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GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

GLOBAL HEALTHCARE WASTE PROJECT

MODULE 19:
Rationale for Mercury-Free Health Care

World Health Organization

Health Care Without Harm

UIC SCHOOL OF PUBLIC HEALTH
UNIVERSITY OF ILLINOIS AT CHICAGO
Environmental and Occupational Health Sciences Division

Module Overview

- Present the chemical and physical properties of mercury
- Describe the health effects of different forms of mercury from acute and chronic exposures
- Describe the health effects of mercury on children from pre-natal exposures
- Present the sources of mercury in the environment
- Introduce the WHO policy on mercury and the international campaign for mercury-free health care

Learning Objectives

- Understand key properties of mercury including how mercury cycles in the environment
- Describe the health effects of mercury from acute and chronic exposures, as well as from pre-natal exposure
- Describe the contribution of the health sector to global mercury emissions
- Explain the WHO policy on mercury
- Understand the benefit of mercury-free health care

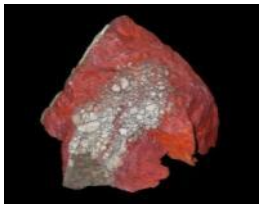
Properties of Mercury

- Properties of Mercury
  - Chemical forms
  - Volatilization
  - Persistence in the environment
    - The Mercury Cycle
  - Bioaccumulation
  - Toxicity

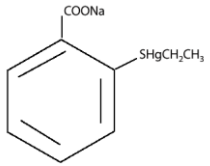
Chemical Forms of Mercury

- Elemental
  - Liquid metal

- Inorganic
  - Mercuric chloride
  - Mercuric sulfide (cinnabar)

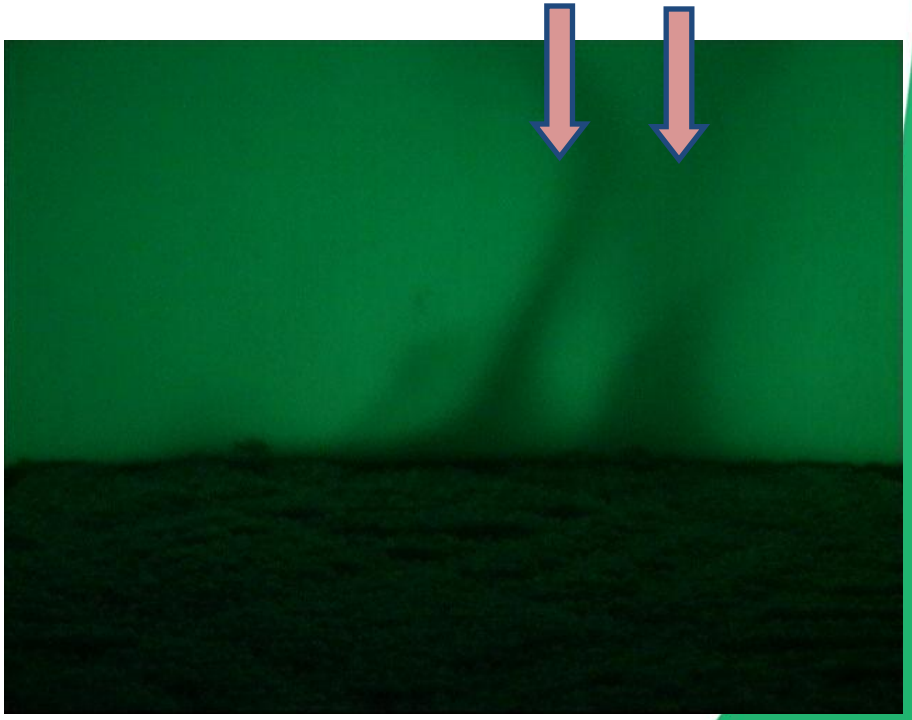


- Organic
  - Methyl, ethyl, dimethyl mercury
  - Phenyl organic groups



Volatilization of Mercury

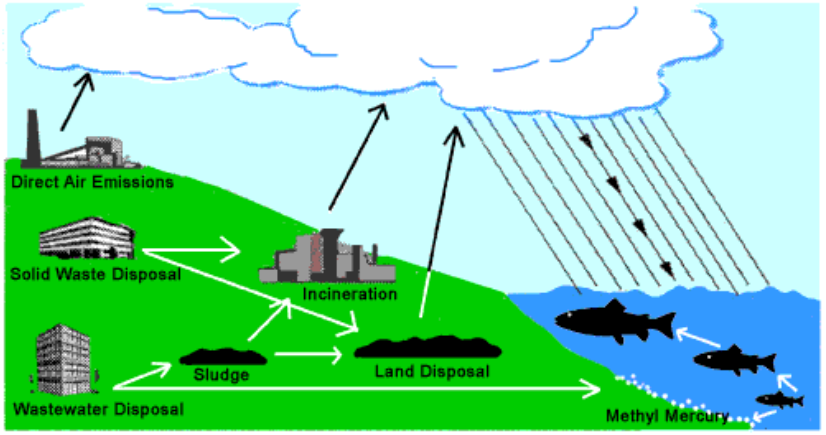
Mercury vapors from the same carpet seen under UV light and a fluorescent screen



Bowling Green State University:
http://wbgustream.bgsu.edu/bgsu/epa/index-fl.html

Persistence of Mercury in the Environment

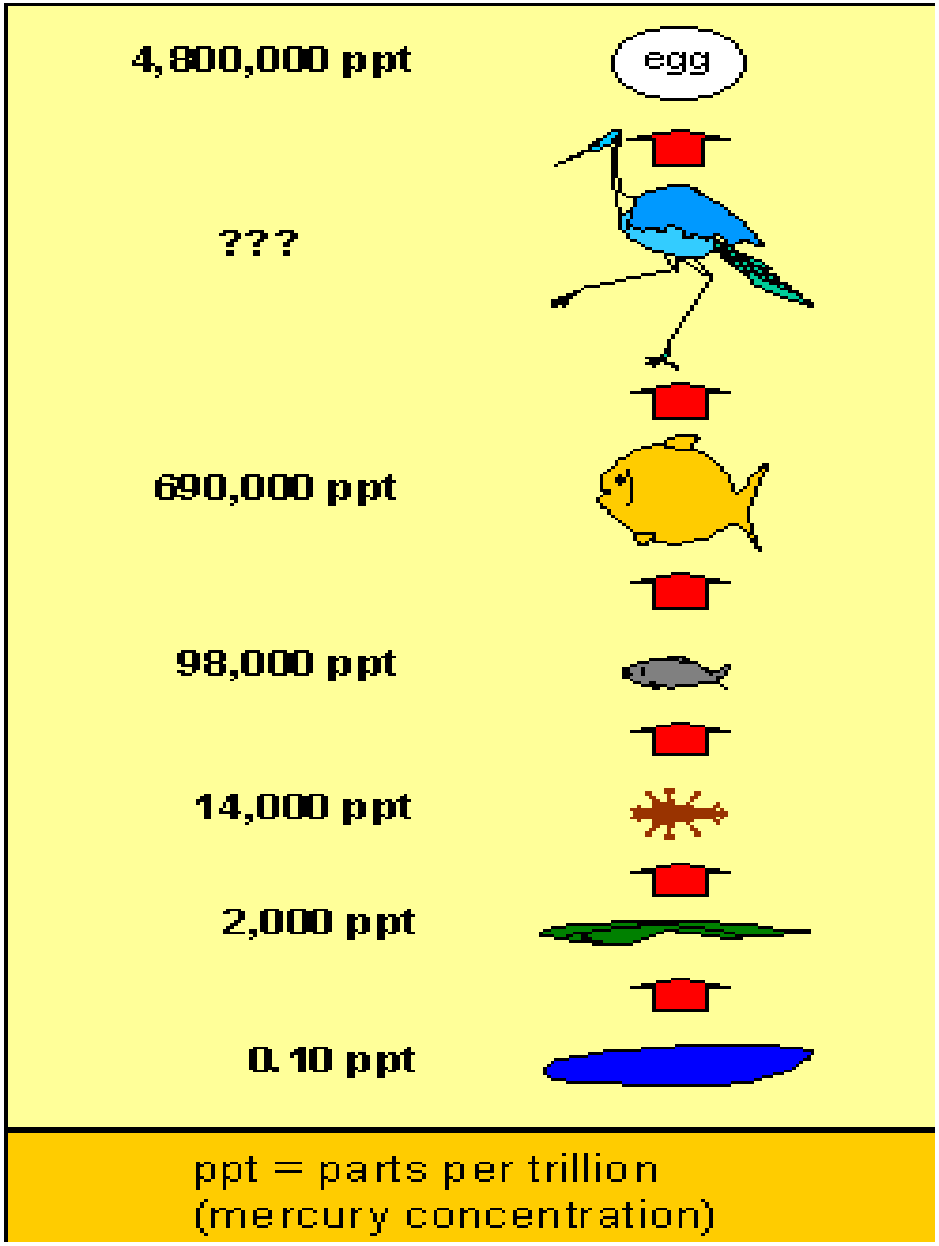
- The Mercury cycle



Source: New York State Department of Environmental Conservation

- Emitted from human activities & natural sources
- Circulates in the atmosphere from 6 months to 1½ years
- Deposited back onto land or into bodies of water
- Converted into insoluble forms, settling into sediment
- Converted by bacteria into methyl mercury and enters the food chain
- Released back into the atmosphere by volatilization

Bio-magnification of Mercury



Source: South Florida Restoration Science Forum

Health Effects of Mercury (Hg)

- Depend on the form of mercury, type of exposure (acute or chronic), route of exposure, dose

Examples:

- Acute exposure to high levels of elemental Hg
  - tremors, slowed motor nerve functions, memory loss
- Acute inhalation of high amounts of elemental Hg
  - chest pains, acute renal failure, shortness of breath
- Acute ingestion of inorganic Hg
  - nausea, vomiting, abdominal pains
- Chronic exposure to inorganic Hg
  - kidney damage

Chronic Exposure to Elemental Hg

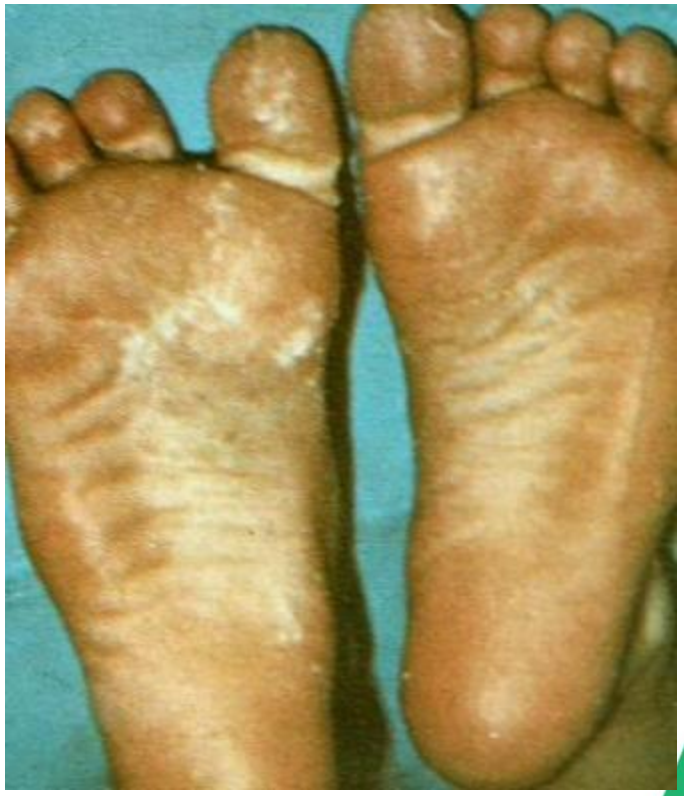
- Classic symptoms of the “Mad Hatter” syndrome
  - Erethism
  - Tremors
  - Gingivitis
- Renal impairment

The Mad Hatter from
Alice's Adventures in Wonderland

Chronic Exposure to Elemental and Inorganic Mercury

Acrodynia (Pink disease)

- Affects children
- Toxic/allergic syndrome
- Symptoms
  - Skin rashes
  - Hypertension
  - Fever
  - Pneumonia
  - Pink, peeling hands and feet



Health Effects of Organic Forms of Hg

- Organic forms of mercury
  - Methyl, ethyl, dimethyl, and phenyl organic groups
- Methyl mercury
  - Absorbed by the body six times more easily than inorganic mercury
  - Crosses the placenta and concentrates in the central nervous system

Health Effects of Organic Forms of Hg

- Example of Organic Mercury Poisoning
  - Mercury dumped in Minamata Bay, Japan by Chisso Corporation from 1932 to 1968 resulting in “Minamata disease”
  - 2,265 cases confirmed in Minamata, Japan as of March 2001

Photo: William Eugene Smith

Chronic Exposure to High Levels of Methyl Mercury

- Effects of Minamata disease
  - Constriction of visual fields
  - Irregular gait
  - Loss of muscular coordination
  - Loss of speech, hearing, and taste
  - Emotional disturbance
  - "Living wooden dolls"

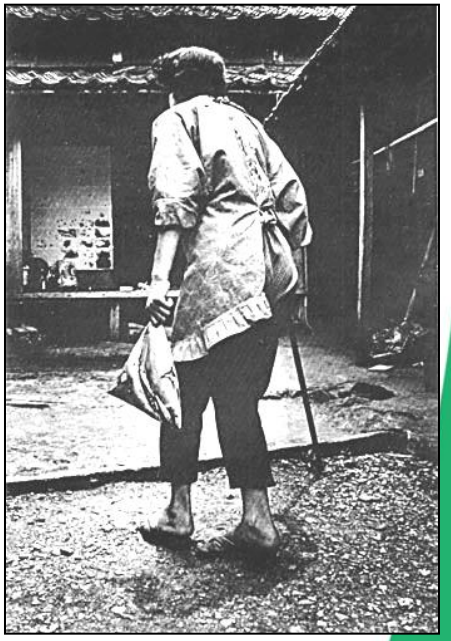


Photo: William Eugene Smith

- Congenital Minamata disease diagnosed in 1961

16-year old child with congenital Minamata disease

Photo: William Eugene Smith

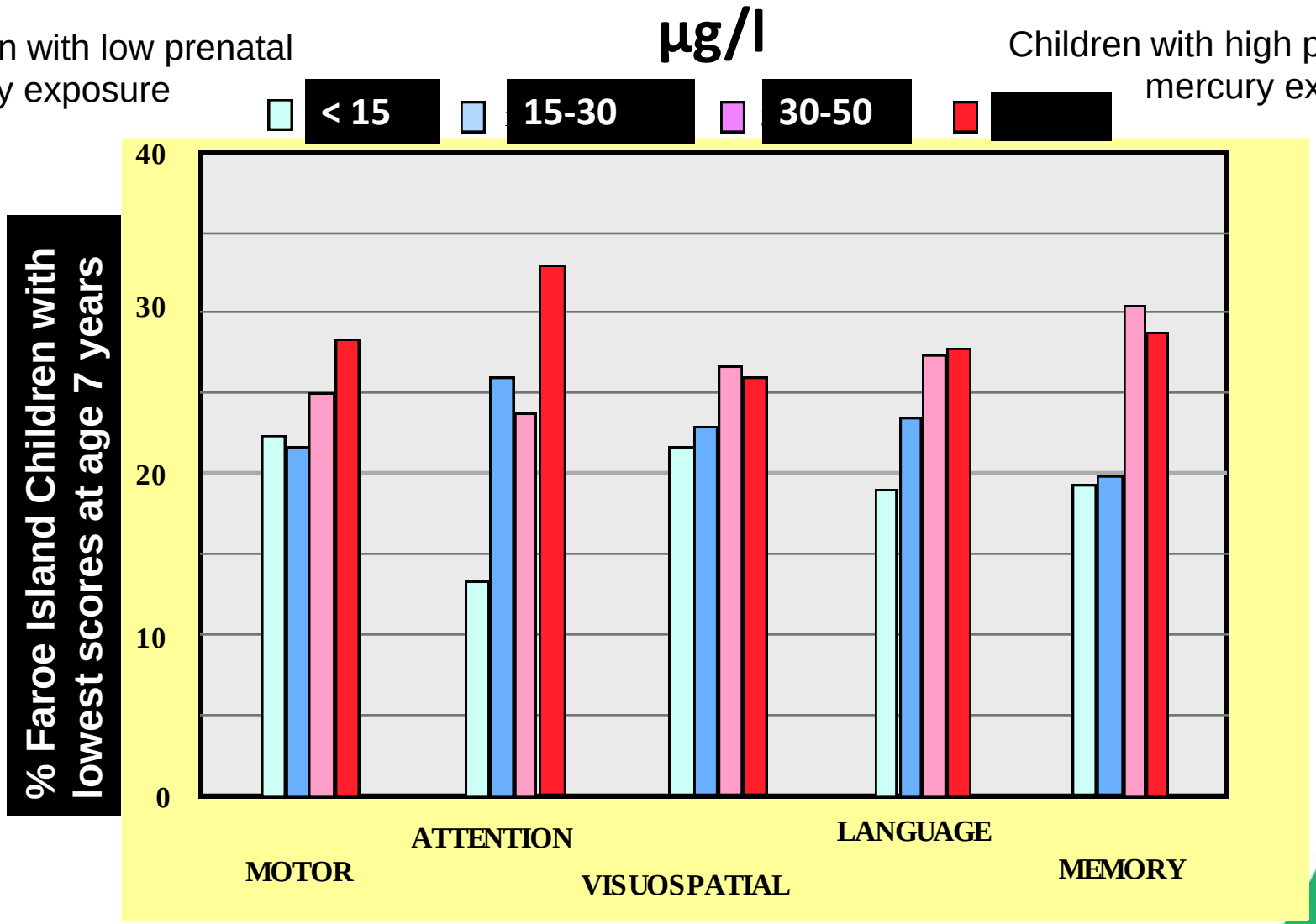
Health Effects of Prenatal Exposure to Mercury: Faroe Islands Study

- Prospective cohort study of 700 mother-infant pairs
- Exposure to methyl mercury from pilot whale meat indicated by mercury levels in umbilical cord blood and maternal hair
- Mean mercury levels in mothers' hair was 6.8 ppm (range 0.5-27 ppm)
- Study controlled for PCB exposure from whale meat

Results of Faroe Island Study

Children with low prenatal mercury exposure

Children with high prenatal mercury exposure



P. Grandjean, et. al., *Neurotoxicology and Teratology*, 19:6, 1997

Seychelles Study

- Fish have relatively low methyl mercury concentrations (<0.3 ppm)
- Mean mercury levels in mothers hair 6.3 ppm (range 0.5-27 ppm)
- Adverse effects on development or IQ were not found in the Seychelles study to 9 years of age.

GJ Myers et al., *Lancet*, 361, 1686-1692, 2003

Follow-up to the Seychelles Study

Benefits of long-chain polyunsaturated fatty acids mask effects of mercury

- Adverse associations were found between prenatal methyl mercury exposure and the Psychomotor Development Index of children at 30 months when long-chain polyunsaturated fatty acids were accounted for.

- Beneficial effects of long chain polyunsaturated fatty acids in fish mask the deleterious effects of fetal methyl mercury exposure.

PW Davidson, et al., *NeuroToxicology,* 29(5), 767-775, September 2008

Prenatal Methyl Mercury Exposure and Cognitive Development

Prenatal methyl mercury exposure sufficient to increase the mercury concentration in maternal hair at childbirth by 1 micrograms per gram could decrease the child's IQ by about 0.7 points.

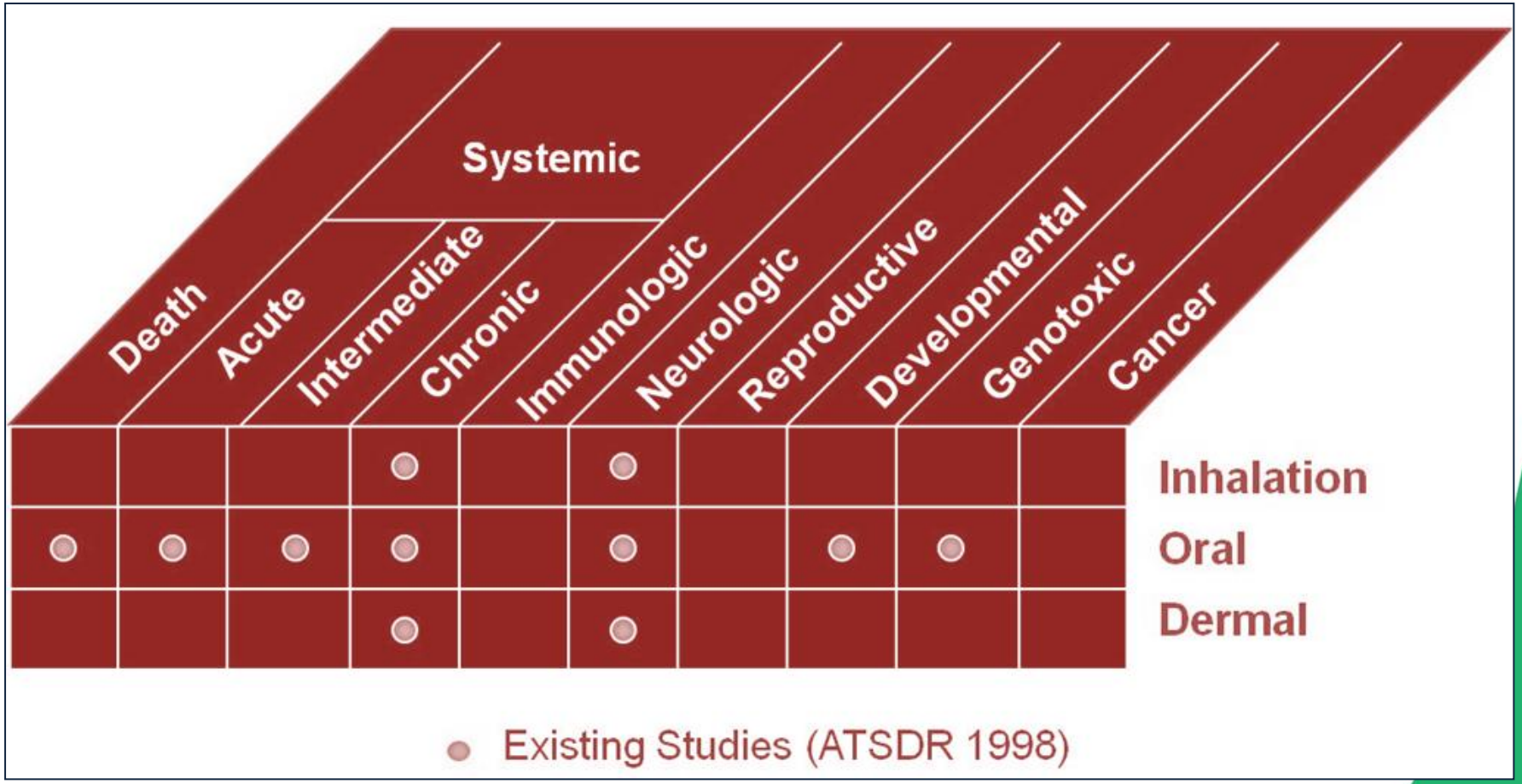
JT Cohen, DC Bellinger and BA Shaywitz, *Am J Prev Med*, 29(4):353-65, November 2005.

Maternal Fish Consumption and Risk of Preterm Delivery

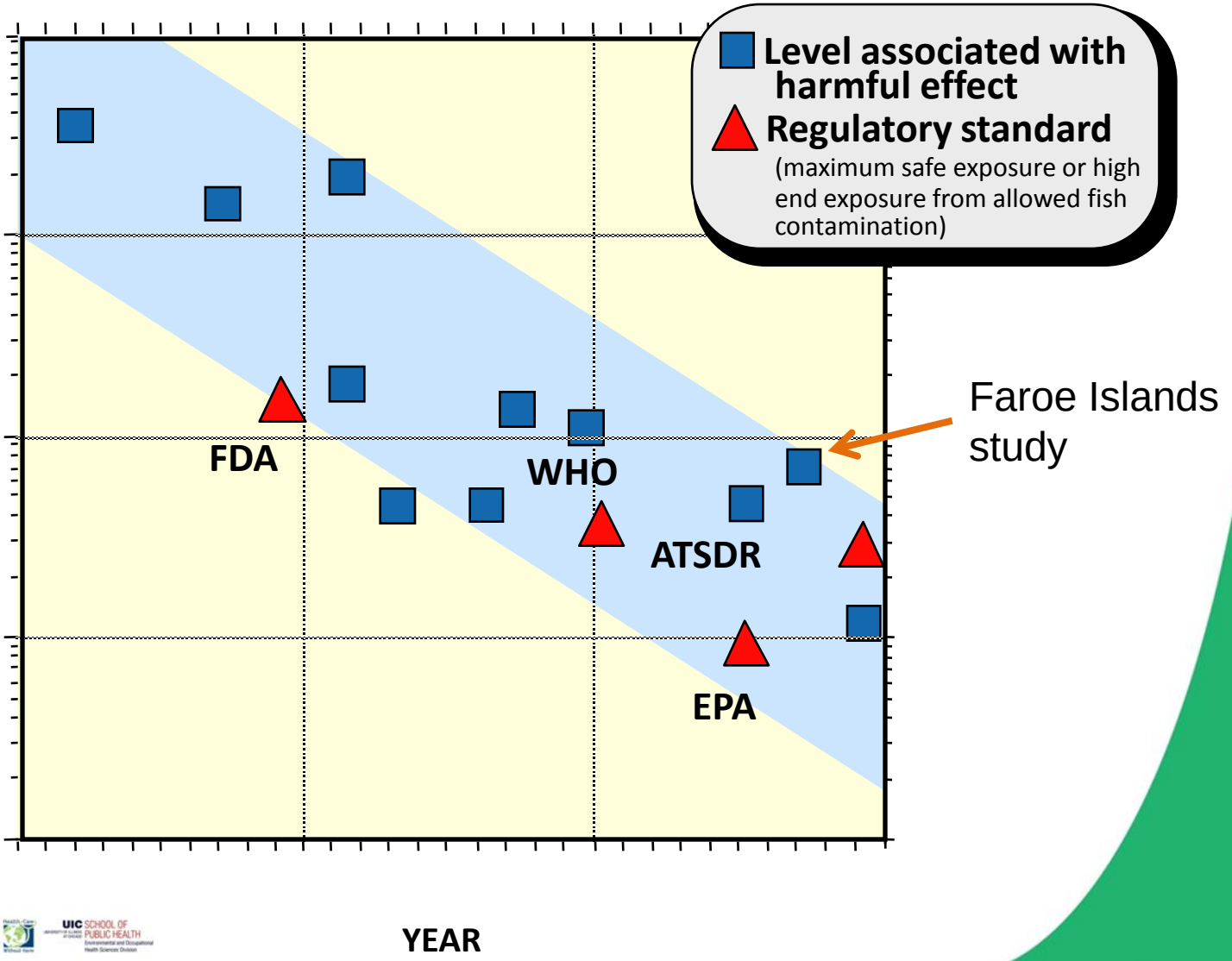
Compared with women delivering at term . . . women who delivered before 35 weeks' gestation were more likely to have higher hair mercury levels.

F Xue, C Holzman, MH Rahbar, K Trosko and L Fischer, *Environmental Health Perspectives*, Vol. 115, No. 1, January 2007

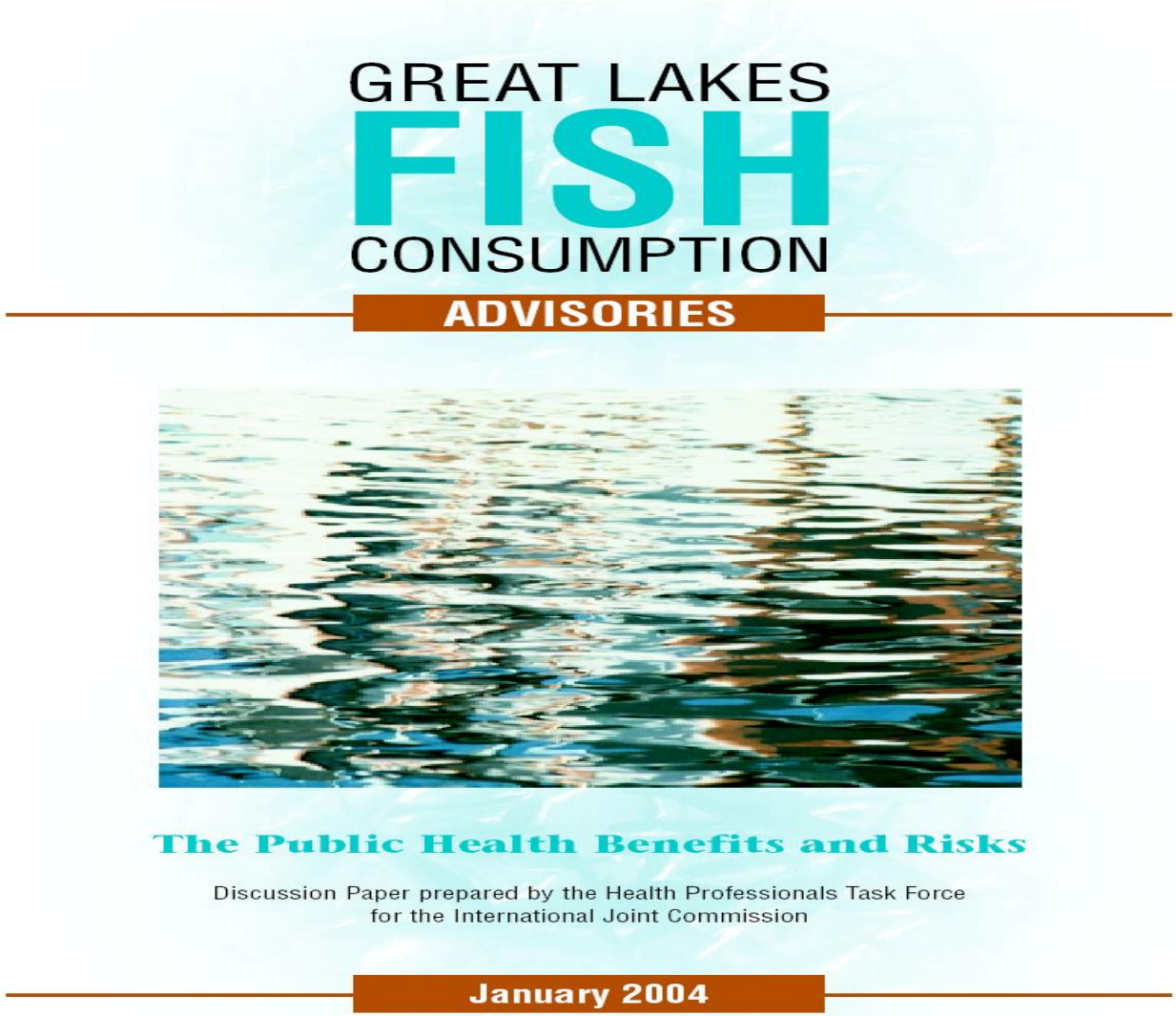
Summary of Health Effects of Methyl Mercury on Humans



Mercury: Declining Threshold of Harm

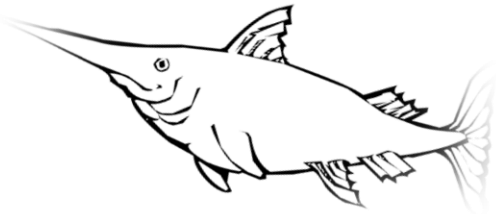


Growing number of fish consumption advisories due to high fish mercury levels



Hg Exposure Potential from Seafood

- Swordfish, shark ≥ 1 ppm
- Tuna steak ≈ 0.3 – 0.5 ppm
- Canned tuna ≈ 0.1-0.3 ppm

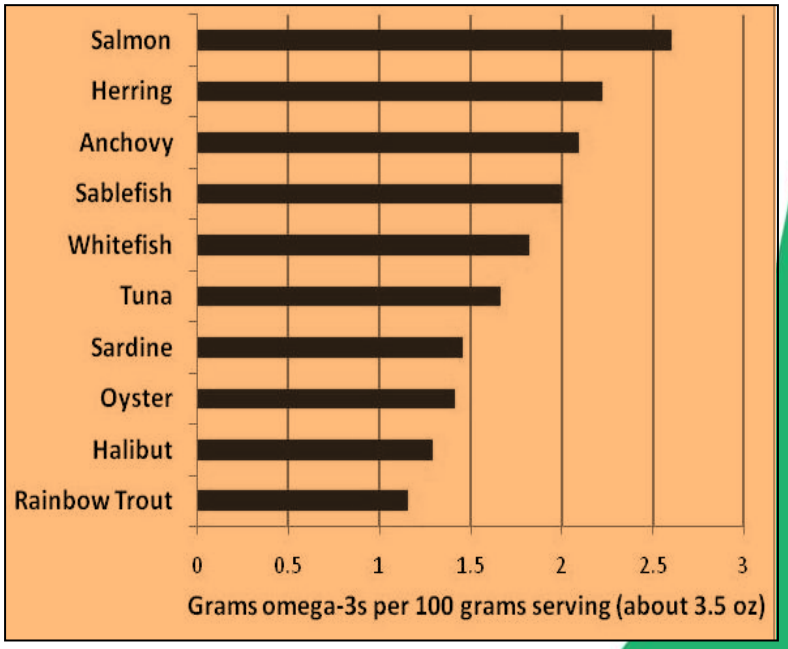


- ➢ Once a month consumption of swordfish or shark could equal the RfD
- ➢ Greater than two times per week of canned tuna may exceed the RfD

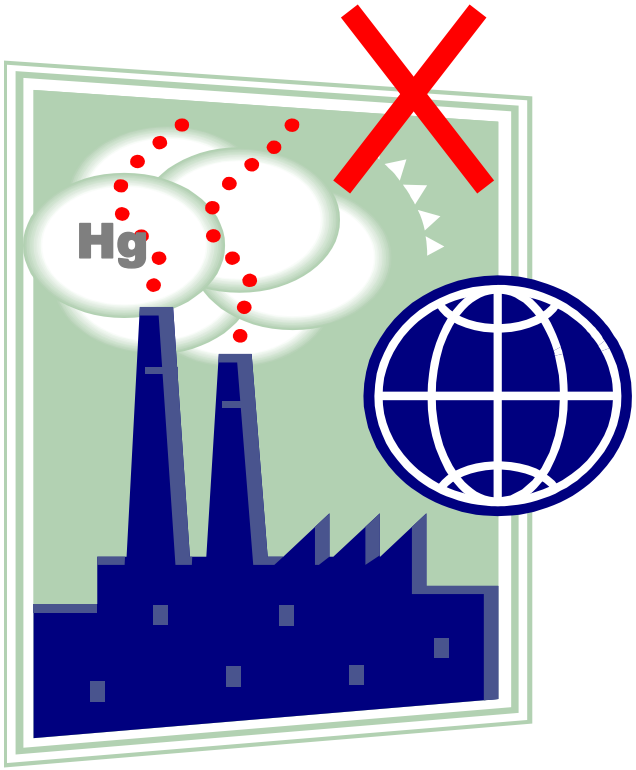
ppm = concentration in parts per million
RfD = Reference Dose

Mercury and Omega-3 Fatty Acids

- Additional data in 2003 raised interest in mercury as a cardiac toxin.
- *Omega-3 fatty acids in fish are cited as a health benefit of fish and shellfish to help protect against heart disease.*
- Substantial species-specific differences in the distribution of mercury and of omega-3s.
  - *Species high in mercury … not necessarily high in omega-3s*
  - *Species high in omega-3s … not necessarily higher in mercury*

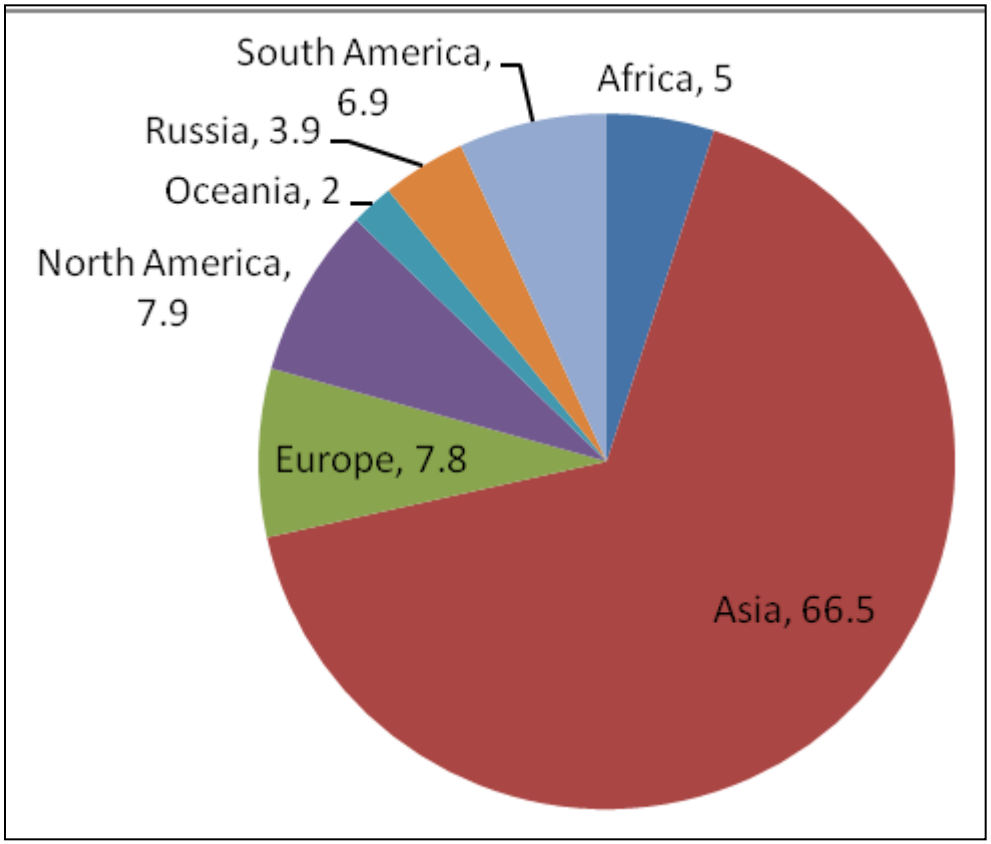


Keep Mercury Out Of The Fish
Not Fish Out Of The Mother!



Mercury Emissions & Sources from Human Activity

- Levels of mercury in the environment have significantly increased since pre-industrial times

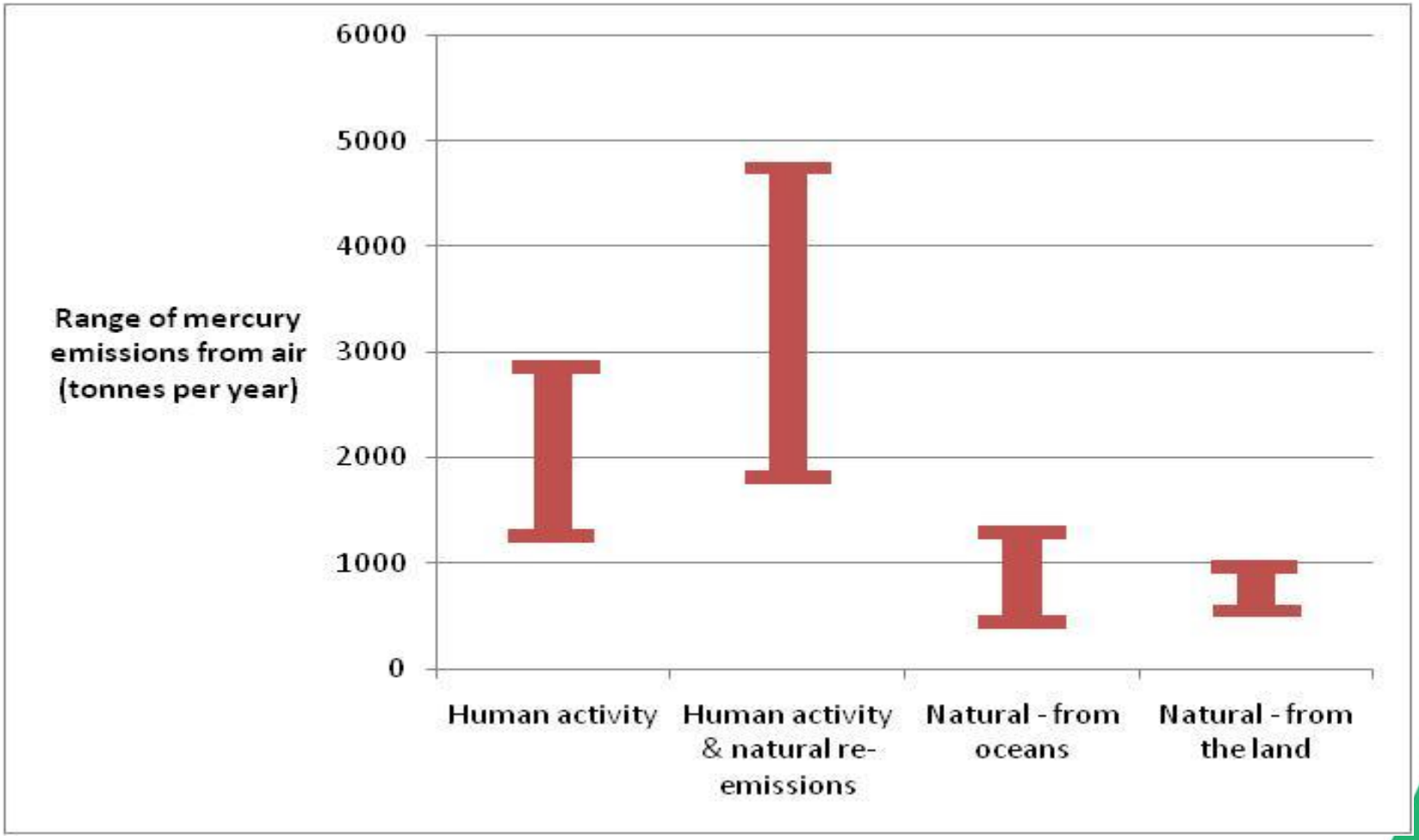


Global mercury emissions to air from human activities in 2005 by regions

Global Mercury Trends

- Mercury in the atmosphere has increased 20 times since 1840
- Human activities account for about 70% of the mercury compared to natural sources

Range of Global Mercury Emissions in 2005



The global air emissions of mercury from human activities averages about 1930 tonnes per year.

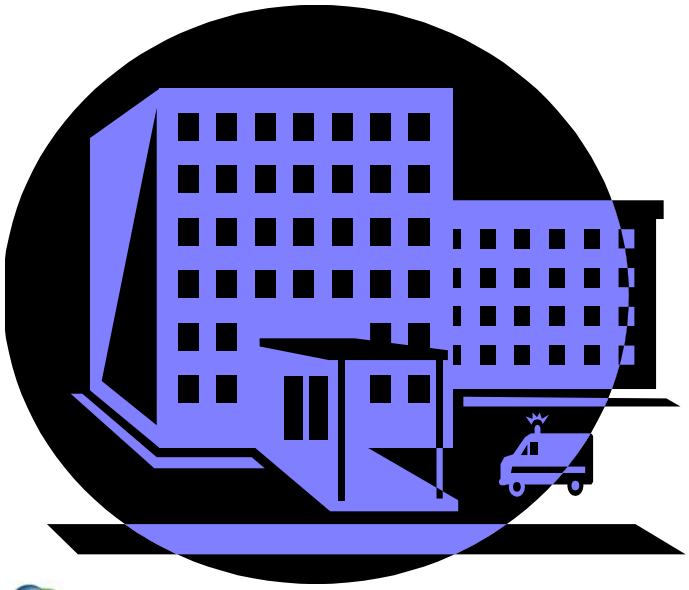
Sources of Mercury from Human Activities

- Major global sources include:
  - Coal combustion
  - Gold mining, metal production
  - Waste incineration
  - Product-use

- Major sources from the health sector:
  - Medical waste incineration
  - Mercury-containing products

Environmental Mercury and Medical Waste Incinerators

- In the United States, medical waste incinerators accounted for 10% of the total mercury emissions from combustion sources in 1995 (before hospital incinerators started shutting down).



Source: US EPA

World Health Organization

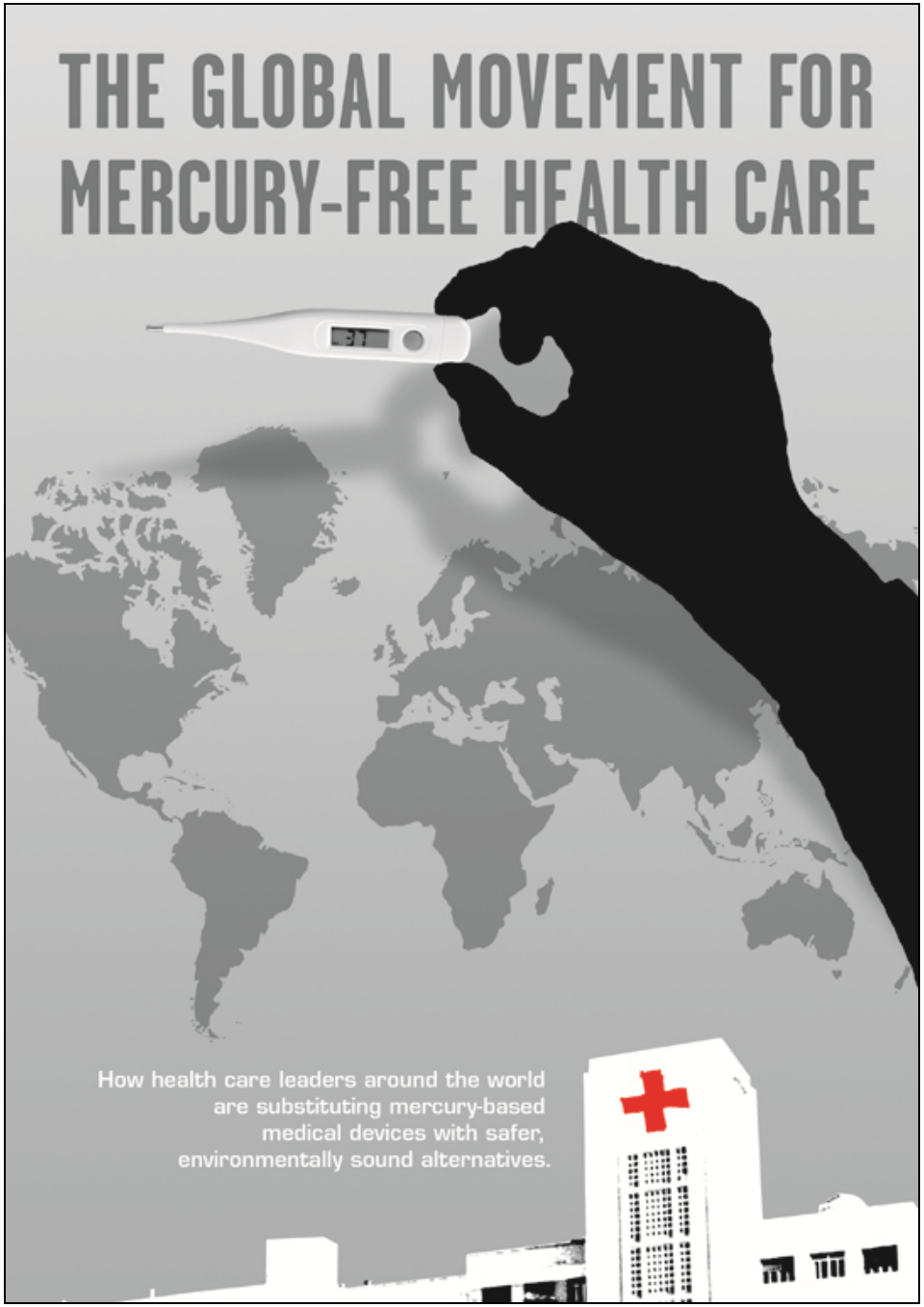
Policy on Mercury in Health Care

Short Term: Develop and implement plans to reduce the use of mercury equipment and replace with mercury free alternatives. Address mercury clean up, waste handling and storage procedures.

Medium Term: Increase efforts to reduce use of unnecessary mercury equipment

Long Term: Support a ban of mercury containing devices and promote alternatives.

www.who.int/water_sanitation_health/medicalwaste/mercury/en/


THE GLOBAL MOVEMENT FOR
MERCURY-FREE HEALTH CARE
How health care leaders around the world
are substituting mercury-based
medical devices with safer,
environmentally sound alternatives.

Source: Health Care Without Harm

Acknowledgements

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Minamata Convention on Mercury

- A globally negotiated international treaty that addresses global mercury pollution and its serious health damage
- The convention calls for the phase-out of mercury thermometers and sphygmomanometers used in health care

Discussion

- How might a mercury spill affect patients, health providers and waste workers?
- What happens to mercury when it is released into the environment?
- How can mercury in the environment affect the community?
- Is your healthcare facility mercury-free?
- Does your healthcare facility have plans that follow the WHO policy on mercury?
- What are your country specific regulations for mercury?