PEHSU NATIONAL CLASSROOM

Pediatric Environmental Health Specialty Units

www.pehsu.net/nationalclassroom.html

Webinars

- Series of scientific webinars that provide a forum for discourse on scientific issues.
- Live and On-Demand
- Case Conferences
  Journal Clubs
  Grand Rounds
- CE Available

Online Courses

- Evidence-based online courses on a variety of children's environmental health topics.
- Interactive and Self-Paced
- CE Available

Resource Catalog

- Fact sheets, journal publications, reports, and other resources for parents, community members, patients and healthcare professionals
- Topics included:
  Air Quality, Pesticides, Natural Disasters, BPA, Mold, Lead, Mercury

Riesgos Ambientales: Pesticidas
Environmental Risks: Pesticides

Beatriz Tapia, MD, MPH, EdD

*Adapted from Environmental Impacts on Reproductive Health: Pesticide Exposure

PEHSU
Pediatric Environmental Health Specialty Units

Objectives

- Discuss the impact of pesticide exposure during pregnancy.
- Identify critical windows of susceptibility for pesticide exposures.
- Describe pesticide exposures among pregnant women in South Texas.
- Identify resources to facilitate patient counseling of risk and risk reduction of hazardous exposures.

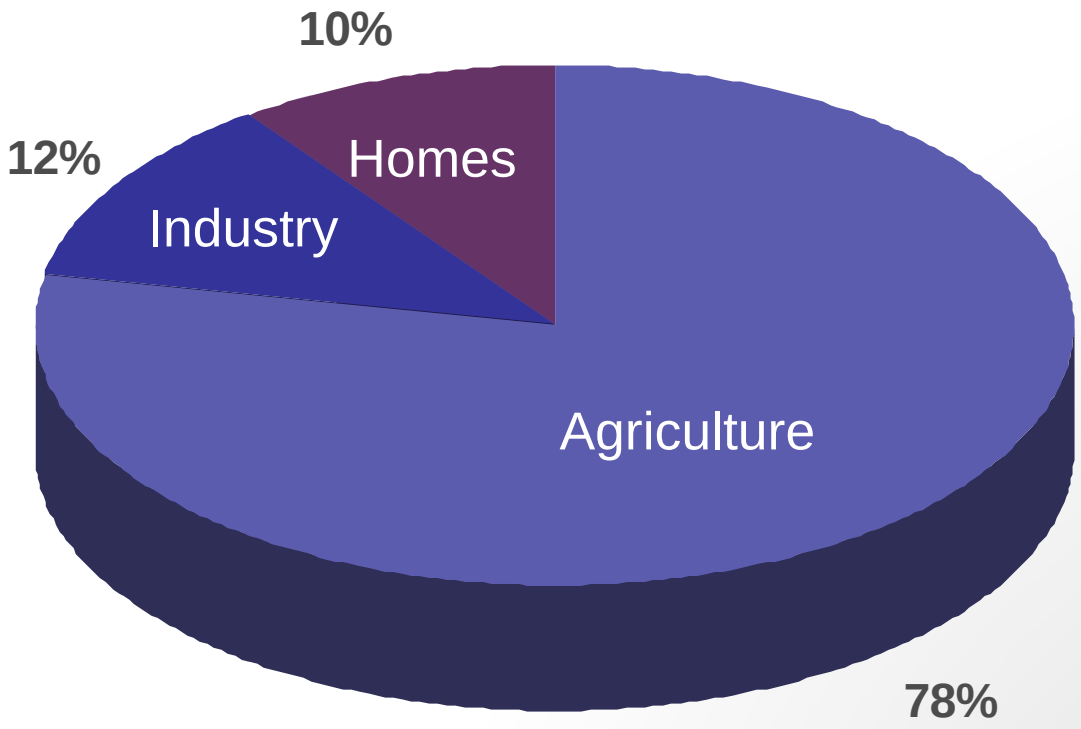
Pesticides Defined

Chemicals used against unwanted organisms:

- Insects
- Rodents
- Plants
- Fungi

US EPA, 2009.

Pesticide Use Is Widespread in United States

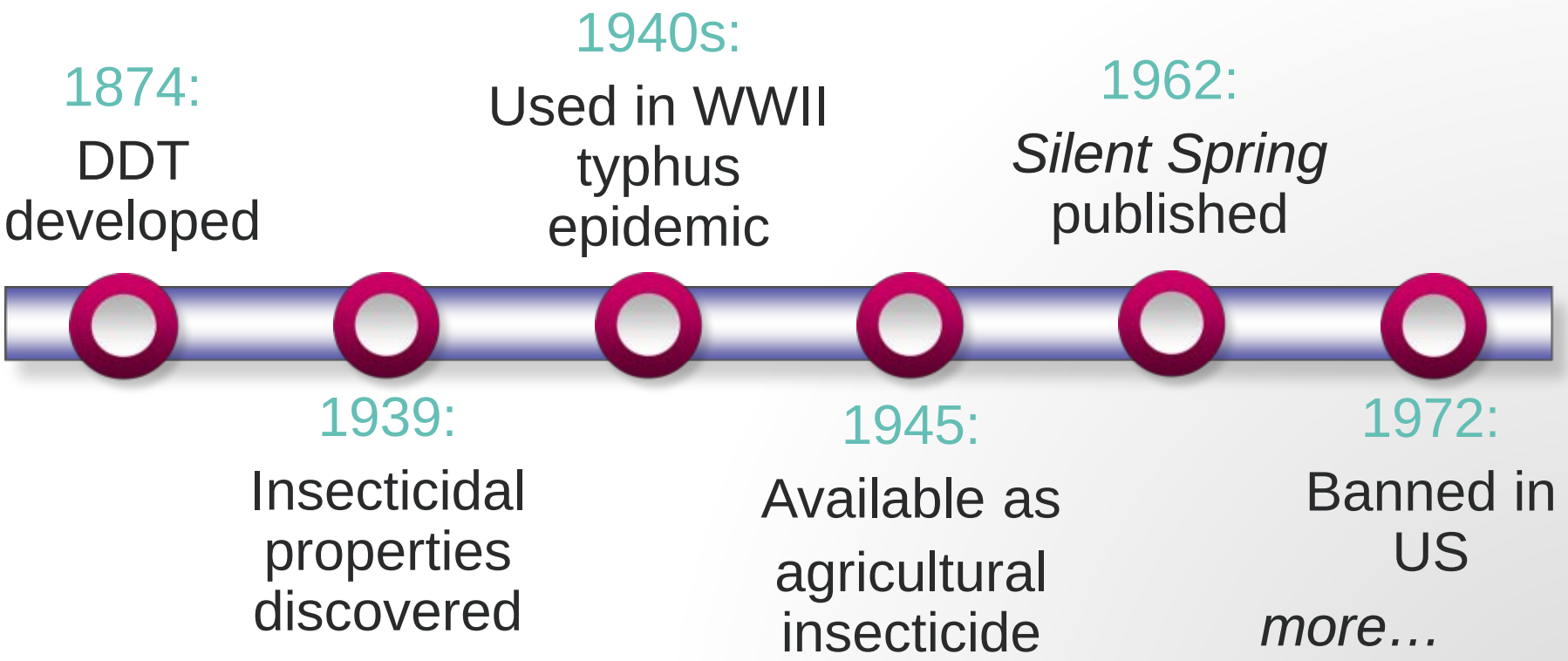


More than 1.2 billion pounds used annually

Kiely T, et al. 2004
US EPA, 2008

Lesson Learned: DDT

A well-known harmful pesticide



Types of Pesticides

Examples:

Type of Pesticide	Target Organisms	Chemical Class
Insecticide	Aphids, fleas, beetles	Organophosphates, pyrethroids
Rodenticide	Mice, rats	Coumarins
Herbicide	Invasive grasses	Acetyl-coenzyme A carboxylase inhibitors

Délye C, et al. Plant Physiol, 2005
EPA, 2008

Sources of Pesticide Exposure

Residues on food

Community applications

Occupational exposure

Tap water

Household use

Personal use

EPA, 2008
NPIC, 2008

Household Use Is Common

75% of US households use at least 1 pesticide product indoors.

May be used to:

Eliminate insects and rodents

Care for lawn and garden

Prevent fleas and ticks

US EPA, 2008

Pesticides Contain Active and Inert Ingredients

more…

Cox C. Environ Health Perspect, 2006
PANNA, 2008

Inert Ingredients: Examples of Effects

Some inert ingredients have been found to:

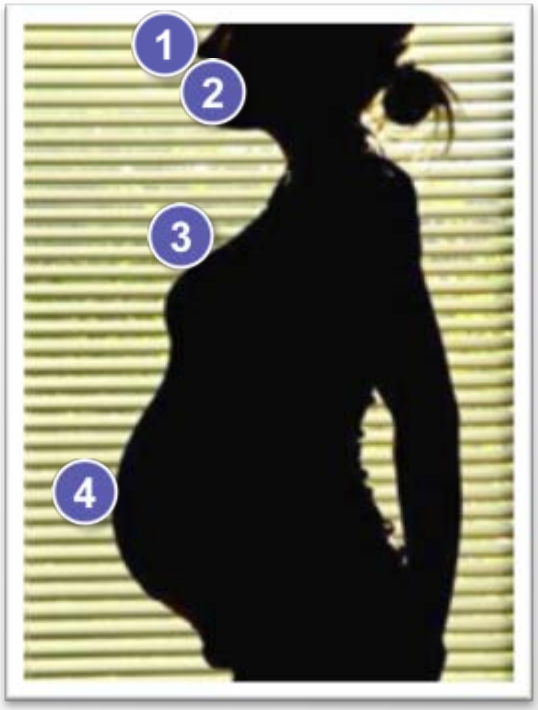
- Decrease heart rate and blood pressure
- Reduce mitochondrial activity
- Be toxic to human placenta cell cultures

Data come primarily from animal studies

Cox C. Environ Health Perspect, 2006
Richard S, et al. Environ Health Perspect, 2005

Routes of Exposure

1. Inhalation
2. Ingestion
3. Skin contact
4. In utero exposure (fetus)



more…

Klaassen C. In: Casarett & Doull's Toxicology: The Basic Science of Poisons. 7th ed. 2007

Acute vs. Chronic Pesticide Exposure

Acute exposure

- Increase likelihood to identify the source
- Initial insult can be responsible for various health effects

Chronic exposure

- Not obvious to patient thus less likely to be reported to physicians as a health concern

Environmental Exposures and Adverse Pregnancy Outcomes

Table 1. Selected Studies Showing Environmental Links to Adverse Birth Outcomes

Birth Outcome	Pollutant	Author and Year Published	Study Type	Exposure Characterization[a]	Sample Size
Fetal growth	Particulates	Wang et al[28]	Retrospective cohort	Ambient monitoring	n = 74 671
		Bobak[29]	Retrospective cohort	Ambient monitoring	n = 73 148
		Dejmek et al[30]	Retrospective cohort	Ambient monitoring	n = 4883
		Ha et al[31]	Time series	Ambient monitoring	n = 276 763
		Wilhelm and Ritz[32]	Retrospective cohort	Ambient monitoring	n = 498 235
		Parker et al[33]	Retrospective cohort	Ambient monitoring	n = 18 247
	Organophosphate insecticides	Perera et al[41]	Prospective cohort	Serum levels	n = 263
		Levario-Carrillo et al[42]	Case–control	Residential history	n = 371
	Triazine herbicides	Munger et al[43]	Cross sectional	Drinking water monitoring	n = 9551
		Dabrowski et al[44]	Case–control	Residential and occupational history	n = 494
		Villanueva et al[45]	Retrospective cohort	Municipal drinking water monitoring	n = 9721
Preterm birth		Bobak[29]	Retrospective cohort	Ambient monitoring	n = 73 148
		Wilhelm and Ritz[32]	Retrospective cohort	Ambient monitoring	n = 498 235
		Sagiv et al[48]	Time series	Ambient monitoring	n = 187 997
		Huynh et al[49]	Matched case–control	Ambient monitoring	n = 42 692
	SO_2	Bobak[29]	Retrospective cohort	Ambient monitoring	n = 108 173
		Liu et al[38]	Retrospective cohort	Ambient monitoring	n = 229 085
	CO	Liu et al[38]	Retrospective cohort	Ambient monitoring	n = 229 085
Congenital abnormalities	Chlorophenoxy herbicides	Garry et al[50]	Cross sectional	Occupational history	n = 210 723
		Garry et al[51]	Cross sectional	Occupational history	n = 1532[b]
		Basso 1999[52]	Cohort	Occupational history	n = 8671
		Schreinemachers[53]	Ecologic	Pesticide use and proximity	n = 43 634
	Other pesticides	Rull 2006[54]	Case–control	Pesticide use and proximity	n = 1671
	byproducts	Toledano et al[62]	Cohort	water utility monitoring data Monitored tap water extrapolated to populations	n = 920 571

Stillerman, et al. Reprod Sci, 2008

Environmental Exposures and Adverse Pregnancy Outcomes (cont)

Table 1. (continued)

Birth Outcome	Pollutant	Author and Year Published	Study Type	Exposure Characterization[a]	Sample Size
	DDT	Korrick et al[63]	Case–control	Serum levels	n = 30
		Longnecker et al[64]	Prospective cohort	Serum levels	n = 1717
		Law et al[65]	Prospective cohort	Serum levels	n = 390
		Cocco et al[66]	Retrospective cohort	Occupational history	n = 105
		Venners et al[67]	Prospective cohort	Serum levels	n = 388
	Bisphenol-A	Sugiura-Ogasawara et al[68]	Case–control	Serum levels	n = 45

[a] Ambient monitoring for the common air pollutants is assumed to be a reasonable surrogate for individual level exposures.
[b] The study evaluated families with children with birth defects, the n is for the number of children in the study.

Stillerman, et al. Reprod Sci, 2008

NHANES: Chemicals in Pregnant Women

Table 1. Chemical classes measured in biological tissue of pregnant women, NHANES 2003–2004.

Chemical class	No. of chemical analytes measured			
	Blood	Serum	Urine	Total
Cotinine		1		1
Environmental phenols			4	4
Metals	4			4
Organochlorine pesticides		13		13
Organophosphate insecticides			6	6
Perchlorate			1	1
Phthalates			13	13
PBDEs and other brominated flame retardants		11		11
PCBs and dioxin-like chemicals		55		55
PAHs			10	10
PFCs		12		12
VOCs	33			33

See Supplemental Material, Table 1 (doi:10.1289/ehp.1002727), for individual chemical analytes included in each chemical class.

Woodruff TJ, et al. Environ Health Perspect, 2011

NHANES: Chemicals in Pregnant Women

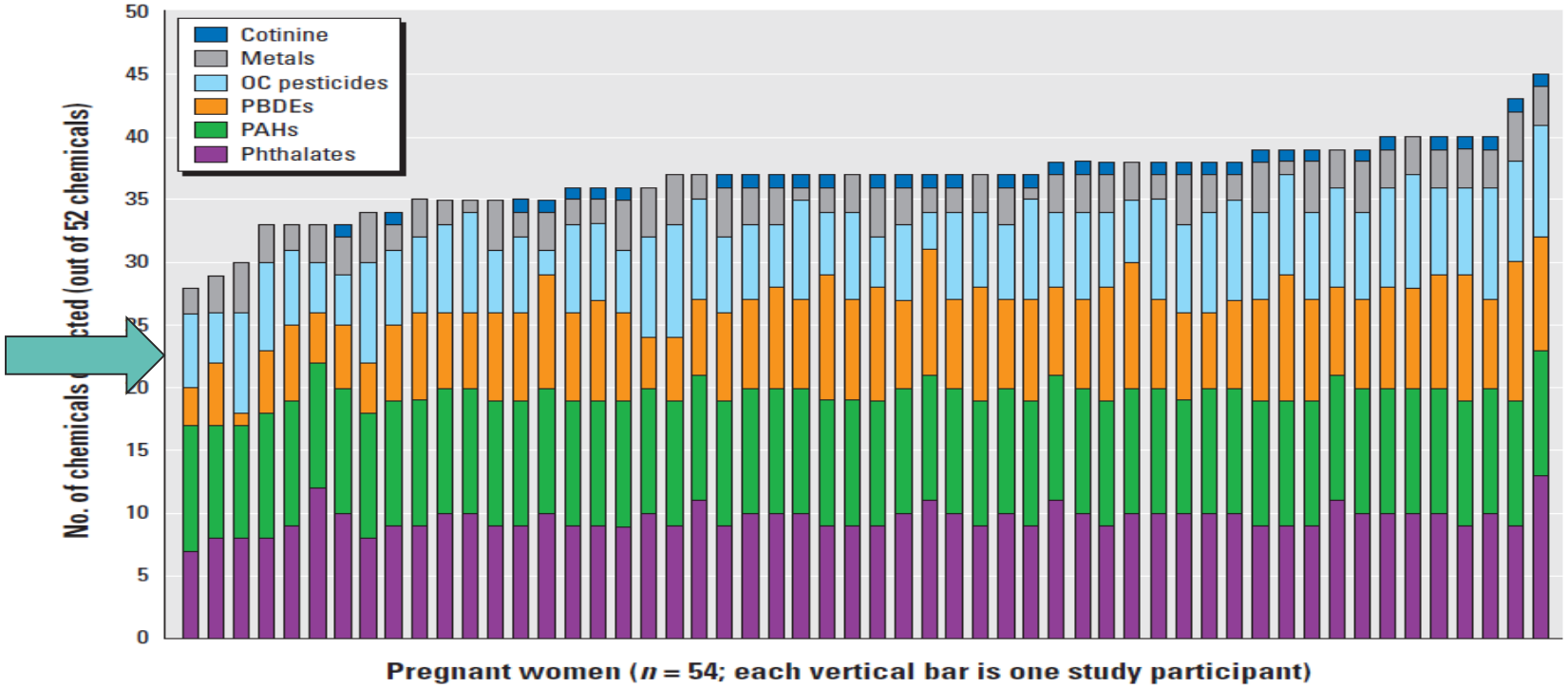


Figure 3. Number of chemicals detected by chemical class in U.S. pregnant women, NHANES subsample B [metals, cotinine, organochlorine (OC) pesticides, phthalates, brominated flame retardants (PBDEs), and PAHs], 2003–2004 (n = 54). Each vertical bar represents one study participant. Other subsamples showed similar results.

Woodruff TJ, et al. Environ Health Perspect, 2011

Reproduction-Related Effects

"…every child conceived today in the Northern hemisphere is exposed to pesticides from conception throughout gestation and lactation regardless of where it is born."

Colborn T.
Environ Health Perspect. 2006

Pesticide Exposure During Pregnancy among Hispanic Women in South Texas

Research Question:

How do pesticide exposures of pregnant women living in the Lower Rio Grande Valley compare with those of pregnant women living in New York City (NYC)?

(in partnership with U.S. Hispanic Nutrition Research and Education Center)

Pesticide Exposure in New York

Prenatal insecticide exposure, birth weight and length among an urban minority cohort. Whyatt, et al. Environ Health Perspect. 2004 Jul; 112(10):1125-32.

- Inner city of NYC has highest pesticide application rates in NY State, principally used for roach control in low-income housing.
- Measured pesticides in dust, air, maternal blood, etc.

Results: Babies born to mothers exposed to organophosphate pesticides had decreased birth length and head circumference. Currently assessing cognitive/behavioral measures up to age seven. N=314

Whyatt, et al. Environ Health Perspect, 2004

Pesticide Exposure in South Texas

Study Population:

25 pregnant Hispanic Women, 18-35 y/o, 30-34 weeks gestation, recruited from maternity clinics in Hidalgo County

Inclusion criteria:

- Stable residency within drivable distance
- Non smoker/no illicit drugs/moderate drinker
- No major health problems (DM, AHT, HIV, NS)
- Homemakers who spend majority day in home

Pesticide Exposure in South Texas

Methods:

- Questionnaire covering demographics, home characteristics, residential history, and lifestyle
- Installation of PUF sampler in home
- Two weeks later - follow-up questionnaire
- All samples (air and dust) sent for analysis

Pesticides analyzed in home air and dust (~45 total)

Organophosphates
- Azinophos-methyl
- **Chlorpyrifos**
- **Diazinon**
- Ethyl Parathion
- **Malathion**
- Methyl parathion
- Propetamophos

Carbamates
- Bendiocarb
- Carbaryl
- Carbofuran
- Fenoxycarb (also IGR)
- **Propoxur**

Synergists
- **MGK 264**
- **Piperonyl butoxide**

Fungicides
- Captan

Synthetic Pyrethroids
- Bioallethrin
- **Bifenthrin**
- **Cis-permethrin**
- Cyfluthrin
- **Cypermethrin**
- Deltamethrin/tralomethrin
- Fenvalerate
- Lamda-cyhalothrin
- Prallethrin
- Sumithrin
- Tetramethrin
- **Trans-permethrin**

Pesticides Analyzed (continued)

Insect Growth Retardant (IGR)

- Fenoxycarb (also carbamate)
- Hydroprene
- Methoprene

Organochlorines

- 4,4’-DDD
- 4,4,’-DDE
- 4,4’-DDT
- **Alpha-chlordane**
- Dieldrin
- **Gamma-chlordane**
- Heptachlor
- Lindane

Herbicides

- Atrazine
- Metolachlor
- Pendimethalin
- Simazinc
- **Trifluralin**

Others

- Fipronil
- **Ortho-phenylphenol**
- Sulfluramid

Pesticide Exposure in South Texas

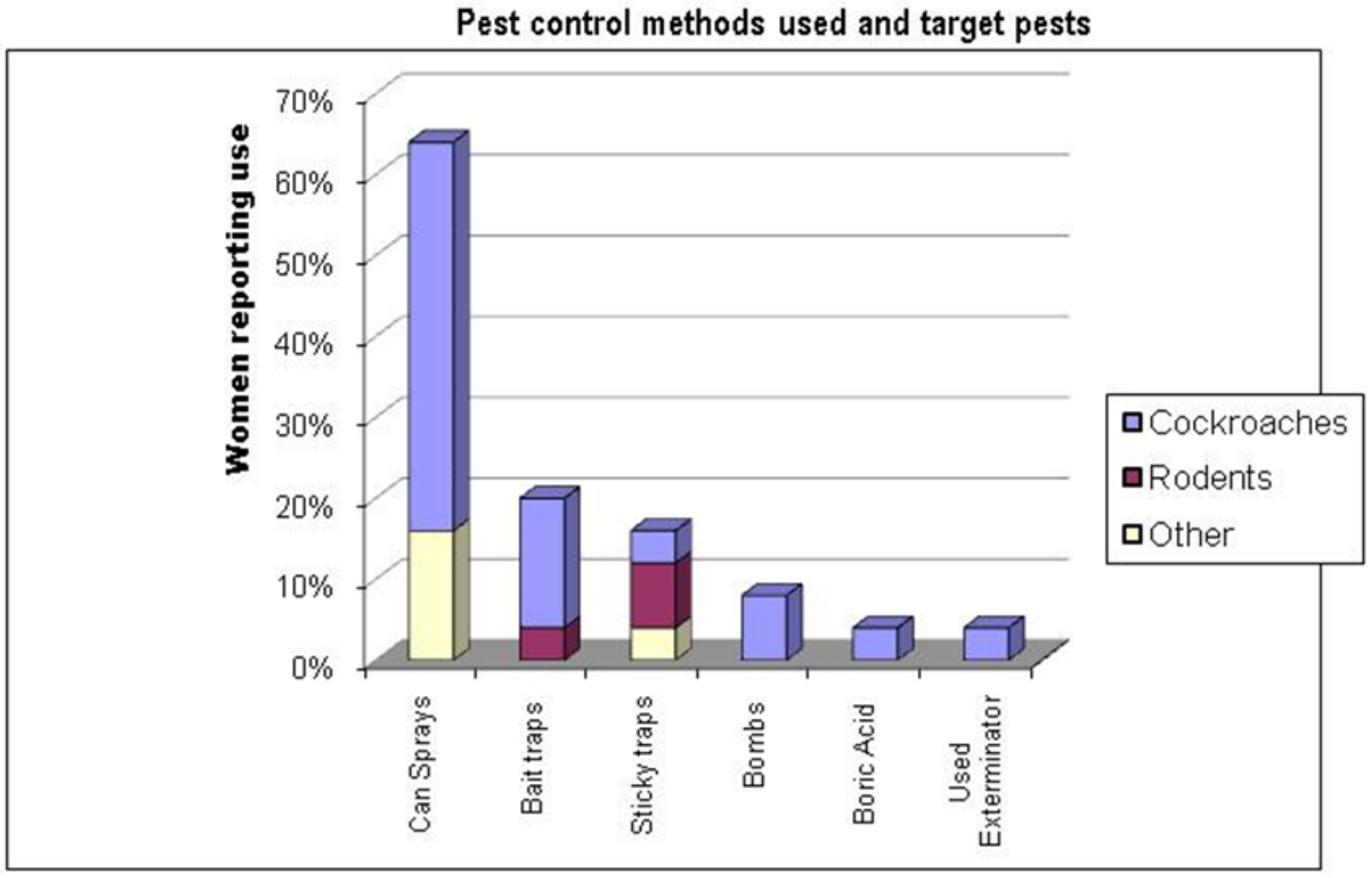
Results:

68% of these households reported pesticide use vs. 85% of previously studied NYC households

35% used two or more pest control methods

14 pesticides detected including several organophosphates: ortho-phenylphenol in 92% of home air samples, followed by chlorpyrifos in 80%, propoxur in 76%, diazinon in 72%, and trifluralin in 60%

Pest control methods used and target pests for Texas women who reported pest control measures used in their homes during



Conclusions Result cont.

Household pesticide exposures during pregnancy in South Texas were similar to those in NYC

In both Hidalgo County and NYC, the principal reason for organophosphate pesticide use were **roaches**

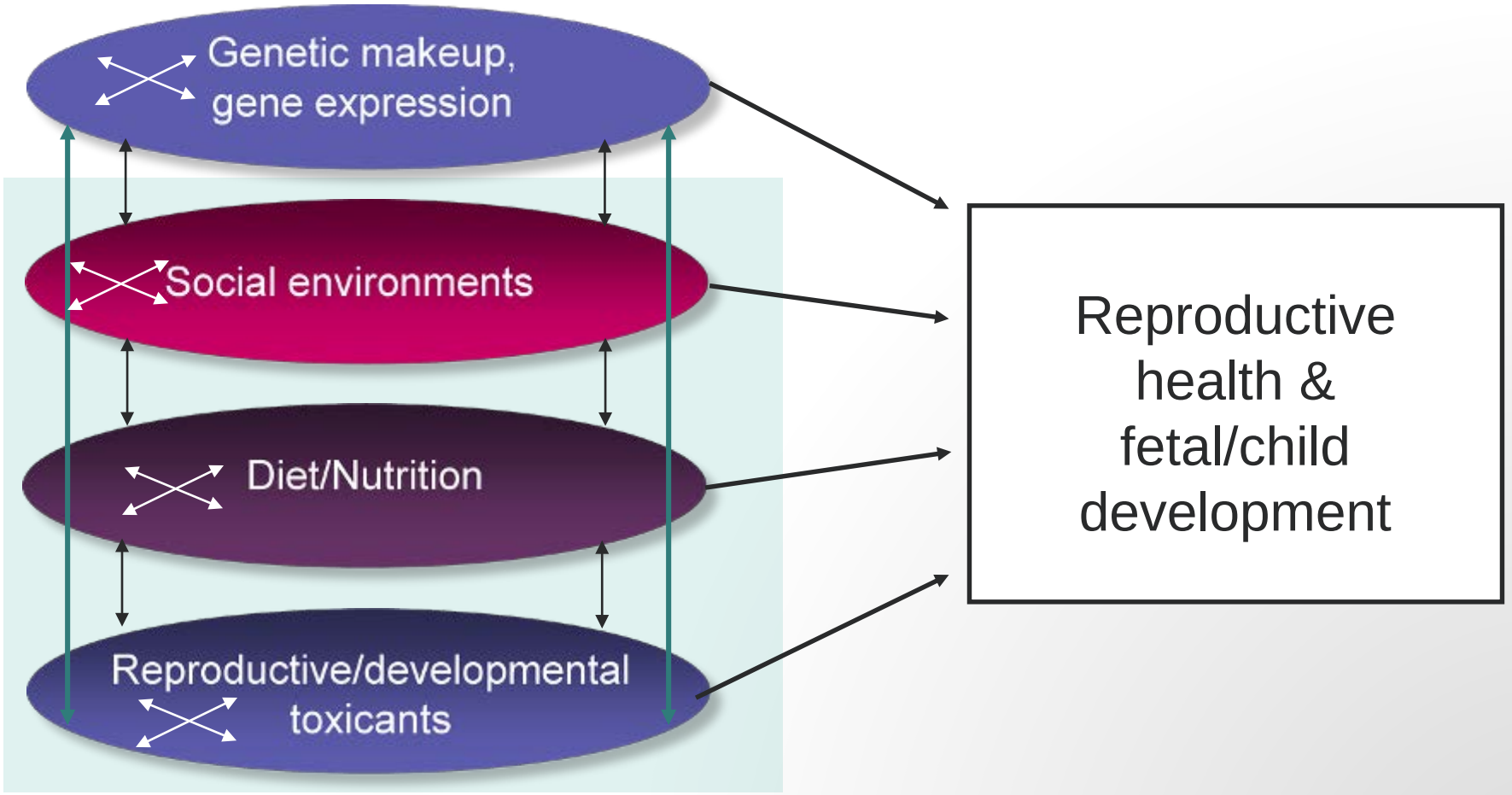
Offspring of mothers exposed in NYC showed significant neurodevelopmental problems

Neurodevelopmental studies among South Texas children exposed to pesticides are lacking

Studying Pesticide Exposure Has Inherent Challenges

- Limitations impeding research:
  - Human trials precluded by ethical considerations
  - Difficulties in assessing impacts
  - Difficulties in measuring outcomes

Many Complex Factors Interact to Affect the Impact of Exposures

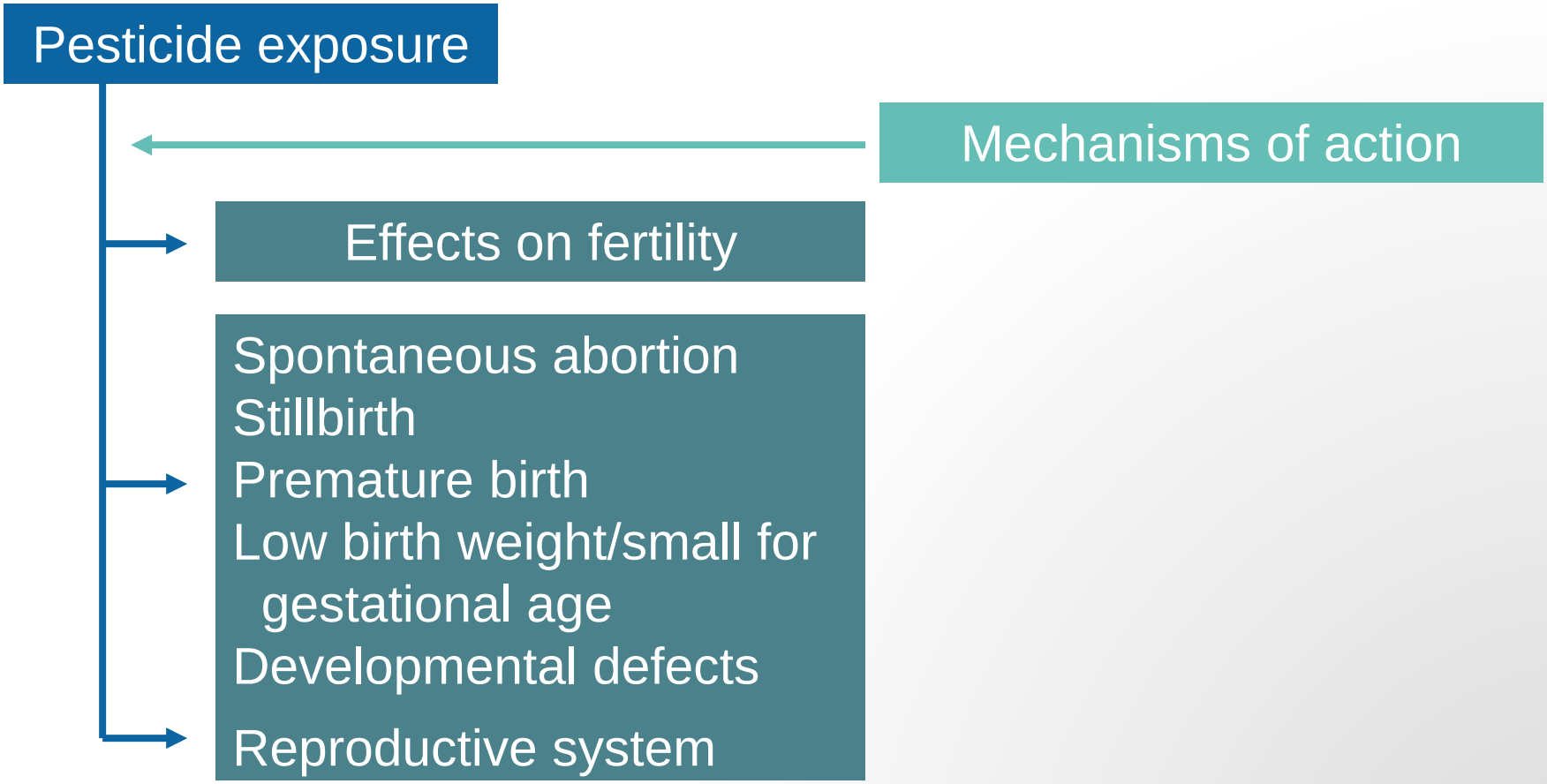


Adapted from Hubbs-Tait, et al. Psychological Science in the Public Interest, 2005

Environmental Exposures and Critical Windows of Susceptibility

Woodruff TJ, et al. Fertil Steril, 2008

Reproduction-Related Effects: Women



Bretveld RW, et al. Reprod Biol Endocrinol, 2006

Reproduction-Related Effects: Women

Changes in Menstrual Cycle (1.5 ↑ odds)

- Longer cycles
- Missing periods
- Bleeding mid cycle

Consequently affecting Fertility!

Pesticides: Lindane, atrazine and mancozeb

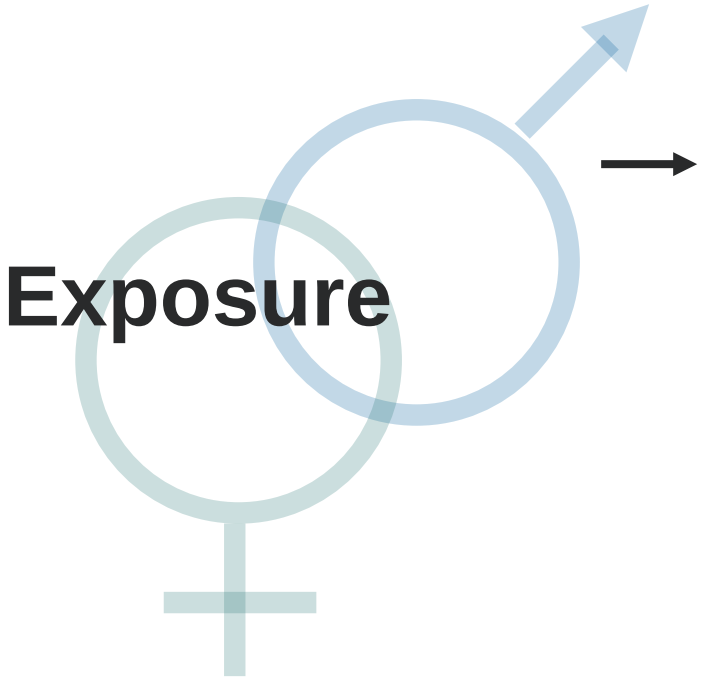
Farr SL, et al. Am J Epidemiol, 2004

Reproduction-Related Effects: Men

- Testicular damage:
  - Azoospermia, oligospermia
  - Damage to germinal epithelium
  - Genetic alterations in sperm
  - Reduced fertility
- Altered hormone function

Figà-Talamanca I, et al. Occup Med, 2001
Whorton MD, et al. Lancet, 1977

Delayed Effects of Exposure



Critical windows of susceptibility:

- Preconception
- Prenatal
- Postnatal (lactation)

- Childhood and adult cancer
- Delayed development
- Childhood asthma and allergies
- Infections
- Postnatal growth effects

Wigle DT, et al. J Toxicol Environ Health B Crit Rev, 2008

The Barker Hypothesis

"Exposures to adverse insults during critical…windows of development can permanently reprogram normal physiologic responses, and thus give rise to…disorders later in life."

Woodruff TJ, et al.
Fertil Steril. 2008

Barker DJ. Trends Endocrinol Metab, 2002; Woodruff TK, Walker CL. Fertil Steril, 2008; Woodruff TJ, et al. Fertil Steril, 2008

Delayed Development

Strong evidence implicating pesticides and developmental disorders, including PDD-NOS

Organochlorine exposure *in utero*

- > abnormal reflexes in neonates
- ↓Psychomotor ↓mental at 12 months
- ↓General cognitive, memory, verbal and executive functions at 4 years

Rosas LG, et al. Currt Opin Pediatr, 2008

Fetal Origin of Adult Disease

- Parkinson Disease
  - ↑ evidence that the environment plays a major role
  - Animal studies of faulty neurochemistry in offspring are linked to low level exposure of pesticides.
  - Alterations to the CNS may induce a “silent” state of dopamine dysfunction leaving individuals vulnerable

Stillerman, et al. Reprod Sci, 2008

“So What Do I Do?”

- Science regarding environmental exposures and reproductive health is:
  - Primarily based on animal studies
  - Warrants guidance to limit/avoid exposure
- Approach patients on case-by-case basis
- Exposure is unavoidable, but specific changes can make a difference

Expert Medical Advisory Committee on Environmental Impacts on Reproductive Health, 2009

Using your flip chart

Insect Control and Pesticide Use

- Pesticides can be highly toxic.
- Seal or caulk crevices to keep insects and rodents out.
- Use boric acid or traps to control p

Insect Control and Pesticide Uses

Pesticides

- Pesticides are chemical products that include herbicides, rodenticides, and insecticides. They can be extremely toxic.

Harm they produce:

- Chronic exposure to pesticides may cause learning and developmental problems in children as well as autism. Adults may develop cancer.

Prevention:

- Seal or caulk crevices where insects can enter your home.
- Avoid leaving food or dishes to be washed lying out in your kitchen.
- Take out garbage daily.
- Use insect traps and baits instead of sprays wherever possible.
- Use boric acid powder to help control cockroaches in your kitchen. Place it behind the refrigerator, stove, etc., keeping it away from places children or pets can reach.
- Minimize “harborage,” or clutter, where insects tend to hide and breed.
- Roaches often obtain water from condensation on pipes, so insulate cold water lines with foam wrap and seal wrap with tape
- Keep flour and sugar in resealable plastic bags.
- If you have many cockroaches, even if they are coming from neighboring residences, consider hiring a professional exterminator who uses integrated pest management (IPM). Baits and traps are preferable to insecticides that add chemicals to the air. Explain your child’s condition to the pest control service before allowing anyone to treat you house.

Using your flip chart

Illegal Pesticides

What are they?

- Illegal pesticides may be more toxic than legal ones and they may even have unknown chemicals as part of their formula.
- Legal pesticides are the ones registered and approved by the U. S. Environmental Protection Age
- For example, the "Chinese Ch registered with EPA.
- Manufacturer states that the " any harm to humans or pets. "

Harm they produce:

- Children may confuse "Chines have been reports of children such as vomit, abdominal pair "Chinese Chalk."

Prevention

- Do not purchase illegal pestic your house.

Illegal Pesticides

Airplane Powder

- **Airplane powder is a very powerful pesticide**.
- Chronic exposure may cause irreversible damage to the nervous, cardiovascular, and reproductive organs. It has been reported that it may also cause Parkinson's and Alzheimer's.

How to know if a pesticide is legal?

- Check for the EPA registration number on the product's label.
- Purchase products only from authorized vendors and never from a Street vendor.
- In the U. S. call the National Pesticide Information Center at 1-800-858-7378 if you have questions or need more information.
- In Mexico call your local Red Cross or local Health Community Center.

Focus on Windows of Susceptibility

- For male and female adolescents
- For male and female patients who experience unintended pregnancy
- For women and men during pregnancy planning
- For pregnant women
- For male and female patients with newborns and children

Expert Medical Advisory Committee on Environmental Impacts on Reproductive Health, 2009

Environmental Health History Should Be Routine

The Environmental Health History

How? Incorporate into reproductive health history

Why? Identify and reduce or eliminate potentially harmful exposures

When?

Vulnerable Stages:

- Early childhood
- Puberty
- Adolescence
- Preconception planning (men & women)
- Pregnancy

Guide patients in making decisions

Expert Medical Advisory Committee on Environmental Impacts on Reproductive Health, 2009

An Important Take-Home Message

Identifying and reducing exposures to potentially harmful toxicants *now*, when couples plan (or not) a pregnancy, increase the likelihood of a successful outcome.

Expert Medical Advisory Committee on Environmental Impacts on Reproductive Health, 2009

Association of Reproductive Health Professionals (ARHP) Resources

- Learn more at the ARHP Website:
  - Click on Environmental and Reproductive Health topic area
  - www.arhp.org/topics/enviro-repro-health
    - Fact Sheet: Environmental and Reproductive Health Resources for Health Care Providers
    - Patient handout: Health Matters: The Connection Between Your Health and the Environment

Pesticide Resources

- Fact sheets from CDC's National Agricultural Safety Database (http://nasdonline.org/)
- National Pesticide Information Center (http://npic.orst.edu/)
- EPA's Pesticides Information Web site (includes information for children) (www.epa.gov/pesticides)
- Pesticide Action Network (PAN) database (www.pesticideinfo.org)

Questions?

Thank you!