The Price of Pollution: Costs of Environmental Health Conditions in Children

CHE Call: October 8, 2015

Gala King, MPH
Health Surveillance Director

Blair Sevcik, MPH
Epidemiologist

Chiahui Chawla, MS, MA
Environmental Health Data Analyst
What we’ll talk about

- Why consider environmental health costs
- Report background and methods
- Summary results from each state report
- Methods for:
  - Cancer (California)
  - Asthma (New Hampshire)
  - Lead (Minnesota)
- Discussion and Q&A
Why Measure Environmental Health Costs?

➤ Growing concern about the environment and health

➤ Costs can inform policy decisions, priority setting, and resources allocation

➤ Economic benefits of health should be considered when assessing costs of pollution prevention
Impact from Past Studies

- In NYS, estimated costs due to 4 occupational illnesses totaled $600 million per year in NYS
  - Persuaded NYS Legislature to fund medical care to employees injured/ill at work

- In the U.S., estimated costs of 4 diseases in children caused by harmful exposures totaled $54.9 billion
  - Led to U.S. government funding the National Children’s Study
Report Background

- Collaborative effort between grantees of the CDC National Environmental Health Tracking Program

- California*
- Connecticut
- Florida
- Minnesota*
- New Hampshire*
- Oregon
- Utah

* Published state cost reports
General Methods

Based on methods from:
- Landrigan et al. (2002)
- Trasande and Liu (2011)
- CDC’s Chronic Disease Cost Calculator (2013)

Selected conditions (vary by state):
- Asthma
- Cancer
- Lead exposures
- Neurobehavioral disorders
- Mercury poisoning
Summary Calculation

Costs due to the Environment =

Size of population at risk * Rate of disease * Cost per case * Environmentally attributable fraction (EAF)
Types of Costs Included

- **Direct costs**
  - Medical and non-medical

- **Indirect costs**
  - Lost earnings to care for child due to the condition

- **Lost potential earnings**
  - Due to premature death, reduction in IQ, or disability

Both *Annual* and *Lifetime* costs were included when feasible.
Environmentally attributable fraction (EAF)

The percentage of the disease burden that would be eliminated if environmental risk factors were reduced to their lowest feasible levels

<table>
<thead>
<tr>
<th>Condition</th>
<th>EAF (range of values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>30% (10-35%)</td>
</tr>
<tr>
<td>Cancer</td>
<td>5% (2-10%)</td>
</tr>
<tr>
<td>Lead exposures</td>
<td>100%</td>
</tr>
<tr>
<td>Neurobehavioral disorders</td>
<td>10% (5-20%)</td>
</tr>
<tr>
<td>Mercury poisoning</td>
<td>70%</td>
</tr>
</tbody>
</table>
**Environmentally attributable fraction** (EAF)

The percentage of the disease burden that would be eliminated if environmental risk factors were reduced to their lowest feasible levels.

<table>
<thead>
<tr>
<th>Condition</th>
<th>EAF (range of values)</th>
<th>California specific EAF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>30% (10-35%)</td>
<td>30% (20-41%)</td>
</tr>
<tr>
<td>Cancer</td>
<td>5% (2-10%)</td>
<td>15% (9-21%)</td>
</tr>
<tr>
<td>Lead exposures</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Neurobehavioral disorders</td>
<td>10% (5-20%)</td>
<td></td>
</tr>
<tr>
<td>Mercury poisoning</td>
<td>70%</td>
<td></td>
</tr>
</tbody>
</table>
# Summary Findings in California

<table>
<thead>
<tr>
<th>Cost due to the environment</th>
<th>Annual costs</th>
<th>Lifetime costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asthma</strong></td>
<td>$208 million</td>
<td>$6 million</td>
</tr>
<tr>
<td><strong>Cancer</strong> (lymphomas, leukemia, brain/CNS)</td>
<td>$19 million</td>
<td>$33 million</td>
</tr>
<tr>
<td><strong>Neurobehavioral disorders</strong></td>
<td>$27 million</td>
<td>$2.3 billion</td>
</tr>
<tr>
<td>(intellectual disability, attention deficit and hyperactivity disorder, autism spectrum disorder)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lead exposures</strong></td>
<td>N/A</td>
<td>$8-11 billion</td>
</tr>
<tr>
<td><strong>Total costs due to the environment</strong></td>
<td>$254 million</td>
<td>$10-13 billion</td>
</tr>
</tbody>
</table>
CANCER
### Summary Calculation

**Costs due to the Environment =**

| Size of population at risk | * | Rate of disease | * | Cost per case | * | Environmentally attributable fraction (EAF) |
Summary Calculation

Costs due to the Environment =

Size of population at risk * Rate of disease * Cost per case * Environmentally attributable fraction (EAF)

Number of cases
Annual Cancer Burden in California Children, ages 0-14

Children **diagnosed** with cancer in 2010:
- All types: 1,240
- Most common cancers: 803 (leukemia, lymphoma, and brain/CNS)

Child **deaths** from cancer in 2010:
- All types: 194
- Most common cancers: 135 (leukemia, lymphoma, and brain/CNS)
Summary Calculation

Costs due to the Environment =

- Size of population at risk
- Rate of disease
- Cost per case
- Environmentally attributable fraction (EAF)
Costs of Childhood Cancers in California

➢ Annual Costs

• Direct medical costs: prescription medications, physician visits, ED visits, hospitalizations.

• Indirect: Lost parental wages due to caring for child being hospitalized/treated for cancer.

➢ Lifetime Costs

• Lost future potential earnings due to:
  – premature mortality
  – reductions in IQ from radiation treatment for brain/CNS cancers only.
Costs of Childhood Cancers in California

➢ Annual Costs Total: $125 million
  • Direct medical: $122.5 million
  • Indirect: $2.7 million

➢ Lifetime Costs Total: $222 million
  • Lost future potential earnings due to:
    – premature mortality: $200 million
    – reductions in IQ: $19.9 million

Appendix A:
Summary Calculation

Costs due to the Environment =

\[ \text{Size of population at risk} \times \text{Rate of disease} \times \text{Cost per case} \times \text{Environmentally attributable fraction (EAF)} \]
EAF for Childhood Cancer in California

Included both outdoor and indoor hazards:

- Associated with leukemia, lymphoma, and/or brain/CNS cancer
- Had California-specific hazard data available

<table>
<thead>
<tr>
<th>Hazard included in California EAF calculation</th>
<th>Timing of exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Radon</td>
<td>Childhood</td>
</tr>
<tr>
<td>Secondhand smoke (SHS)</td>
<td>In-utero</td>
</tr>
<tr>
<td>Solvents</td>
<td>In-utero and/or childhood</td>
</tr>
<tr>
<td>Parental occupational pesticides</td>
<td>Periconception</td>
</tr>
<tr>
<td>Residential pesticides</td>
<td>In-utero and/or childhood</td>
</tr>
<tr>
<td>Traffic pollution</td>
<td>In-utero</td>
</tr>
<tr>
<td>Parental occupational traffic pollution</td>
<td>Periconception</td>
</tr>
</tbody>
</table>

Appendix B:
EAF for Childhood Cancer in California

Approach:

• Calculate individual EAFs for each hazard – cancer combination
• Calculate an EAF for each cancer type
• Combine EAFs for all three cancer types

EAF for childhood cancer in California = 15% (9-21%)

Appendix B:
Preventing childhood cancer and annual costs in California

<table>
<thead>
<tr>
<th>EAF</th>
<th>Annual number of new cancer cases</th>
<th>Cancer cases due to the environment each year</th>
<th>Annual cost for cancer (2013$)</th>
<th>Annual cost of environmentally attributable cancer (2013$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>803</td>
<td>72</td>
<td>$125 million</td>
<td>$11</td>
</tr>
<tr>
<td>15%</td>
<td>120</td>
<td>120</td>
<td>$19 million</td>
<td>$19 million</td>
</tr>
<tr>
<td>21%</td>
<td>169</td>
<td>169</td>
<td>$26</td>
<td>$26</td>
</tr>
</tbody>
</table>

By reducing environmental hazards, each year we could

- Prevent cancer in **120** children
- Save **$19 million** in medical costs and wages
Preventing childhood cancer deaths and lifetime costs in California

<table>
<thead>
<tr>
<th>EAF</th>
<th>Annual number of deaths</th>
<th>Cancer deaths due to the environment</th>
<th>Lifetime cost for cancer (2013$)</th>
<th>Lifetime cost of environmentally attributable cancer (2013$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>135</td>
<td>12</td>
<td>$222 million</td>
<td>$20</td>
</tr>
<tr>
<td>15%</td>
<td>20</td>
<td>20</td>
<td>$222 million</td>
<td>$33 million</td>
</tr>
<tr>
<td>21%</td>
<td>28</td>
<td>28</td>
<td>$222 million</td>
<td>$47</td>
</tr>
</tbody>
</table>

By reducing environmental hazards, we could
• Prevent **20 cancer deaths** among children each year, and
• Prevent the loss of **$33 million in lifetime earnings** for
Costs of Environmental Health Conditions in California Children

15 in 100 cases could be prevented if environmental hazards were reduced to their lowest levels.

Saving...
$19 million each year.

Preventing...
$33 million in losses over the lifetime of all children born in a single year.

Select childhood cancers in California

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>Total Cases</th>
<th>Directs Costs (per case)</th>
<th>Indirects Costs (per child)</th>
<th>Total Annual Cost</th>
<th>Total Lifetime Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leukemia cases:</td>
<td>453</td>
<td>$152,578</td>
<td>$3,325</td>
<td>$255 million</td>
<td>$125 million</td>
</tr>
<tr>
<td>Brain/CNS cancer cases:</td>
<td>223</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphoma cases:</td>
<td>127</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cases:</td>
<td>803</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total deaths:</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Environmental factors: radiation, pesticides, parental occupational exposures, in-utero exposures, solvents.

For more information: Galatea.King@phi.org

Full report, appendices, FAQs, all infographics: www.phi.org/CEHTPKidsHealthCosts

Thank you!

CEHTP staff:
- Paul English
- Liang Guo
- Justin Howell
- Galatea King
- Daniel Madrigal
- Dan Meltzer
- Susan Paulukonis
- Faith Raider
- Max Richardson
- Eric Roberts
- Jackie Valle
- Alexa Wilkie
- Michelle Wong

California Collaborators:
- UC Merced, Environmental Health Investigations Branch, California Breathing, Childhood Lead Poisoning Prevention Branch, California Cancer Registry

Tracking Implementation Advisory Group