Extra, extra – read all about it!

S. Eliza Dunn, MD
Disclosures

I work for Bayer Crop Science
Dilemma
Dilemma

Pesticide development very slow

- 8-10 years to test, develop and register
- Costs ~$200 million (not including cost of building production facilities)

Difficult to balance concerns over pesticides and insect borne illnesses

Questionable reports allege associations between pesticide exposure and neurologic illness, cancer, ADHD, autism and many other diseases
Pesticides

Insecticides kill bugs – ticks, mosquitoes, fleas, lice, bed bugs

Herbicides kill weeds & invasive plants – kudzu, honeysuckle

Antibiotics kill bacteria – Strep, Staph, typhus, plague

Fungicides kill fungi – Athlete’s foot, fungi that produce carcinogenic toxins
TECH & SCIENCE
STUDY FINDS 25 PERCENT HIGHER RATE OF AUTISM WHERE MOSQUITO KILLER IS SPRAYED FROM PLANES

BY ZOE SCHLANGER ON 4/30/16 AT 6:16 AM
Natural Pesticides – 1990 study

99% of pesticides consumed are chemicals that are produced by plants to defend themselves

52 natural pesticides tested in this 1990 study

27 of these are rodent carcinogens

// Commonly found thousands of times higher than synthetic pesticides

Americans eat ~ 1.5 g of these natural pesticides/day

// ~10,000x higher than synthetic residues

Vegans likely eat more

Ames, B et.al. Dietary pesticides (99.99% all natural). PNAS 1990; 87:7777-81
“You are going to treat my kid with what?”
Acute Toxicity Studies
Hazard Assessment
Standard Battery of Studies

// Physical Properties
// Residue Chemistry
// Environmental fate
  // General fate
  // Degradation/Metabolism
  // Mobility/Dissipation
  // Accumulation
// Spray Drift
// Non-Target Organisms
  // Acute
  // Chronic
// Product Performance
// Applicator and Re-entry

HUMANS/DOMESTIC ANIMALS
// Acute oral, dermal & inhalation
// Eye & skin irritation
// Dermal sensitization
// 21-d dermal
// 90-day rat, mouse & dog
// 1-year dog chronic
// 18-mo. mouse oncogenicity
// 2-year rat chronic/ oncogenicity
// Genotoxicity battery
// Developmental toxicity (rat & rabbit)
// 2-Gen. rat reproduction
// Acute neurotoxicity
// Subchronic neurotoxicity
// Developmental neurotoxicity
// Immunotoxicity
// Rat ADME

$ 200 million and 10 years
Toxicological studies demonstrate that glyphosate is:

- Not acutely toxic – oral, dermal, inhalation
- Not irritating to skin, not a sensitizer
- Not genotoxic, not carcinogenic
- Not a reproductive toxicant, not an endocrine disruptor, not a teratogen
- Not neurotoxic, not immunotoxic
Chronic Low-Level Exposures
Cancer Incidence among Glyphosate-Exposed Pesticide Applicators in the Agricultural Health Study

Anneclare J. De Roos, 1 Aaron Blair, 2 Jennifer A. Rusiecki, 2 Jane A. Hoppin, 3 Megan Svec, 1 Mustafa Dosemeci, 2 Dale P. Sandler, 3 and Michael C. Alavanja 2

Author information ➤ Article notes ➤ Copyright and License information ➤
Table 2. Association of glyphosate exposure (ever/never used) with common cancers among AHS applicators.

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>Total no. of cancers</th>
<th>Ever used glyphosate (% of total)</th>
<th>Effect estimates adjusted for age (n = 54,315)</th>
<th>Adjusted for age, demographic and lifestyle factors, and other pesticides</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cancers</td>
<td>2,088</td>
<td>73.6</td>
<td>1.0 (0.9–1.1)</td>
<td>1.0 (0.9–1.2)</td>
</tr>
<tr>
<td>Lung</td>
<td>204</td>
<td>72.1</td>
<td>1.0 (0.7–1.3)</td>
<td>0.9 (0.6–1.3)</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>59</td>
<td>76.3</td>
<td>1.1 (0.6–2.0)</td>
<td>1.0 (0.5–1.8)</td>
</tr>
<tr>
<td>Colon</td>
<td>174</td>
<td>75.3</td>
<td>1.1 (0.8–1.6)</td>
<td>1.4 (0.8–2.2)</td>
</tr>
<tr>
<td>Rectum</td>
<td>76</td>
<td>77.6</td>
<td>1.2 (0.7–2.1)</td>
<td>1.3 (0.7–2.3)</td>
</tr>
<tr>
<td>Pancreas</td>
<td>38</td>
<td>76.3</td>
<td>1.2 (0.6–2.5)</td>
<td>0.7 (0.3–2.0)</td>
</tr>
<tr>
<td>Kidney</td>
<td>63</td>
<td>73.0</td>
<td>1.0 (0.6–1.7)</td>
<td>1.6 (0.7–3.8)</td>
</tr>
<tr>
<td>Bladder</td>
<td>79</td>
<td>76.0</td>
<td>1.2 (0.7–2.0)</td>
<td>1.5 (0.7–3.2)</td>
</tr>
<tr>
<td>Prostate</td>
<td>825</td>
<td>72.5</td>
<td>1.0 (0.8–1.1)</td>
<td>1.1 (0.9–1.3)</td>
</tr>
<tr>
<td>Melanoma</td>
<td>75</td>
<td>84.0</td>
<td>1.9 (1.0–3.4)</td>
<td>1.6 (0.8–3.0)</td>
</tr>
<tr>
<td>All lymphohematopoietic cancers</td>
<td>190</td>
<td>75.3</td>
<td>1.1 (0.8–1.5)</td>
<td>1.1 (0.8–1.6)</td>
</tr>
<tr>
<td>NHL</td>
<td>92</td>
<td>77.2</td>
<td>1.2 (0.7–1.9)</td>
<td>1.1 (0.7–1.9)</td>
</tr>
<tr>
<td>Leukemia</td>
<td>57</td>
<td>75.4</td>
<td>1.1 (0.6–2.0)</td>
<td>1.0 (0.5–1.9)</td>
</tr>
<tr>
<td>Multiple myeloma</td>
<td>32</td>
<td>75.0</td>
<td>1.1 (0.5–2.4)</td>
<td>2.6 (0.7–9.4)</td>
</tr>
</tbody>
</table>

* Cancers for which at least 30 subjects had sufficient information for inclusion in age-adjusted analyses. RR and 95% CIs from Poisson regression models. Frequencies among subjects included in age-adjusted analyses. Numbers of subjects.
Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate

Kathryn Z Gayton • Dana Loomis • Yana Grosse • Fatih El Ghissassi • Lamia Benbrahim-Tallaa • Neela Guha • et al

Show all authors

Published: March 20, 2015 • DOI: https://doi.org/10.1016/S1470-2045(15)70134-8

In March, 2015, 17 experts from 11 countries met at the International Agency for Research on Cancer (IARC; Lyon, France) to assess the carcinogenicity of the organophosphate pesticides tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate (table). These assessments will be published as volume 112 of the IARC Monographs. 1
Worldwide Regulatory Reviews

Have repeatedly concluded that glyphosate is **not genotoxic** and is **not a carcinogenic hazard to humans**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>EU ECHA RAC Classification&lt;br&gt;Canada PMRA&lt;br&gt;Australia APVMA&lt;br&gt;US EPA Registration&lt;br&gt;Korean RDA</td>
</tr>
<tr>
<td>2016</td>
<td>New Zealand EPA&lt;br&gt;WHO/JMPR&lt;br&gt;Japan FSC&lt;br&gt;US EPA CARC Report&lt;br&gt;EU EFSA Peer Review&lt;br&gt;EU Annex I Renewal (BFR)&lt;br&gt;Canada PMRA Registration Rev. (draft published)</td>
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<td>2015</td>
<td>WHO/IARC</td>
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<tr>
<td>2013</td>
<td>Australia APVMA</td>
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<tr>
<td>2012</td>
<td>US EPA Human Health RA</td>
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<tr>
<td>2011</td>
<td>WHO/JMPR</td>
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<tr>
<td>2008</td>
<td>US EPA Effects Determination</td>
</tr>
<tr>
<td>2007</td>
<td>Brazil ANVISA (ongoing)</td>
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<td>2005</td>
<td>OEHHA</td>
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<tr>
<td>2004</td>
<td>WHO/Water Sanitation Health</td>
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<tr>
<td>2002</td>
<td>EU Annex I</td>
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<tr>
<td>2000</td>
<td>FAO Specifications</td>
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<tr>
<td>1999</td>
<td>Japan FSC</td>
</tr>
<tr>
<td>1994</td>
<td>WHO/IPCS</td>
</tr>
<tr>
<td>1993</td>
<td>US EPA RED</td>
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<tr>
<td>1991</td>
<td>Canada PMRA</td>
</tr>
<tr>
<td>1987</td>
<td>WHO/JMPR</td>
</tr>
</tbody>
</table>
Glyphosate Use and NHL


NHL data U.S. 1992-2016

Glyphosate Use and Cancer Incidence in the Agricultural Health Study

Gabriella Andreotti, Stella Koutros, Jonathan N Hofmann, Dale P Sandler, Jay H Lubin, Charles F Lynch, Catherine C Lerro, Anneclaire J De Roos, Christine G Parks, Michael C Alavanja, ... Show more

JNCI: Journal of the National Cancer Institute, Volume 110, Issue 5, 1 May 2018, Pages 509–516, https://doi.org/10.1093/jnci/djx233
“In this updated evaluation of glyphosate use and cancer risk….we observed no associations between glyphosate use and overall cancer risk or with total lymphohematopoietic cancers including NHL and multiple myeloma”
News Releases

News Releases from Headquarters > Chemical Safety and Pollution Prevention (OCSPP)

EPA Takes Next Step in Review Process for Herbicide Glyphosate, Reaffirms No Risk to Public Health

04/30/2019

Contact Information:
EPA Press Office (press@epa.gov)
The Safety of Glyphosate
What is Glyphosate?

Organophosphonate (not organophosphate)

//Not an insecticide.
//Works by preventing plants from making certain amino acids needed for growth.
//BUT, animals and humans are not affected, as they do not have this enzyme.

Glycine is a normal part of proteins

\[
\begin{array}{c}
\text{HO} - \text{C} - \text{CH}_2\text{NH} - \text{CH}_2 - \text{P} - \text{OH} \\
\text{OH}
\end{array}
\]
Formulations

Formulations are simple:

- Glyphosate
- Surfactant (a detergent, like shampoo)
- Anti-foam (like simethicone for intestinal gas)
- Sometimes colorant (food coloring).
- Water

Most surfactant exposure comes from shampoos, soaps, and detergents at home.

Globally, glyphosate from major producers meets the FAO standard for purity.
Properties of Glyphosate

Glyphosate…

// Has relatively high water solubility and low fat solubility –
  // Does not bioaccumulate
// Has low absorption through the skin
// It is not metabolized -
  // Quickly eliminated from the body.
Glyphosate and Breast Milk

**MYTH**
Glyphosate is found in breast milk.

**FACT**
- This claim was made by an activist group that used an unvalidated test on breast milk.
- When the study was conducted using a validated test, no glyphosate was detected in breast milk.
Glyphosate and aminomethylphosphonic acid are not detectable in human milk


Author Notes

Glyphosate and The Gut Microbiome

**MYTH**
- Glyphosate disrupts the gut microbiome

**FACT**
- Glyphosate works by inhibiting EPSPS enzyme which is found in some microbes
- Plants use enzyme to make certain amino acids
- Gut flora are bathed in amino acids so microbes can live without it
- Tiny amount of glyphosate compared to gut microbes
Glyphosate has limited short-term effects on commensal bacterial community composition in the gut environment due to sufficient aromatic amino acid levels

Lene Nørby Nielsen a, Henrik M. Roager a, Mònica Escola Casas b, Henrik L. Frandsen a, Ulrich Gosewinkel b, Kai Bester b, Tine Rask Licht a, Niels Bohse Hendriksen b, Martin Iain Bahl a,*

a National Food Institute, Technical University of Denmark, Kgs. Lyngby, Denmark
b Department of Environmental Science, Aarhus University, Roskilde, Denmark
Glyphosate and Human Health

**MYTH**
Glyphosate (Roundup®) causes a wide variety of human health issues:
- Autism
- Celiac disease
- Parkinson’s disease
- Obesity

**FACT**
These are SPECULATIVE relationships based on a mixture of:
- Correlation (Which is NOT causation)
- Not supported by laboratory data – no mechanism
Confusing Correlation with Causation
Rate of illness in the US vs Glyphosate use

**Glyphosate and Autism**

Number of children (6-21 yrs) with autism served by IDEA plotted against glyphosate use on corn & soy.

*Pearson Correlation Coefficient = 0.985*


**The real cause of increasing autism prevalence?**

Implications of Ban
Major crisis in Sri Lankan plantations due to ban on weedicides

The Planters Association of Ceylon (PA), faced with devastating crop losses in excess of Rs. 15 billion in 2016, is urging the Government to immediately provide a rational and effective solution to the management
Pesticide Ban
Pesticide Ban
Implications of a ban
Pesticides are Critical for Human Health
Human Health

// Pesticides are some of the most important advances in the control of infectious disease

// >1 million insect borne deaths/year

// > ½ the world’s population at risk of insect borne diseases

// Dengue

// Yellow Fever

// Filariasis

// Onchocerciasis

// Zika
Parting thoughts

Malaria & other infectious diseases were wiped out in the USA and Europe by draining swamps and using pesticides

Pesticides are more regulated than antibiotics

Major contribution to public health

Bans put food supply and children’s health at risk