

# Is Roundup the Toxic Chemical That's Making Us All Sick?

Stephanie Seneff

MIT CSAIL

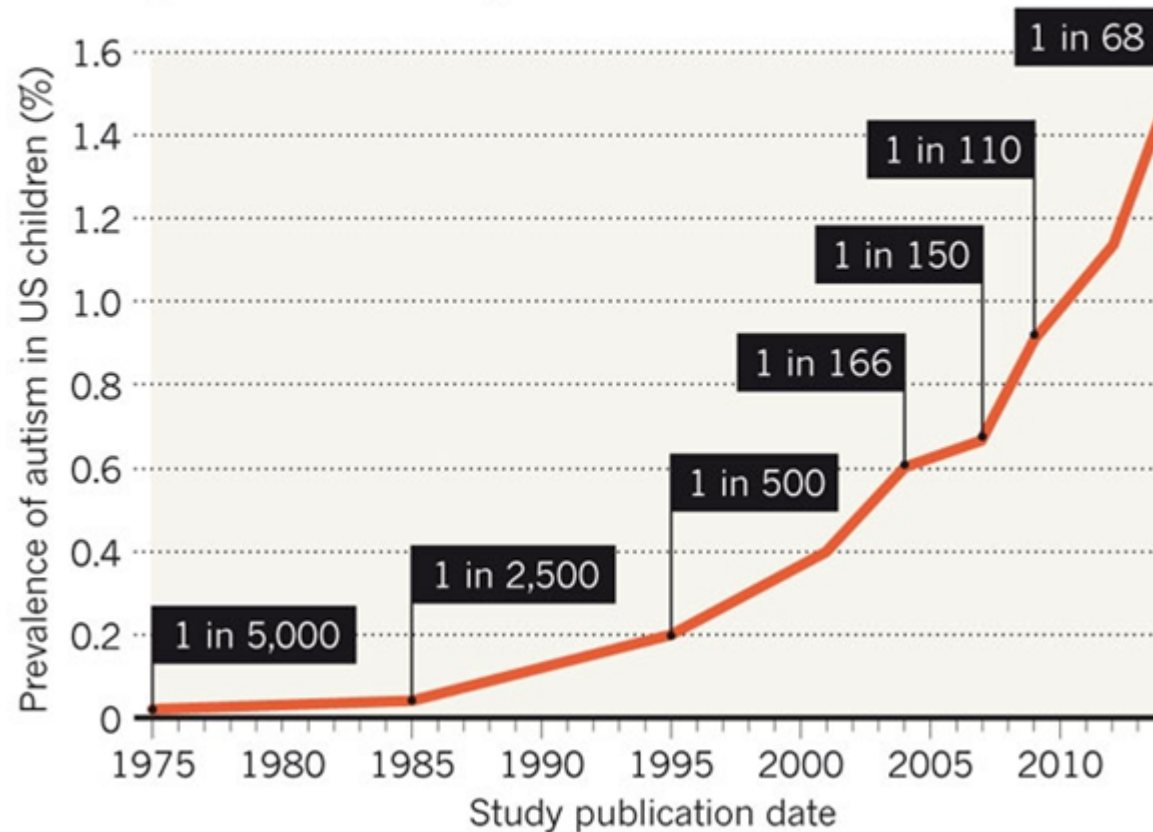
June 5, 2014



# A Frightening Trend\*

## AUTISM DIAGNOSES RISING

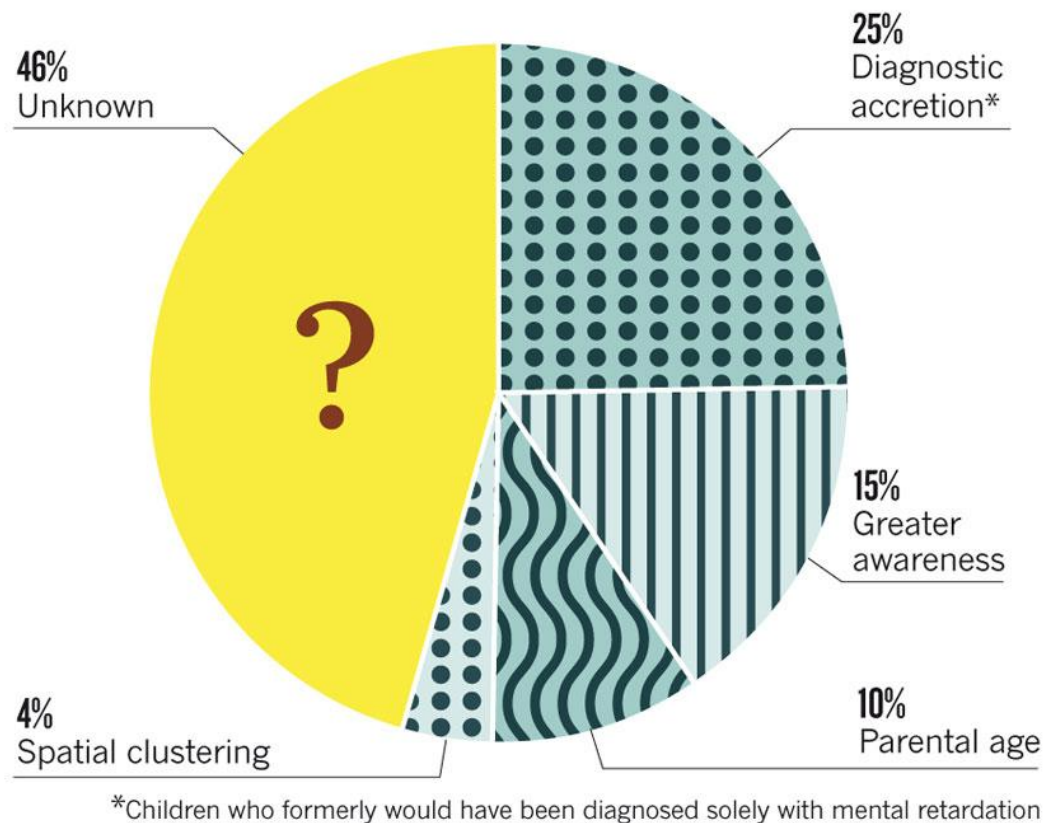
Almost 1.5% of US children are now diagnosed with autism, according to data from 11 regions in the United States.



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

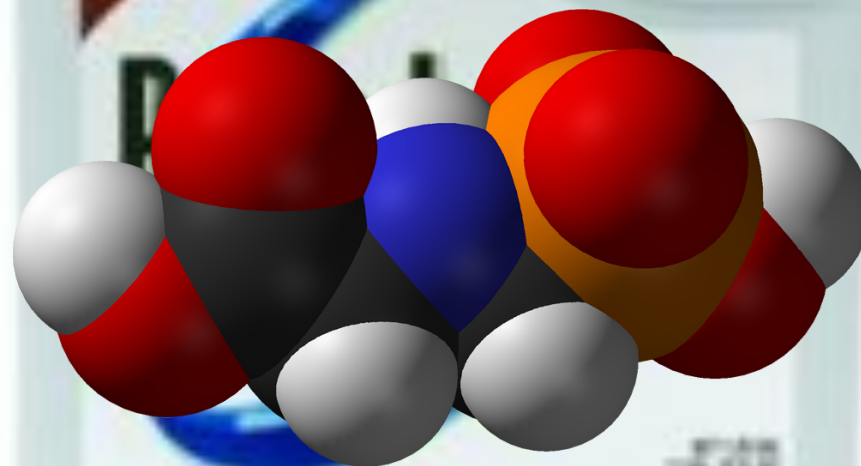
***“If it is an environmental cause contributing to an increase, we certainly want to find it.”\****

***Reasons: unclear***



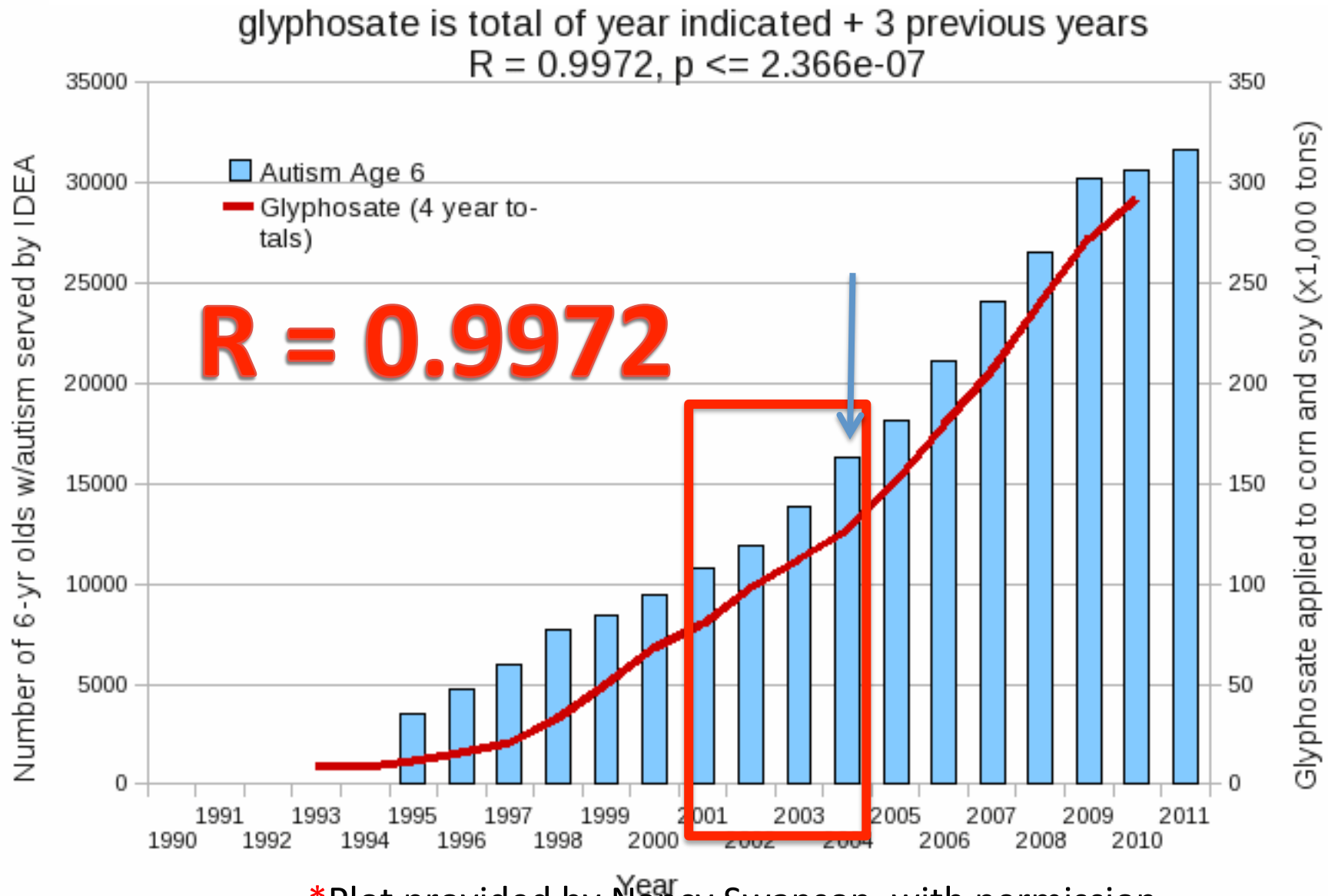
\*K. Weintraub, Nature 479, Nov. 3 2011, 22-24.

**GLYPHOSATE**



# **Glyphosate and Autism**

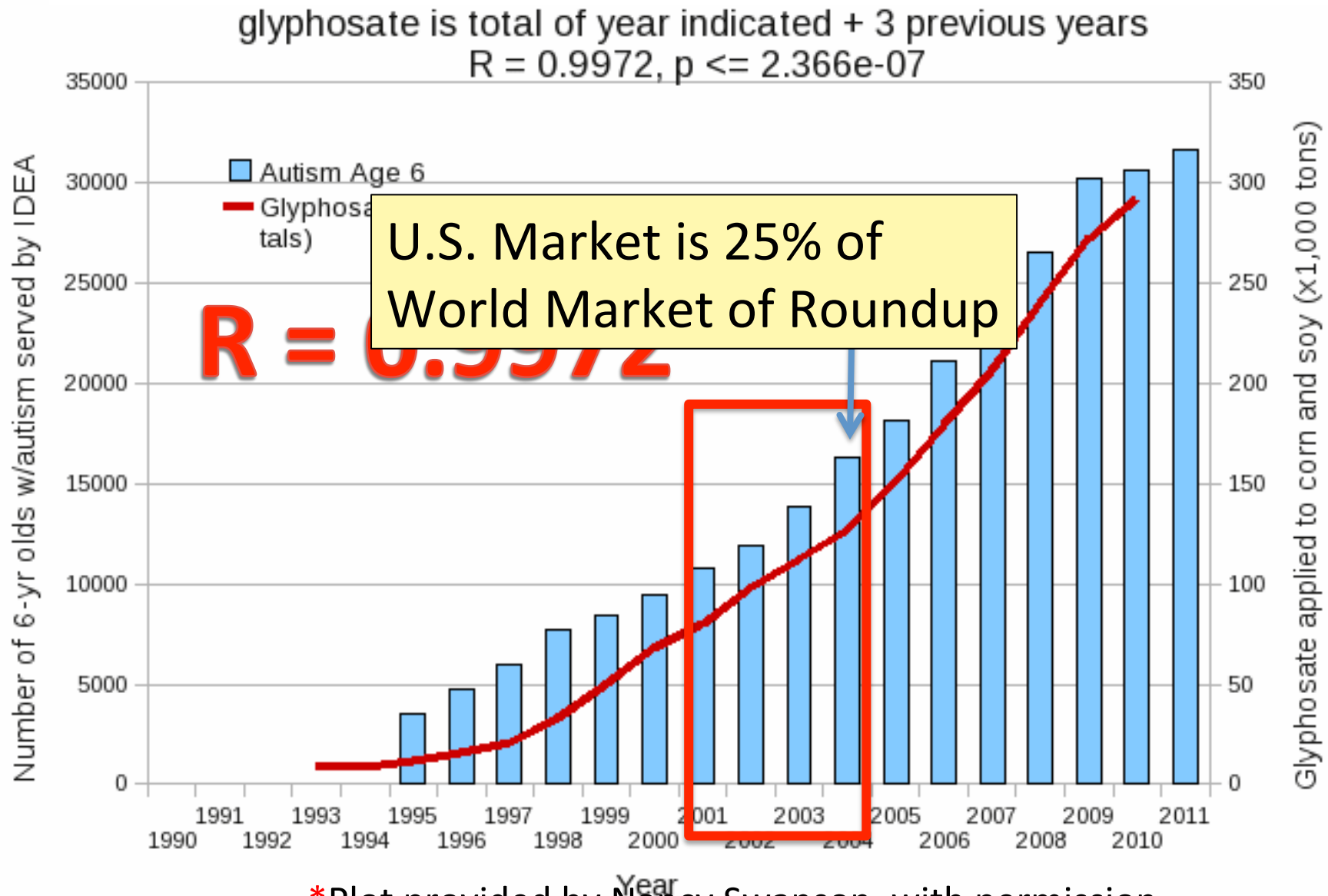
# Autism Prevalence: 6 year olds



\* Plot provided by Nancy Swanson, with permission

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

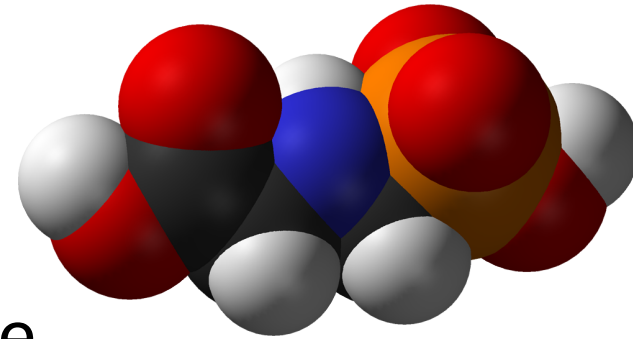
# Autism Prevalence: 6 year olds



\* Plot provided by Nancy Swanson, with permission

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

# *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?**

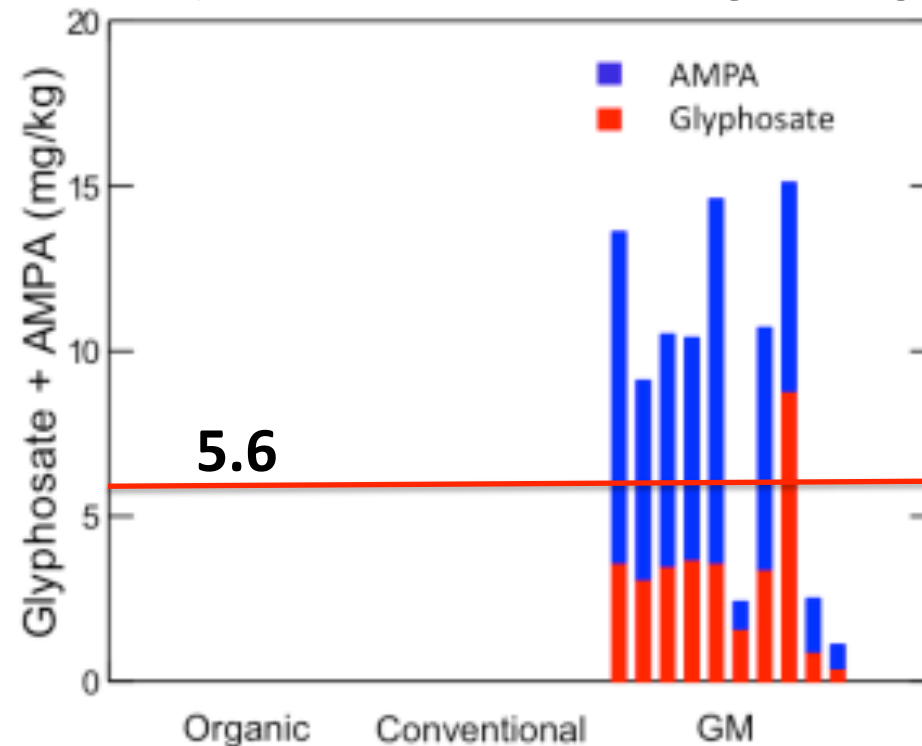
**Very little data!**

# **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

\*Posted on Apr 6 2014 - 4:19am by Sustainable Pulse

# 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\*

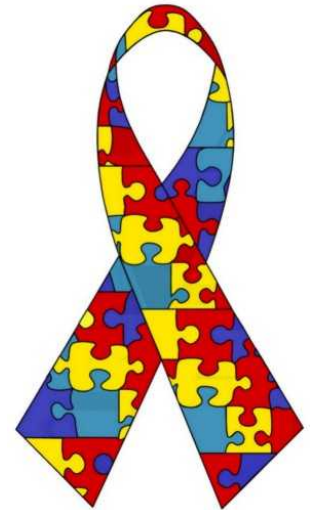
*"There was a 2.6-fold higher rate of febrile seizures, a 2.1-fold higher rate of epilepsy comorbidity and a 4-fold higher rate of simple partial seizures in the autistic children fed soy-based formula"*



\*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



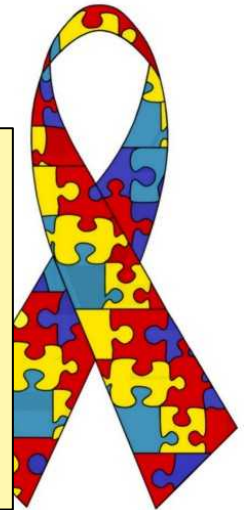


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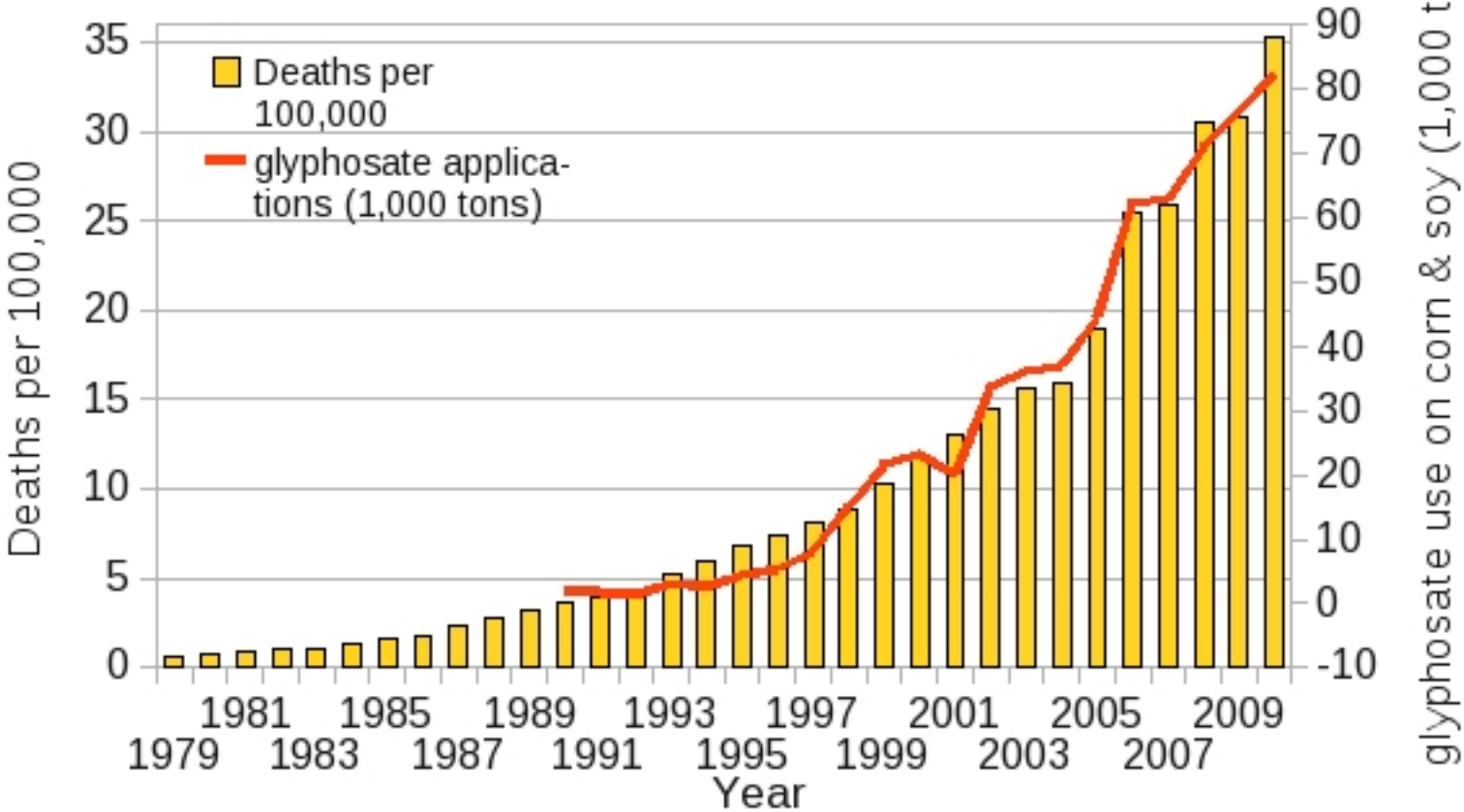
These can all be explained as potential effects of glyphosate on biological systems

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



# Dementia 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

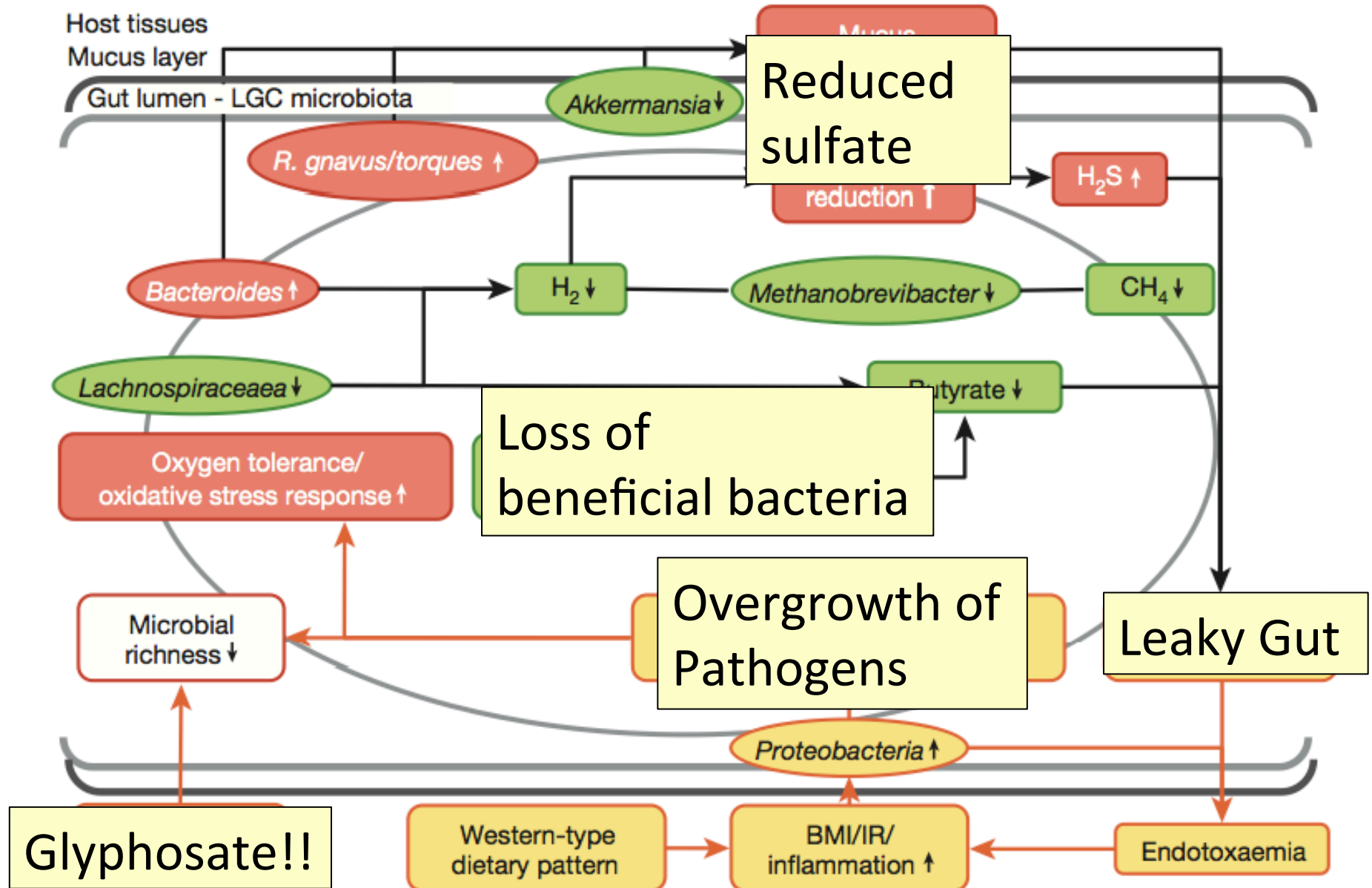
# Digestive System Disorders

# 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\*

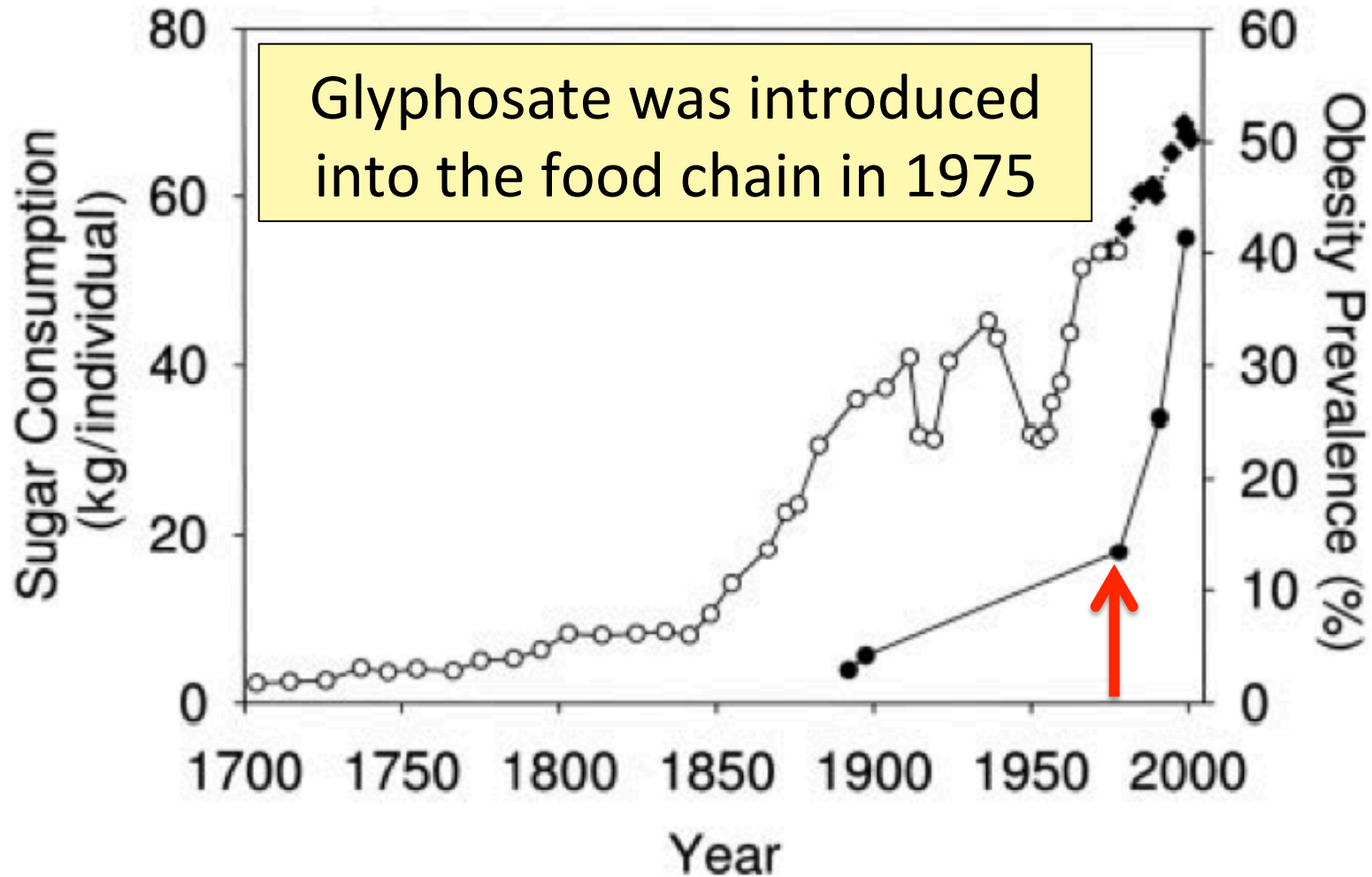
\*N. Fei and L. Zhao, The ISME Journal, Online Publication Dec. 2012

# Obesity Switch\*



\*Figure 3, Le Chatelier et al., Nature 500, Aug 29, 2013, 541-548.

# Obesity in US over Time\*

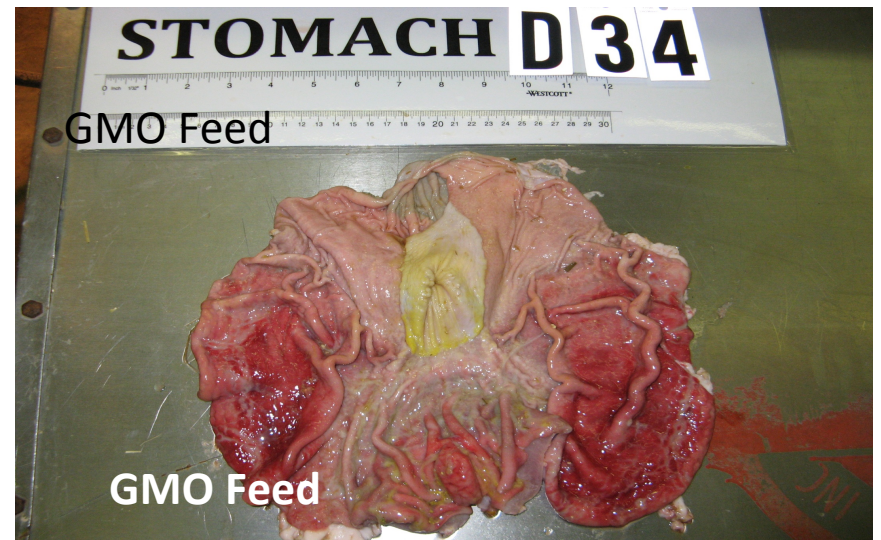


\*Figure 1 in R.J. Johnson et al., Am J Clin Nutr 2007;86:899–906.

# 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.

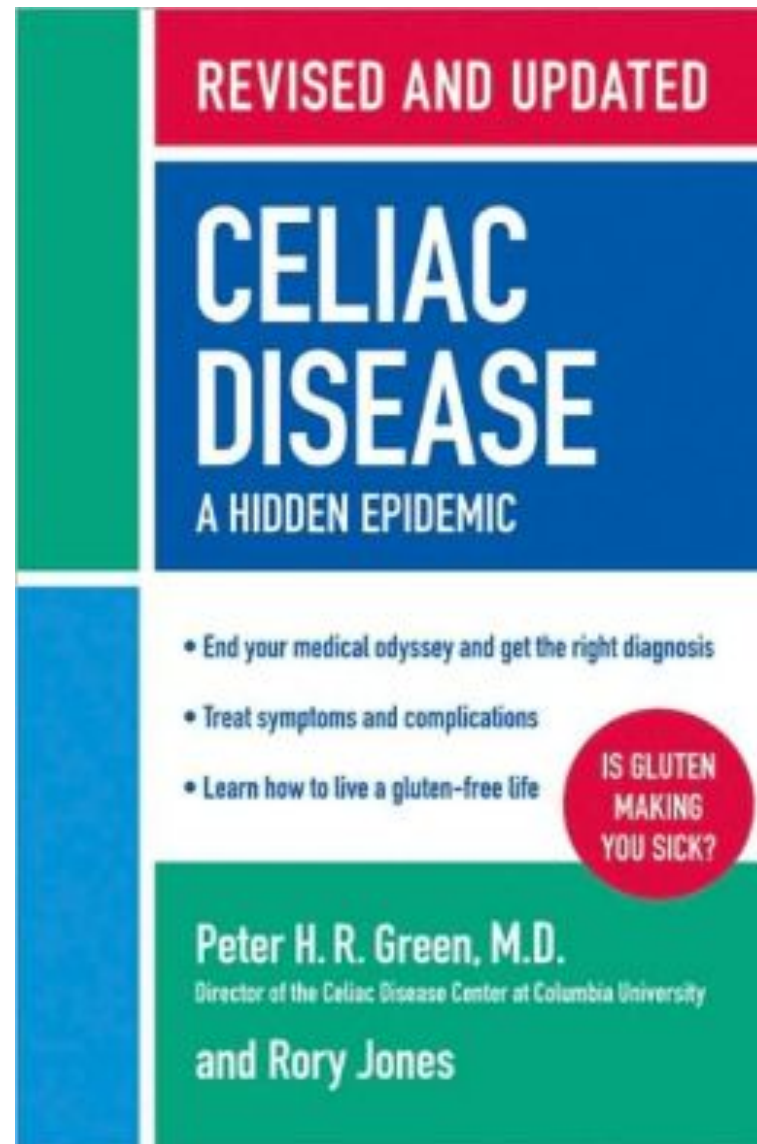
# Human Digestive System Disorders

- 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





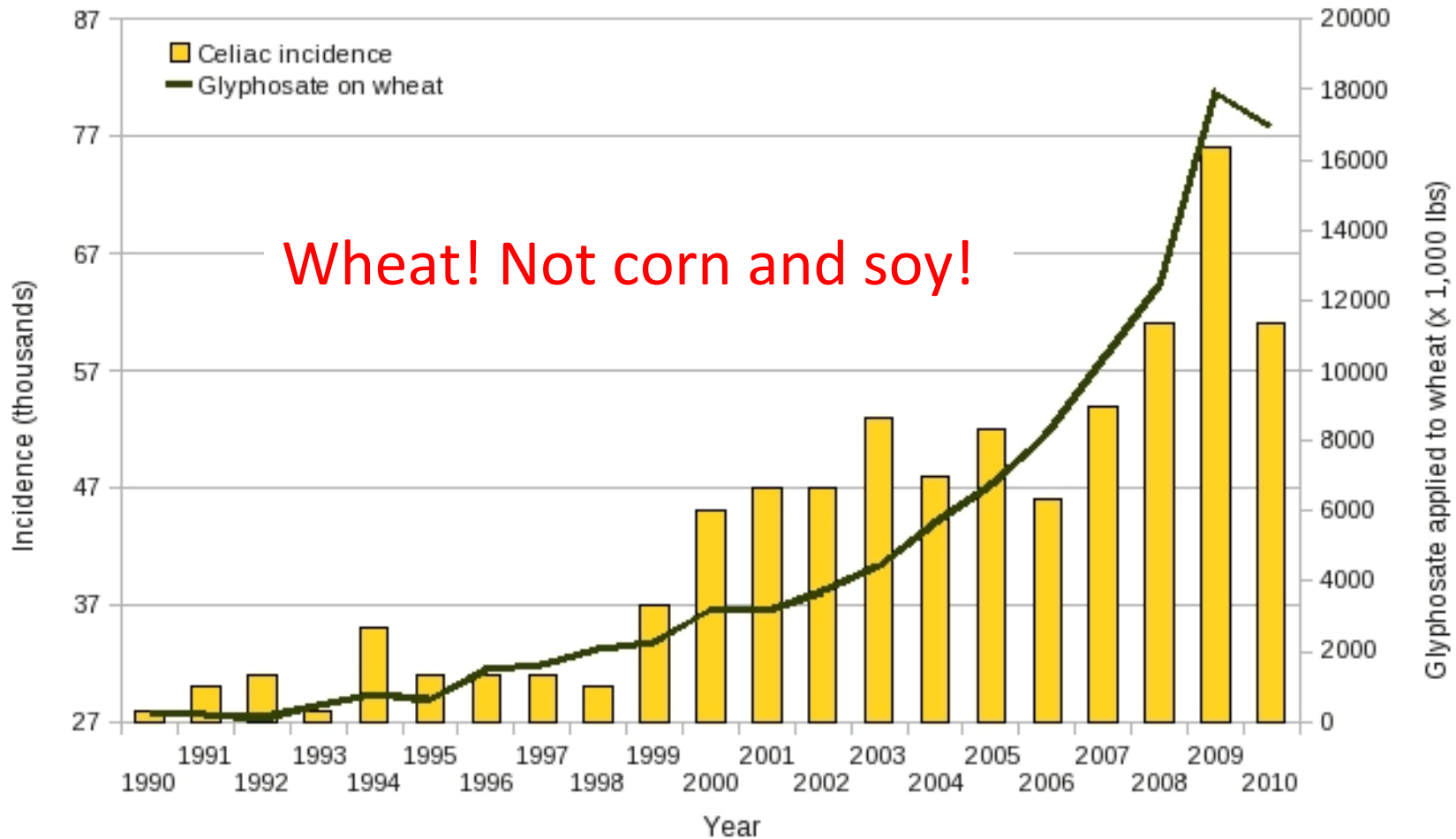
# Celiac Disease has Quadrupled in the US in the Last 50 Years



# 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

Published online in:  
[www.intertox.sav.sk](http://www.intertox.sav.sk) & [www.versita.com/it](http://www.versita.com/it)

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## REVIEW ARTICLE

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

Anthony SAMSEL<sup>1</sup> and Stephanie SENEFF<sup>2</sup>

# 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.

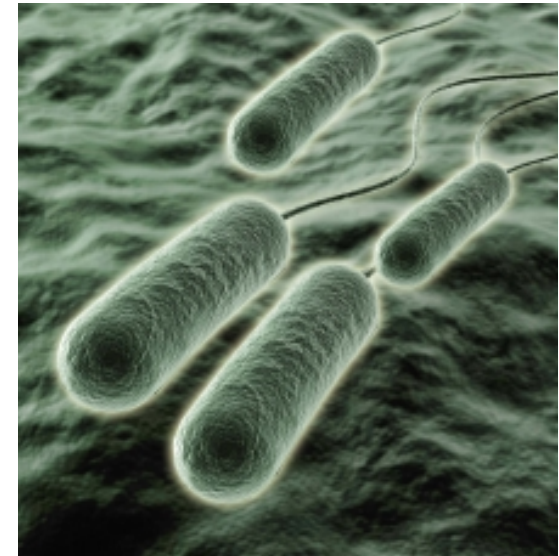
\*\*\* C. Catassi et al., JAMA. 2002 Mar 20;287(11):1413-9.

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



# Pseudomonas and Glyphosate\*

- Pseudomonas aeruginosa, a gram negative bacterium, is a major problem today in hospitals due to its resistance to multiple antibiotics
- P. aeruginosa is one of only three bacterial species that can break down glyphosate.
  - It produces formaldehyde as a by-product
  - Formaldehyde is a well established neurotoxin



\*S. de Betzmann and P. Plésiat Environ Microbiol. 2011 Jul;13(7):1655-65.

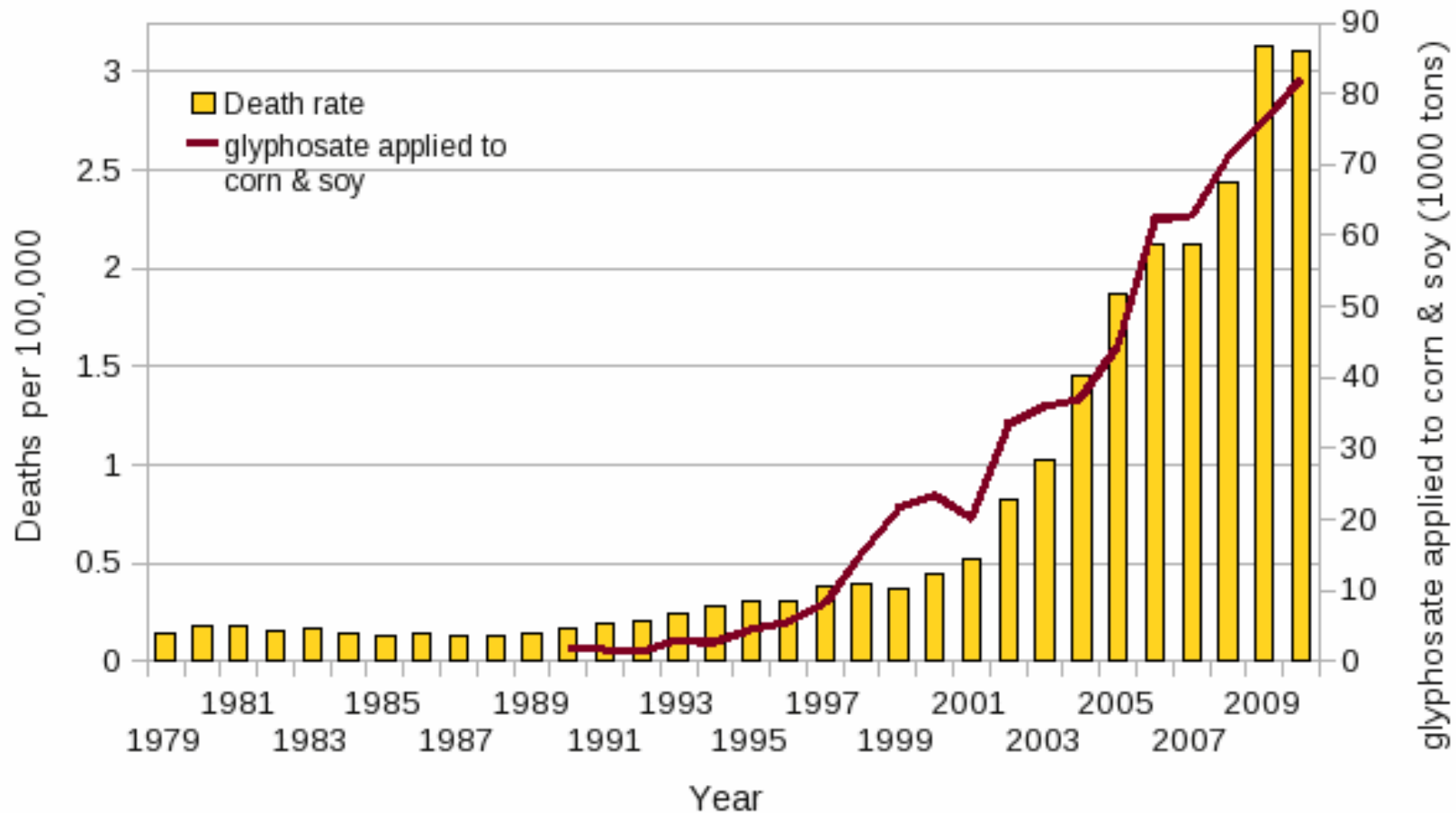
# **“Dramatic Increase in Hospitalization of US Children With Inflammatory Bowel Disease”\***

- 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

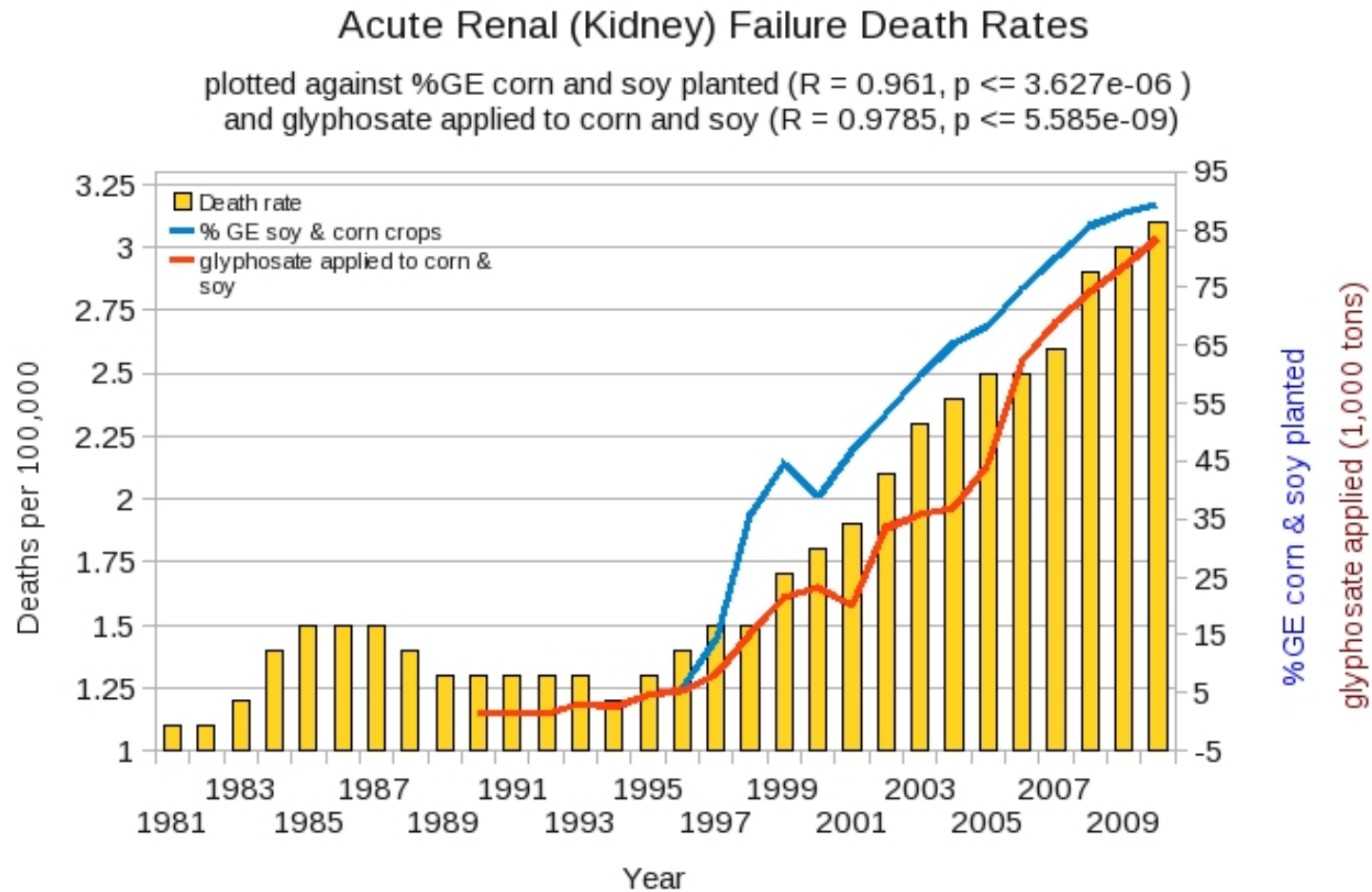
# Kidney Failure in Agricultural Workers\*

- 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



# 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 should be banned from agriculture