, Online Publication Dec. 2012

wallpaperzz.com

Obesity in US over Time*

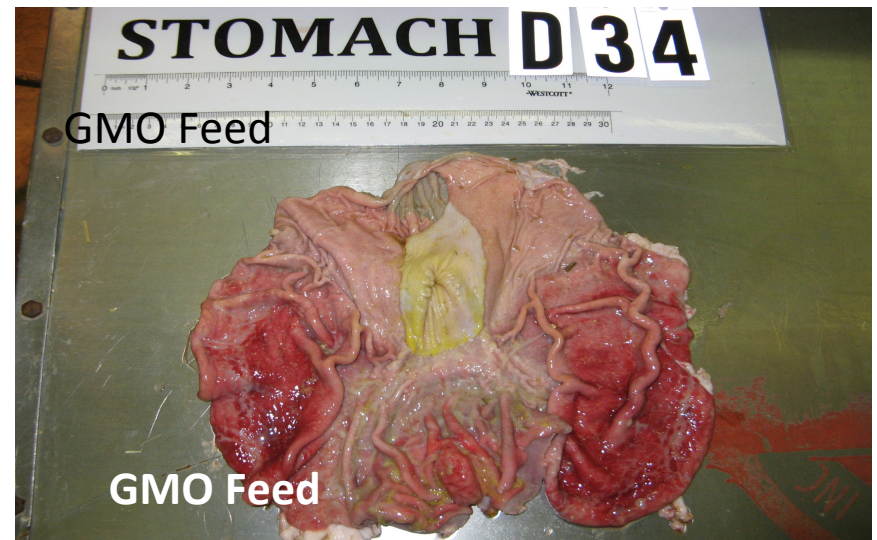
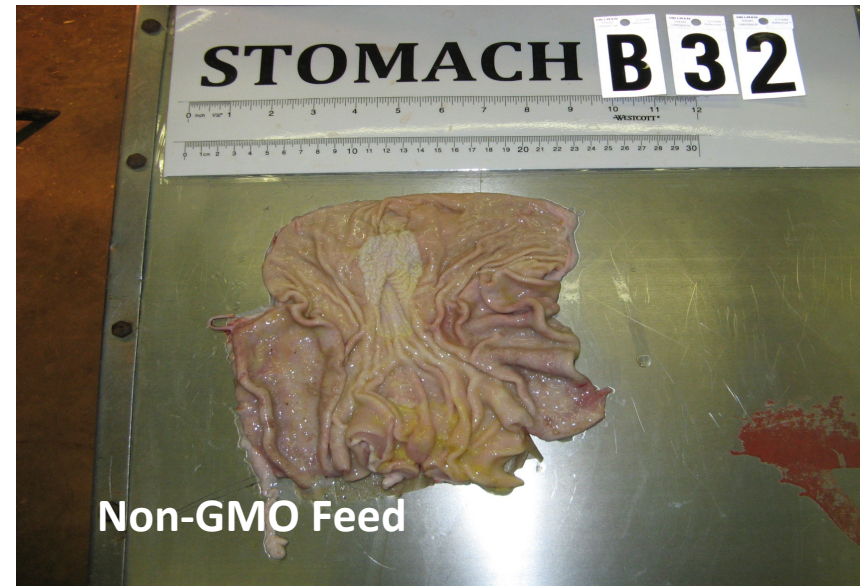


*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.

Pigs Fed GMOs Develop Inflamed Gut*

- Blind autopsies conducted
 - Female pigs' uterus 25% larger in GMO-fed pigs
 - Female pigs 2.2x more likely to get severe stomach inflammation on GMO diet
 - Males were 4x more likely

Photos kindly provided by Howard Vlieger



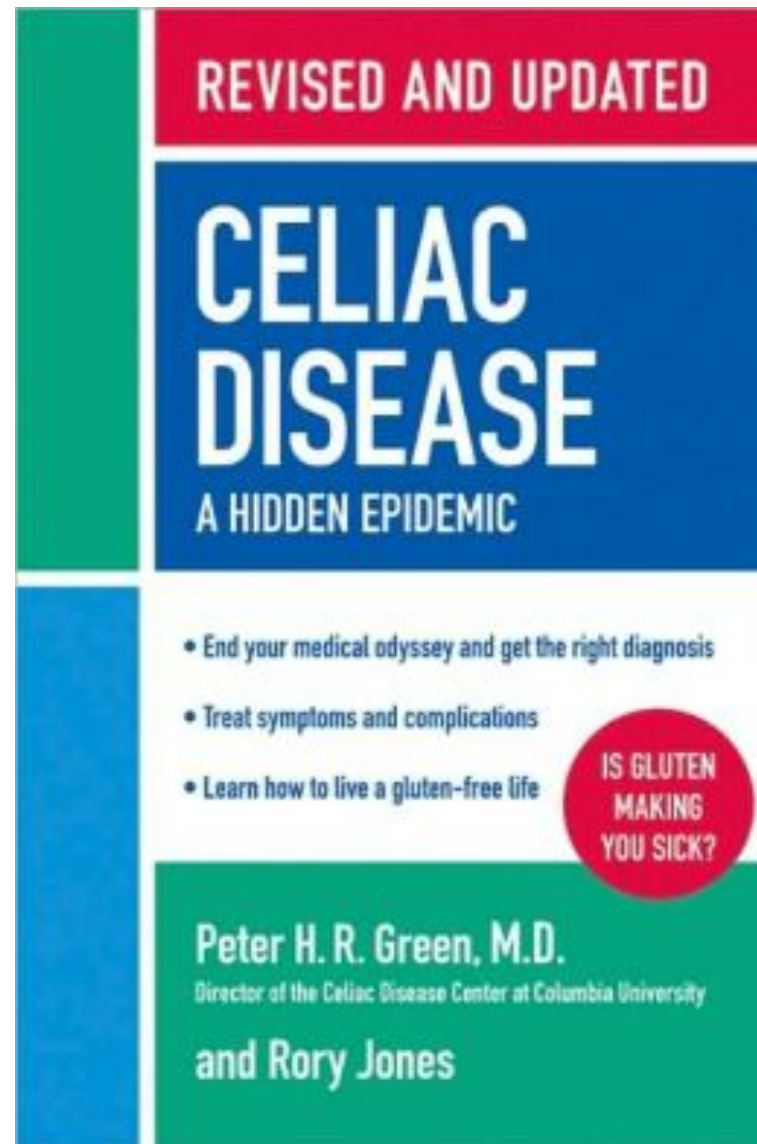
*J.A. Carman et al., *Journal of Organic Systems*, 8(1), 2013.

Human Digestive System Disorders

- Alarming increase in the US in many diseases related to the gut
 - Crohn's disease, inflammatory bowel disease, colitis, acid reflux disease, gluten and casein intolerance, celiac disease, leaky gut
- The gut-brain axis links neurological disorders with gut disorders
- I believe that glyphosate is a major cause



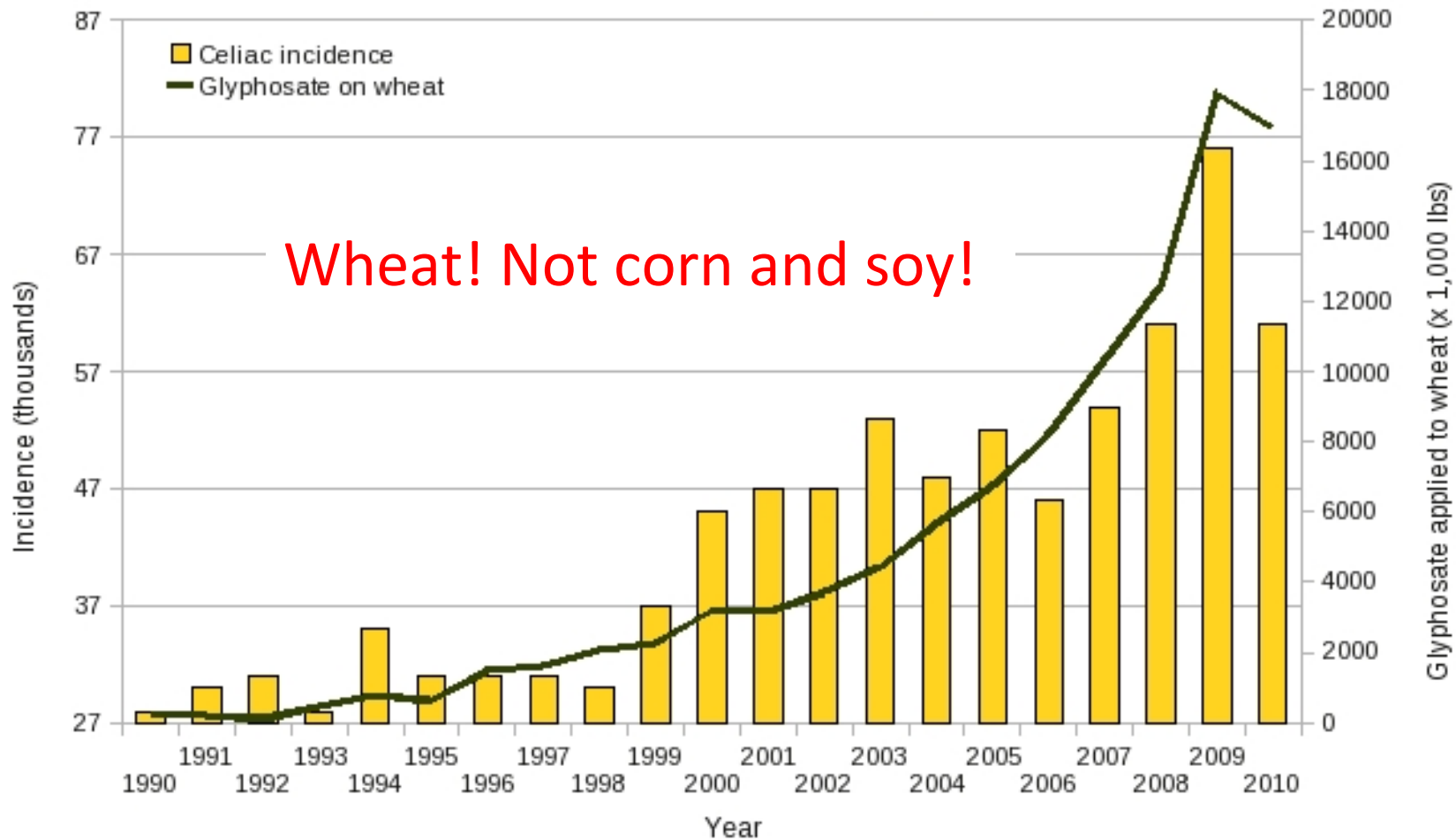
Celiac Disease has Quadrupled in the US in the Last 50 Years



Hospital Discharge Diagnosis (any) of Celiac Disease ICD-9 579

and glyphosate applications to wheat ($R = 0.9759$, $p \leq 1.862e-06$)

sources: USDA:NASS; CDC



Graph provided by Nancy Swanson, with permission

**Why is glyphosate usage
on wheat going up?**

“Herbicide Resistant Ryegrass Troubling for Wheat Growers”*

“If you see ryegrass at harvest following an Axial XL application, it may be resistant. And you can scatter seed all over the field with the combine.”

“A reduced-tillage approach, using a *burndown herbicide* ahead of planting in a stale seedbed, also holds promise for improved control.”

“ ‘We may be able to knock out 80% to 90% of the resistant ryegrass with glyphosate.’ ”

-- Jim Swart, integrated pest management specialist

*Ron Smith, Western Farm Press, Mar. 23, 2013

Human Dietary Experiment on Wheat & Inflammatory Bowel Syndrome*

- Significant improvement in symptoms with dietary organic wheat from ancient source

- Abdominal pain ($P < 0.0001$)
- Bloating ($P = 0.004$)
- Stool consistency ($P < 0.001$)
- Tiredness ($P < 0.0001$)



- Reduced pro-inflammatory cytokines: IL-6, IL-17, interferon-gamma, VEGF

*F. Sofi et al., Br J Nutr. 2014 Feb 13:1-8. [Epub ahead of print]

Paper on Glyphosate and Celiac Disease

Interdiscip Toxicol. 2013; **Vol. 6**(4): 159–184.
doi: 10.2478/intox-2013-0026

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www.intertox.sav.sk & www.versita.com/it

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REVIEW ARTICLE

Glyphosate, pathways to modern diseases II: Celiac sprue and gluten intolerance

Anthony SAMSEL¹ and Stephanie SENEFF²

Celiac Disease, Glyphosate and Non-Hodgkin's Lymphoma

- Bifidobacteria are depleted in celiac disease*
 - They convert gluten to less toxic form
- Glyphosate preferentially kills bifidobacteria**
- Celiac disease is associated with increased risk to non-Hodgkin's lymphoma***
- Glyphosate itself is also linked directly to non-Hodgkin's lymphoma****

*M. Velasquez-Manoff, NY Times Sunday Review, Feb. 23, 2013

**A.A. Shehata et al., Curr Microbiol. 2013 Apr;66(4):350-8.

*** C. Catassi et al., JAMA. 2002 Mar 20;287(11):1413-9.

****M. Eriksson et al., Int J Cancer. 2008 Oct 1;123(7):1657-63.

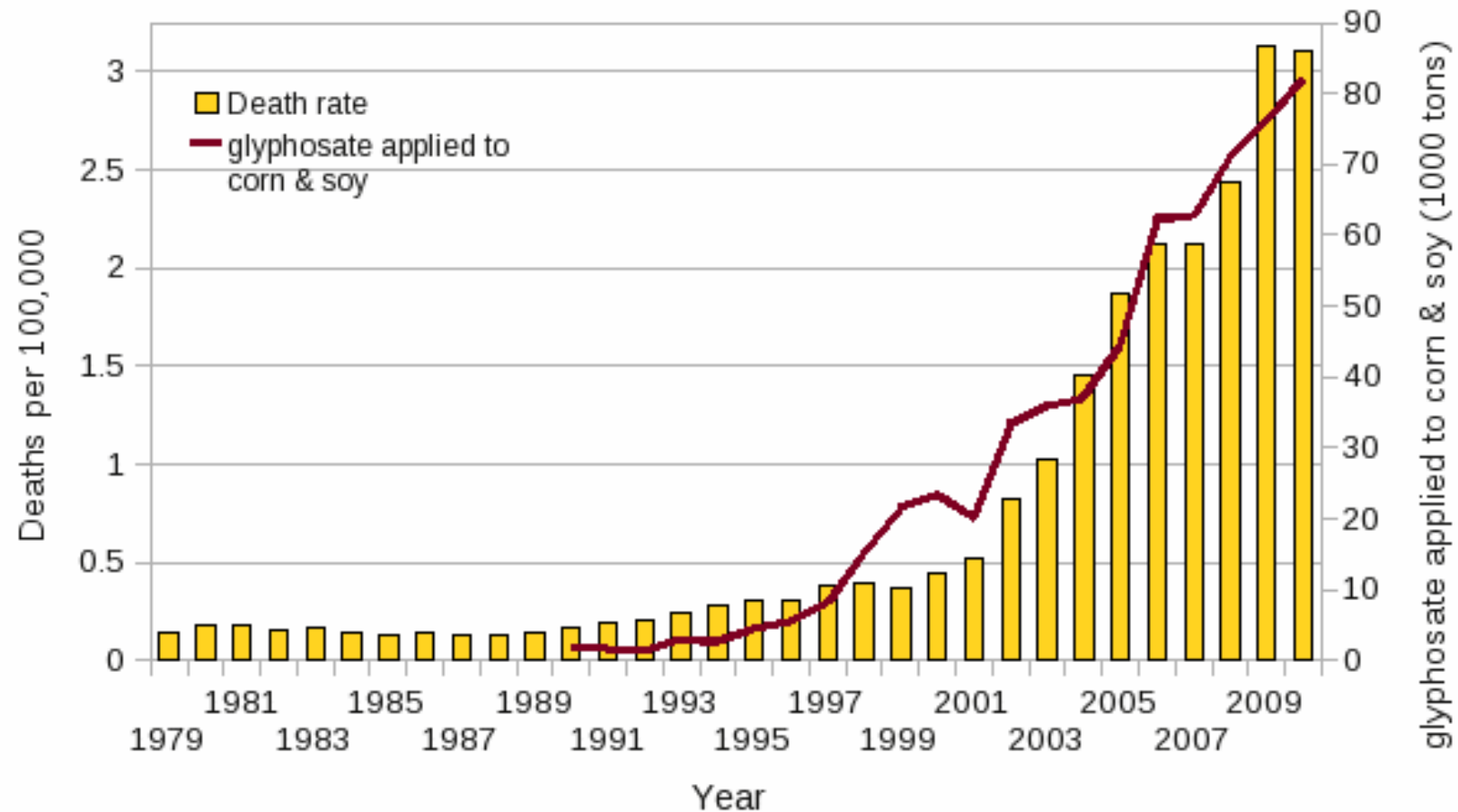
“Dramatic Increase in Hospitalization of US Children With Inflammatory Bowel Disease”*

- Study conducted at Case Western Reserve University School of Medicine
- > 11 Million hospitalization records examined
- Patients < 20 years old
 - 49% increase from 2000 to 2009 in Crohn’s disease discharges
 - 71% increase in ulcerative colitis discharges

* Science Daily, June 25, 2013

Age Adjusted Deaths due to Intestinal Infection (ICD A04, A09; 008, 009)

plotted against glyphosate applied to corn & soy ($R = 0.9738$, $p \leq 7.632e-09$)
Sources USDA:NASS; CDC



*Plot prepared by Nancy Swanson from available data online

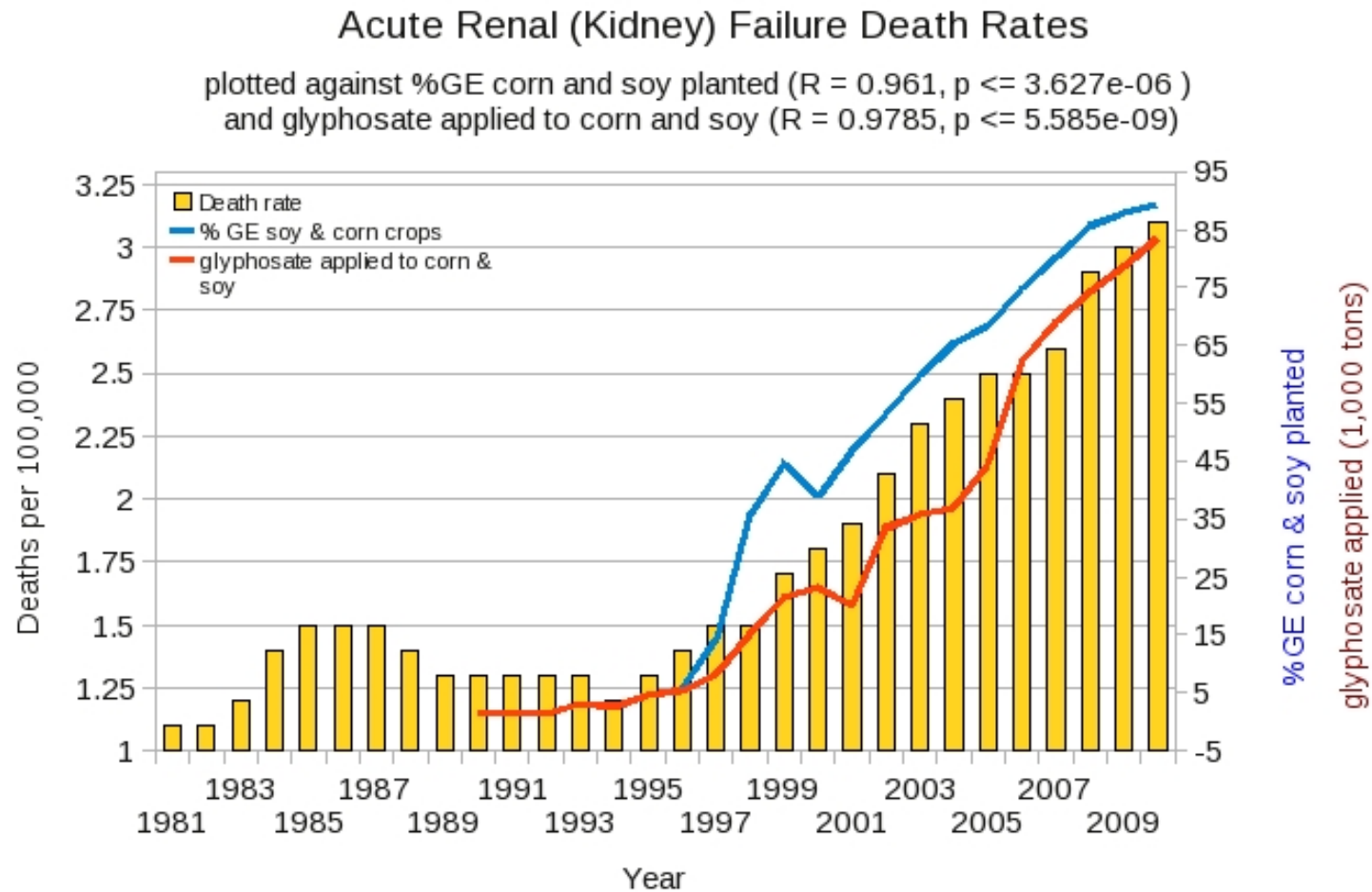
Kidney Failure in Agricultural Workers*

- Workers in sugarcane fields in Central America and in India are dying at a young age in record numbers from kidney failure
- Arsenic exposure from drinking water?
- Excess use of tylenol?

Glyphosate disrupts the enzyme that breaks down tylenol, leading to tylenol toxicity

*ticotimes.net, San Jose, Costa Rica, August 8, 2013.

Acute Kidney Disease Death Rate Plotted Against Glyphosate and GMOs*



*Plot prepared by Nancy Swanson from available data online

Sri Lanka is the first
Country to Ban Glyphosate

Hypothesis

**Glyphosate, Hard Water and Nephrotoxic Metals: Are They the
Culprits Behind the Epidemic of Chronic Kidney Disease of
Unknown Etiology in Sri Lanka?** **arsenic**

Another Country Responds to Kidney Failure in Agricultural Workers!



Recapitulation

- We depend on our gut bacteria in many ways
 - Bacteria from an obese person induce obesity in mice
- Glyphosate is an antibiotic that preferentially kills the good bacteria
 - Pigs fed GMO corn and soy develop inflammatory gut
 - Humans are experiencing an epidemic in gut disorders like inflammatory bowel disease and gluten intolerance
 - Due to herbicide-resistant rye grass, farmers use glyphosate as a desiccant at harvest time
- Kidney failure among agricultural workers can be explained by glyphosate

**Hexane (正己烷),
Glyphosate and Aluminum
in Vaccines**

Soybean Oil and Protein Products*

Heavily used in processed foods

- “White flakes” made by defatting soybeans by *hexane* extraction
- Protein isolate and soy lecithin
- Fat separated into soybean oil and used in soy infant formula



* EW Lusas and MN Riaz, J Nutr 1995, 125(3 Suppl): 573S-580S.

Protein Bars!

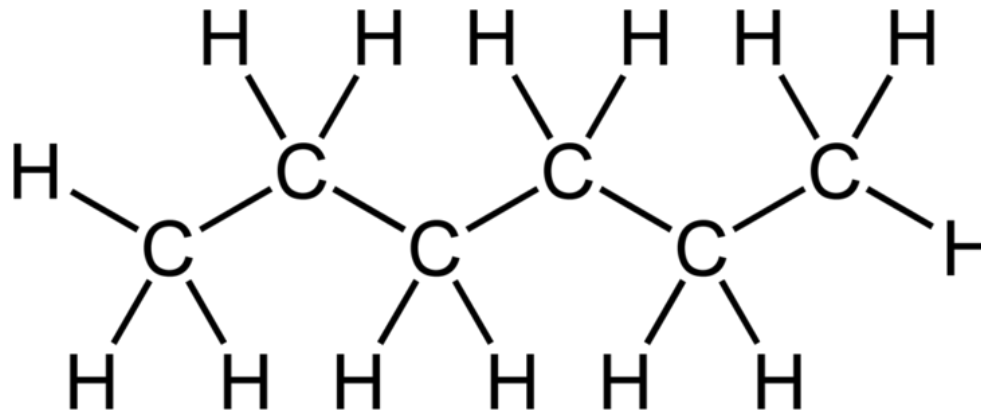
“Most soy protein ingredients in meat analogs and nutrition bars, which are listed on labels as soy protein isolate, soy protein concentrate or textured vegetable protein, have undergone *hexane* processing.”*



*berkeleywellness.com/healthy-eating/food-safety/article/hexane-soy-food

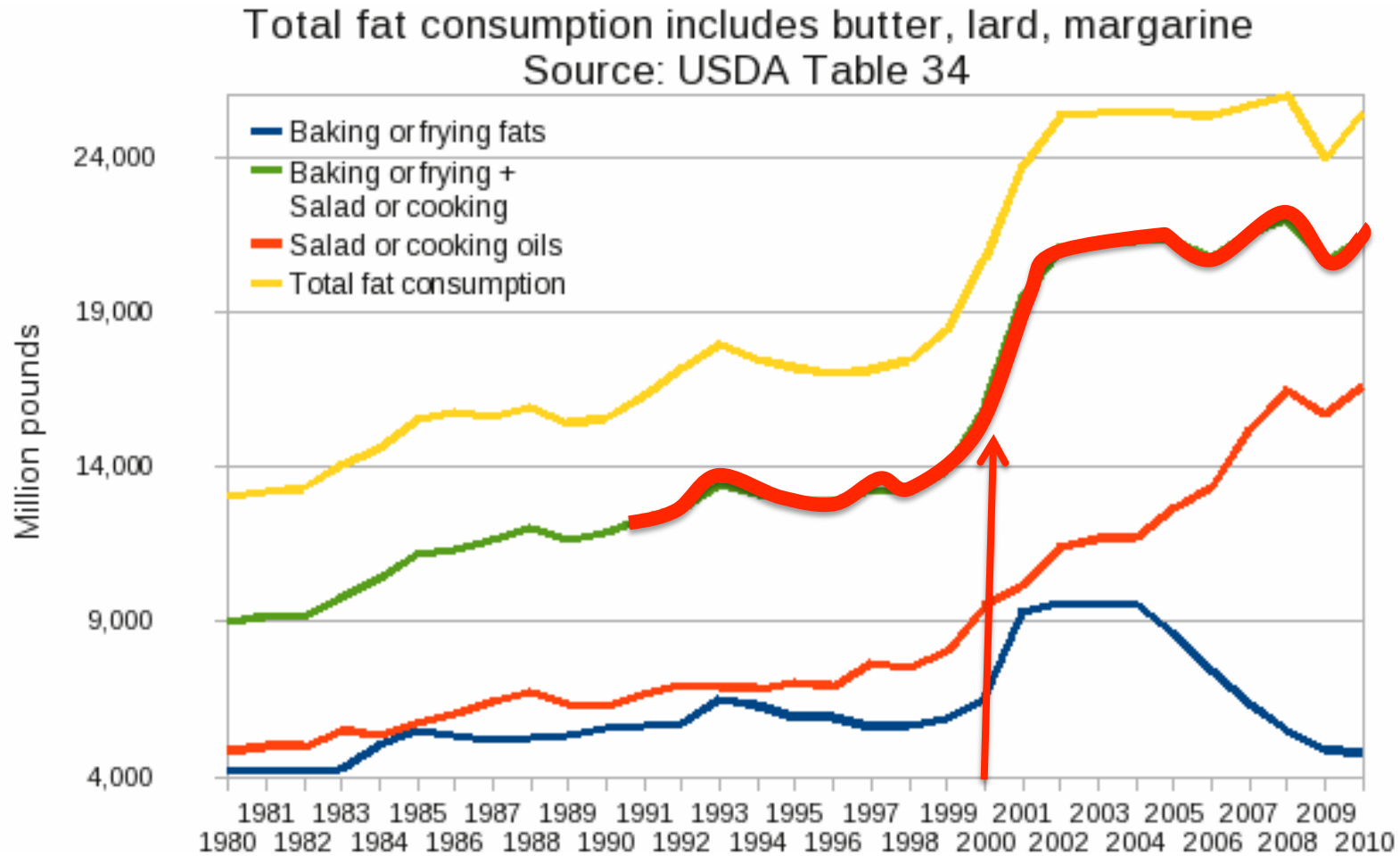
Toxic Effects of Inhaled Hexane*

- Low: Dizziness, headache, nausea, vomiting
- High: Death from asphyxiation
- Chronic: Peripheral neuropathy, pain, weakness, loss of sensation, impaired gait, muscle atrophy, visual disturbances



*N-HEXANE. *Toxicology data network Hazardous Substances Data Bank. US National Library of Medicine*

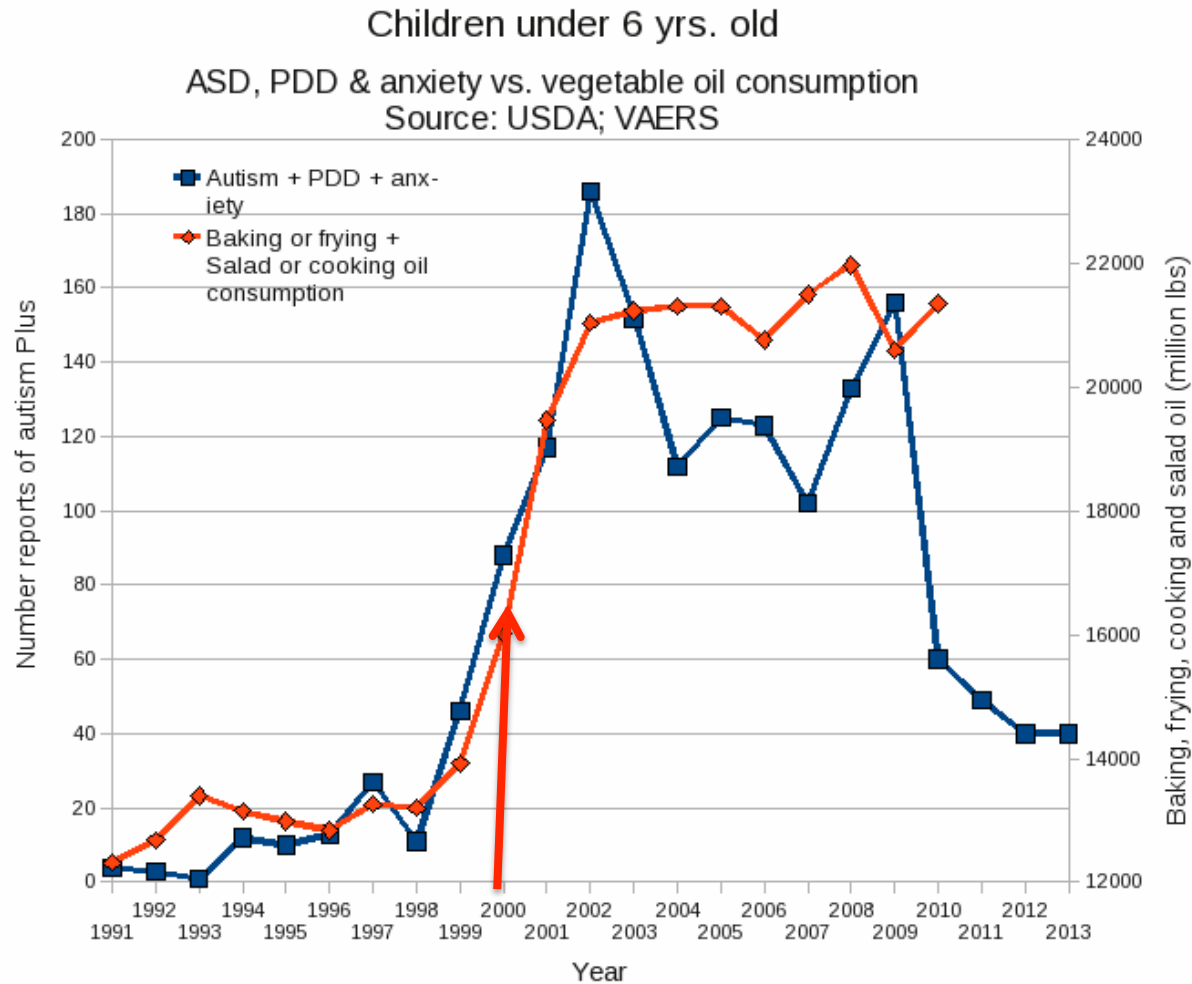
Human Fat and Oil Consumption: US*



*Graphs provided by Dr. Nancy Swanson, with permission

Oil Consumption

Autism & Developmental Delay & Anxiety



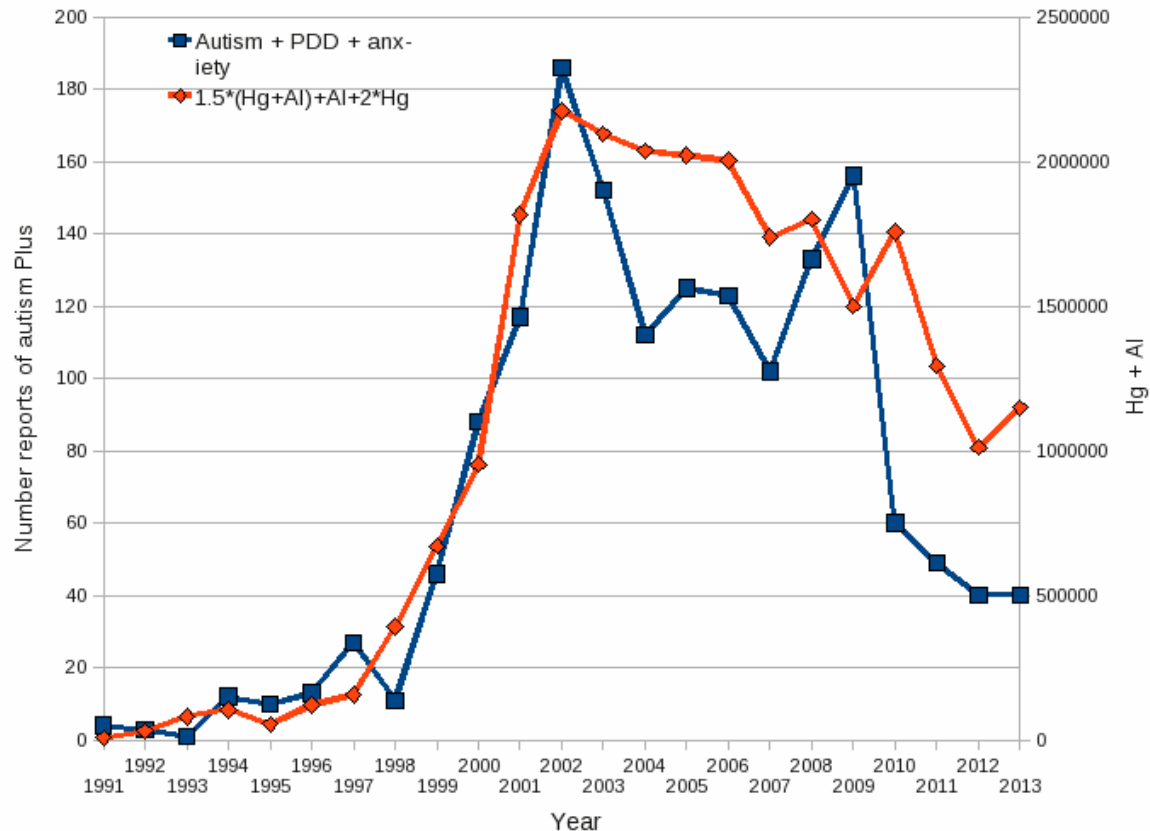
Tabulations from US Vaccine Adverse Event Reporting System (VAERS)

* Plots provided by Dr. Nancy Swanson with permission

Aluminum & Mercury

Autism & Developmental Delay & Anxiety

R = 0.9024, p <= 1.115e-07



Tabulations from US Vaccine Adverse Event Reporting System (VAERS)

Formula: $Al + 1.5 \times (Al \text{ w/ Hg}) + 2.0 \times Hg$

* Plots provided by Dr. Nancy Swanson with permission

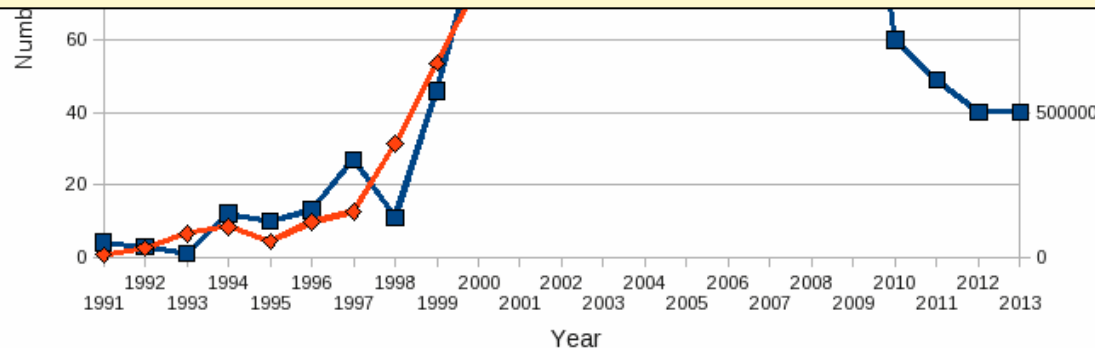
Aluminum & Mercury

Autism & Developmental Delay & Anxiety

R = 0.9024, p <= 1.115e-07



Hypothesis: Glyphosate makes the aluminum and mercury in vaccines more toxic than they would otherwise be

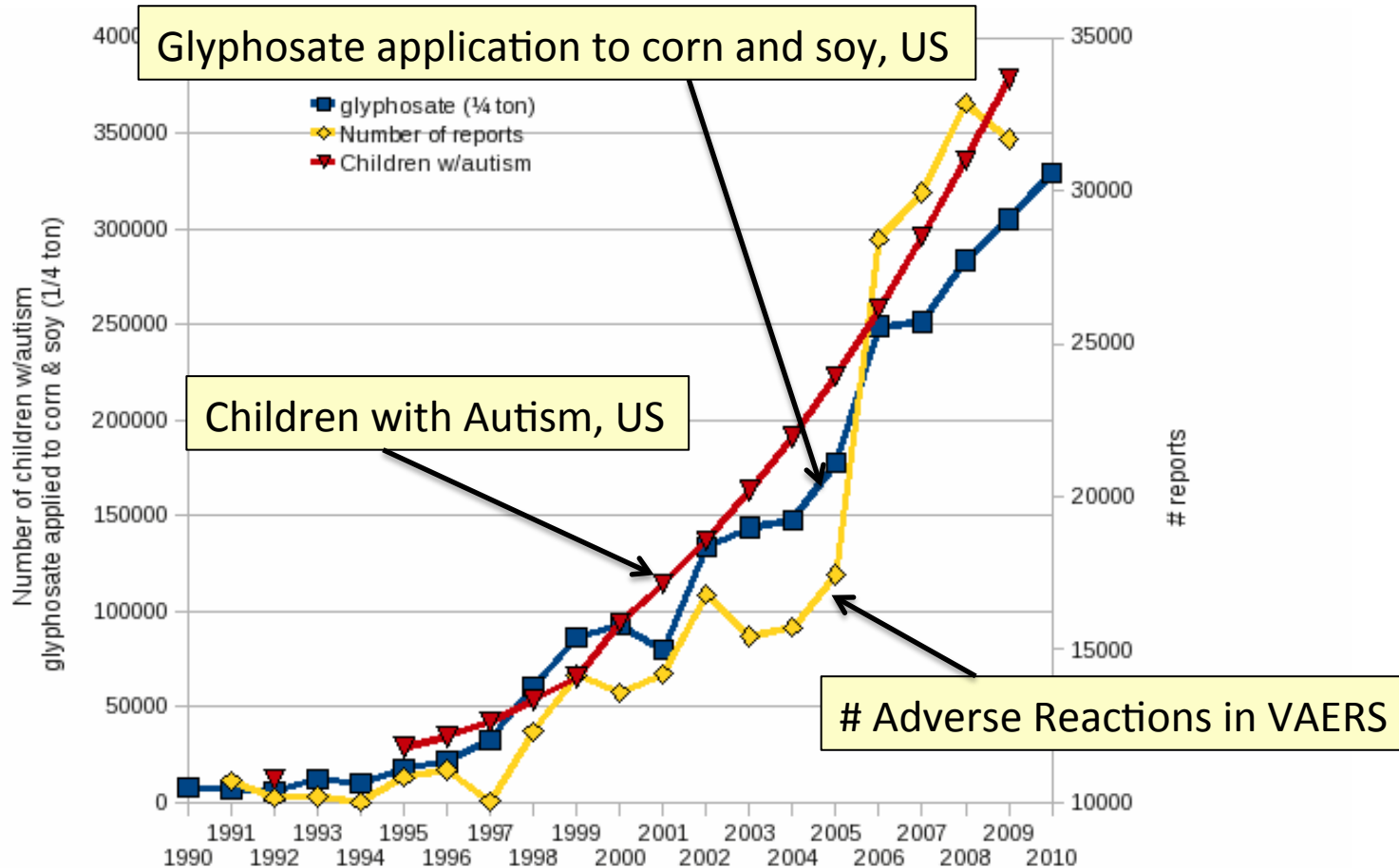


Tabulations from US Vaccine Adverse Event Reporting System (VAERS)

Formula: $Al + 1.5 \times (Al \text{ w/ Hg}) + 2.0 \times Hg$

* Plots provided by Dr. Nancy Swanson with permission

Glyphosate, Autism and Vaccine Reactions*



*Collaboration with Nancy Swanson

MIT Computer Science and Artificial Intelligence Laboratory

Glyphosate and Aluminum: Partners in Crime



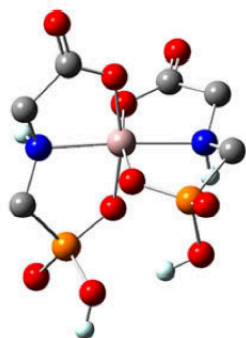
- Glyphosate induces pathogens like *C. difficile* in gut, leading to *leaky gut syndrome*
 - *C. diff* produces *p-cresol* which promotes aluminum uptake by cells
 - p-Cresol is a known biomarker for autism
 - p-Cresol is an important factor in *kidney failure* which leads to aluminum retention in tissues → dementia
- Glyphosate *cages* aluminum to promote entry
- Glyphosate promotes *calcium uptake* by voltage-activated channels
 - Aluminum gains entry as calcium mimetic
- Aluminum promotes calcium loss from bones → pineal gland calcification

Aluminum Glyphosate*

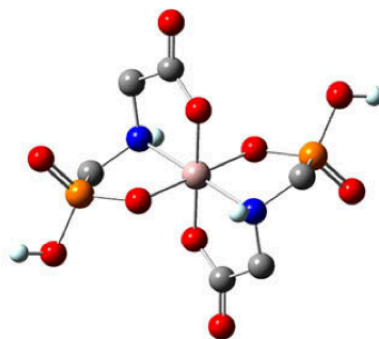
Six different ways two glyphosate molecules can chelate aluminum



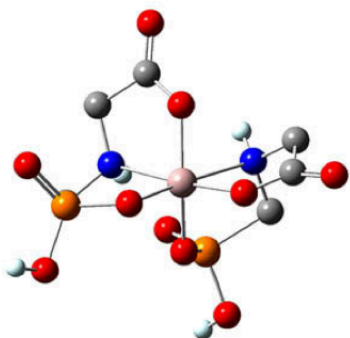
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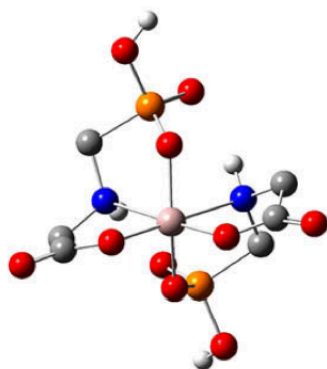
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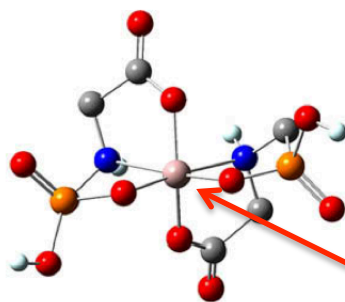
B3



B4

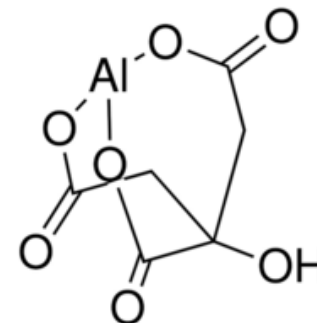


B5



B6

aluminum



Aluminum citrate**



ALUMINA

* M. Purgel et al., Journal of Inorganic Biochemistry 103 (2009) 1426–1438

** P. Sianina et al., Clin. Chem. 32/3, 539-541, 1986.

Recapitulation

- GM Roundup-Ready soy is a core food crop
 - It is processed into soy formula and protein bars that are contaminated with glyphosate and hexane
- The current vaccine schedule in the US includes many aluminum-containing vaccines
- Aluminum, hexane and glyphosate are synergistically toxic
- Studies of the VAERS database reveal interesting links among aluminum in vaccines, oil consumption and autism, developmental delay and anxiety

Summary

- We should be very worried about glyphosate contamination in the food supply
- Glyphosate usage on corn and soy crops correlates with the epidemic we're seeing in autism, Alzheimer's disease, celiac disease, and other intestinal disorders
- This correlation can be explained by the known effects of glyphosate in biological systems
- Glyphosate works synergistically with other important toxic chemicals in our environment, especially arsenic, aluminum and hexane
- Glyphosate should be banned like DDT

Go Organic!



Thank You!

謝謝!