



# Glyphosate: The Most Damaging Toxic Chemical in our Environment

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**In a time of universal deceit,  
telling the truth is a revolutionary act.**

**— George Orwell**

**You never change things by fighting the existing reality.**

**You change something by building a new world that makes the existing model obsolete.**

**— Buckminster Fuller**

# Outline

- Overview
- Evidence of Toxicity
- Gluten Intolerance and Glyphosate
- Aluminum, Glutamate, Vaccines and Glyphosate
- Glyphosate Insertion Into Peptides
  - Neurological Diseases
  - Neural Tube Defects
  - Diabetes, Obesity and Adrenal Insufficiency
  - Impaired Blood Flow
  - Kidney Disease
  - Liver Disease
  - Hyperkeratosis
- How to Safeguard Yourself and Your Patients



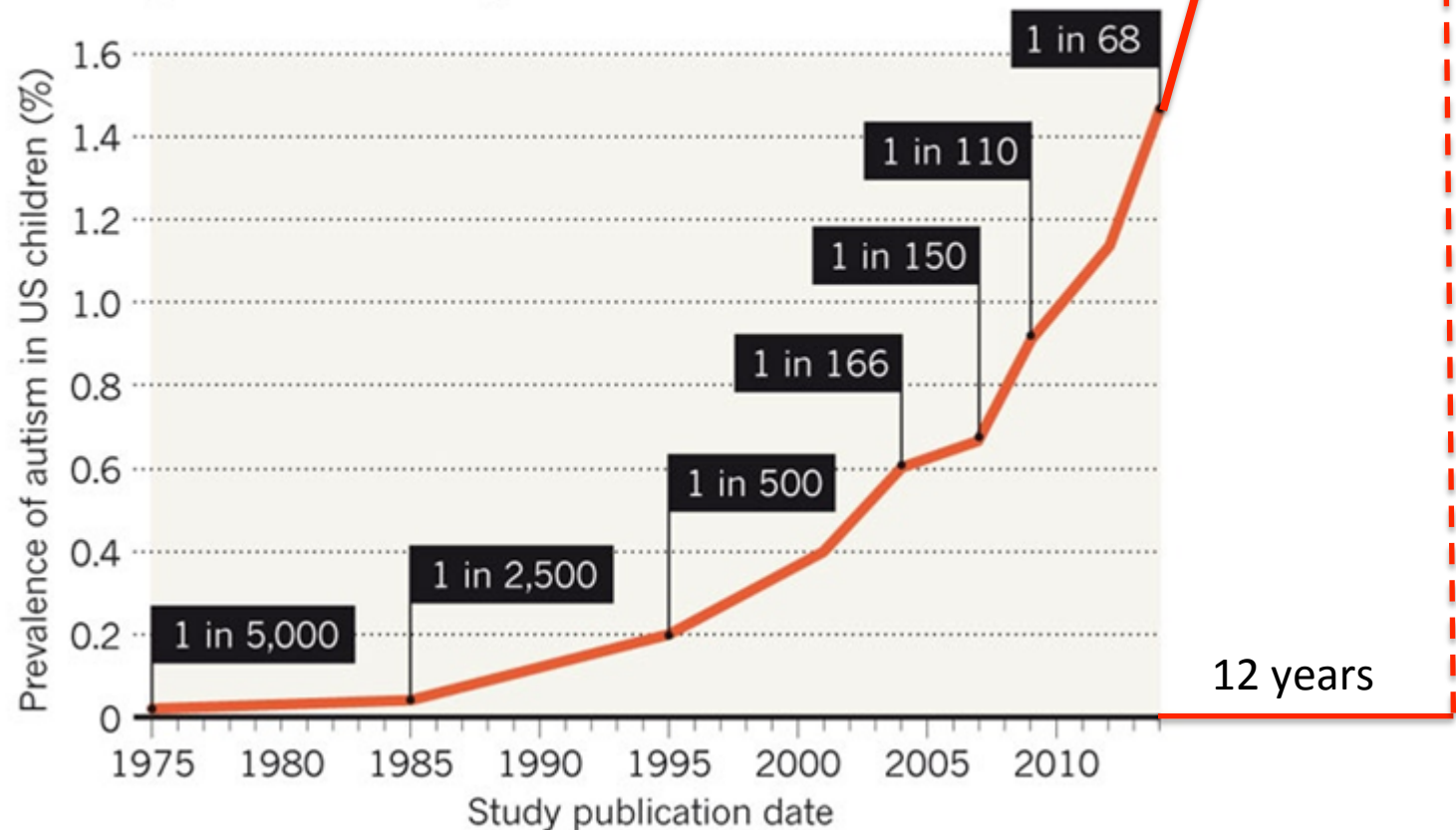
# Overview

# A Frightening Trend\*



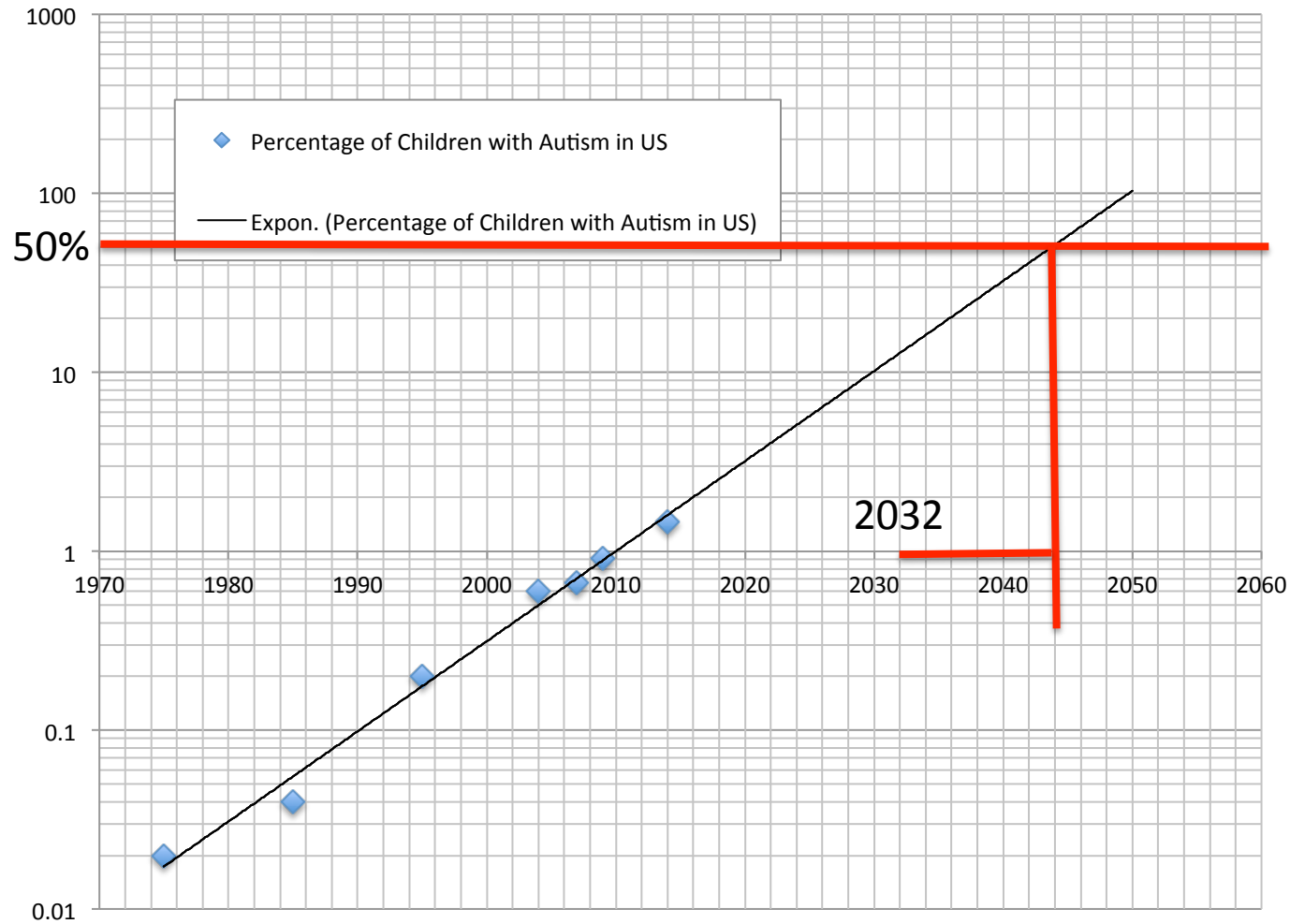
## AUTISM DIAGNOSES RISING

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

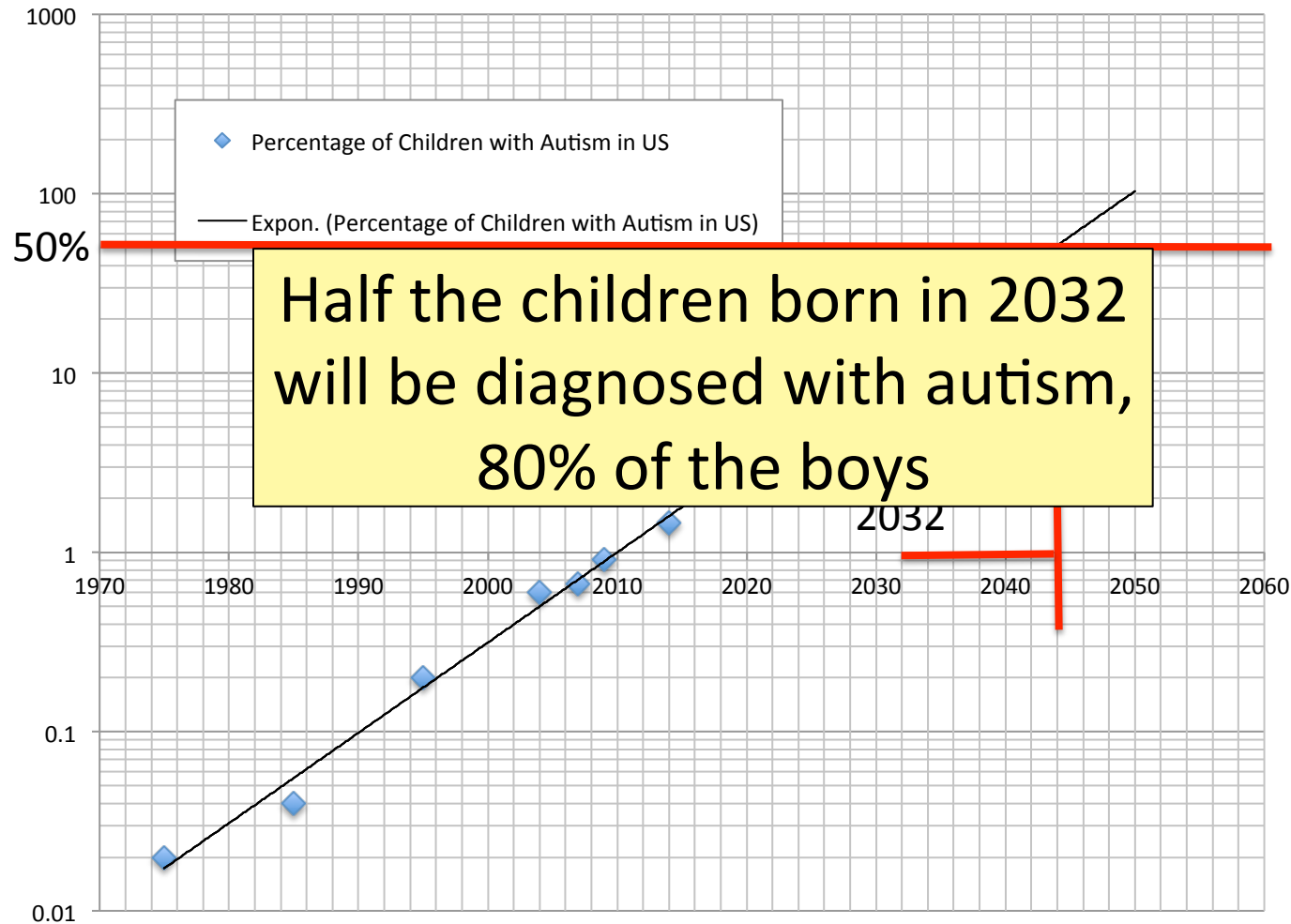


\*K. Weintraub, Nature 479, Nov. 3 2011, 22-24.

# Percentage of children with Autism in the US

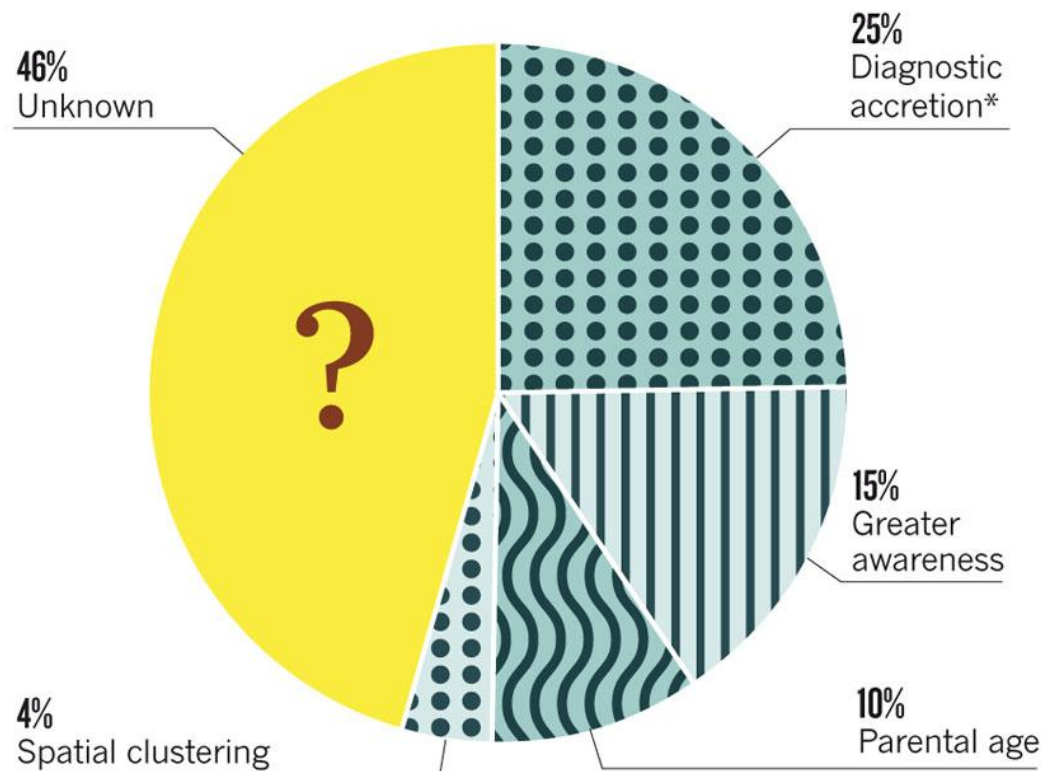


# Percentage of children with Autism in the US



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

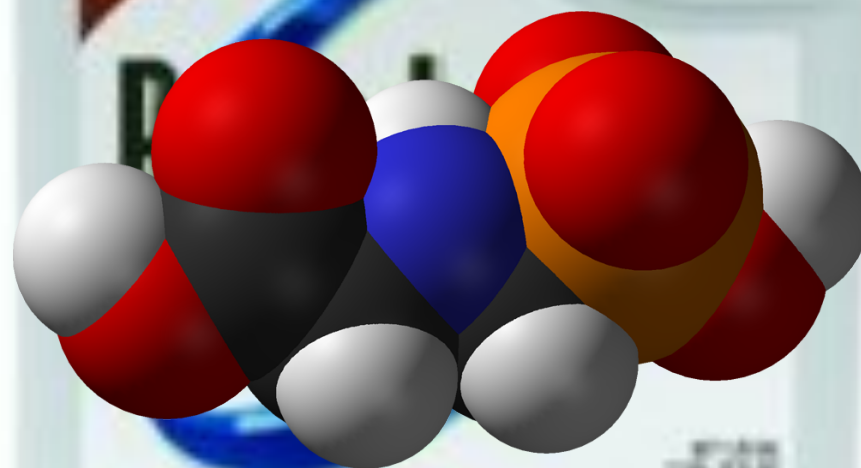
***Reasons: unclear***



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

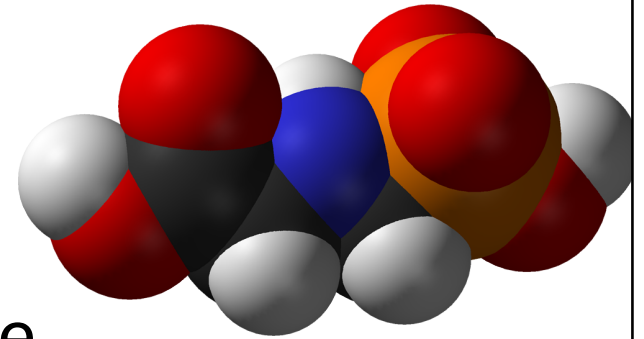
\*K. Weintraub, Nature 479, Nov. 3 2011, 22-24.

**GLYPHOSATE**





# ***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 and are themselves toxic
- Insidious effects of glyphosate accumulate over time
  - Most studies are too short to detect damage

# Main Toxic Effects of Glyphosate\*

- 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*

# Glyphosate:

## The Central Mechanisms\*

- Glyphosate acts as an antibiotic to disrupt gut bacteria, leading to overgrowth of pathogens
- Disruption of liver CYP enzymes leads to impaired bile flow and low vitamin D
  - This disrupts sulfate synthesis and transport
  - Also impairs detoxification of other toxic chemicals
- Damage to red blood cells leads to anemia and toxicity due to free iron
  - Hypoxia ensues → low grade encephalopathy
- Leaky gut and leaky brain barrier lead to neuronal exposure to dangerous metals and neurotoxins

\* A Samsel and S Seneff, *Entropy* **2013**, 15(4), 1416-1463

# **“Glyphosate Now the Most-Used Agricultural Chemical Ever”\***

By Douglas Main, Feb 2, 2016 Newsweek

- Glyphosate usage has increased 50-fold since 1996, when GMO glyphosate-resistant crops were introduced in the US.
- Today, 50 times more glyphosate is allowed by the EPA on corn grain than in 1996
- Half of the American farmers' fields have weeds that are resistant to glyphosate
- New GMO crops offer dual resistance to glyphosate & 2,4-D → Enlist Duo

\*[www.newsweek.com/glyphosate-now-most-used-agricultural-chemical-ever-422419](http://www.newsweek.com/glyphosate-now-most-used-agricultural-chemical-ever-422419)

# Enlist Duo!

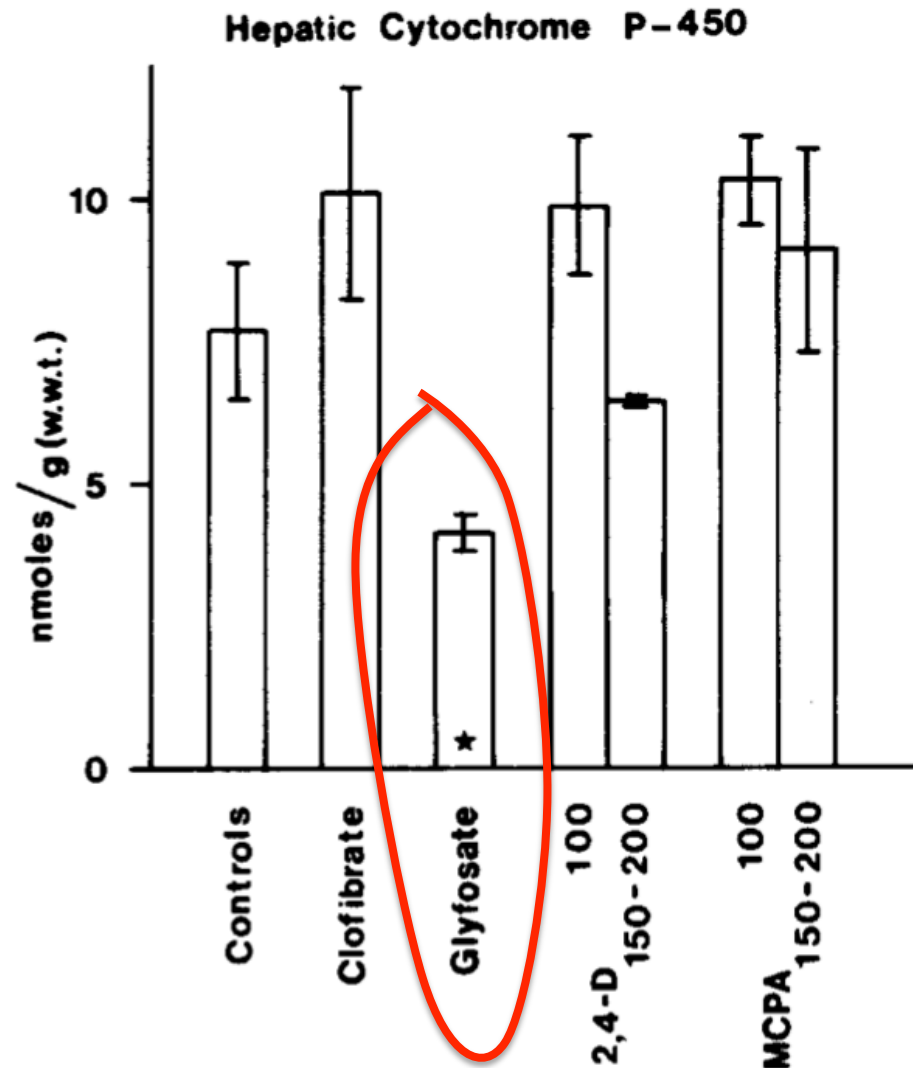
- The answer to glyphosate resistance in weeds!
- Corn and soybean crops will soon be engineered to resist both glyphosate and 2,4 D
- Enlist Duo contains a mixture of both of these herbicides
- The synergistic effects can only be imagined at this time



# **Evidence of Toxicity**



# Inhibition of Cytochrome P450 Enzymes (CYPs) by Various Pesticides\*



Study in rats on  
2,4-D, clofibrate,  
MCPA, and  
glyphosate

\*E Hetanen et al., Acta Pharmacol.  
Et Toxicol. 1983, 53, 103-112.

# Glyphosate Depletes Iron, Manganese and Zinc in Plants\*

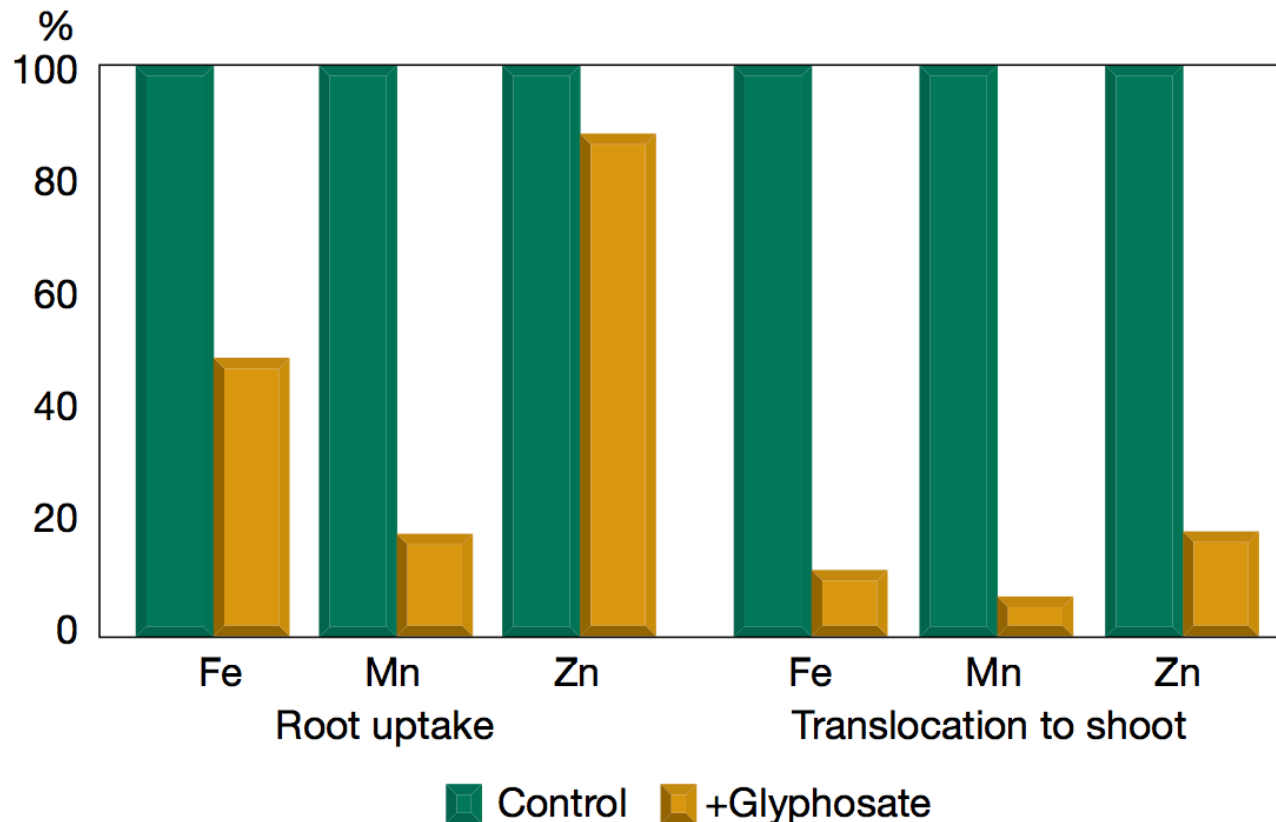
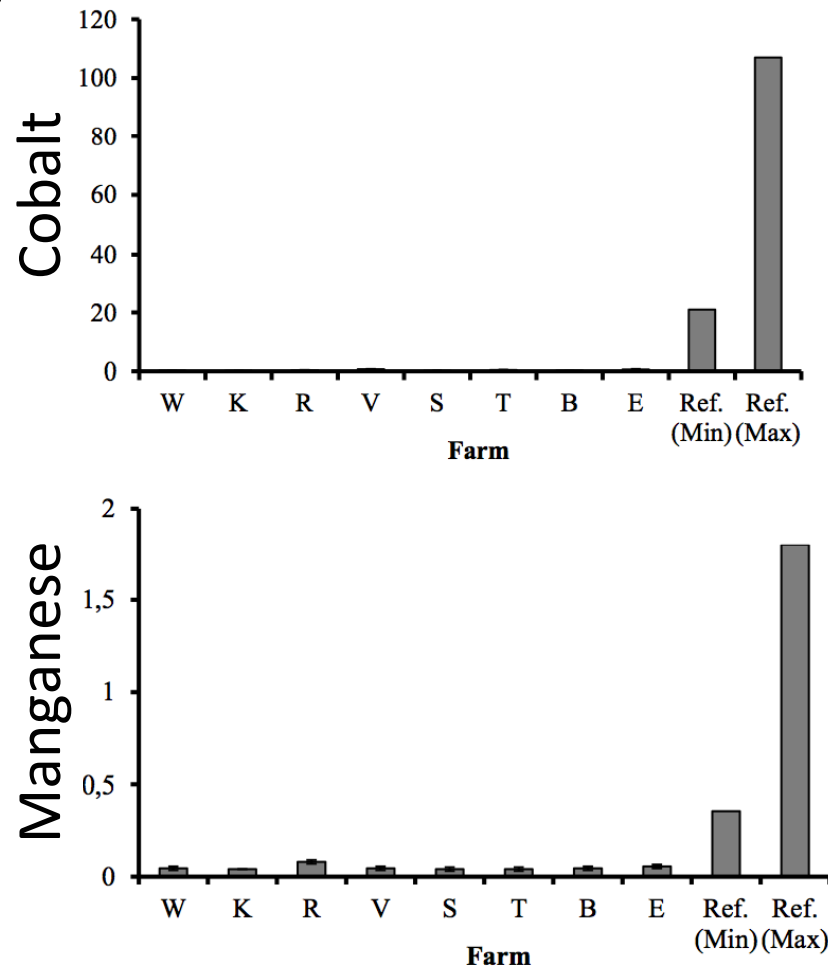


Figure 1. Effect of glyphosate\* on nutrient uptake and translocation by “non-target” plants, Eker, et al. 2006. (\* 2.5% of recommended herbicidal rate of glyphosate.)

\*D Huber, **What About Glyphosate-Induced Manganese Deficiency?** Fluid Journal, 20-22.

# Severe Deficiency in Serum Manganese and Cobalt in Cows\*



Eight different farms: all cows tested had glyphosate in the urine

\*M. Krüger et al., J Environ Anal Toxicol 2013, 3:5

# 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

While it was claimed that the GMO Roundup-Ready Crops (corn, soy, canola, sugar beets, cotton, tobacco and alfalfa) would lead to *less* glyphosate usage, the exact opposite has happened, due to the appearance of multiple “Roundup-Ready” weeds



# **Glyphosate Enters Cells via Amino Acid Transporters\***

- Glyphosate is a synthetic amino acid analog of glycine
- Glyphosate is taken up by mucosal cells via L-type amino acid transport mechanisms
- Inhaled glyphosate can cross the mucosal layer of the nasal passages to gain access to the brain
- Glyphosate also passes the gut and lung barriers through this mechanism

\*J Xu et al., Chemosphere 2016;145:487-494.

# **Glyphosate and Autism:**

## **Some Biological Mechanisms**

- Disruption of gut microbes<sup>1</sup>
  - Children with autism suffer from many digestive issues
- Disruption of sulfur metabolism, glutathione deficiency, impaired methylation pathways<sup>1</sup>
- Metal chelation (especially manganese)<sup>2</sup>
  - Manganese deficiency leads to impaired mitochondrial function and glutamate toxicity in the brain
- Inhibition of pituitary release of thyroid stimulating hormone → hypothyroidism<sup>3</sup>
  - Moms with hypothyroidism have 4-fold increased risk to autism in the fetus

1. Samsel and Seneff, Entropy 2013;15(4):1416-1463.

2. Samsel and Seneff, Surg Neurol Int. 2015;6:45.

3. Beecham and Seneff, Journal of Autism 2016;3:1.

# Paper Showing Strong Correlations between Glyphosate Usage and Chronic Disease

Journal of Organic Systems, 9(2), 2014

ORIGINAL PAPER

## Genetically engineered crops, glyphosate and the deterioration of health in the United States of America

**Nancy L. Swanson<sup>1</sup>, Andre Leu<sup>2\*</sup>, Jon Abrahamson<sup>3</sup> and Bradley Wallet<sup>4</sup>**

<sup>1</sup> *Abacus Enterprises, Lummi Island, WA, USA*

<sup>2</sup> *International Federation of Organic Agricultural Movements, Bonn, Germany*

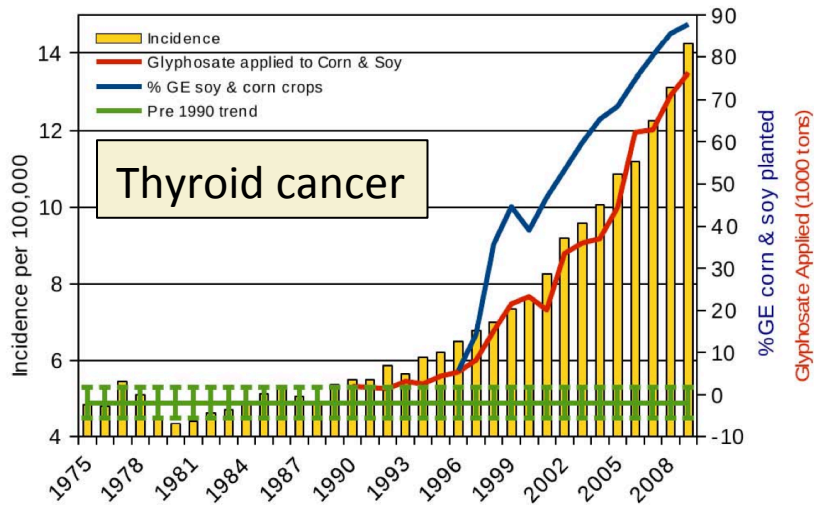
<sup>3</sup> *Abacus Enterprises, Lummi Island, WA, USA*

<sup>4</sup> *Crustal Imaging Facility, Conoco Phillips School of Geology and Geophysics, University of Oklahoma, USA*

*\* Corresponding author: andreleu.al@gmail.com*

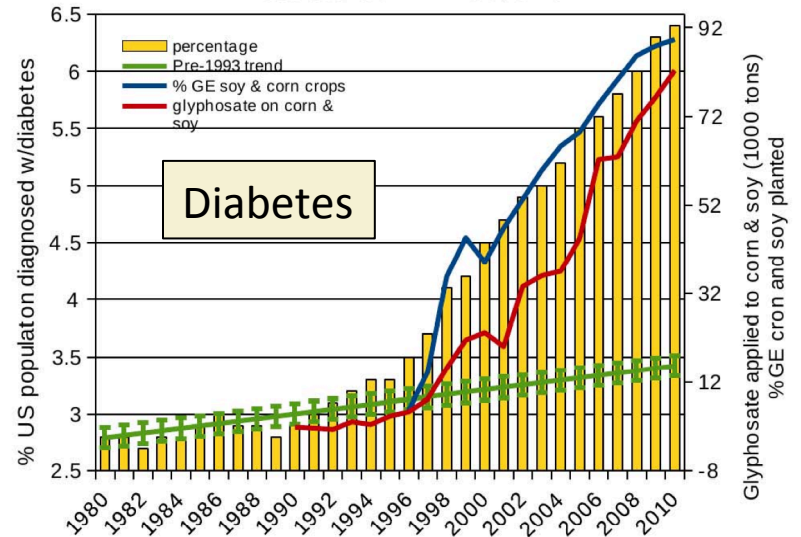
### Thyroid Cancer Incidence Rate (age adjusted)

plotted against glyphosate applied to U.S. corn & soy ( $R = 0.988$ ,  $p \leq 7.612e-09$ )  
along with %GE corn & soy crops  $R = 0.9377$ ,  $p \leq 2.152e-05$   
sources: USDA:NASS; SEER



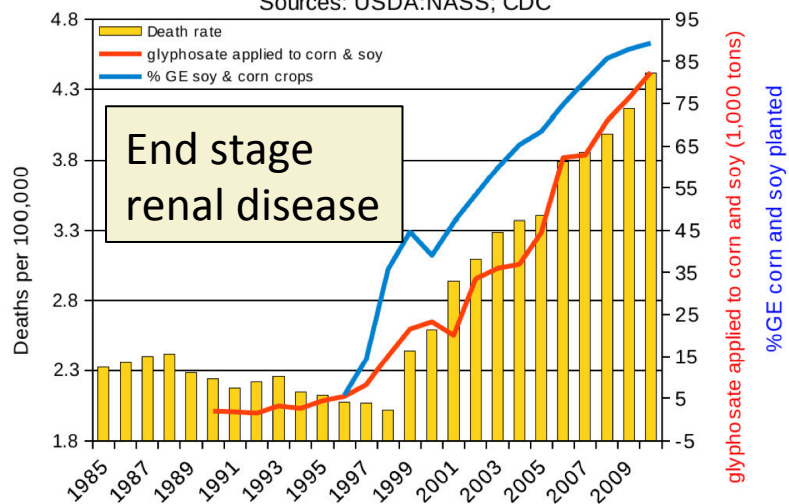
### Prevalence of Diabetes in US (age adjusted)

plotted against glyphosate applied to corn & soy ( $R = 0.971$ ,  $p \leq 9.24e-09$ )  
along with %GE corn & soy grown in US ( $R = 0.9826$ ,  $p \leq 5.169e-07$ )  
sources: USDA:NASS; CDC



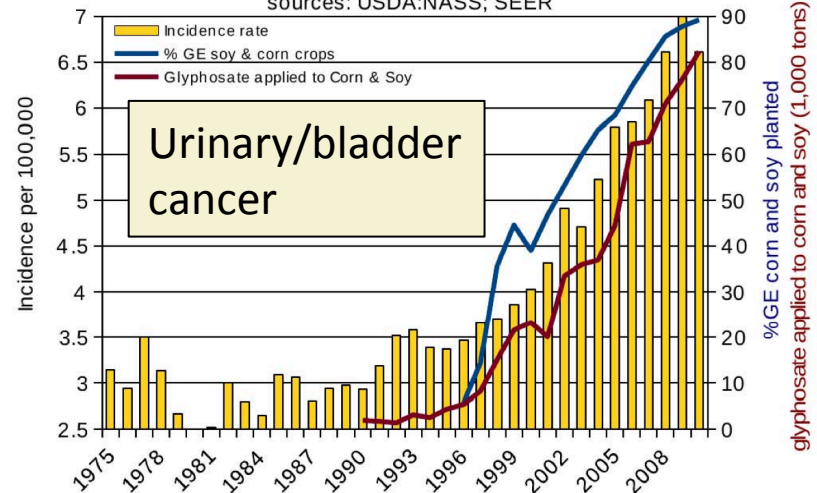
### Age Adjusted End Stage Renal Disease Deaths (ICD N18.0 & 585.6)

plotted against %GE corn & soy planted ( $R = 0.9578$ ,  $p \leq 4.165e-06$ )  
and glyphosate applied to corn & soy ( $R = 0.9746$ ,  $p \leq 7.244e-09$ )  
Sources: USDA:NASS; CDC



### Age Adjusted Urinary/Bladder Cancer Incidence

Plotted against % GE corn and soy ( $R = 0.9449$ ,  $p \leq 7.1e-06$ )  
and glyphosate applied to corn and soy ( $R = 0.981$ ,  $p \leq 4.702e-09$ )  
sources: USDA:NASS; SEER



## Quote from the Conclusion\*

“Although correlation does not necessarily mean causation, when correlation coefficients of over 0.95 (with *p*-value significance levels less than 0.00001) are calculated for a list of diseases that can be directly linked to glyphosate, via its known biological effects, it would be imprudent not to consider causation as a plausible explanation.”

\*NL Swanson et al. Journal of Organic Systems 9(2), 2014, p. 32,

# **Gluten Intolerance & Glyphosate**



# Gluten Intolerance or Glyphosate Intolerance?



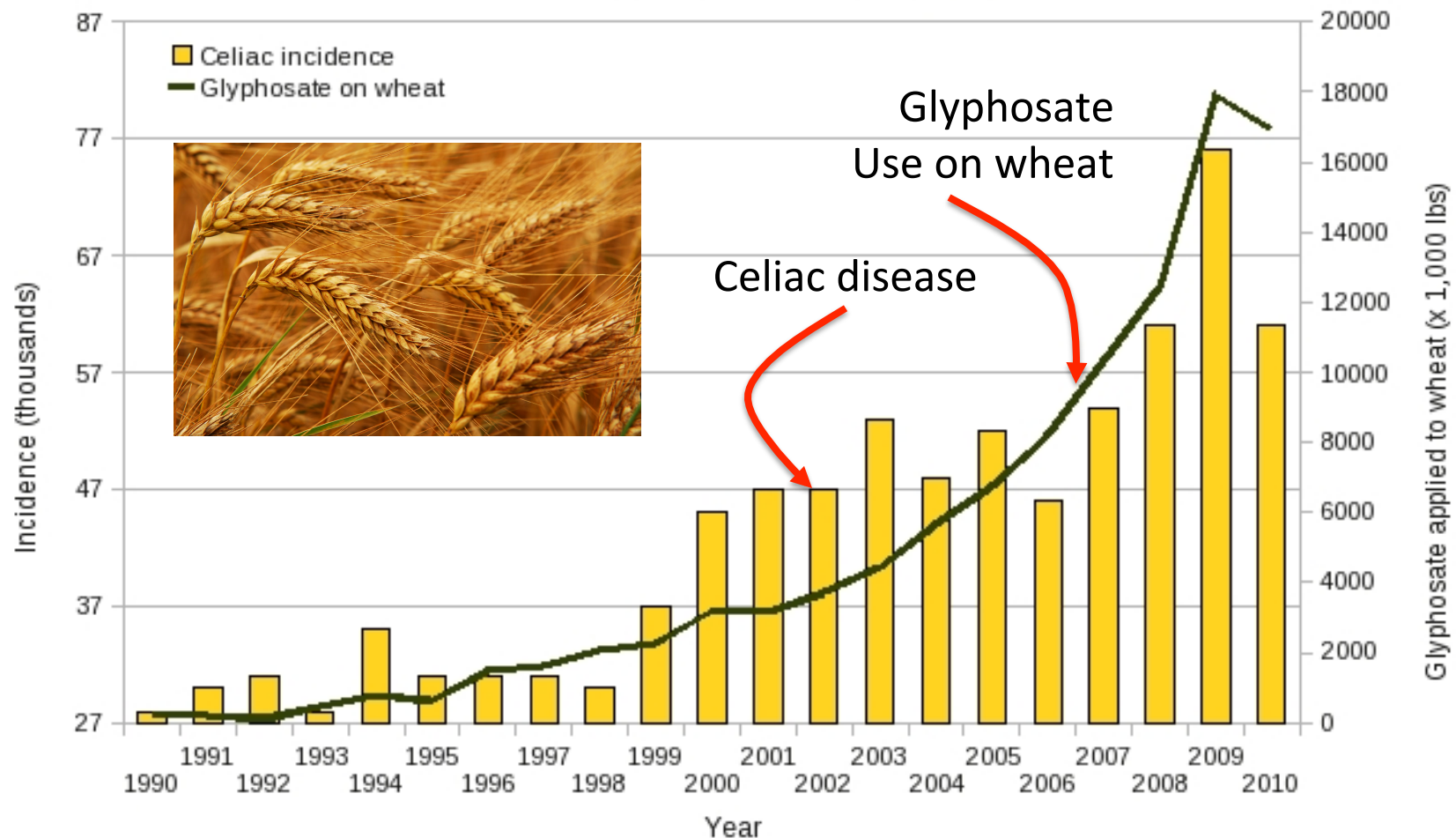
- Glyphosate: the key ingredient in Monsanto's RoundUp
- Routinely used to "dry down" wheat prior to harvest
- Linked to celiac disease, gluten intolerance, and irritable bowel



**Get the facts. Share the awareness.**

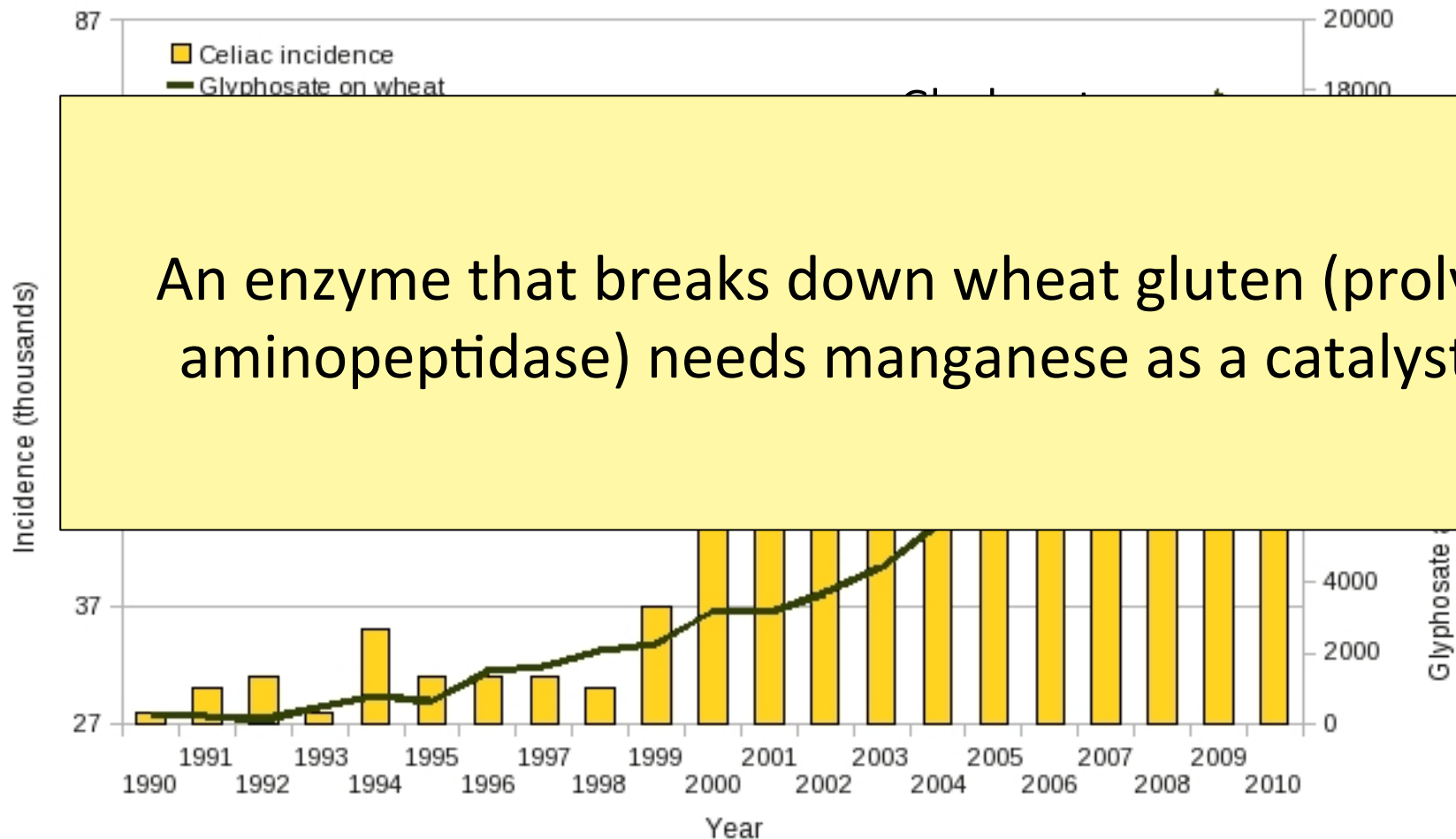
[facebook.com/gmoawarenessusa](https://facebook.com/gmoawarenessusa)

# Glyphosate and Celiac Disease\*



\*Samsel and Seneff, Interdiscip Toxicol. 2013;6(4): 159–184.

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\*Samsel and Seneff, Interdiscip Toxicol. 2013;6(4): 159–184.

# 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]

# Celiac Disease, Glyphosate and Non Hodgkin's Lymphoma (cancer)

- Glyphosate preferentially kills bifidobacteria\*
- Bifidobacteria are depleted in Celiac disease\*\*
- Celiac disease is associated with increased risk to non Hodgkin's lymphoma\*\*\*
- Glyphosate itself is also linked directly to non Hodgkin's lymphoma\*\*\*\*

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

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

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

\*\*\*\* L. Schinasi and M.E. Leon. Int. J. Environ. Res. Public Health 2014, 11, 4449-4527.

# **Other Crops Routinely Sprayed with Glyphosate or Other Herbicides Right Before Harvest**

- Maize, barley, and oats
- Oilseed rape (canola)
- Legumes, including lentils, garbanzos, and soybeans
- Sunflowers (sunflower oil)
- Potatoes
- Cotton
- Peanuts

# **Aluminum, Glutamate, Vaccines and Glyphosate**



# **Case Study: Evidence that Glyphosate Penetrates the Brain Barrier\***

- 58 year old woman ingested glyphosate (suicide attempt)
- Glyphosate showed up in blood (1294 µg/mL) and cerebrospinal fluid (122 µg/mL)
- Associated with both disseminated intravascular coagulation (DIC) and aseptic meningitis

\*C Sato et al., Clinical Toxicology (2011) 49, 118–120



# Glyphosate Suppresses Melatonin Synthesis!

- Glyphosate interferes with shikimate pathway in plants and microbes → tryptophan depletion\*
- Tryptophan is sole precursor to melatonin
- Melatonin binds to aluminum, cadmium, copper, iron and lead, reducing their toxicity\*\*
- Melatonin is produced by the pineal gland and regulates the wake/sleep cycle



\*N. de María et al., J Agric Food Chem 2006, 54, 2621-2628.

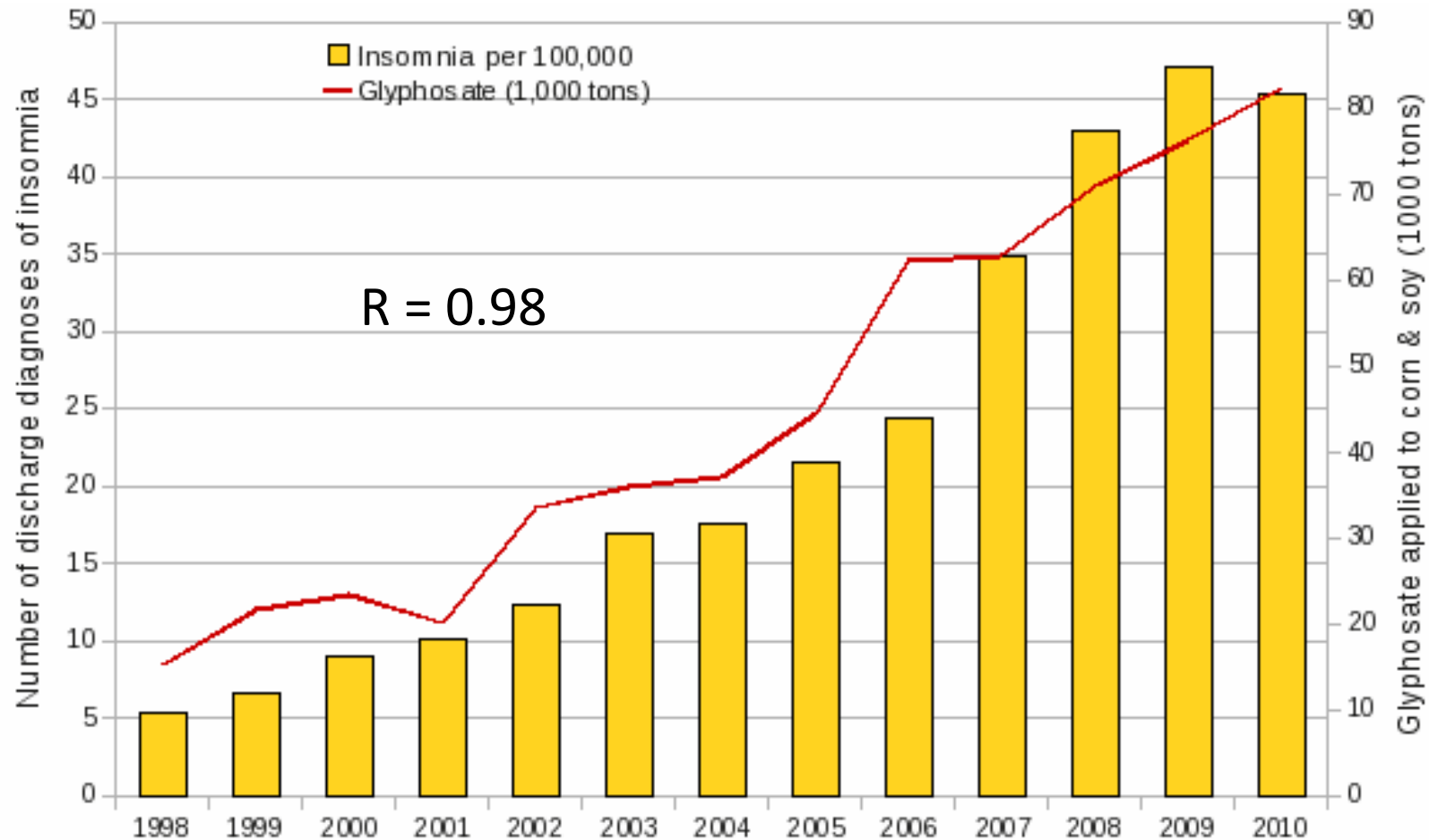
\*\*J. Limson et al. J. Pineal Res. 1998; 24:15–21.

# Sleep Disorder, Aluminum, and the Pineal Gland

- Sleep disorder is linked to many neurological diseases:
  - Autism, Alzheimer's, ADHD, depression, schizophrenia, ALS, Parkinson's disease, etc.
- Insomnia occurs much more frequently as an adverse reaction to vaccines containing aluminum than to those not containing aluminum ( $p < 0.0025$ )\*
- Insomnia also occurs much more frequently in ALL adverse reactions after the year 2000 compared to before 2000 ( $p < 0.009$ )\*
- Pineal gland is heavily perfused and outside of the blood brain barrier
  - Susceptible to aluminum toxicity

\*Seneff et al., *Entropy* **2012**, 14, 2227-2253.

# Insomnia is Strongly Correlated with Glyphosate Usage



Plot provided by Dr. Nancy Swanson; Data from CDC Hospital Discharge database

# Aluminum in the Pineal Gland\*

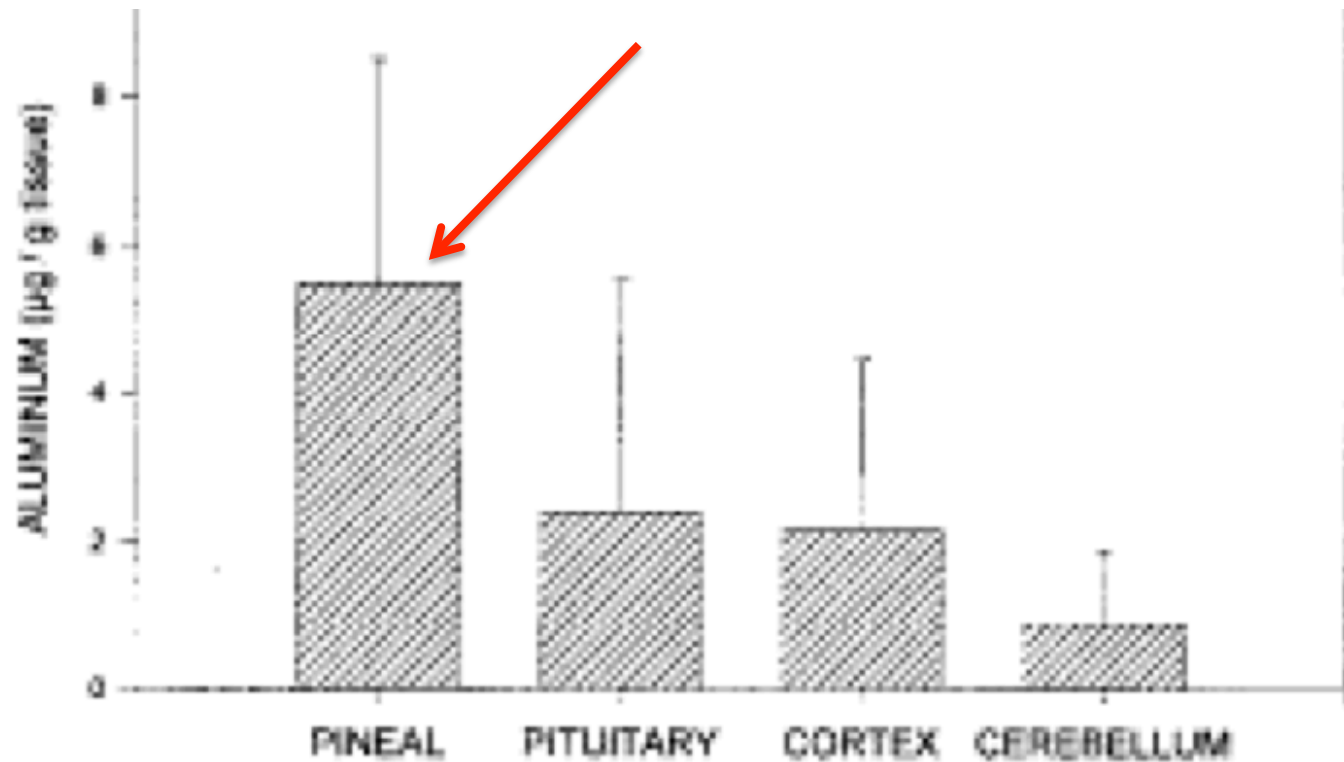


Fig. 6. Aluminum contents of brain tissues (mean  $\pm$  SD). The results are expressed per unit weight of dried tissues. Four samples of each tissue were examined.

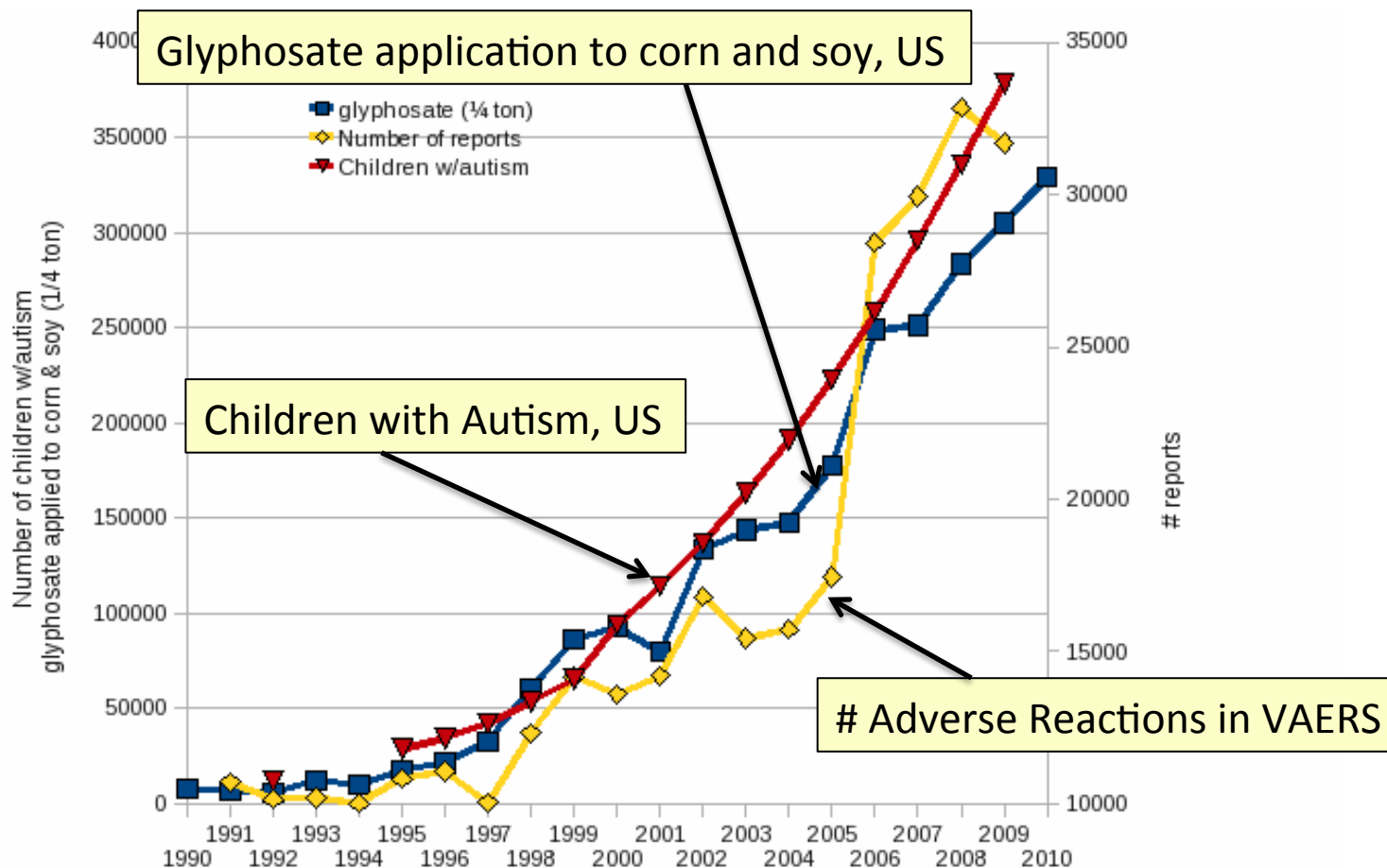
\*S.B. Lang et al./Bioclectrochemistry and Bioenergetics 41(1996)191—195

# 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

\*S Seneff et al., Agricultural Sciences 2015;6:42-70

# Autism, Glyphosate, Vaccine Reactions\*



\*Collaboration with Dr. Nancy Swanson

# Symptoms of Adverse Reactions to MMR before and after 2002\*

## More Common Before 2002

Reaction	Count Before 2002	Count After 2002	<i>p</i> -value
joint pain	126	65	0.036

## More Common After 2002

Reaction	Count Before 2002	Count After 2002	<i>p</i> -value
hospitalization	71	319	0.00037
seizures	203	462	0.0014
shortness of breath	100	216	0.010
hives	324	504	0.011
mumps	5	51	0.014
abscess	51	120	0.022
autism	69	143	0.024
eczema	4	36	0.026
ear infection	16	56	0.031
anaphylactic shock	16	54	0.034
facial swelling	45	95	0.040
swelling	860	1018	0.048

\*Data analyzed from the VAERS database

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shortness of breath	100	216	0.010
hives	324	504	0.011
mumps	5	51	0.014

These are all characteristic symptoms of allergies to MSG

autism	69	143	0.024
eczema	4	36	0.026
ear infection	16	56	0.031
anaphylactic shock	16	54	0.034
Facial swelling	45	95	0.040
swelling	860	1018	0.048

\*Data analyzed from the VAERS database



# Glyphosate in Vaccines?

- For MMR, flu vaccine, and rabies vaccine, live virus is grown on gelatin derived from ligaments of cows
  - Cows are fed GMO Roundup-Ready corn and soy feed
- Gelatin contains significant amounts of both glycine and glutamate
  - These two neurotransmitters excite the NMDA receptors in the brain
  - Glyphosate substitution in the protein for glycine is a possibility!
- Glyphosate stimulation of NMDA receptors could cause neuronal burnout

# Glyphosate and Glutamate\*



- Acute exposure activates NMDA receptors and voltage-dependent calcium channels
  - Oxidative stress and neural cell death
  - Increased glutamate release into the synaptic cleft → *excessive extracellular glutamate levels*
  - Decreased glutathione content
  - Increased peroxidation of lipids (fats)

\*<http://www.greenmedinfo.com/blog/roundup-weedkiller-brain-damaging-neurotoxin>

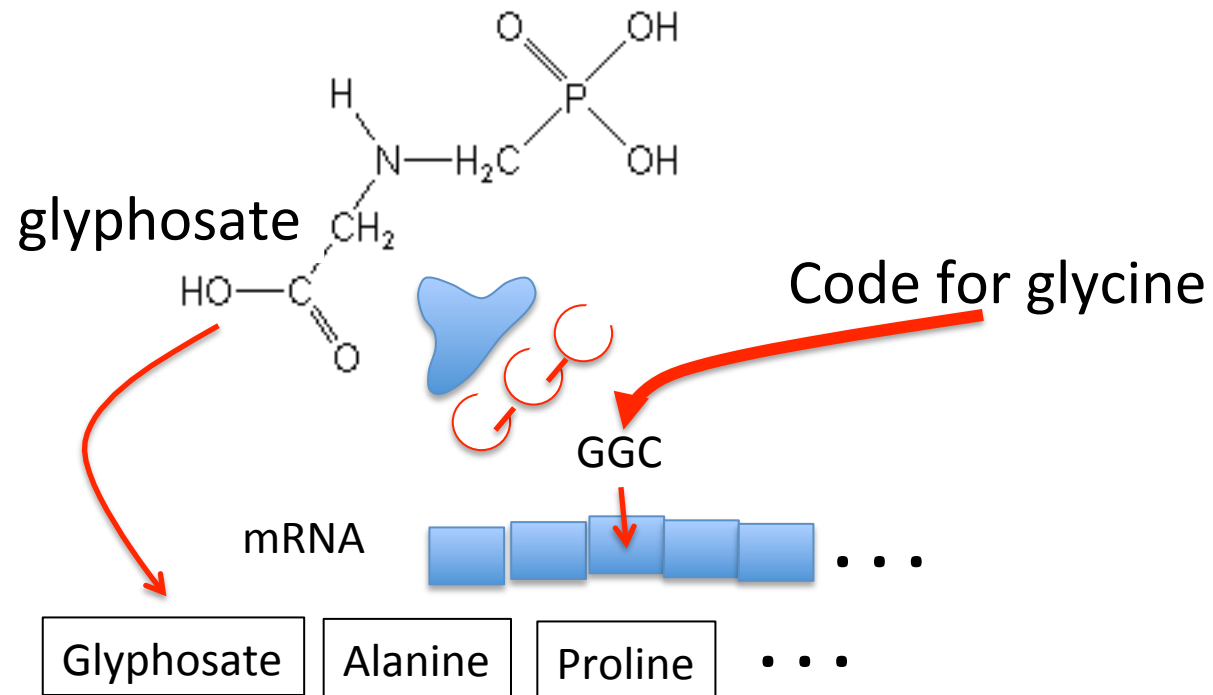
# **Pandemrix® (H1N1 vaccine) and Glyphosate ??**

- Finns vaccinated with Pandemrix® developed narcolepsy
  - Polysorbate 80 played an important role
  - Polysorbate 80 is derived from sunflower oil
  - Sunflowers are sprayed with glyphosate right before the harvest  
High oleic sunflower oil → oleic acid → polysorbate 80
- Narcolepsy is controlled by neurons in the hypothalamus called orexin cells\*
- Loss of orexin cells causes severe narcolepsy
- Orexin cells have glycine receptors that could cause burnout if over-stimulated
- Glyphosate acts as a glycine mimetic
- Vaccines containing polysorbate 80 have more acute reactions in VAERS in recent years compared to 1990's
  - Seizures, hospitalization, shortness of breath, pain, etc.

\*MM Karnani et al., J Physiol 2011; 589(Pt 3): 639-651

# **Glyphosate insertion into peptides**

# What If Glyphosate Could Insert Itself Into Protein Synthesis???



Any proteins with conserved glycine residues are likely to be affected in a major way

# Some Predicted Consequences

- Neurological diseases
- Neural tube defects
- Celiac disease
- Impaired collagen → osteoarthritis
- Steatohepatitis (fatty liver disease)
- Obesity and adrenal insufficiency
- Impaired iron homeostasis and kidney failure
- Insulin resistance and diabetes
- Cancer

# An Analogy: ALS in Guam

- An epidemic in ALS in Guam was traced to a natural toxin found in cycads
- BMAA is a non-coding amino acid that gets inserted by mistake in place of serine
- Defective versions of a glutamate transporter have been linked to ALS\*
- The transporter has an essential serine-rich region in its sequence\*\*



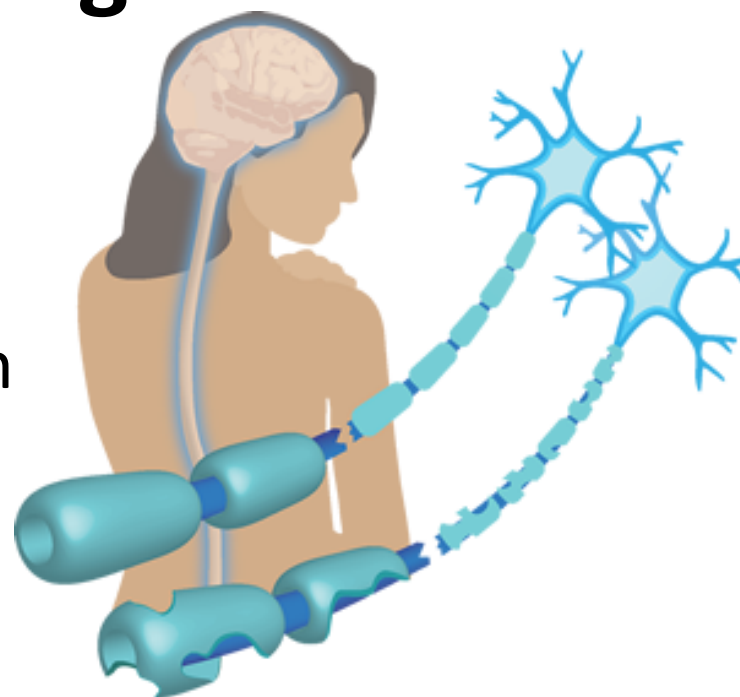
\* Antioxidants & Redox Signaling 2009;11: 1587-1602.

\*\* DJ Slotboom et al., PNAS 1999; 96(25): 14282-14287.

# Another Analogy:

## Multiple Sclerosis & Sugar Beets\*

- Sugar beets contain an analogue of proline called Aze
- Remarkable correlation between MS frequency and proximity to sugar beet agriculture
- Myelin basic protein contains a cluster of proline residues that are absolutely essential for its proper function



\*E. Rubenstein, J Neuropathol Exp Neurol 2008;67(11): 1035-1040.



# Vulnerable Proteins: Resulting Pathologies

Conserved Glycines	Disease Profile
Hormone-sensitive Lipase	Obesity
Insulin Receptor	Diabetes
Amyloid Beta Plaque	Alzheimer's Disease
OGG1	DNA Damage → Cancer
Lipocalin	Kidney Failure
ACTH	Adrenal Insufficiency
Cytochrome C Oxidase	Mitochondrial Disease
Alpha Synuclein	Parkinson's Disease
TDP-43	ALS

# Neurological Diseases

# Neurological Diseases

At least four neurological diseases related to misfolded proteins involve conserved glycine residues:

- Alzheimer's: Amyloid-beta
- Parkinson's Disease: Alpha-synuclein
- ALS: TDP-43
- Madcow/Prion diseases: Prion proteins

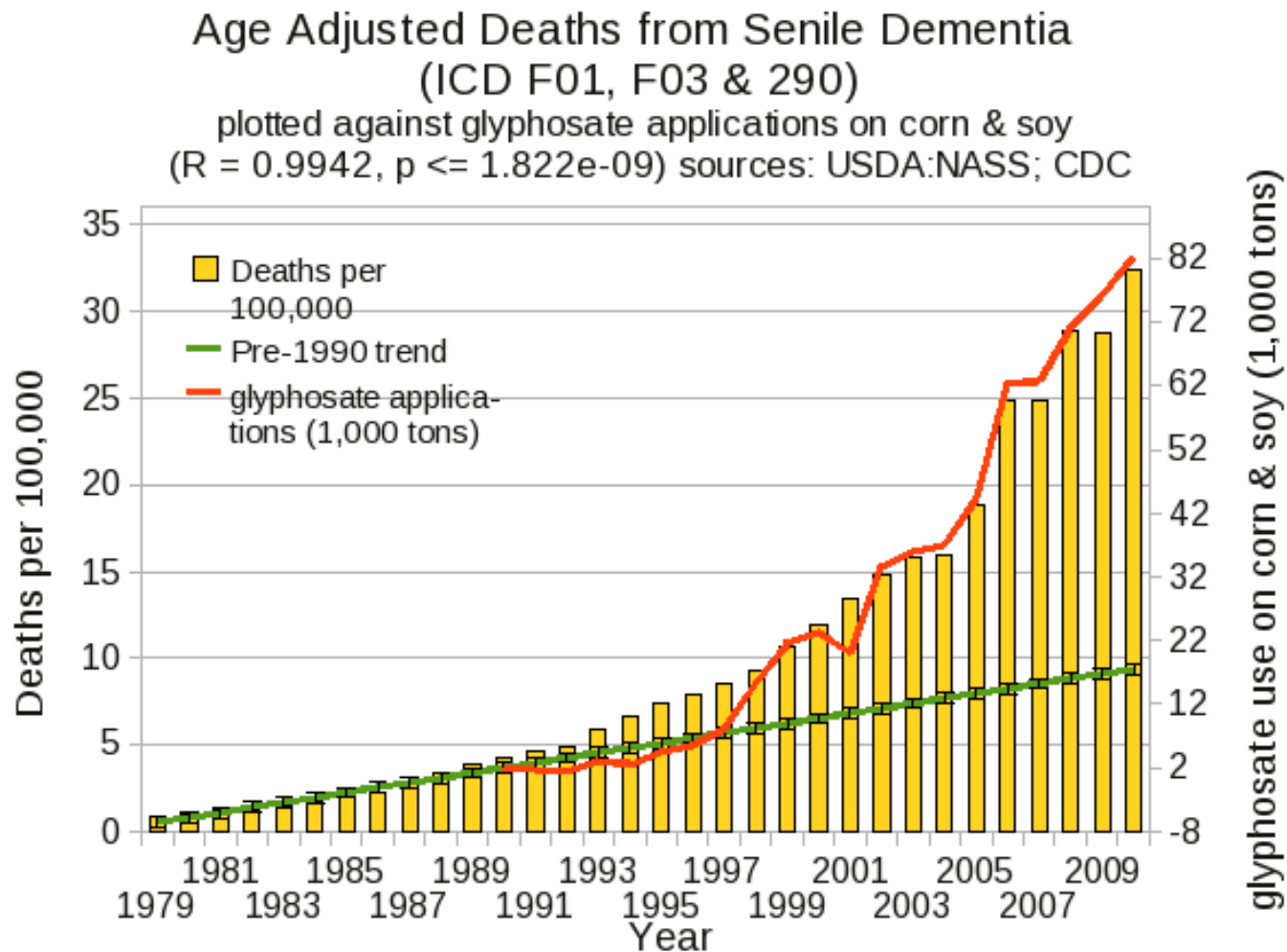
# Neurological Diseases

At least four neurological diseases related to misfolded proteins involve conserved glycine

In all cases, the issue is a RARE SOLUBLE peptide rather than the precipitated plaque.

Glyphosate increases the protein's solubility

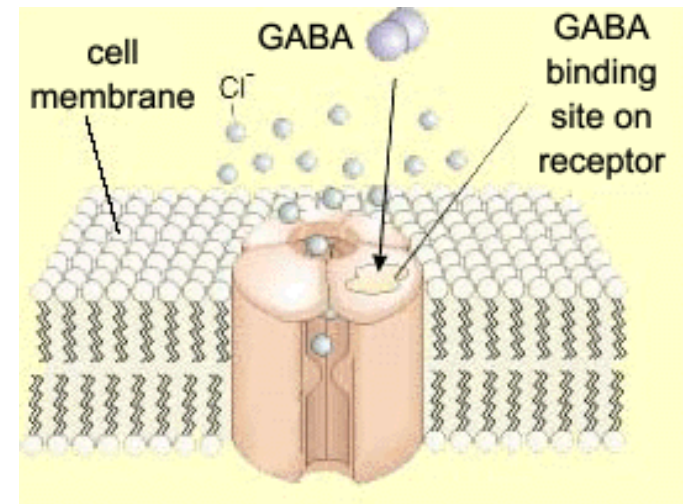
# Deaths from Senile Dementia\*



\*Plot provided by Dr. Nancy Swanson

# Impaired GABA Receptor Activity and Autism

- Autism has been linked to a weakened response of the inhibitory GABA receptor to stimuli\*
- The GABA receptor has a conserved glycine at the entrance to the first membrane-spanning domain that is essential for its function\*\*



\*CD Robertson et al., Current Biology 2016;26: 80-85

\*\*BX Carlson et al., Mol Pharmacol. 2000;57(3):474-84

# Neural Tube Defects

# Glyphosate and Anencephaly\*

- Yakima, Benton and Franklin counties in Washington State have an unusually high number of pregnancies affected by the birth defect, anencephaly
- 75 pesticides were analyzed in studying contamination due to surrounding agriculture
  - 47 (63%) of these were detected
  - Glyphosate was applied in large amounts, but was not studied
- 5% solution of glyphosate was also used heavily around irrigation ditches to control weeds
  - Main herbicide recommended due to its “low toxicity”



***Glyphosate has been linked to anencephaly  
due to its effect on retinoic acid***

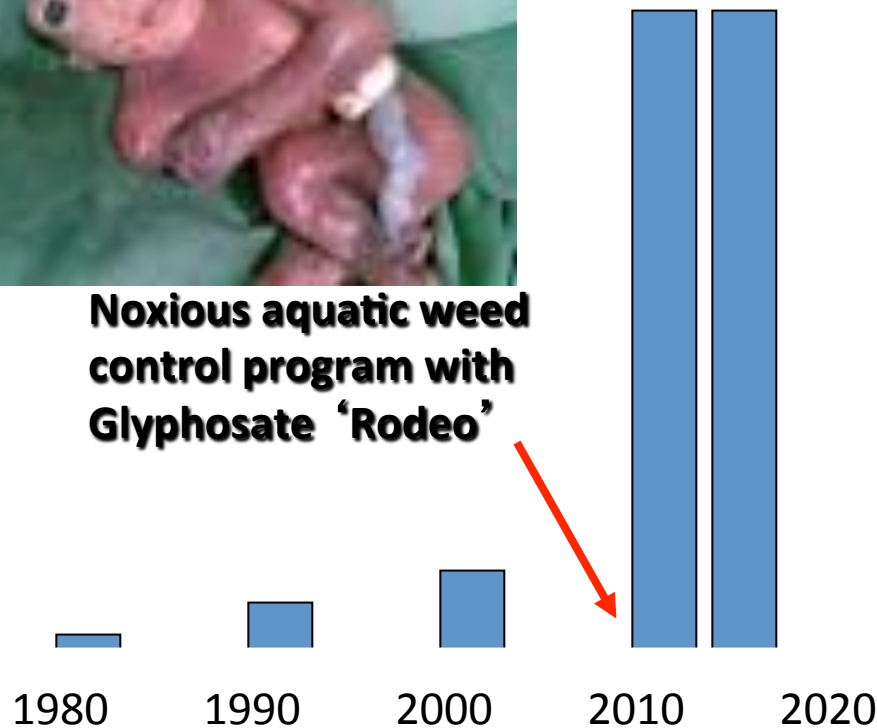
**\*Barbara H. Peterson. Farm Wars, <http://farmwars.info/?p=11137>**



# **“Glyphosate, Brain Damaged Babies, and Yakima Valley - A River Runs Through It”\***



**Noxious aquatic weed  
control program with  
Glyphosate ‘Rodeo’**



## ***“Glyphosate, Three Rivers, and Anencephaly”***

**Yakima Harold Republic**

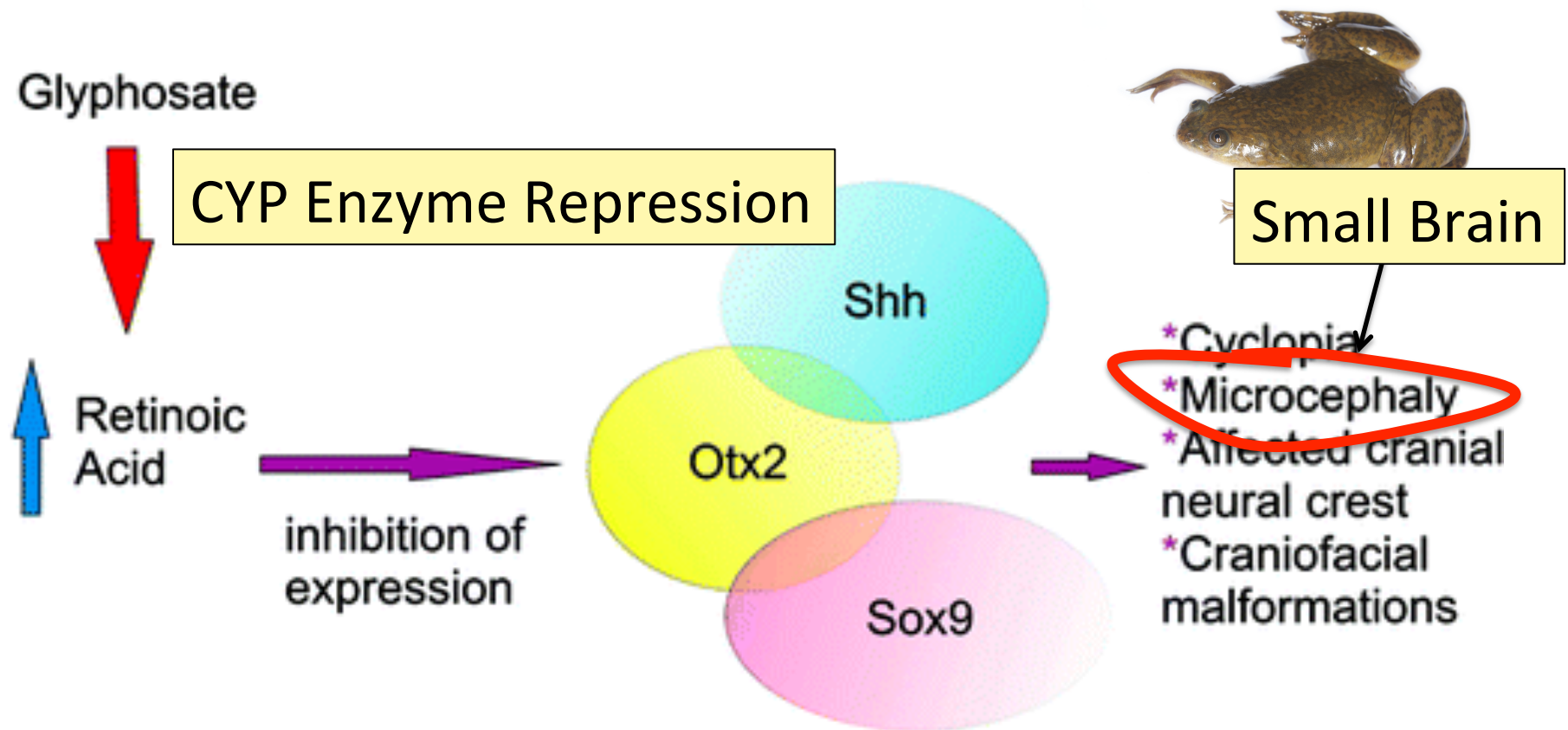
Slide thanks to Prof. Don Huber, with permission

**\*Farm Wars 3/6/14**

# How might glyphosate cause anencephaly?

- Neural tube defects linked to folate deficiency
  - Impaired methylation pathway
- Folate production by gut microbes depends on the shikimate pathway (blocked by glyphosate)
  - Gut microbes that synthesize folate are especially sensitive to glyphosate
- Glyphosate interferes with retinoic acid metabolism → toxic accumulation
- Disruption of glycine cleavage system

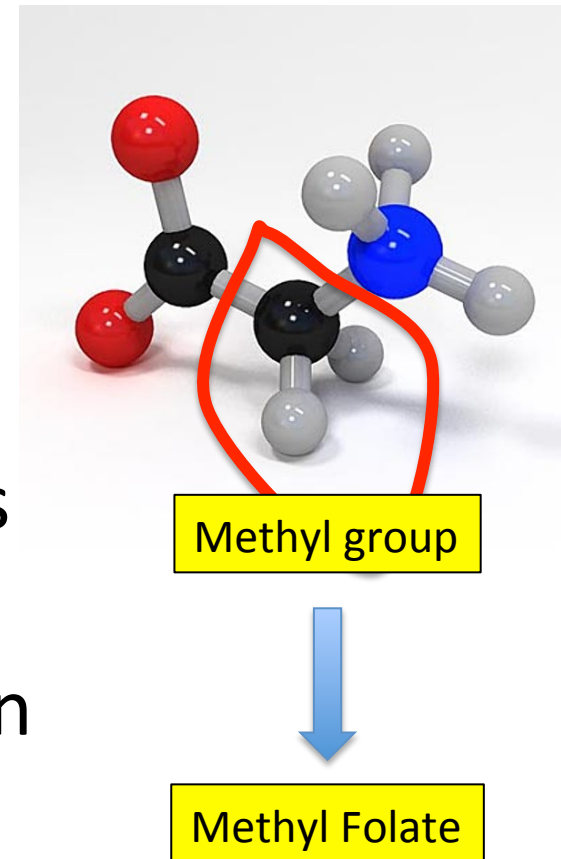
# Glyphosate Upregulates Retinoic Acid\*



\* A. Carrasco, Teratogenesis by glyphosate based herbicides and other pesticides. Relationship with the retinoic acid pathway. In Breckling, B. & Verhoeven, R. (2013) GM-Crop Cultivation – Ecological Effects on a Landscape Scale. Theorie in der Ökologie 17. Frankfurt, Peter Lang.

# Glycine, Methyl-folate and One-carbon Metabolism

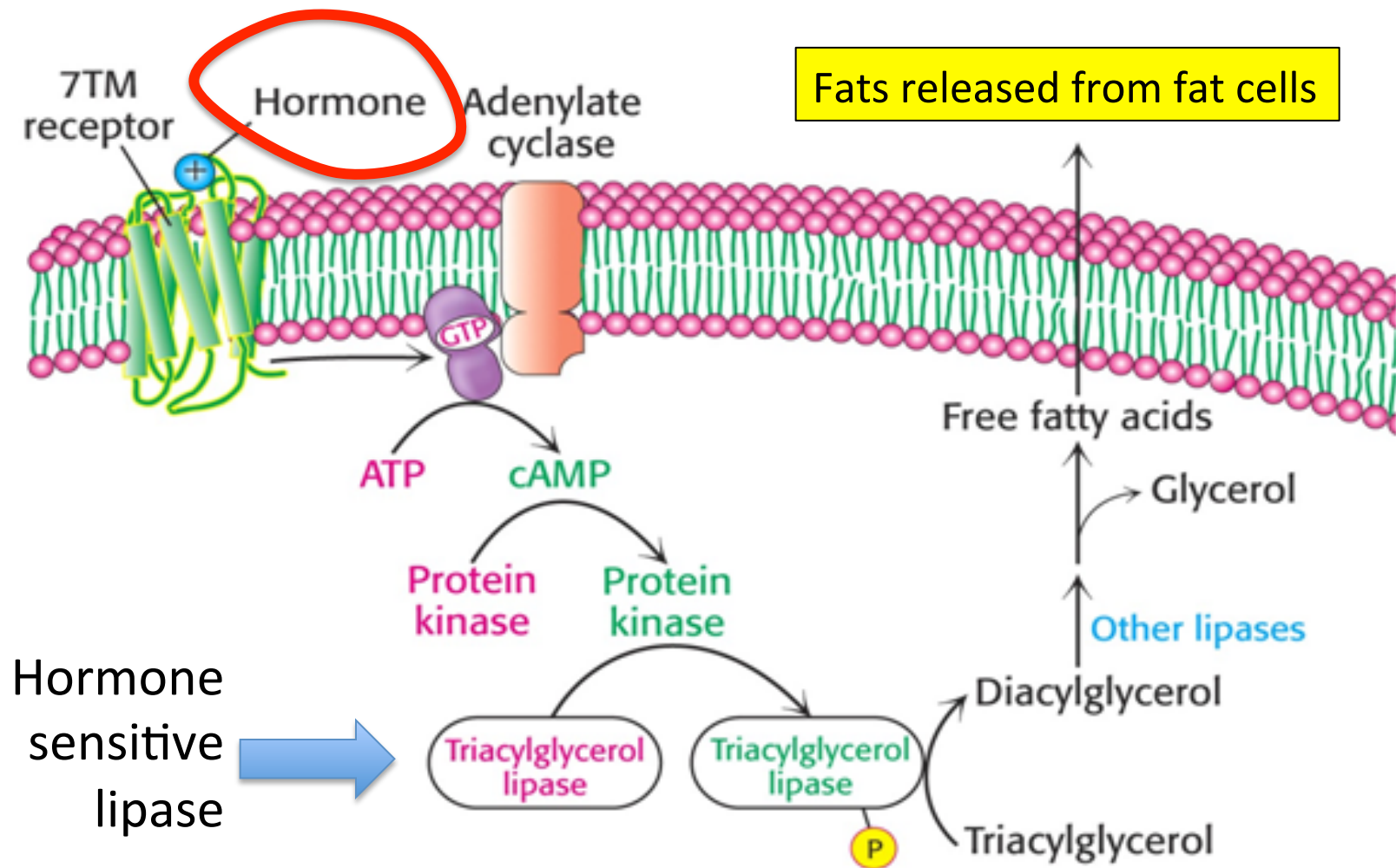
- Glycine is a key source of methyl groups for the one-carbon cycle via the glycine cleavage system
- A glycine-rich region maintains shape and flexibility of glycine decarboxylase, a key enzyme in the glycine cleavage system\*



\*A Kume et al., JBC 1991; 266(5): 3323-3329.

# **Diabetes, Obesity and Adrenal Insufficiency**

# Regulating Fat Release



# Impaired Fatty Acid Release from Fat Cells

- Hormone sensitive lipases (aka triacylglycerol lipases)
  - Release fatty acids from fat cells
  - Supply cholesterol to adrenal glands and sex glands for hormone synthesis
  - Respond to glucagon, adrenalin, dopamine, and ACTH
- Depend on multiple conserved glycines<sup>\*</sup>:
  - Contain HGGG motif as “oxyanion hole”
  - Member of the class of “serine proteases” that contain a GX SXG motif essential for enzyme activity

<sup>\*</sup>RC Wilmouth et al. Nat. Struct. Biol 2001;8: 689-694.

# Impaired Fatty Acid Release from Fat Cells

- Hormone sensitive lipases (aka triacylglycerol lipases)
  - Release fatty acids from fat cells

Impaired hormone sensitive lipases have been linked to obesity, atherosclerosis and type II diabetes\*\*

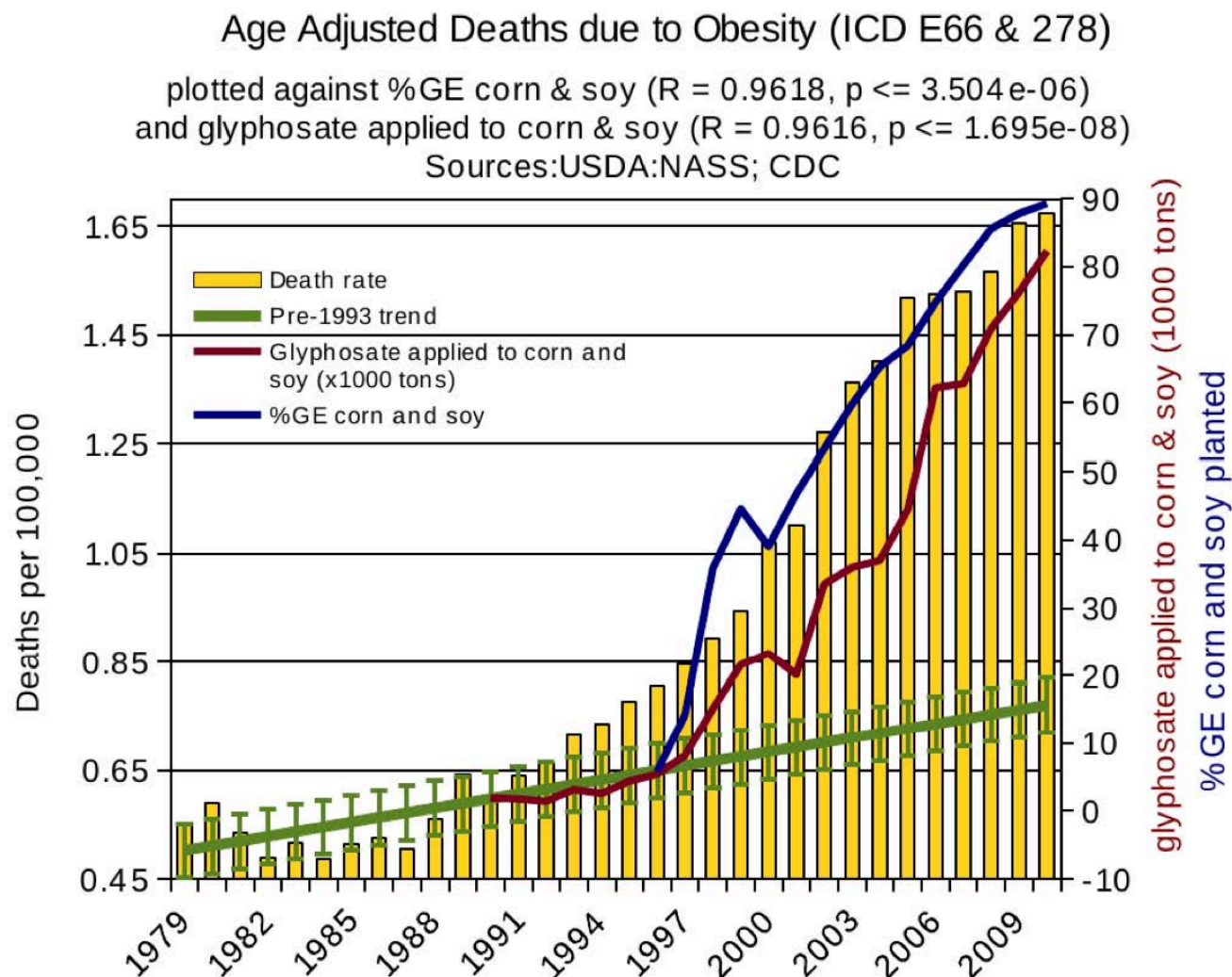
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\*\*SJ Yeaman, Biochem. J. (2004) 379, 11-22.

\*RC Wilmouth et al. Nat. Struct. Biol 2001;8: 689-694.



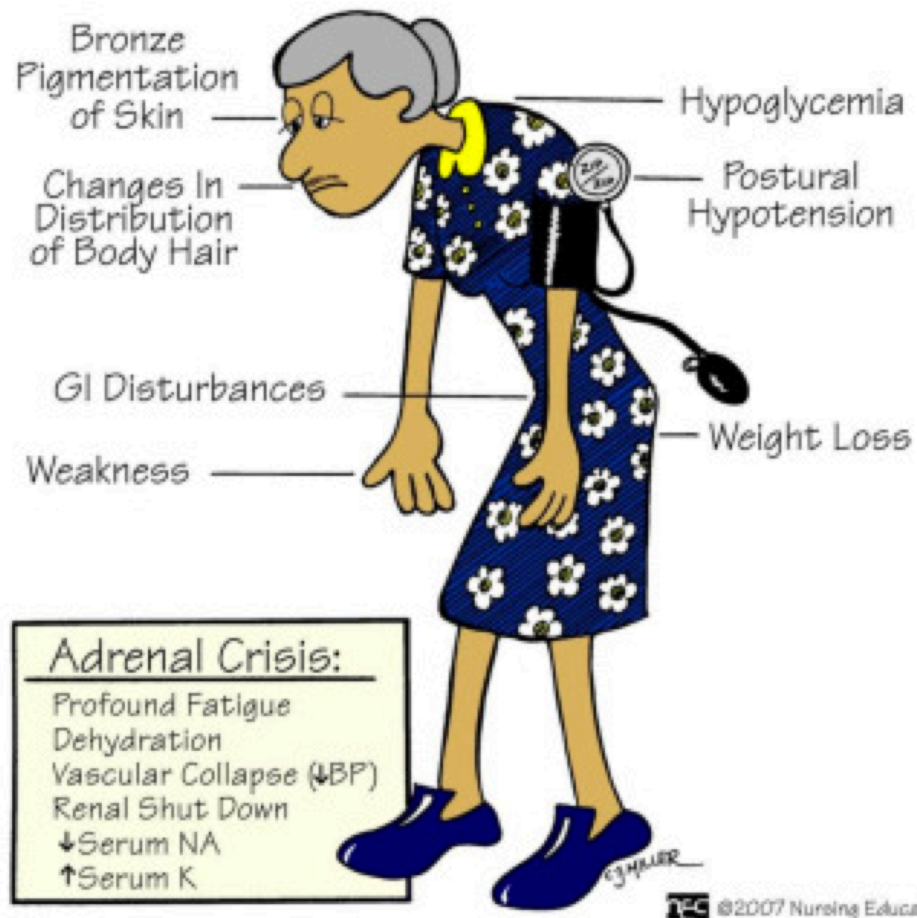
# Glyphosate Usage & Death due to Obesity\*



\*N Swanson et al., *Journal of Organic Systems*, 9(2), 2014

# Adrenal Insufficiency

## ADDISON'S DISEASE



Roundup has been shown to severely impair adrenal hormone synthesis\*

\*A Pandey and M Rudraiah, Toxicology Reports 2 (2015) 1075-1085.

# Insulin Receptor & Diabetes\*,\*\*

- Glucagon release is regulated by insulin receptors (IRs)
  - When IRs are dysfunctional in mice, excess glucose is released from the liver, leading to elevated blood sugar and diabetes
- Eight repeats of a glycine-centered motif determine IR 3-D structure
- ATP-binding site contains a GXGXXG motif\*\*\*

\*PE Cryer, Endocrinology 2012;153(3):1039-1048.

\*\*D Kawamori et al., Cell Metab 2009;9:350-361.

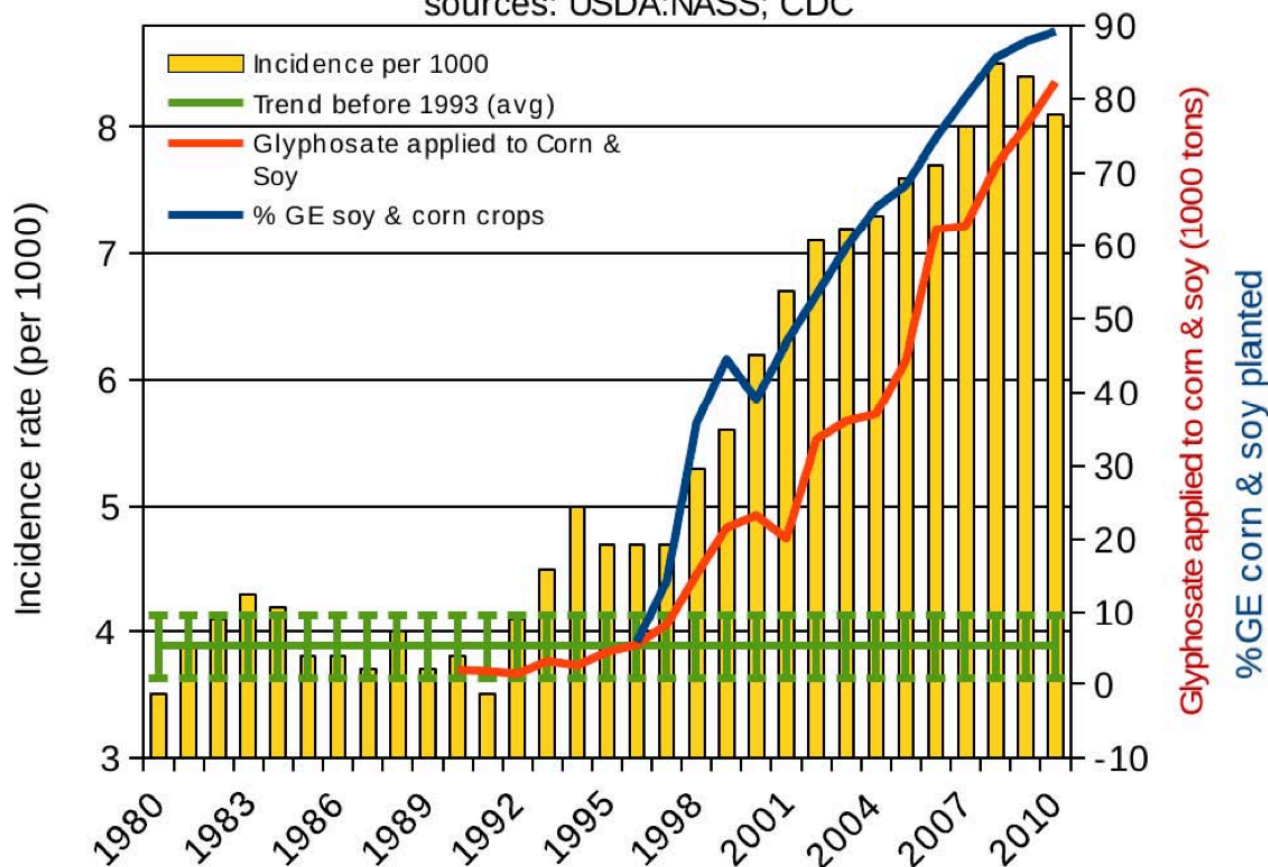
\*\*\*DR Knighton et al., Proc Natl Acad Sci U S A. 1993;90(11):5001-5

# Diabetes and Glyphosate\*

Annual Incidence of Diabetes (age adjusted)

plotted against %GE corn & soy crops planted ( $R = 0.9547$ ,  $p \leq 1.978e-06$ )  
along with glyphosate applied to corn & soy in US ( $R = 0.935$ ,  $p \leq 8.303e-08$ )

sources: USDA:NASS; CDC



\*Figure 14, Swanson et al. Journal of Organic Systems 2014; 9(2):6-37.

# Celiac Disease and Prolyl Aminopeptidase

- Gluten intolerance and Celiac disease result from inability to break down gluten, which is enriched in proline\*
- Prolyl aminopeptidase, the enzyme that breaks down proline-containing peptides, depends on manganese as a catalyst
- Prolyl aminopeptidase also contains a highly conserved GxSxGG motif plus two other regions with conserved glycines\*\*
- Malabsorption due to celiac disease can lead to nutritional deficiencies and symptoms of autism\*\*\*

\*G. Janssen et al., PLoS One 2015; 10(6): e0128065

\*\*F Morel et al., Biochimica et Biophysica Acta 1999;1429: 501-505

\*\*\*SJ Genuis and TP Bouchard, J Child Neurol. 2010;25(1):114-9

# Impaired Blood Flow

# Endothelial Nitric Oxide Synthase (eNOS)

- eNOS produces nitric oxide which relaxes blood vessels and promotes blood flow
- We hypothesize that eNOS produces sulfate when it is membrane-bound as a dimer, with sunlight as a catalyst\*
- eNOS depends on conserved glycines both for dimer formation and for binding to the membrane
- Replacement of the glycines with larger molecules disrupts both dimer formation and membrane attachment: impairing eNOS function
  - This explains the “pathology” of superoxide release

\*Seneff et al., *Entropy* **2012**, 14, 2492-2530

# Endothelial Nitric Oxide Synthase (eNOS)

- eNOS produces nitric oxide which relaxes blood vessels and promotes blood flow

Impaired eNOS function leads to oxidative damage in the artery wall, as well as deficient supply of both nitric oxide and sulfate to the vasculature

disrupts both dimer formation and membrane attachment: impairing eNOS function

– This explains the “pathology” of superoxide release

\*Seneff et al., *Entropy* **2012**, 14, 2492-2530



# Kidney Disease

# Bacterial Siderophores & Kidney Disease

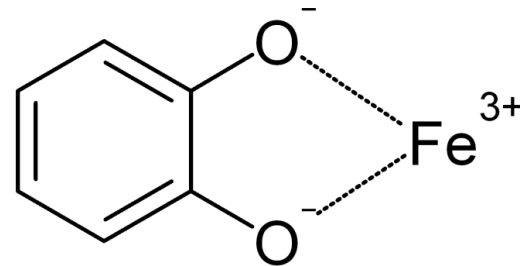
- Alarming incidence of kidney failure among agricultural workers in sugar cane fields
  - Characterized by proximal tubular necrosis
  - Sugar cane sprayed with glyphosate preharvest
- Defective iron uptake from bacterial siderophores in the proximal renal tubule can cause simultaneous iron deficiency and iron toxicity\*

\*K Mori et al. The Journal of Clinical Investigation 2005;115(3):610-621.

# How Proximal Tubule Gets Iron\*

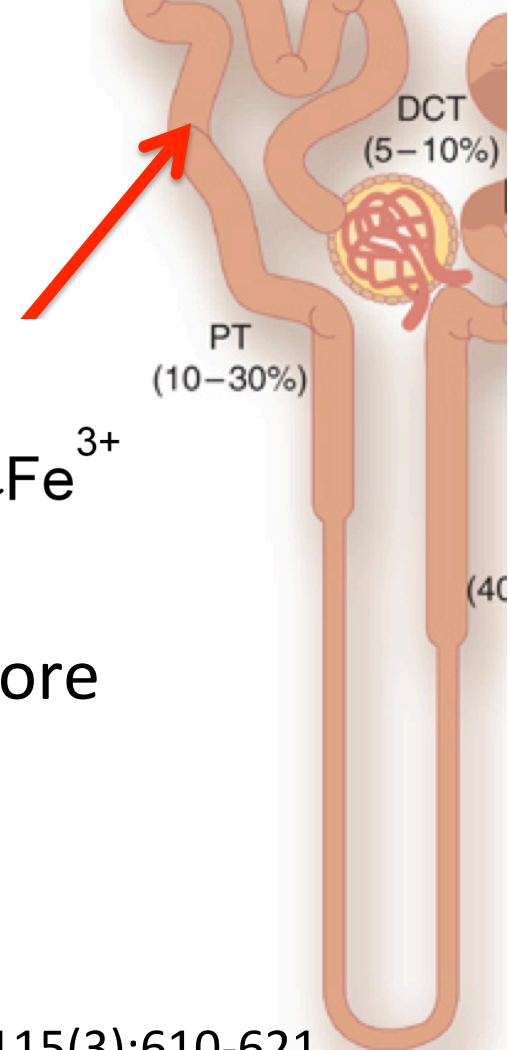
- Protein that synthesizes siderophore in bacillus depends on two conserved glycines
- Protein that uptakes siderophore in renal tubule contain a conserved GXW motif

Bacillus



siderophore

Proximal Tubule



\*K Mori et al. The Journal of Clinical Investigation 2005;115(3):610-621.

# From Samsel and Seneff: Glyphosate IV\*

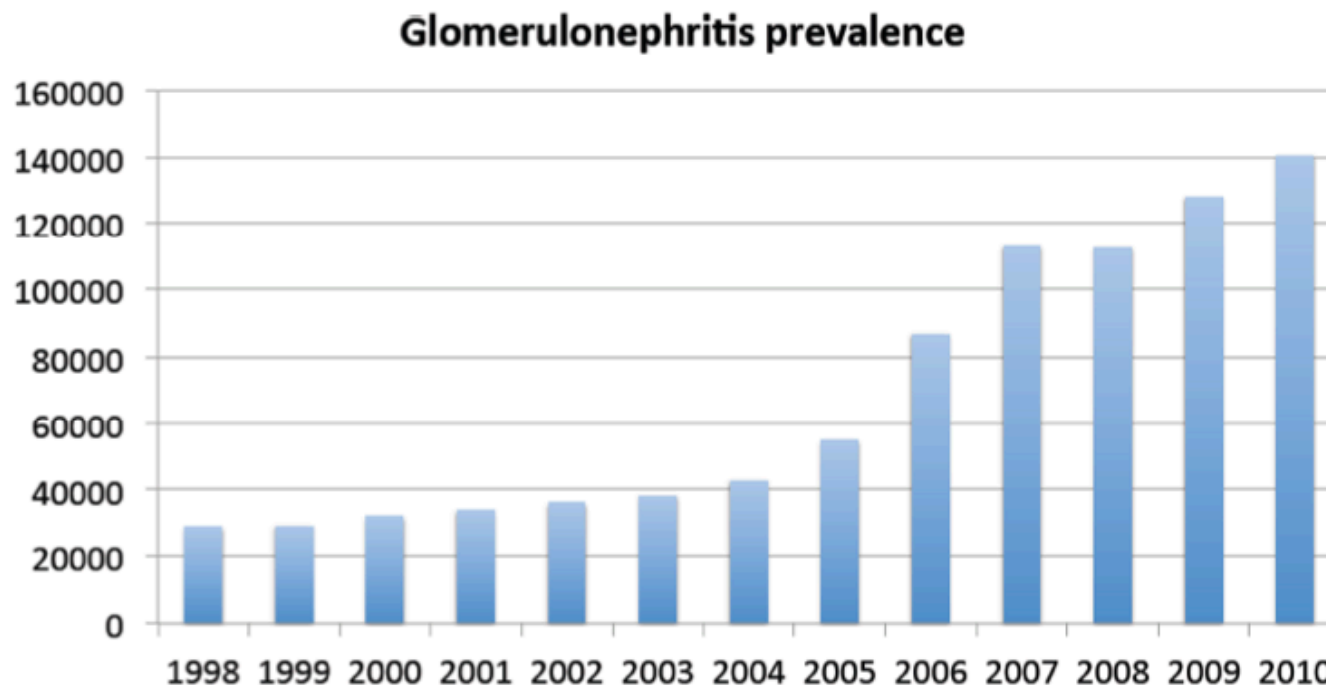


Figure 2. Incidence of nephritis and kidney failure reports in the US CDC's hospital discharge data from 1998 to 2010 normalized to counts per million population each year. This includes all reports of ICD-9 codes from 580 to 589.

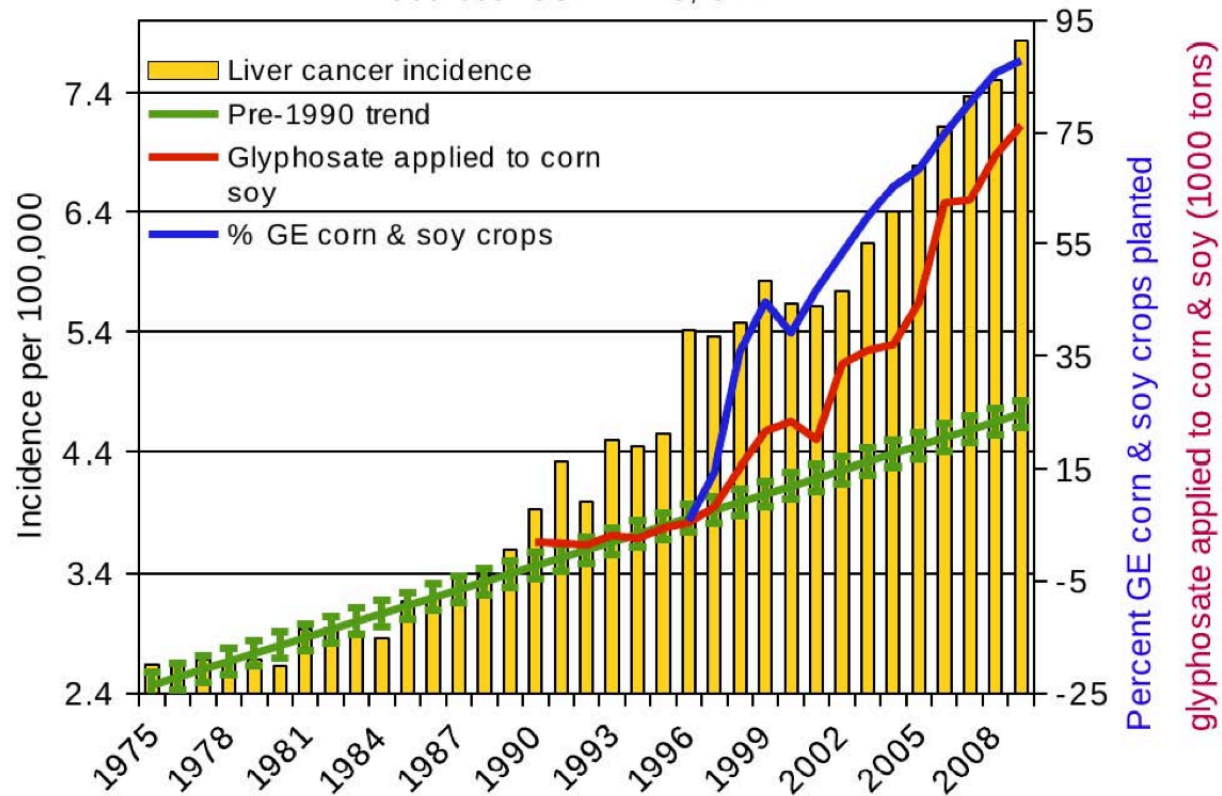
\*A Samsel and S Seneff, *Journal of Biological Physics and Chemistry* **15** (2015) 121–159

# Liver Disease

# Liver Cancer & Glyphosate\*

## Liver and Intrahepatic Bile Duct Cancer Incidence (age adjusted)

plotted against glyphosate applied to corn & soy ( $R = 0.9596$ ,  $p \leq 4.624e-08$ )  
along with %GE corn & soy planted in U.S. ( $R = 0.9107$ ,  $p \leq 5.402e-05$ )  
sources: USDA:NAS; SEER



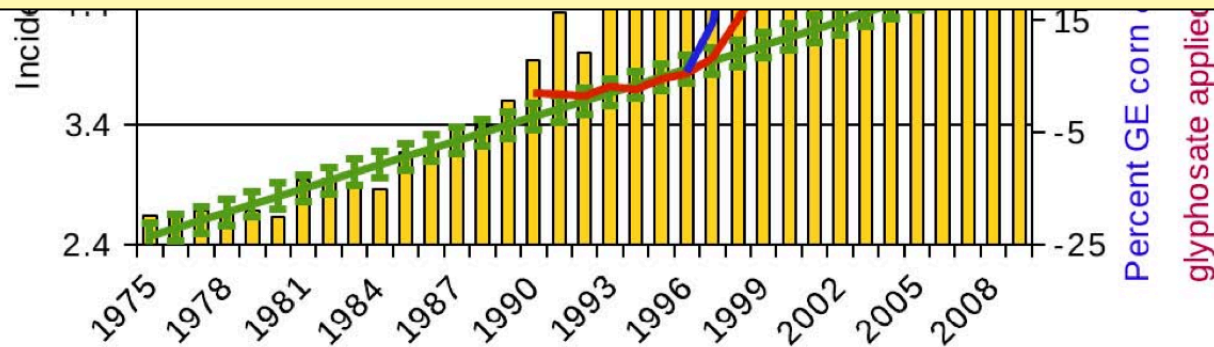
\*N Swanson et al., *Journal of Organic Systems*, 9(2), 2014

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Fatty liver disease is a strong risk factor  
for liver cancer

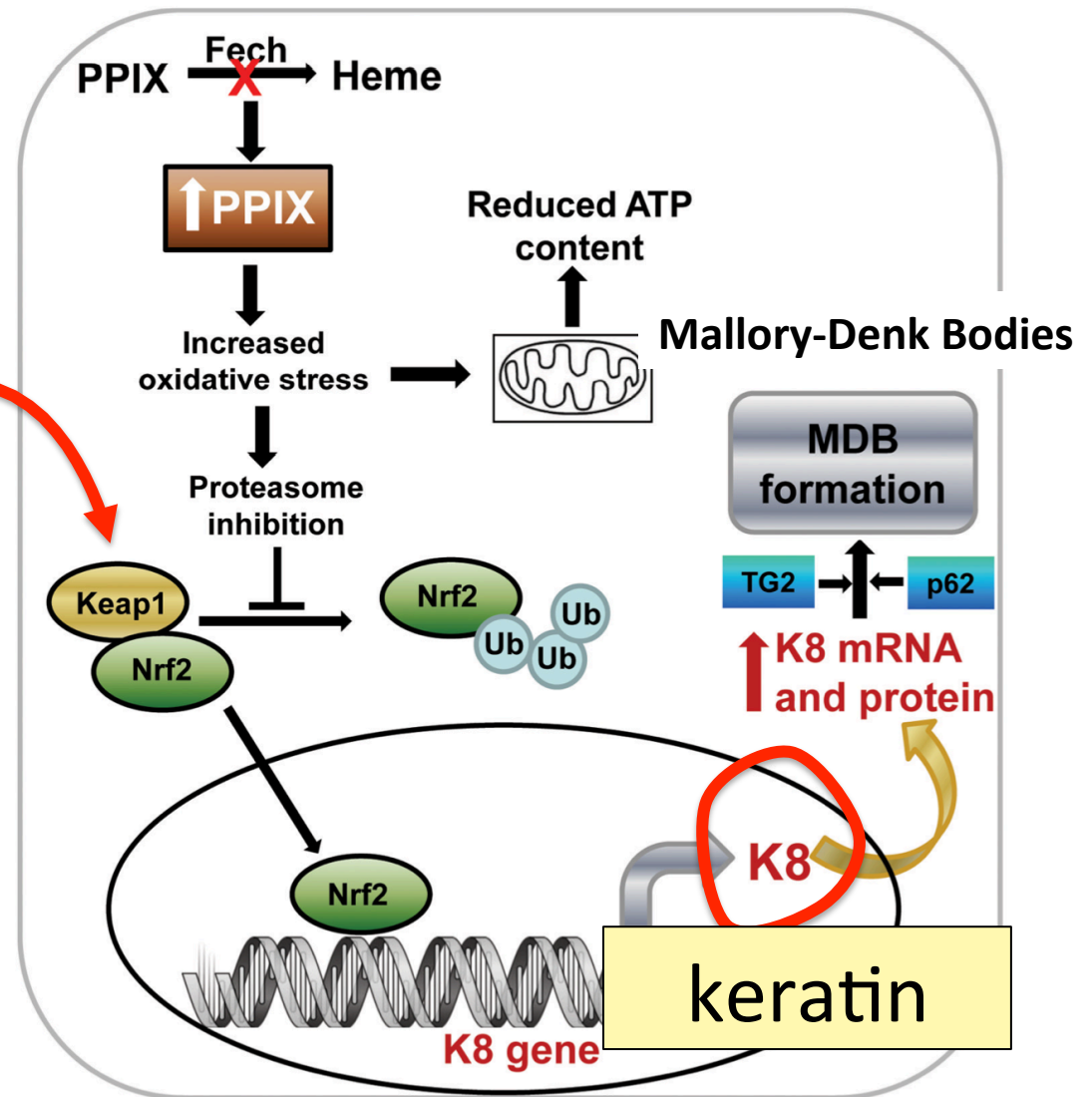


\*N Swanson et al., *Journal of Organic Systems*, 9(2), 2014

# Steatohepatitis (Fatty Liver Disease)\*

Mallory-Denk bodies (MDBs) are liver cell inclusions associated with steatohepatitis (fatty liver disease)

Keap1 has a conserved *double glycine repeat* that anchors it to the cytoskeleton



\*A Singla et al., Hepatology 2012 July ; 56(1): 322–331.



# Hyperkeratosis

# Beak Deformities in Chickadees\*

- Beak deformities involving excess *keratin* synthesis have been appearing among chickadees and other birds in the Great Lakes region, in central Alaska and in areas exposed to California agricultural run-off
- No link could be found with investigated toxic chemicals and metals
- Glyphosate was not investigated



\*CM Handel and C van Hemert, Environ Toxicol Chem 34, 2015; 314-327.

# Beak Deformities in Chickadees\*

Chickadees frequent bird feeders to consume sunflower seeds sprayed with glyphosate just before harvest

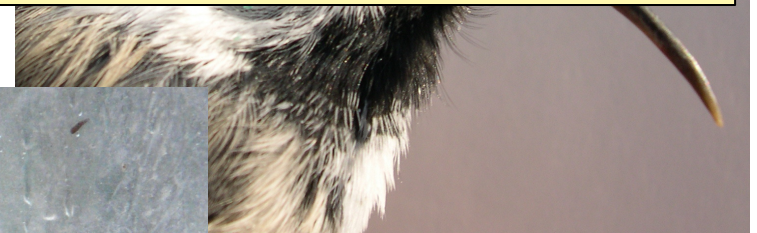
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\*CM Handel and C van Hemert, Environ Toxicol Chem 34, 2015; 314-327.

# **How to Safeguard Yourself and Your Patients**



# Extracts from Common Plants Can Treat Glyphosate Poisoning\*

- Roundup is toxic to hepatic and embryonic cells at doses far below those used in agriculture and at residue levels present in some GM food.
- Extracts from common plants such as dandelions, barberry, and burdock can protect from damage, especially if administered prior to exposure.



\*C Gasnier et al. Journal of Occupational Medicine and Toxicology 2011, 6:3

# Treating Glyphosate Poisoning in Animals (e.g., cows) \*

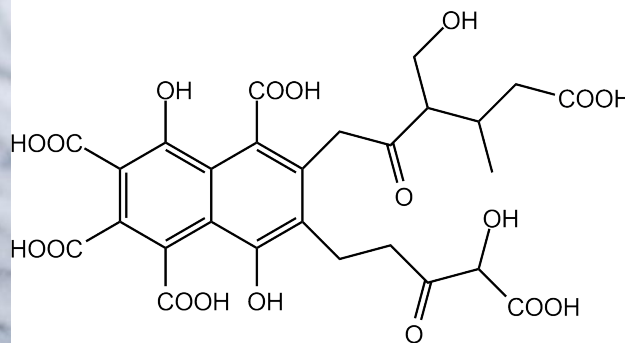
Sauerkraut  
Juice



Activated charcoal, bentonite clay, humic and fulvic acids, and sauerkraut juice have been shown to be effective in reducing urinary levels of glyphosate and improving animal health



Bentonite Clay



Fulvic Acid



Activated Charcoal

\*H Gerlach et al., J Environ Anal Toxicol 2014, 5:2

# Some Important Nutrients

- Curcumin
- Garlic
- Vitamin C
- Probiotics
- Methyl tetrahydrofolate
- Cobalamin
- Glutathione
- Taurine
- Epsom salt baths



# Get Grounded

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# Go Organic!



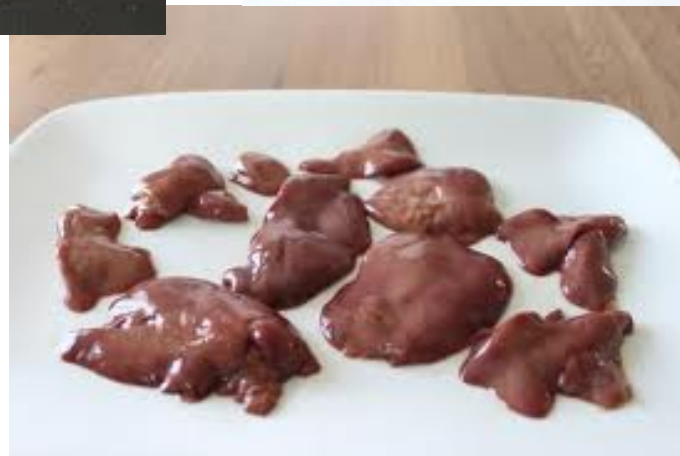
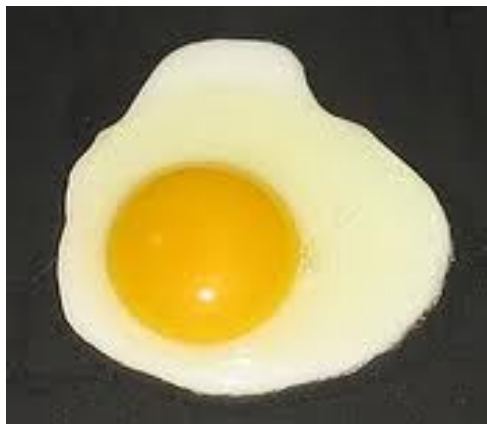


# Eat Foods Containing Manganese





# Eat Foods Containing Sulfur



# Summary

- Glyphosate contamination in our food supply is a serious threat to health
  - Toxic mechanisms include mineral chelation, disruption of CYP enzymes, and disruption of gut microbes
  - I believe glyphosate is the most important factor in the autism epidemic
- Glyphosate works synergistically with aluminum and glutamate in vaccines
- Glyphosate may erroneously replace glycine during protein synthesis
  - Huge consequences to multiple diseases whose incidence is going up in step with glyphosate usage on core crops: diabetes, obesity, Alzheimer's and other neurological diseases, liver and kidney disease, vascular diseases, Celiac disease, etc.
- Eating an organic diet rich in sulfur and manganese and probiotics can help protect from glyphosate