Reproductive Health and Pesticides

What Do We Know, What Can Clinicians Do?

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Faculty disclosure

- Dr. Woodruff has no financial affiliations to disclose

Note: Additional disclosure information is located within the program

Objectives

At the conclusion of the session, participants will be able to:

- Summarize the scientific literature on the impacts of environmental contaminants on reproductive health in adolescents, men, and women.

Objectives (cont)

At the conclusion of the session, participants will be able to:

- Identify and implement use of tools that can assist patients in making informed decisions about avoiding common environmental contaminants.

Objectives (cont)

At the conclusion of the session, participants will be able to:

- Propose clinical care recommendations related to environmental contaminants that have the potential to improve reproductive health.

Background

- Pesticides are chemicals intended to be toxic to living organisms.
- Classified by “target” organism and chemical class — i.e., insecticide and organophosphate.
- Over 1.2 billion pounds of pesticides used in U.S. in 2001.

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Background
- Pesticides are formulated from mixtures of “active” and “inert” ingredients.
- Over 1300 active ingredients with dissimilar structures and diverse toxicities that may act through different mechanisms.
- “Inert” is a functional designation, NOT a measure of health risk.
- “Inerts” can increase the ability of pesticide formulations to affect significant toxicologic endpoints, including developmental neurotoxicity, genotoxicity, and disruption of hormone function.


The dilution of glyphosate (the active ingredient) in Roundup (with inerts) may multiply glyphosate’s endocrine effect.

Exposure
- Ubiquitous
- In nearly every home, business, farm, school, hospital and park in the U.S.
- The USEPA estimates almost three of four U.S. households use pesticides.
- Every child conceived today in the Northern hemisphere is exposed to pesticides from conception throughout gestation and lactation regardless of where it is born.
- Disparities
- Most vulnerable populations are fetus, infants, children and exposed workers.

Pesticides Exposure: Disparities
- Women in a largely agricultural cohort in the Salinas Valley of California had median postpartum urinary DAP metabolite levels that were 2.5 times higher than those for NHANES women.

Pesticides in Food
- Pesticide Residues in Samples of:
  - 62.1 % Fruits & Vegetables (N= 6101/9818)
  - 30% Peanut Butter (N= 223/739)
  - 19% Bottled Water (N=70/367)

Source: USDA Pesticide Data Program
http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateC&navID=PesticideDataProgram&rightNav1=PesticideDataProgram&topNav=&leftNav=ScienceandLaboratories&page=PesticideDataProgram&resultType=

Pesticide residue data on commodities most frequently consumed by infants and children. Samples collected close to the point of consumption and prepared emulating consumer practices - washed, peeled, etc.

Pesticides in Water
- Environmental Effects of Pesticide Runoff
  - Millions of birds, fish and smaller aquatic animals that fish depend on for food die every year from exposure to pesticides.
  - Major contamination of waterways.
  - Populations declines in animals and plants by destroying habitats and reducing food supplies.
  - Impairment of normal reproduction.
  - Destruction of both pests and beneficial organisms.
Pesticides at Home

- Lawn application of 2,4-D
  - Pre-application exposure: 1.94 mcg/d
  - Post-application: 8.87 mcg/d

Two Weeks After Application
- 2,4-D pesticide tracked in by family dog and Home owner (applicator)

Potential effects of pesticides on female reproduction

Preconception and Prenatal Exposures (Male and Female)

Every chemical class of pesticides has at least one agent capable of affecting a reproductive or developmental endpoint in laboratory animals or people.

Preconception, prenatal, and/or pesticide exposure via lactation has been linked to:
- Delayed conception
- Spontaneous abortion
- Stillbirth
- Preterm birth
- Fetal growth deficit
- Birth defects
- Childhood and adult cancer
- Delayed developmental milestones
- New-onset childhood asthma
- Childhood lung and middle ear infections, allergies, and impacts on postnatal growth in height

Pesticides Known to Cause Reproductive Toxicity

Cal-EPA’s list of chemicals known to have reproductive toxicity includes 42 pesticides

Sources:
Prevention - What Can Clinicians Do?

- **Prevent Harm** - Health care providers can be extremely effective in addressing pesticide exposures in the lives of their patients and in their communities. They do not need to become experts in order to fill an important and crucial role (NEETF, 2002).

- **Intervene Early** - By the first prenatal care visit, disruptions of organogenesis may have already occurred (Frazier, 2007).

Clinical Setting

**Provide Anticipatory Guidance to Patients**

**Prevent Exposure At Work**

- Do not enter treated areas until it is safe.
- Do not bring food into a treated area.
- Keep pesticides off your skin.
- Use respiratory protection when required.
- Wash hands before eating.

**Don’t Take The Workplace Home**

- Do not use water in drainage ditches for drinking, bathing, swimming or fishing.
- Change clothes and shower if possible before entering house and or/playing with your children.
- Never take pesticide containers home.
- Keep pesticides out of your home.
- Store and wash clothes separately.

**Know Your Rights**

- Workers in agriculture and structural pest control are at risk.

**Prevent Exposure From Food**

- Grow your own organic vegetables (test the soil for lead first!)
- Buy organic food.
- Your patients can lower their pesticide exposure by almost 90 percent by avoiding the top twelve most contaminated fruits and vegetables and eating the least contaminated instead.

Source: Environmental Work Group

Organic Diet Reduces Exposure to Agricultural Pesticides

- 23 children monitored for metabolites before/after organic diet.
- Levels of urinary metabolites for chlorpyrifos and malathion reduced to non-detectable.
- Again elevated on re-introduction of conventional diet.

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Policy Arena
Advocate for Healthy Food Systems

- Global Health and Safety Initiative

A sector-wide collaboration to transform the way that healthcare designs, builds and operates its facilities as well as the products healthcare uses within those facilities

Farmers Market
Kaiser Hospital, Richmond, CA


Policy Arena
Advocate for Improved Public Policy

California Medical Association Pesticide Exposure Prevention Policies

- IMPROVING HEALTH THROUGH SUSTAINABLE FOOD PURCHASING (2007)
  Encourage hospitals to adopt policies and practices that increase the purchasing and serving of food grown according to organic or other methods that emphasize renewable resources, ecological diversity, and fair labor practices

  Encourage school administrators, teachers, and other school employees to ensure that food served at school sites is grown using methods that avoid the use of highly toxic pesticides

- AGRICULTURAL PESTICIDE DRIFT (2000)
  Strengthen efforts to protect schools and residential areas from pesticide drift and off-site pesticide movement

- FARMWORKER PROTECTION FROM PESTICIDES (2000)
  Support efforts to reduce farmworker exposure to pesticides; strengthen enforcement of existing laws by increasing fine levels; encourage physician awareness of pesticide illness and reporting

- HEALTHY SCHOOLS (1999)
  Protect indoor air at California schools; recommend statewide implementation of least-toxic school pest management programs; include parents in pest management decision making.

Complete text of California Medical Association resolutions at http://www.sfbaypsr.org/work_cma.html

Conclusions

- The body of scientific evidence continues to build regarding the impact of pesticides on reproductive health
- A precautionary approach that emphasizes prevention provides for good patient and public health
- Guidance on preventing patient exposures to pesticides should be incorporated into preconception and prenatal visits
- Clinicians can contribute greatly to “upstream” prevention issues beyond the clinical setting

Additional Resources

- U.S. Environmental Protection Agency www.epa.gov/pesticides
- California Environmental Protection Agency Office of Environmental Health Hazard Assessment http://www.oehha.ca.gov/pesticides/programs/services.htm
- Online free training ~ https://www.mededpesticide.org/
- Association of Occupational and Environmental Clinics http://www.aaec.org
- National Pesticide Information Center http://npic.orst.edu/

One person, one pesticide, multiple routes

Air
Work
Food
Amniotic fluid and breast milk
Drinking water

“The Timing Makes the Poison”

- Stage specific effects of pesticide exposure
  - Ethylene oxide can induce skeletal effects when administered to mice at the zygote stage of development … long before skeletogenesis begins
  - Spectrum of skeletal effects observed after exposure at the zygote stage differs from those observed after exposure during organogenesis

Characteristics of pesticide exposure that influence health outcome

- Nature of the chemical
- Individual susceptibility
- Amount
- Duration
- Timing

Preconception & Prenatal Exposure

<table>
<thead>
<tr>
<th>Event</th>
<th>Concept</th>
<th>Exposure</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preconception &amp; Prenatal Exposure</td>
<td>Concept</td>
<td>Fungicides (any)</td>
<td>Unspecified pesticides</td>
</tr>
</tbody>
</table>

Preconception and Prenatal Exposure

Limited data [do] not provide consistent evidence for the presence or absence of links between pesticides, [and] some chemicals that can influence internal balance (e.g., DDT, DDE, and other pesticides) may increase the risk for many adverse reproductive outcomes.” Examples...

- Menstrual and ovarian function
- Sperm adversely affected
- Reproduction
- Birth outcomes
- Fetal growth
- Childhood conditions

Adult Exposures (Women and Girls)

- Science linking environmental contaminants with fertility and reproductive health impacts in the adult female

Adult Exposure (Males)

- Sterility
  - Occupational exposure to dichlorodiphenylchloroethylene (DDECP) caused profound and in many cases permanent effects on spermatogenesis (Whorton et al., 1977)
  - Human data on the relationship of semen quality with pesticide exposure are limited and do not currently allow for a definitive conclusion on whether adult exposure, at background environmental levels, affects semen quality (Fauci, 2006)

Hormonally Active Pesticides

- Signals from wildlife and animal studies

- Alkylamines are the most commonly used herbicides in US — found regularly in rain and drinking water in the US

- Exposure to alkylamines induced testosterone levels in frogs

- Hundreds of animal studies demonstrate developmental effects of hormone-like compounds present in the environment are biologically plausible — exposure and effect relationships in human populations have not been established (Foster, 2000)
Human Evidence
Pesticides and Reproductive and Developmental Health

Scope of human evidence

- 257 studies and reports as of 2002
- Few human studies of reproductive and developmental outcomes for most currently used pesticides
- Most human data are for banned or restricted pesticides

- 5 pesticides accounted for over one-third of all studies (87/257) and almost two-thirds of all studies that specified a pesticide (N=87/137)
  - DDT
  - Agent Orange
  - DBCP
  - Lindane
  - Pentachlorophenol
- DDT and its metabolite DDE had greatest number of studies (27/257)