HYDRAULIC FRACTURING - “FRACKING” - AND CHILDREN’S HEALTH
The Mid-Atlantic Center for Children’s Health and the Environment, Region 3 PEHSU
Disclaimers

• This material was supported by the American Academy of Pediatrics (AAP) and funded (in part) by the cooperative agreement FAIN: 1U61TS000237-03 from the Agency for Toxic Substances and Disease Registry (ATSDR).

• Acknowledgement: The U.S. Environmental Protection Agency (EPA) supports the PEHSU by providing partial funding to ATSDR under Inter-Agency Agreement number DW-75-95877701. Neither EPA nor ATSDR endorse the purchase of any commercial products or services mentioned in PEHSU publications/presentations.
OBJECTIVES

Participants will review and discuss:

1. Children’s biological vulnerability to toxins
2. Framework for understanding health impacts of toxicants
3. Implications of direct and indirect exposures to hydraulic fracturing
4. Cumulative impact of environmental exposures
WHY ARE CHILDREN MORE VULNERABLE?
Unique Biological Vulnerabilities of Children to Environmental Hazards

Children are at higher risk from toxic exposures

*Key windows of vulnerability*
- Dizzying pace of development in utero
- Infant’s immature nervous system
- Diet
- Behaviors
Physiologic Differences with Exposure to Toxins

- Differ in absorption, distribution, metabolism, and elimination
  - Larger surface-to-volume ratio and more permeable skin
- Blood-brain transport expression varies by age
Children are not little adults

- Drink more water per unit of body mass
- Eat more food per unit of body mass
- Breath more air per unit of body mass - ↑ RR
- Closer to the ground
Children are not little adults

- Have longer “shelf-life”
- Developing organism with stages of vulnerability
- Differing metabolism
- Active exploration and “mouthing” of their environment
# Social Determinants of Health

<table>
<thead>
<tr>
<th>Income and social status</th>
<th>Physical environments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social support networks</td>
<td>Practices and coping skills</td>
</tr>
<tr>
<td>Education</td>
<td>Healthy child development</td>
</tr>
<tr>
<td>Employment/working conditions</td>
<td>Gender</td>
</tr>
<tr>
<td>Social environments</td>
<td>Culture</td>
</tr>
</tbody>
</table>

Poverty is especially important

Children living in poverty more likely to encounter multiple exposures

Limited access to required services or support to be healthy
Framework for Understanding

NUTRITION
TOXICANTS
GENETICS
SOCIAL ENVIRONMENT

Health Impacts
HEALTH IMPACT OF FRACKING
Fracking linked to air pollution, water pollution, noise and light pollution, and earthquakes

Bradford County, Pennsylvania
Direct and indirect exposures to toxicants
More than **1000 chemicals** are used in fracking

- 75% affect skin, eyes, respiratory, and GI systems
- Approximately 40-50% affect the brain, nervous, immune, renal, and cardiovascular systems
- 37% affect the endocrine system
- 25% are carcinogens and mutagens (Howarth et al., 2011; PSR, 2017)

- 100 are **known endocrine disruptors** – developmental toxicants - disrupt organ systems, lower sperm counts, and cause reproductive harm at levels to which people can be realistically exposed
What are they?

• That’s a good question!
• Chemical additives are proprietary information – “trade secrets”
• Each fracturing fluid varies to meet the specific needs of each area
  – No one-size-fits-all formula for the volumes for each additive

*Source: https://fracfocus.org/water-protection/drilling-usage
Chemicals routinely used include:

<table>
<thead>
<tr>
<th>Acids</th>
<th>Friction reducers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biocides</td>
<td>Iron control</td>
</tr>
<tr>
<td>Breakers</td>
<td>pH Adjusting agents</td>
</tr>
<tr>
<td>Clay stabilizers</td>
<td>Scale inhibitors</td>
</tr>
<tr>
<td>Corrosion inhibitors</td>
<td>Surfactants</td>
</tr>
</tbody>
</table>
Exemption from Safe Drinking Water Act

• 2005 Energy Policy Act exempts hydraulic fracturing from key provisions of the Safe Drinking Water Act

• Only U.S. industry permitted to inject known hazardous materials near or into underground drinking water aquifers
Additional Exposures

• Heavy metals, radioactive elements, brine, and VOCs
  – occur naturally in deep geological formations
  – carried to surface with the flowback fluid

• Spills of fracking fluids and wastewater – 6,678 significant spills documented over a period of 9 yrs in only 4 states
Community Impact

Credit: Ruth McDermott Levy
Each child lives in many different environments...

- Home
- School
- Neighborhood
- Town, state, country and world
Direct & Indirect Exposures

Air pollution

- ⩵ ground-level ozone (smog)
- ⩴ air quality
- ⩵ health issues related to air quality
- ⩵ VOCs, especially benzene and formaldehyde – exceed safety standards
- Benzene levels in ambient air sufficient to elevate risks for future cancers
- Emissions from gas flaring and truck diesel exhaust – 4000-6000 trips per well

Coal-Fired Power Plants in U.S. (EPA eGrid Data)

NOTE: Data for this map comes from the U.S. EPA's eGRID database. Not all power-generating facilities in the U.S. are plotted on this map.
Children’s Health: Air Pollutants
Air Pollution

- 31.3 million children lived in counties with unhealthful levels of either ozone or particle pollution in 2014-2016
  - 6 million children in the U.S. have asthma -
  - leading childhood chronic disease in our country

American Lung Association's (ALA) 2018 "State of the Air" report
Water pollution

- Groundwater contamination
- PA – documented 300 private wells contaminated over an 8 yr period
- Animal studies - fertility and reproductive threats from chemicals at levels representative of those in drinking water
Children’s Health: Water Pollution
Direct & Indirect Exposures

Noise and Light Pollution

• Continuous noise and light pollution sustained for months
  – Chronic night exposure linked to adverse health effects, including sleep disturbances and breast cancer
• Noise pollution includes blasting, drilling, flaring, generators, compressor stations, and truck traffic
  – Exposure linked to cardiovascular disease, cognitive impairment, and sleep disturbance
• Existing “setback distances” not adequate to reduce public health threats for vulnerable populations
Direct & Indirect Exposures

Radiation Exposure

- **Radium** in fracking wastewater as high as 3,600 X regulatory limit for drinking water (EPA)
- Toxic levels found in PA waterway after wastewater disposed of in industrial wastewater treatment plant
- High levels of radon in heavily drilled areas of PA
- Unsafe levels of radon & decay products in natural gas may contaminate pipelines & compressor stations
- Increasing evidence of illegal dumping of radioactive fracking waste
Direct & Indirect Exposures

Radiation Exposure

- Wastewater brine spread on PA roadways in winter for ice and in summer to control dust
- Levels of salt, lead, radium, organic contaminants and other heavy metals in concentrations above safe levels
- Metals from brine leach out from roadways when it rains
- Most activity is in Allegheny River watershed – drinking water source for the city of Pittsburgh
- From 2008 to 2014 – spreading wastewater on roads released
  - 4X more radium than that released from treatment facilities
  - 200X more than from spills

Direct & Indirect Exposures

• **WHY** spread contaminated radioactive brine on our roads???
  – Radioactive radium has been linked to bone marrow and lung cancer, lowered IQ levels and behavioral issues in children, kidney, brain and central nervous system, threats to aquatic life

• 200 commercially available dust suppressants, with vigorous testing

• **Gas industry provides brining services for free** - cheapest method of disposal available
Exposures

- Route influences the time of onset, intensity, and duration of effects
  - Ingestion
  - Inhalation
  - Dermal
  - Ocular
  - Parenteral (envenomations)
Developing Fetus and Infants

- Increased congenital heart & neural tube defects (McKenzie, et al., 2014)

- Low birth weight & low APGAR scores, unrelated to water source (Hill, 2013)

- Pre-term birth, low APGAR scores, low birth weight and high risk pregnancy (Casey, et al. 2015)

- Infant death (Busby & Mangano, 2017)
Symptoms & Illness

- Fatigue, nasal and throat irritation, sinus problems, burning eyes, shortness of breath, joint and muscle pain, severe headaches, sleep disturbances, forgetfulness, irritation, nausea, skin irritation and rashes, depression, anxiety, and dizziness (Steinzor et al., 2013)
Symptoms & Illness

• Number and density of wells (number of wells within a square mile) increases hospitalizations (Jemielita et al., 2015)
TOP PA COUNTIES – ACTIVE WELLS

- Washington 1,146 WELLS
- Bradford 1,097
- Susquehanna 1,079
- Greene 870
- Lycoming 832
- Tioga 661
- Butler 321
- Fayette 257
- Westmoreland 251
Are Safety Guidelines Followed?

• 66 OPERATORS
• 7,788 ACTIVE WELLS
• 4,006 VIOLATIONS
• TOTAL FINES = $6.1 MILLION

• 6,678 significant spills (gas & wastewater) documented over a period of nine years in only four states (2017 study)

CUMULATIVE EFFECT OF TOXINS IN CHILDREN

MULTIPLE SOURCES IN ADDITION TO PROXIMITY TO FRACKING
Daily Environmental Threats to Children

Water pollution

- Toxic bacteria, lead, PFCs
Daily Environmental Threats to Children

- Farming and lawn pollutants
  - fertilizers, pesticides
- Contaminated food
- Processed food
Potential Household Exposures

Bathroom
- Drain opener
- Medicines
- Vitamins
- Mouthwash
- Personal hygiene products
- Cleaners, toilet cleaners

Bedroom
- Cosmetics
- Perfumes
- Nail polish remover
- Jewelry cleaner
- Deodorants

Garage
- Antifreeze
- Fertilizer
- Gasoline, kerosene
- Lighter/charcoal fluid
- Weed killer

Workshop
- Paint remover, thinner
- Lime, acids
- Lye, alkalis
- Pesticides
- Pool chemicals

Laundry
- Bleaches
- Disinfectants
- Softeners (Concentrates)
- Detergents/Soaps

Kitchen
- Ammonia
- Oven cleaner
- Dishwasher detergent
- Furniture polish

Living Room
- Lamp oil
- Cigarettes, tobacco
- Alcoholic beverages
- House plants
Dr. Bruce Lanphear, MD, MPH

• Little Things Matter: The Impact of Toxins on the Developing Brain

**Little Things Matter**

• https://www.youtube.com/watch?v=E6KoMAbz1Bw&feature=youtu.be
Summary

• New research reports an increase in infant mortality in heavily fracked communities

• Severe impacts like cancer, chronic respiratory disease, impaired cognition, and neurological impairment may appear in the future, given long latency periods
Summary

• Comprehensive evidence regarding health impacts of “fracking” cannot be obtained due to incomplete testing, incomplete disclosure of chemicals, and non-disclosure agreements

• Robust scientific studies needed as “fracking” expands throughout the world

• Until then we continue an uncontrolled experiment ….on our children’s health ~

(Bamberger & Oswald, 2012)
QUESTIONS
Environmental Resources

PEHSUs – Pediatric Environmental Health Specialty Units
https://www.pehsu.net/
Region 3: MACCHE https://kidsandenvironment.georgetown.edu/

Children’s Environmental Health: Online Resources for Healthcare Providers
https://www.epa.gov/children/childrens-environmental-health-online-resources-healthcare-providers

Centers for Disease Control and Prevention - Protecting kids from environmental exposures
https://www.cdc.gov/features/pehsu/index.html

Children’s Environmental Health Network
http://cehn.org/

Alliance of Nurses for Healthy Environments
https://envirn.org/
Thank You

1-866-622-2431 or 202-687-2330

Email: kidsandenvironment@georgetown.edu

Website: kidsandenvironment.georgetown.edu