ENVIRONMENTAL THREATS TO REPRODUCTIVE HEALTH: SCIENCE AND SOLUTIONS

Tracey Woodruff, PhD, MPH
Alison S Carlson Endowed Professor & Director
Program on Reproductive Health and the Environment, Dept Ob/Gyn & RS
Environmental Research and Translation for Health (EaRTH) Center
PRL Institute for Health Policy Studies
University of California, San Francisco
Nothing to Disclose
What Are Sperm Telling Us?

Scientists are concerned by falling sperm counts and declining egg quality. Endocrine-disrupting chemicals may be the problem.

Temporal trends in sperm count: a systematic review and meta-regression analysis


59.3% decline

Total sperm count (million)

Year of sample collection

Unselected Western
Unselected Other
Fertile Western
Fertile Other
Reproductive Capacity Under Strain

Scientific indicators of declining reproductive function and increasing rates of reproductive illnesses since the mid-20th century

↑ Difficulty conceiving & maintaining pregnancy

↑ Rates testicular cancer

↓ Sperm counts

Federal reserve data on chemical production is only offered as relative production, which is unit-less. A specific reference year is chosen and values are calculated relative to that year's production. In this particular data set, 2007 is the reference year and is assigned a value of 100. Data from: U.S. Federal Reserve Board, Division of Research and Statistics.
~30,000 lbs of industrial chemicals produced for each person in the U.S. each year

Most chemicals in the marketplace have not been tested for

43+

“to a disturbing extent babies are born ‘pre-polluted’

EPA CDR 2015; Woodruff et al 2011; National Cancer Institute 2010
**Pharmaceuticals**

Diethylstilbestrol

**Hormones**

Estradiol

**Industrial Chemicals**

BPA

Phthalates

Thyroid hormone

PBDEs
PHTHALATES

- Cosmetics: Shampoo, lotion, nail polish and other personal care products
- Toys: Baby products including lotion, shampoo, powders and teethers
- Medical equipment including tubing, blood bags, and plastics in the NICU
- Building materials including vinyl flooring, wall paper, paint, glue and adhesives
- Automobiles (phthalates are responsible for the 'new car smell')
- Enteric coatings of pharmaceuticals
- Scented products such as candles, detergent and air fresheners
- Art supplies including paint, clay, wax and ink
Some health effects linked to phthalates:

- Male reproductive health effects (e.g. sperm effects)
- Reduced fertility
- Learning and behavior effects
- Obesity and diabetes

These chronic diseases are on the rise.
Racial Disparities in Phthalates Exposure

Beauty product-related phthalate exposure was more than 30% higher in Black women

Zota et al. *Fertility and Sterility* 2018
Fueling Plastics

How Fracked Gas, Cheap Oil, and Unburnable Coal are Driving the Plastics Boom
Petro-chemical connection

Plastic Supply Chain

ETHYLENE CHAIN

Natural Gas
Ethane
Cracker

Intermediate Products

Phthalates

Adhesives
Coatings
Films
Paper Coatings
Models
Instrument Lenses

Pool Liners
Window Siding
Trash Bags
Sealants
Carpet Backing
Insulation
Detergent
Flooring
Pipes

Food Packaging
Bottles
Cups
Housewares
Crates

Footwear
Clothes
Diapers
Stockings
Toys
Textiles

Tires
Sealants
Paint
Antifreeze

We offer the industry's broadest range of high-molecular-weight (HMW) plasticizers. "Jayflex" high-molecular-weight plasticizers provide an optimum balance of properties with outstanding performance and permanence.

ExxonMobil
Triple Jeopardy and Environmental “Riskscapes”

**Social Context**: Social inequality, segregation, discrimination

**Demographics**: Race/ethnicity, immigration status, income, wealth, geography

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Morello-Frosch et al., 2011
Gee and Payne-Sturges, 2004
O’Neill et al. 2003
IOM, 1999
Manufactured pharmaceuticals are required to have data to show safety before use.

Manufactured chemicals do NOT
Recommendation 1: Advocate for policies to prevent exposure to toxic environmental chemicals

Recommendation 2: Work to ensure a healthy food system for all

Recommendation 3: Make environmental health part of health care

Recommendation 4: Champion environmental justice
California

Gov. signs bills to track bullets ban toxic toys
Some bullets must be marked, chemical in toys is banned

U.S.A.

Lawmakers Agree to Ban Toxins in Children’s Items
By Lyndsay Layton
Washington Post Staff Writer
Tuesday, July 29, 2003

Congressional negotiators agreed yesterday to a ban on a family of toxins found in children's products, handing a major victory to parents and health experts who have been championing the government to remove harmful chemicals from toys.

Overseas

Europe bans chemical use in toys
The European Parliament has voted to permanently ban the use of a group of chemicals to soften children's toys followings health concerns.

Phthalates have been linked to damage to the reproductive system, and an increased risk of asthma and cancer.

Canada Bans BPA From Baby Bottles
By Lyndsay Layton and Christopher Lee
Washington Post Staff Writers
Saturday, April 18, 2006, Page A03

Canada yesterday became the first country to ban a widely found chemical from use in baby bottles, spurring a leading Democrat in the U.S. Senate to call for legislation that would prohibit use of bisphenol
Banned Phthalates

Phthalates not Banned
(Replacements)

Phthalates Targeted in Market Campaigns
Toxic Substances Control Act (TSCA) – law that governs ~40,000 industrial, commercial, consumer product chemicals
TSCA amended in 2016

- Federal actions override states
- Key decisions left to implementation
- Require addressing risk to susceptible subpopulations who ‘...may be at greater risk than the general population of adverse health effects from exposure to a chemical substance or mixture, such as infants, children, pregnant women, workers, or the elderly.’

**High Priority Chemicals Undergoing Review**

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Phthalates</th>
<th>Chlorinated solvents</th>
<th>Flame retardants</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-Dichlorobenzene</td>
<td>Di-isoamyl phthalate (DIBP)</td>
<td>Di-isobutyl phthalate (DIBP)</td>
<td>Phthalic anhydride</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>Dicyclohexyl phthalate</td>
<td>Dibutyl phthalate (DBP)</td>
<td>Formaldehyde</td>
</tr>
<tr>
<td>trans-1,2- Dichloroethylene</td>
<td>Dibutyl phthalate</td>
<td>Butyl benzyl phthalate (BBP)</td>
<td>Phosphoric acid, triphenyl ester (TPP)</td>
</tr>
<tr>
<td>o-Dichlorobenzene</td>
<td>Di-ethylhexyl phthalate (DEHP)</td>
<td>Ethylene dibromide</td>
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<tr>
<td>1,1,2-Trichloroethane</td>
<td></td>
<td>1,3-Butadiene</td>
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<tr>
<td>1,2-Dichloropropane</td>
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<tr>
<td>1,1-Dichloroethane</td>
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<tr>
<td>4,4'-(1-Methylethylidene)bis[2, 6-dibromophenol] (TBBPA)</td>
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<tr>
<td>Tris(2-chloroethyl) phosphate (TCEP)</td>
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<tr>
<td>Phosphoric acid, triphenyl ester (TPP)</td>
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**Chlorinated solvents**

- p-Dichlorobenzene
- d-Chloroethane
- o-Dichlorobenzene
- 1,1,2-Trichloroethane

**Flame retardants**

- Di-isobutyl phthalate (DIBP)
- Dicyclohexyl phthalate
- Butyl benzyl phthalate (BBP)
- Di-ethylhexyl phthalate (DEHP)

**Phthalates**

- Phthalic anhydride
- Formaldehyde
- Phosphoric acid, triphenyl ester (TPP)
Conclusions:

- Environmental chemical exposures ubiquitous and adversely affecting health inequitably
- Science alone cannot move systematic change but engagement by scientists and health care providers is critical
- Research and translation that leads to less biased science is needed
- Community partnership & support are key
- Public policy is necessary to create lasting and fair solutions for all
Thank You to Our Funders & Our Team

PRHE Faculty, Staff & Affiliates:
Aditi Shah
Aileen Andrade
Alana D’Aleo
Allison Landowski
Allison Rozema
Amy Padula
Anne Sausser
Annemarie Charlesworth
Cheryl Godwin de Medina
Courtney Cooper
Cynthia Melgoza Canchola
Dana Goin
Dimitri Abrahamsson
Erin DeMicco
Harim Lee
Jessica Trowbridge
Joshua Robinson
Kristin Shipler
Laura Bettencourt
Lynn Harvey
Nadia Gaber
Nicholas Chartres
Maribel Juarez
Marya Zlatnick
Max Aung
Rachel Morello-Frosch
Stephanie Eick
Susan Lamontagne
Swati Rayasam
Tali Felson

Thank you to our funders:
The Tides Foundation
The Marisla Foundation
The California Environmental Protection Agency
The Passport Foundation
The JPB Foundation
The National Institutes of Health
The Clarence E. Heller Charitable Foundation
National Institute for Environmental Health Sciences

EaRTH Center
Peggy Reynolds
Diana Laird
Susan Fisher
Jennifer Fung
Plastics generation and recovery in the US has been increasing since 1960s

Social Justice Movements (Re)Shape Research Priorities
ACOG/ASRM Committee Opinion

All exposures are not created equal

• Underserved & minority populations are disproportionately impacted
• Higher risk for occupational exposure
Changing demographics shapes conversations about environmental health and policy-making...

![U.S. Changing Demographics, 1970-2050](chart.png)
Funding incentives for community-engaged research...change how scientists theorize and study environmental links to disease
Scientists pushed by community research partners and EJ advocates to address cumulative impacts

Consider structural drivers of environmental degradation & links to health disparities:

- **Multiple hazards** where communities live, work, and play
  - e.g., chemical mixtures

- **Vulnerability** due to chronic social stressors
  - poverty, malnutrition, racism, discrimination, chronic health problems

Morello-Frosch et al. *Health Affairs*, 2011
Hicken et al., *Health Affairs*, 2011
Environmental Inequality and Cumulative Impacts in Richmond, CA
Methodological challenges to answering environmental justice questions:

- Lack of statistical power in some cohort studies
- Limited geographic scope of many cohorts
- Time & resources required for data collection and analysis
- Short-term needs for “data judo” to inform decision-making

  - Large administrative data sets conducive to answering questions about structural determinants (e.g., redlining, racial residential segregation, income inequality)
  - Cohort data can elucidate contributions of environmental and social stressors of relevance to health inequities at the individual level (e.g., perceived stress, biomarkers, neighborhoods)

EJ analysis requires both approaches
Racial Segregation in US Cities:
Multi-group Dissimilarity (Dm) by Metropolitan Area in the United States

US Census, 2010
Most chemicals NOT effectively regulated

Food, drugs, pesticides

Everything else:
Toxic Substances Control Act (TSCA)
Since 1976, under TSCA EPA has been able to partially regulate:

a) No chemicals
b) 5 chemicals
c) 500 chemicals
d) 5,000 chemicals
1976 TSCA very weak

- 20,000 new chemicals introduced
- 85% no health hazard data
- No deadlines for EPA review or action on chemicals
- Asbestos not able to be banned

Wilson & Schwarzman, 2009