Preventing, Recognizing and Treating Children’s Environmental Exposures

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THE “NEW PEDIATRIC MORBIDITY”

- Asthma
- Obesity
- Allergies
- Neurodevelopmental Disorders
- Birth Defects

What role do environmental exposures play in the rise of these conditions?
“Genetics loads the gun... but environment pulls the trigger”
WHAT ENVIRONMENTS DO CHILDREN EXPERIENCE?

• Their bedroom
• Home
• Family
• School
• Neighborhood
• Community
• State, country, world…
HURRICANE HARVEY

• Environmental factors are thought to contribute to increase in common conditions
• >80,000 chemicals in US commerce today, most with little data available about toxicity to fetuses, infants, and children

• *How can clinicians find out about environmental exposures?*
THEN…

THEN...
NOW...

• Taking an environmental history
  – Understand physical surroundings
  – Detect exposures through history and/or testing
  – Offer guidance to prevent other exposures

• Opportunities
  – Well visits
  – Visits for illness
  – When symptoms are unusual or persistent
LEARNING OBJECTIVES

• Review why children often are more susceptible to environmental toxicants
• Discuss acute and chronic exposures
• List common exposures
• Review how pediatric environmental histories can help clinicians identify some exposures, prevent others
Pesticides in the Diets of Infants and Children

• 1993 National Academies Report
• Most environmental policy had focused on assessment of risk to the “average adult.”
• Little attention had been paid to the unique risks of infants and children
• Produced a paradigm shift in approach
Increased Vulnerability

1. Exposure
   • Unique
   • Higher

2. Physiology
   • Immature
   • Anabolic

3. Lifespan

4. Politically Powerless

“Child”
Judith Shea
Flossmoor, Ill, Completed 2001, Bronze
Exposure: Quantitative Differences

Maintenence Requirements

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Calories</th>
<th>Water</th>
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<tr>
<td>&lt;1</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>1.0-3.0</td>
<td>80</td>
<td>40</td>
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<tr>
<td>4.0-6.0</td>
<td>60</td>
<td>30</td>
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<td>7.0-10.0</td>
<td>40</td>
<td>20</td>
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<tr>
<td>11.0-14</td>
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<td>10</td>
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<td>15-18</td>
<td>10</td>
<td>5</td>
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<tr>
<td>19-24</td>
<td>5</td>
<td>2.5</td>
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<tr>
<td>25-50</td>
<td>2.5</td>
<td>1.25</td>
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<tr>
<td>50+</td>
<td>1.25</td>
<td>0.625</td>
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Harriet Lane, 13th ED

Ershow and Cantor NCI 1989
INFANT AND TODDLER

- Birth weight: 3.5 Kg (7 1/2 lbs)
- Birth weight doubles by 5 months, triples by 1 year
- Length increases 10” in a year
- 2nd yr: adds 5 lbs and 5”
EXPOSURE:
QUALITATIVE DIFFERENCES

• After infancy, distinct dietary patterns
• More milk products, fruits, vegetables
• May have distinct preferences for certain foods
• Food contaminants may have greater effect
Exposure: Qualitative Differences

- Unique Exposures
  - Transplacental
  - Breast Feeding

- Environmental Inter-activists
  - Hand-to-Mouth
  - Object-to-Mouth
  - Non-nutritive Ingestion
  - Living Zones

- Children do not understand danger
  - Toddler: “All brawn and no brains”
  - Adolescent: “High risk” behaviors
METABOLIC DIFFERENCES

• Absorption
• Distribution
• Metabolism
ORGAN SUSCEPTIBILITY

- Immature organ systems are often more susceptible to infectious agents and toxins
- Lead: low levels can cause behavioral and developmental problems in children
- Some organ systems continue developing for several years
  - Brain
  - Lung
Critical Windows of Vulnerability

• Preconception
  – Paternal Occupation

• Gestation
  – Thalidomide
  – DES
  – Methylmercury

• Post-natal
  – Strabismus
  – SHS

(Moore, 1973)
Life Expectancy

- Exposures early in life permit manifestation of environmental illnesses with long latency periods.
Political Standing

- Children have no political voice
- History of advocacy in Pediatrics
  - Abuse and Neglect
  - Toy and Product Safety
- Environmental laws and regulations
  - FQPA
  - Executive Order 13045
ACUTE VS CHRONIC EXPOSURES

• High dose exposures to chemicals often result in obvious morbidity or mortality
• Increasing evidence of effects of low dose exposures
写真集

水俣 MINAMATA

W.ユージン・スミス
アイリーン M.スミス

中尾ハジメ訳

三一書房
MERCURY POISONING

• 1960’s report from Minamata, Japan: epidemic of CP, MR, convulsions among children.
• Traced to ingestion of fish and shellfish contaminated with mercury
• Plastics factory discharged metallic mercury into Minamata Bay
• Mercury transformed by microorganisms into methyl mercury, ingested by fish and then pregnant women.
METHYLMERCURY

• Mental Retardation
• Ataxia
• Seizures
• Vision Problems
• Hearing Loss
• Delayed Development
• Attention Disorders
• Memory Problems
• Auditory Processing Problems
• Language Deficits
Subclinical toxicity has become a widely recognized phenomenon in pediatric environmental health

- Lead
- Methyl mercury
- Tobacco smoke
- Polychlorinated biphenyls (PCB’s)
- Others...
SUBCLINICAL TOXICITY EXAMPLES

- Prenatal tobacco smoke exposure increases the risk of learning and neurobehavioral problems*
- Prenatal PCB exposure linked to reduction in children’s intelligence and alterations in behavior**
- Prenatal phthalate exposure linked to shortening of the ano-genital distance in boys, a finding indicative of feminization***
- Prenatal perfluorinated chemical exposure (PFOA & PFOS) linked to decreased birth weight and head circumference in newborns infants****

UNIVERSAL EXPOSURES

• The CDC measures environmental chemicals in a representative sample of the US population
• Universal exposure – ALL are exposed to hundreds of industrial chemicals detected in blood, urine, hair, bones, teeth
• Chemicals detected in placentas, cord blood, human milk
• Children often have higher exposures
HIGH RISK CHILDREN

- Living in high poverty or predominantly ethnic minority communities
- Whose parents are farm or migrant workers
- Living with parents who have a mental health condition or are substance users
- With developmental delays or pica behavior
- Minorities often face health disparities even across class lines
COMMON ENVIRONMENTAL EXPOSURES

- Secondhand tobacco smoke
- Lead
- Mercury in fish
- Radon
- Pesticides
- Mold

- Radon
- Outdoor air pollutants
- Ultraviolet radiation
- Noise
- Floods, hurricanes
PEDIATRIC ENVIRONMENTAL HISTORY

• Integrating questions into well child visits
• Visits for chronic conditions and illness
• With unusual or prolonged symptoms
Pediatric Environmental Health

3rd Edition

American Academy of Pediatrics

Dedicated to the health of all children.
Environmental Risks to Children: Prioritizing Health Messages in Pediatric Practice

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Practice Gap

There is increasing awareness about the contribution of environmental exposures to today’s health conditions and diseases. Because children and adolescents are often more susceptible to environmental exposures compared to adults, pediatricians and other child health clinicians need information about high-priority environmental exposures and how to incorporate questions and anticipatory guidance into clinical practice.

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Learning Objectives After completing this article, readers should be able to:
• Describe top environmental health issues relevant to children and adolescents, with a focus on families most at risk.
• Counsel families using actionable environmental health messages.
• Connect families to reliable pediatric environmental health resources to assist them in preventing or reducing environmental exposures.
HEALTH SUPERVISION VISITS

- Check-ups, well-child visits
- History, PE, monitoring growth and development, administering immunizations, performing screening tests
- Anticipatory guidance
- 25-40% of US pediatricians’ time spent in health supervision*

* 2000 Nelson’s Textbook of Pediatrics
HEALTH SUPERVISION VISITS

• Consider age, developmental stage (newborn, infant, toddler, preschooler, school-aged child, teen)

• Consider risks in community
HEALTH SUPERVISION – TOPICS IN HISTORY

• Initial visit
  – Birth history
  – Past medical history
  – Review of systems
  – Family history
  – Social history
  – Environmental history
HEALTH SUPERVISION – RANGE OF TOPICS

• Initial/subsequent visits
  – Feeding/nutrition
  – Sleep
  – Safety
  – Elimination
  – Development/behavior
  – Parental employment/child care
  – Child’s physical environment
CHILD’S PHYSICAL ENVIRONMENT

- Where the child lives or spends time
- Exposure to secondhand smoke (SHS)
- Water sources
- Exposures from food
- Parents’ and teens’ occupations
- Sun exposure
WHERE THE CHILD LIVES OR SPENDS TIME

- Type of dwelling
- Age and condition of home
- Renovation
- Heating sources
- Insects, rodents
CASE 1 – INFANT HEALTH SUPERVISION

• You are a clinician working in an urban inner-city area. A mother and father bring their 4 month-old baby for an initial visit. The birth history is unremarkable. There is a family history of asthma. The child drinks cow’s milk formula.

• What questions about environment will you include in your history?
CHILD’S PHYSICAL ENVIRONMENT

- Where the child lives or spends time
- Exposure to secondhand smoke (SHS)
- Water sources
- Exposures from food
- Parents’ and teens’ occupations
- Sun exposure
WHERE THE CHILD LIVES OR SPENDS TIME

• The family’s apartment is in poor condition. There is water damage, visible mold and cockroaches. The parents hope to move soon.

https://www.epa.gov/mold/mold-image-library
EXPOSURE TO SHS

- The mother quit smoking when she found out she was pregnant, but has resumed smoking one pack per day. The father does not smoke tobacco anymore but vapes instead.
SOURCE OF WATER

- The mother prepares the infant’s formula using tap water boiled for 10 minutes.
EXPOSURES FROM DIET

• The parents are planning to introduce rice cereal into the baby’s diet.
PARENTS’ OCCUPATIONS

• The father is a house painter. The mother plans to stay at home before returning to work as an office assistant.
SUN EXPOSURE

• The parents plan to take the baby outside when the weather permits. Neither parent sunburns easily, so they don’t plan to take use any special precautions for the baby.
CASE 2 - TODDLER HEALTH SUPERVISION

• A mother brings her toddler for his 15 month-old well visit. Growth and development are normal. He recently started to walk and his mother says he “gets into everything and puts everything into his mouth”.

• What else do you need to know?
WHERE THE CHILD LIVES OR SPENDS TIME

• The child lives in a newly built apartment building.

• During the day he goes to his grandmother’s home while his mother works. Her apartment was built before World War II. There are holes in the walls and the paint is peeling.
CASE 3 - TEEN HEALTH SUPERVISION

• A 17 year-old asks you to write a certificate of physical fitness for working papers needed for a summer job. His medical history is unremarkable. He does well in school, is not sexually active, doesn’t use tobacco, e-cigarettes, alcohol or drugs. Physical exam shows that he is red-headed with blue eyes. He has many pigmented nevi (moles).

• What else do you need to ask?
OCCUPATION

• The teenager plans to work as a lifeguard.
## Environmental Health Anticipatory Guidance

<table>
<thead>
<tr>
<th>EXAMPLE TOPIC</th>
<th>AGE PERIOD</th>
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<tbody>
<tr>
<td>Home, SHS, mold, occupational exposures, breast/bottle issues</td>
<td>Prenatal or first visit</td>
</tr>
<tr>
<td>SHS, sun exposure, mold</td>
<td>2 months</td>
</tr>
<tr>
<td>Poisons, household pesticides, lead</td>
<td>6 months</td>
</tr>
<tr>
<td>Arts and Crafts</td>
<td>Preschool</td>
</tr>
<tr>
<td>Occupational/Hobby exposures</td>
<td>Teens</td>
</tr>
<tr>
<td>Lawn/garden products/services</td>
<td>Spring/Summer</td>
</tr>
<tr>
<td>Wood stoves/heating</td>
<td>Fall/Winter</td>
</tr>
</tbody>
</table>

AAP PEH Handbook, 2012
VISITS FOR ILLNESS

• Incorporating environmental etiologies into differential diagnoses
CASE 4 - ASTHMA

• A 5 year-old boy comes for follow-up. He has mild persistent asthma. His known triggers for wheezing episodes are cold weather and upper respiratory infections.

• What else do you need to know?
ENVIRONMENTAL TRIGGERS OF ASTHMA

- Secondhand tobacco smoke
- Mold
- Dust mites
- Cockroaches
- Animal allergens
- Nitrogen oxides
- Odors
- Volatile organic compounds
IF YOU SMOKE AROUND YOUR CHILD, HE CAN INHALE THE EQUIVALENT OF 102 PACKS OF CIGARETTES BY AGE 5.

SecondhandSmokesYou.com
A 3 year-old Hispanic girl with a history of seizures comes to the ED after a generalized tonic-clonic seizure. She received rectal diazepam at home before coming to the ED. She is awake, afebrile and PE is normal. Her past history shows that she has had seizures since age 3 months. MRA/MRI and EEG at age 2 were normal.

What is in your differential diagnosis?
SEIZURE – DIFFERENTIAL DIAGNOSIS

- Seizure disorder of unknown etiology
- Infection
- Brain tumor
- Toxic ingestion
- Other toxic exposure
CAMPHOR EXPOSURE

- Seizures reported after camphor ingestion, inhalation and dermal absorption
- Camphor (alcanfor) commonly used as a natural remedy in certain populations
- Mother was rubbing a properly labeled camphor ointment over the child’s upper chest, forehead and back hourly for several hours before the onset of the seizure, to relieve her cold symptoms

CONSIDER ENVIRONMENTAL CAUSES WITH...

- Coma, seizures, developmental delay, irritability, constipation...
  - LEAD

- Asthma, pneumonia, OM...
  - SHS

- Fatigue, headache, dizziness, weakness, nausea, vomiting...
  - CO POISONING
IS A SYMPTOM RELATED TO ENVIRONMENTAL EXPOSURE?

• Illness caused by an environmental agent may present as a common medical problem
• Clinician should consider environmental etiology
• Detecting environmental illness begins with a history. Physical exam and lab tests follow
ENVIRONMENTAL HISTORY-
SOLVING A MYSTERY

• Do symptoms subside or worsen in a particular location?
• Are symptoms better or worse on weekdays or weekends? At a particular time of day?
• Do symptoms increase during specific activities? Hobbies? Athletics?
• Are others similarly affected?
Diagnostic vigilance is an essential component of primary care pediatrics.

Examples of diseases of environmental origin first documented by alert clinicians:

- Phocomelia in babies exposed to thalidomide.
- Adenocarcinoma of the vagina in girls exposed *in utero* to diethylstilbestrol.
- Microcephaly in babies exposed *in utero* to ionizing radiation.

Miller RW. *Pediatrics* 2004.
RESPONDING TO PARENTS’ CONCERNS

• Parents may have questions and concerns about environmental hazards

• Resources are available
  – Pediatric Environmental Health Specialty Units (www.pehsu.net)
  – Mount Sinai PEHSU (http://icahn.mssm.edu/research/pehsu)
ADVOCACY

• Many successful prevention efforts led by pediatricians and other child health advocates
  – Removing lead from gasoline
  – Banning of highly hazardous pesticides
  – Reductions in urban air pollution

• Continued evidence-based advocacy is needed to ensure existence of programs and policies to protect children from environmental hazards
SUMMARY

• Children often are more susceptible to environmental toxicants
• Acute and low-dose exposures
• Many common exposures
• Pediatric environmental histories can help clinicians identify some exposures and prevent others
LEARNING MORE ABOUT KIDS’ HEALTH
ENVIRONMENTAL EXPOSURES

• SHS
• Carbon monoxide
• Mold
• Radon
• Pesticides
• Sun exposure
• Many others

www.aap.org/bookstore
REFERENCES

- Miller RW. How environmental hazards in childhood have been discovered: carcinogens, teratogens, neurotoxicants and others. *Pediatrics* 2004; 113 (4 Suppl):945-51
THANK YOU!

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