CHILDREN’S ENVIRONMENTAL HEALTH

CHE-Alaska Teleconference
March 12, 2014
WHY WRITE THIS BOOK?

• Children’s environments and patterns of disease in children have changed profoundly over the past 5 decades.

• The prevalence of autism, asthma, ADHD, obesity, diabetes, and birth defects have increased substantially in children around the world.

• At the same time, more than 80,000 new chemicals have been developed and released into the global environment.

• Today the World Health Organization attributes 36% of all childhood deaths around the world to environmental causes.
How much disease could be prevented by modifying the environment?
WHO Environmental Burden of Disease
Working Definition of Environment

**Included:**
- Air, water, soil pollution
- Radiation
- Noise
- Occupational risks
- Built environment
- Agricultural methods
- Climate change
- Handwashing

**Not Included:**
- Alcohol, tobacco, drugs
- Diet
- Bed nets
- Unemployment
- Natural hazards
- Person-to-person transmission
THE GLOBAL BURDEN OF ENVIRONMENTAL DISEASE

Source: Preventing disease through healthy environments, WHO, 2006
HOW MUCH DISEASE COULD BE PREVENTED BY MODIFYING THE ENVIRONMENT?

Current evidence - best conservative estimate 24%

Source: Preventing disease through healthy environments, WHO, 2006
ENVIRONMENTAL DISEASE IN NORTH AMERICAN CHILDREN

- Predominantly chronic diseases
- These diseases are on the rise

Rate per 1000 population

Year

Source: Centers for Disease Control and Prevention
Incidence of Childhood Leukemia 1975–2004
US INCIDENCE OF TESTICULAR CANCER

![Graph showing the incidence rate per 100,000* for testicular cancer in the United States from 1973 to 1995, with data for white males, all races males, and black males.](image)

*Age-adjusted to the 1970 U.S. standard population.

OVERWEIGHT AND OBESITY

Prevalence has more than tripled in American children in 30 years from 5% in the 1970s to 17% today.

Stark disparities by socioeconomic status, race and ethnicity.

Serious consequences for child health: 2.5-fold increased risk of overall mortality; 4-fold risk of cardiovascular mortality; 5-fold risk of diabetes.

Terrible demographic consequences: This could be the first generation of US children in a century to have shorter life expectancy than their parents.
CHILDREN TODAY ARE EXPOSED TO THOUSANDS OF SYNTHETIC CHEMICALS. MOST HAVE NOT BEEN TESTED FOR TOXICITY

- 80,000+ chemicals in commerce
- Most invented in the past 30-40 years
- 3,000 are high production volume (HPV) chemicals
- No basic toxicity information is publicly available for nearly half of HPV chemicals
- Information on developmental toxicity is available for less than 20% of HPV chemicals
- Many HPV chemicals are detectable in adult blood, breast milk and infant cord blood
DEVELOPMENTAL DISABILITIES

• Affect 10-15% of all children
• Include: Dyslexia
  ADHD
  Mental Retardation
  Autism
• Reported incidence is increasing
CHILDREN ARE ESPECIALLY VULNERABLE TO TOXIC CHEMICALS IN THE ENVIRONMENT

- Greater exposure proportionate to body mass—
  \textit{7 times more water per Kg per day; Hand-to-mouth activity}
- Diminished ability to detoxify many chemicals
- Heightened biological vulnerability—\textit{thalidomide, DES, fetal alcohol syndrome}
- More years of future life

CHILDREN ARE NOT LITTLE ADULTS
CHILDREN ARE NOT LITTLE ADULTS

- Short Stature - closer to ground
- Increased food intake and metabolic rate
- Altered excretion
- Long “shelf life”
- Hand to mouth activity
- Increased air intake
- Increased skin surface area
- Ongoing organ development
Vulnerable Groups

 Courtesy of Dr. Jerry Nasenbeny
CHILDREN LIVING WORLDS APART

Philadelphia
- Lead in tap water
- Pesticide residues in foods
- Mercury in sneakers

Philippines
- No tap for running water
- Deaths from drinking pesticides
- Mercury from small-scale gold mining
STRONG AND GROWING EVIDENCE OF LINKS BETWEEN TOXIC CHEMICALS AND DISEASE

Air pollution and asthma –
  Indoor and outdoor triggers

Environmental exposures and pediatric cancer –
  Ionizing radiation, DES, pesticides, benzene

Endocrine disruptors and male reproductive problems –
  Emerging evidence for phthalates. Still early stage

Neurodevelopmental disorders –
  Lead, Methylmercury, PCBs, PBDEs, Phthalates, BPA, PAH, Fluoride, Solvents, Organophosphates
Womb, safe womb?
UNDERLYING FACTORS

Poverty
Environmental Degradation
Poor Nutrition
Poor Housing
Advertising

CHILD

CHILD HEALTH
UNDERLYING FACTORS

Poverty
Environmental Degradation
Poor Nutrition
Poor Housing
Advertising

CHILD

HEALTH CARE

CHILD HEALTH
UNDERLYING FACTORS

Poverty
Environmental Degradation
Poor Nutrition
Poor Housing
Advertising

CHILD

ADVOCACY

CHILD HEALTH
ORGANIZATION OF THE BOOK

- 60 chapters by 85 authors on 5 continents
- Introductory/Overview chapters
- Chapters on children’s environments
- Chapters on environmental hazards
- Chapters on the major diseases of environmental origin in children
- Chapters on prevention and control of diseases of environmental origin in children
Home, safe home?
Home, safe home?

• Where does the family’s water come from?
• What fuel is used for cooking?
• Is there any smoking or tobacco use?
• Does the home have any water damage or mold?
• Use of chemicals in or around home?
MOLDS

- A frequently undetected environmental problem
- Occur in damp indoor areas
- Allergies and nonspecific symptoms are common, also rare conditions such as lung bleeding
INFANT ACUTE PULMONARY HEMORRHAGE

• Emerging data show an association with indoor exposure to moldy home environments

• Mycotoxins on surface of spores may lead to capillary fragility

• Additional research ongoing
CHEMICAL AGENTS PRODUCED BY MOLDS

Mycotoxins are associated with human disease and cause acute and chronic effects

- Mycotoxins
  - Aflatoxins
  - Tricothecenes
  - Ochratoxins and citrinin
  - Hundreds of others
- Glucans (cell wall components)
- Volatile organic compounds (irritating)
MOLD-RELATED CONDITIONS

- Airway and conjunctival irritation
- Headache
- Difficulty in concentrating
- Hypersensitivity reactions: asthma, rhinitis
- Systemic infections (immunosuppressed child)
- Acute exposure associated with pulmonary haemorrhage in infants
Water-damaged home environments

• Cleaning up visible mold is not enough!
• Mold requires water
• Find out where the water is coming from
• Fix the source
Indoor Smoke
An Important Health Hazard for Children

• Much of the world relies on biomass fuels (e.g. wood, dung, charcoal) and coal for cooking and space-heating

• Burning such solid fuels on traditional stoves leads to high levels of indoor smoke, a complex mix of pollutants (e.g. PM, CO, carcinogens)

• Exposure doubles the risk of pneumonia among children and triples the risk of chronic respiratory diseases among women.

Courtesy of Nigel Bruce/Practical Action
Reason for Hope: Effective and Cost-effective Solutions Exist

- More fuel-efficient and cleaner-burning stoves and cleaner fuels (e.g. gas, biogas) can reduce indoor smoke.
- These solutions can also decrease pressure on forests and reduce greenhouse gas emissions, presenting an opportunity for carbon trading.
- A switch to cleaner fuels results in a 7-fold return on investment, a switch to improved stoves to a 25- to 60-fold return on investment.
- Global Alliance for Clean Cookstoves

Courtesy of GTZ
DATA ON PRIMARY PREVENTION INDOOR SMOKE INTERVENTION STUDY

New evidence on health impact of interventions

- China – 200 million improved chimney stoves
- 3 cohort studies
- Compared long-term (10+ yrs) users of improved stove vs. traditional stove
- For all 3 outcomes 25-50% reduction in risk for men and women

<table>
<thead>
<tr>
<th>Disease</th>
<th>RR</th>
<th>95% CI</th>
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<tbody>
<tr>
<td><strong>COPD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>0.58</td>
<td>0.49 – 0.70</td>
</tr>
<tr>
<td>Women</td>
<td>0.75</td>
<td>0.62 – 0.92</td>
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<tr>
<td><strong>Pneumonia (deaths)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>0.49</td>
<td>0.31 – 0.78</td>
</tr>
<tr>
<td>Women</td>
<td>0.53</td>
<td>0.32 – 0.88</td>
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<tr>
<td><strong>Lung cancer</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>0.59</td>
<td>0.49 – 0.71</td>
</tr>
<tr>
<td>Women</td>
<td>0.54</td>
<td>0.44 – 0.65</td>
</tr>
</tbody>
</table>
The Growing Epidemic

Rise in Smokers Worldwide

billions of smokers

2000 2025

2000 2025

1.1 1.64
Secondhand Smoke

~700 million (almost half) of the world’s children breathe air polluted by tobacco smoke, particularly at home

- World Health Organization
Exposure to secondhand tobacco smoke caused 166,000 deaths in children in 2004.

Cigarette smoking in homes, restaurants, other work and public places exposes children to significant levels of air pollutants.

Policies designed to eliminate cigarette smoking in work and public settings have been shown to be effective measures for reducing exposure to secondhand smoke. Only 7.4% of world lives in areas with such laws.
Tobacco smoke contains a deadly mix of more than 7,000 chemicals. Hundreds are toxic. About 70 can cause cancer. Here are some of the chemicals.
Changing Views of Tobacco

1944: Smoker = Glamor

1950, first epidemiologic studies demonstrating smoking as the main cause of the most common cancers

1969: Smoker = Villain

1969, cigarette advertising on television and radio banned in US

It took 60 years...

PRIMARY PREVENTION 2003: 192 Member States of the WHO unanimously adopted the Framework Convention on Tobacco Control

2010: Motion Picture Association of America included smoking as a factor in rating movies
Doctors have come a long way

Ask your Doctor, RJ Reynolds, 1947

2013
World No Tobacco Day – WHO
Prohibiting Smoking in Multiunit Housing

• 32.7% of adult subsidized housing residents were current smokers in 2009 (compared to 20.6% of U.S. adults)

• Recent study estimated that $521 million could be saved each year by prohibiting smoking
  $341 million in SHS-related health care costs
  $108 million in renovation expenses
  $ 72 million in smoking-attributable fire costs

WEAPONS OF MASS DESTRUCTION

5 Million Deaths Each Year.

New Albany, Indiana
Estimated reduction in smoking-related deaths if global smoking prevalence drops from 25% to 20%

<table>
<thead>
<tr>
<th></th>
<th>Population 2006</th>
<th>Number of smokers</th>
<th>Reduction in smokers</th>
<th>Premature deaths prevented</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults (age ≥ 18 years)</td>
<td>4357</td>
<td>1089</td>
<td>218</td>
<td>73</td>
</tr>
<tr>
<td><strong>Future</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children (age 0-17 years)</td>
<td>2122</td>
<td>531</td>
<td>106</td>
<td>35</td>
</tr>
<tr>
<td>Unborn (2007-2030)</td>
<td>3020</td>
<td>755</td>
<td>151</td>
<td>50</td>
</tr>
<tr>
<td>Minimum number of smoking related deaths prevented in the 21st century</td>
<td></td>
<td></td>
<td></td>
<td>158</td>
</tr>
</tbody>
</table>

Data are estimated number (millions).
Lead Poisoning

- Lead exposure accounts for about 1% of the global burden of disease and most exposure affects children in developing countries.

- In developing countries as much as 15-20% of mental retardation could be caused by exposure to lead.

- Hundreds of millions of children and pregnant women are exposed to different sources of lead.
Nigeria - 2010 poisoning epidemic

- Largest outbreak of lead poisoning ever recorded
- Estimated 10,000 persons exposed through inhalation of contaminated dust, and ingestion of contaminated water and food
- 2000 children needed chelation therapy, ~ 400 deaths
- Associated with artisanal and small scale mining activities
  - Ore processed by women and children
  - In homes, in common water sources
  - Using same instruments that were used for grinding flour, cooking, and washing
SOCIETAL IMPACT OF A 5-POINT LOSS IN POPULATION MEAN IQ SCORE

www.preventingharm.org/execsum.html Schettler, 2000
Reason for Hope:
Primary prevention of lead poisoning

• Unleaded gasoline – a success story
Lead in Gasoline -- History

- At end of 20th century developed countries phased out leaded gasoline
- But few developing countries had done so
- Concrete targets were set for complete elimination
Success in campaign to phase out leaded gasoline

• Began in 2002
• 120+ members (doctors, parents, scientists, government, industries, international organizations)
• Clearing house in Nairobi; 12 staff
Leaded Petrol Phase-Out: Global Status

Status as of 2005
Leaded Petrol Phase-out: Global Status October 2010

Unleaded
Leaded and Unleaded
Leaded
Unknown

Leaded Countries:
- Afghanistan
- Myanmar
- North Korea

Dual Countries:
- Algeria
- Bosnia
- Montenegro
- Serbia
- Iraq
- Yemen
Leaded Petrol Phase-out: Global Status October 2010

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- Afghanistan
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Unknown

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- Iraq
LEADED GASOLINE & CHILDREN`S BLOOD LEAD LEVELS - U.S.

- Lead removed from gasoline

- Blood lead levels in children fell in parallel lead in air
  - Much more than models predicted

- New understanding of important sources of lead exposure in children

**USEPA, Great Lakes Binational Toxics Strategy**
Multiple countries around the world have phased lead out of gasoline and shown similar reductions in average blood lead concentrations.
Reason for Hope:

Environment – the invisible issue – becoming more visible.
Another alternative
Less DDT in Breast Milk after Sweden's ban

Solomon. EHP 2002;100:A339-A347.
Policy changes make a positive impact

Benefits of the Clear Air Act Amendments of 1990

- Benefits will reach approximately $2 trillion in 2020
- Over 230,000 early deaths prevented

Clean Air Act Amendments benefits exceed costs by a factor of more than 30 to one
Policy changes make a positive impact

• Direct benefits of 1990 CAA Amendments and associated program significantly exceeded their direct costs

• Economic welfare and quality of life for Americans were improved by the passage of the amendments
There is reason for hope to reduce the environmental determinants of health

- More children with illnesses caused by environmental contamination will be recognized as such
- Advocacy can prevent or reduce illness in others in the community
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