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HYDRAULIC FRACTURING - “FRACKING” - AND CHILDREN’S HEALTH



The Mid-Atlantic Center for Children's Health and the Environment, Region 3 PEHSU

Disclaimers

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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
- Breathe 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

Income and social status
Social support networks
Education
Employment/working conditions
Social environments

Physical environments
Practices and coping skills
Healthy child development
Gender
Culture

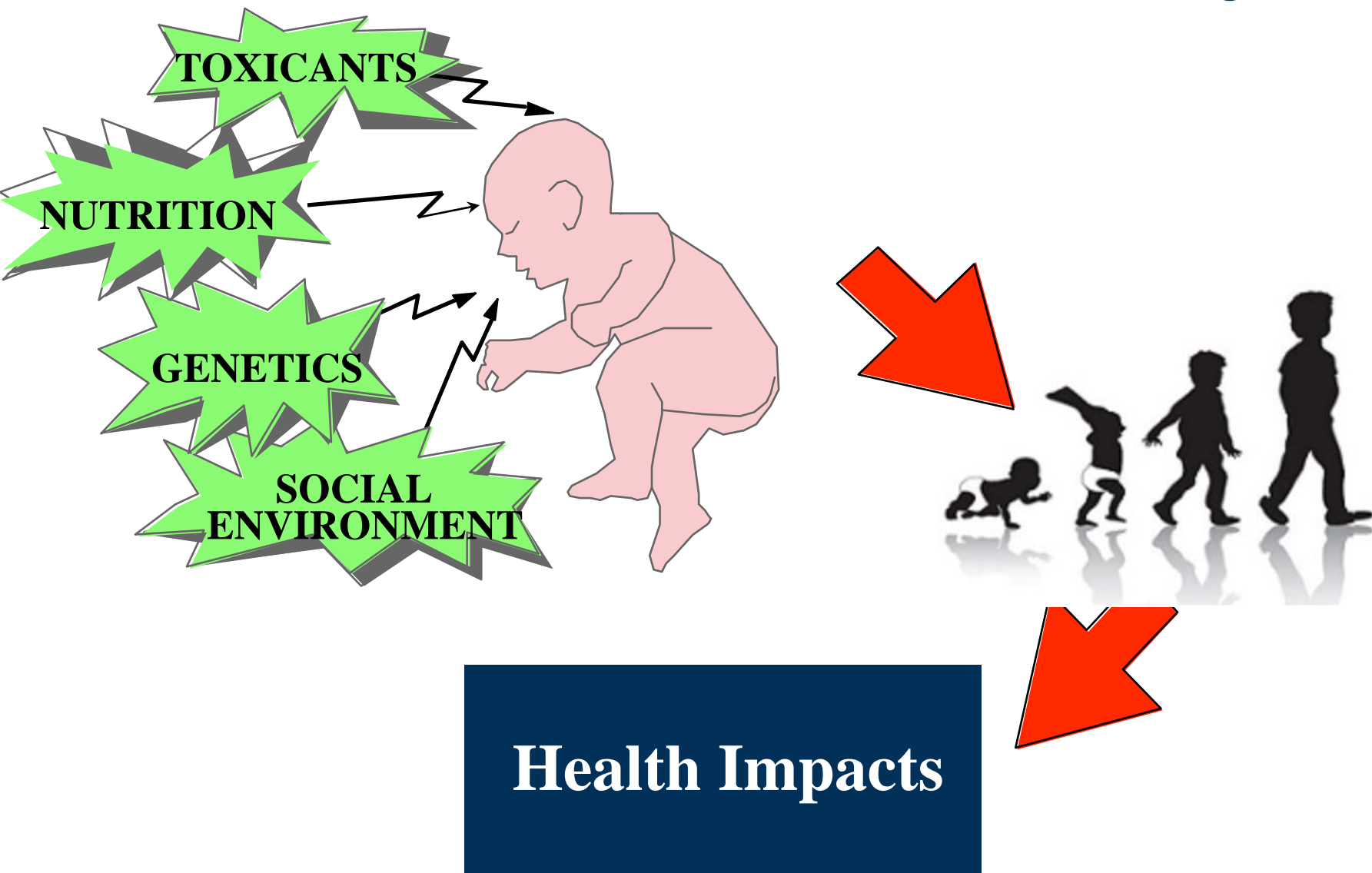
(CDC, 2017)

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





HEALTH IMPACT OF FRACKING

A large, round haystack made of dry straw is in the foreground. In the background, a large, light-colored earthen embankment or well pad is visible. On top of the embankment, there is a bright orange and yellow gas flare. Several pieces of heavy machinery, including a yellow excavator and a white truck, are parked on a road or path near the base of the embankment. The background is filled with a dense forest of bare trees under a grey, overcast sky.

Fracking linked to air pollution, water pollution, noise and light pollution, and earthquakes



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>

Source: Chemical Disclosure Registry

<https://fracfocus.org/chemical-use/what-chemicals-are-used>

- Chemicals routinely used include:

Acids

Biocides

Breakers

Clay stabilizers

Corrosion inhibitors

Friction reducers

Iron control

pH Adjusting agents

Scale inhibitors

Surfactants

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

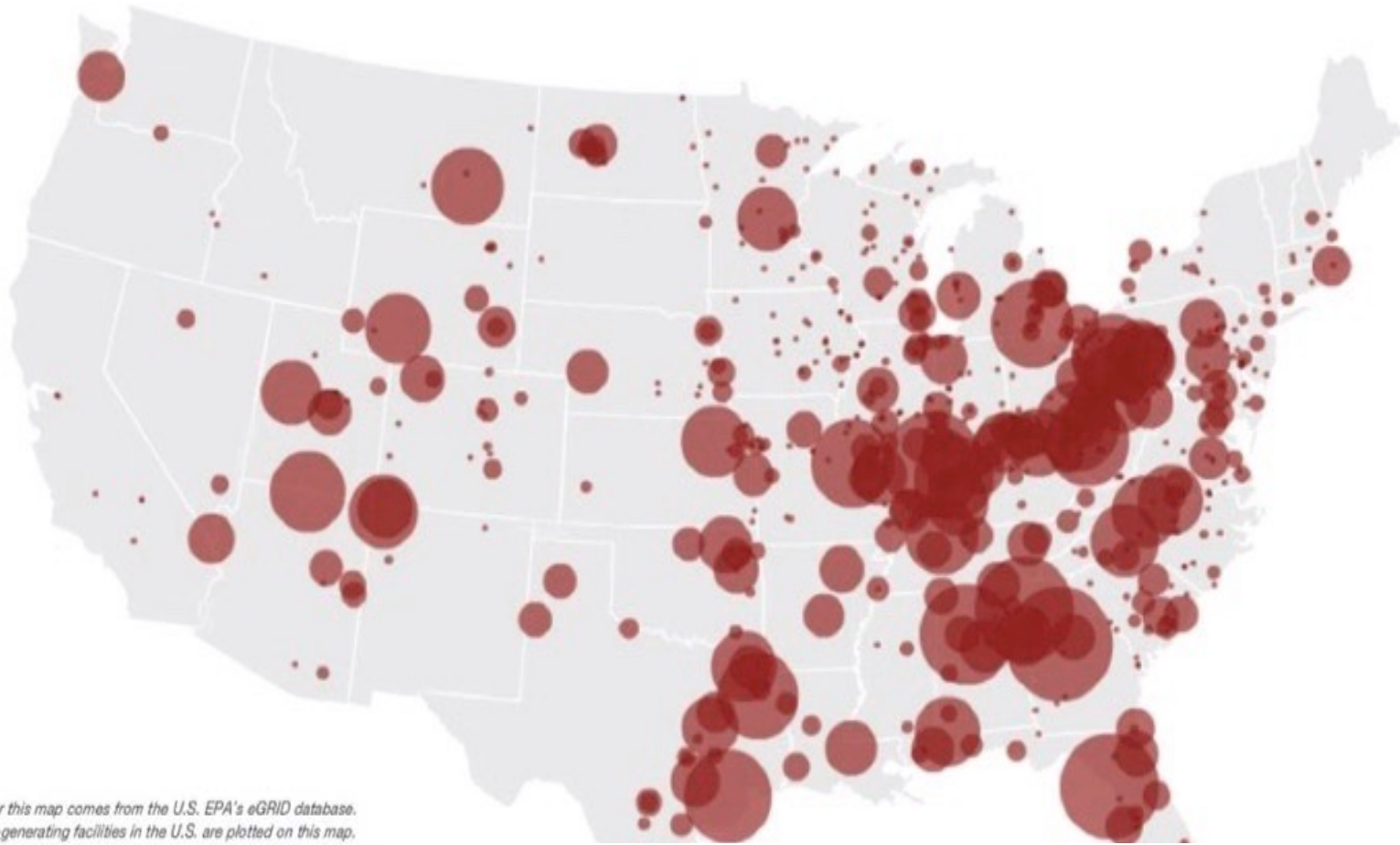
Direct & Indirect Exposures

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

Boiko-Weyrauch, A. (2016, October 5). Ozone, asthma and the oil and gas connection. *Inside Energy*. Retrieved from <http://insideenergy.org/2016/10/05/ozone-asthma-and-the-oil-and-gas-connection/>

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 unhealthy 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

Direct & Indirect Exposures

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

Tasker, T.L., et al. (2018). Environmental and human health impacts of spreading oil and gas wastewater on roads. *Environ. Sci. Technol.*, Copyright © 2018 American Chemical Society. DOI: 10.1021/acs.est.8b00716

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)

Amico, C., DeBelius, D., & Detrow, S. (N.D.) Shale Play: Natural Gas Drilling in Pennsylvania. State Impact Pennsylvania, NPR. Accessed at: <http://stateimpact.npr.org/pennsylvania/drilling/>

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

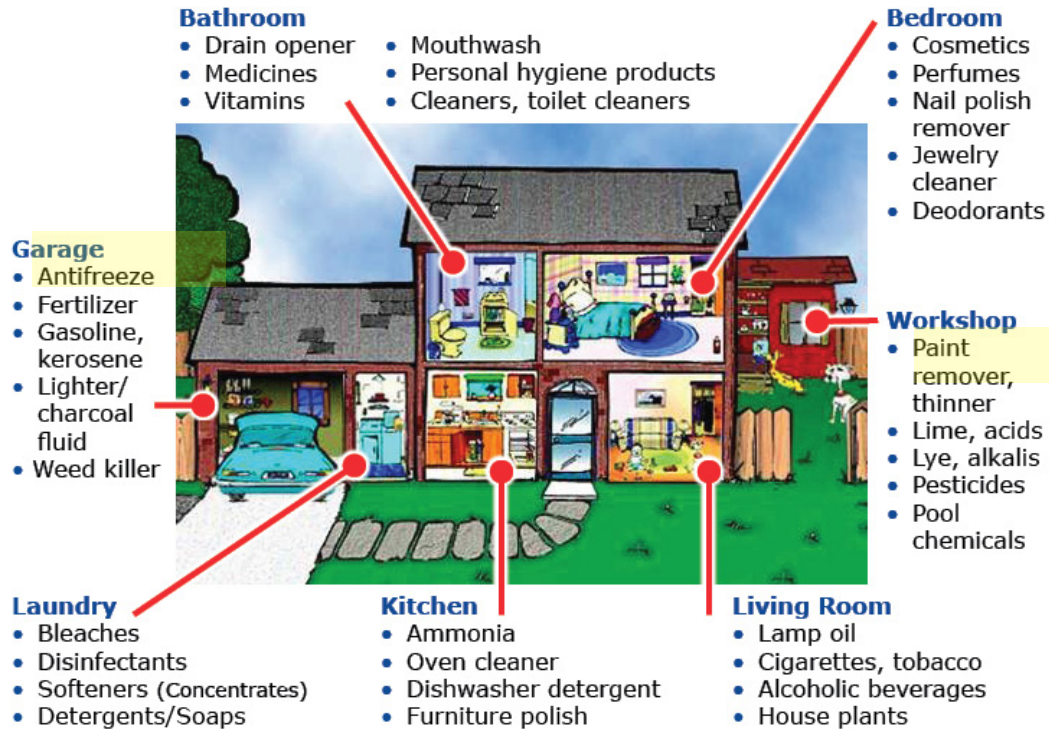


Daily Environmental Threats to Children

- Farming and lawn pollutants
 - fertilizers, pesticides
- Contaminated food
- Processed food



Potential Household Exposures



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 experimenton 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



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