International Chemicals Policy

Health Care Without Harm’s Mercury Strategy

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Global Environmental Threats

Climate Change

Environmental Degradation

Chemical Pollution
Chemical Forms of Mercury

- Elemental
  - Liquid metal
- Inorganic salts
  - Mercuric chloride
- Organic
  - Methyl, ethyl, dimethyl
  - Phenyl organic groups
## Mercury Effects of Low Dose Prenatal Exposure

<table>
<thead>
<tr>
<th>µg/l</th>
<th>Children with low prenatal mercury exposure</th>
<th>Children with high prenatal mercury exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15</td>
<td>30‐50</td>
<td>15‐30</td>
</tr>
<tr>
<td>15‐30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30‐50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Children with low prenatal mercury exposure:

- 15% with µg/l < 15
- 30% with µg/l 15‐30
- 50% with µg/l 30‐50
- >50% with µg/l >50

% Faroe Island Children with lowest scores at age 7 years:

Grandjean, et. al., Neurotoxicology & Teratology, 19:6, 1997
A Quantitative Analysis of Prenatal Methyl Mercury Exposure and Cognitive Development

Joshua T. Cohen PhD, et. Al.
Harvard Center for Risk Analysis, Harvard School of Public Health, Boston,

Prenatal MeHg exposure sufficient to increase
Mercury in maternal hair at birth by 1 μg/g
Decreases IQ by 0.7 points.

American Journal of Preventive Medicine Volume 29, Issue 4, November 2005
$1.3 \text{ billion}

each year is attributable to
mercury emissions from
American power plants.

Leonardo Trasande, Philip J. Landrigan, and Clyde Schechter
Mount Sinai School of Medicine, New York, New York, USA

## Comparison of Mercury (ppm) and Omega-3 Fatty Acid (g/100g) in Fish Species

<table>
<thead>
<tr>
<th>High Mercury Species</th>
<th>High Omega-3 Species</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tilefish:</strong> 1.6 Hg, 0.17 O-3s</td>
<td><strong>Mackerel:</strong> 0.08 Hg, 3.61 O-3s</td>
</tr>
<tr>
<td><strong>Shark:</strong> 1.3 Hg, 0.07 O-3s</td>
<td><strong>Salmon-sockeye:</strong> 0.03 Hg, 3.00 O-3s</td>
</tr>
<tr>
<td><strong>King Mackerel:</strong> 0.97 Hg, 0.18 O-3s</td>
<td><strong>Herring:</strong> 0.01 Hg, 2.34 O-3s</td>
</tr>
<tr>
<td><strong>Swordfish:</strong> 0.95 Hg, 0.58 O-3s</td>
<td><strong>Tuna, albacore:</strong> 0.26 Hg, 2.33 O-3s</td>
</tr>
</tbody>
</table>
Mercury Out Of The Fish
Not Fish Out Of The Mother
Globalization

Without a Global Government
We are able to assure change and controls
By
Market Forces
or
CONSENSUS
Market Forces
Health Care Sector

- **World Wide:**
  - 59,220,000 Full Time Health Care Workers
  - 3% of Gross Domestic Product in 1948
  - 10.2% of GDP in 2003
  - Range 2% to >14%

- **Australia (2008-9):**
  - 360,400 HC Workers
  - 3.5% of Workforce
  - $112.8 billion
  - 9.0% of GDP
  - 31.5% for Public Hospitals

AIWH, Health expenditure Australia 2008-09
Energy: Healthcare is the second most energy intensive sector in commercial buildings.

Waste & Incineration: In 1995, medical waste incinerators were the largest source of dioxin and were responsible for 10% of mercury emissions.

Indoor Air Quality: Asthma more frequent in healthcare workers.

Pharmaceutical Waste: At least 250 million pounds of pharmaceutical waste is generated annually from hospitals and long-term care centers.
Sources of Environmental Mercury from Human Activity

Medical waste incinerators account for **10%** of the total from combustion sources.
Sources of mercury in health care

- Thermometers
- Sphygmomanometers
- Dental amalgam
- Gastrointestinal tubes
- Laboratory chemicals
- Pharmaceutical products
- Electrical applications
- Medical waste incineration, open burning, burning in barrels, gasification, pyrolysis, etc.
Obstacles To Seeing The Problem
1st obstacle
Physicians in Hospitals
Work
in front of the Presidium
Within Health Care
There Is No Argument
About
The Need To Avoid Poisoning
The Environment
Health Care Professionals are Influential Opinion Setters
Clinicians and Patients

Environmental Disease

SOCIAL DISEASES

REQUIRING

SOCIAL SOLUTIONS
Original Article

Alternatives to the mercury sphygmomanometer

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E-mail: josh@hcwh.org

*Corresponding author.

Abstract The mercury sphygmomanometer was introduced over 100 years ago. Mercury, however, is a potent human neurotoxin. An international effort has developed to eliminate health-care sources of mercury – the thermometer and sphygmomanometer – and replace them with less toxic alternatives. There is concern regarding the accuracy of these alternative devices. We conducted a literature review of articles published between 1995 and 2009 evaluating the accuracy of mercury, aneroid, and oscillometric blood pressure devices. Mercury sphygmomanometers fared the best although they do not always perform as expected, failing calibration tests between 1 and 28 per cent of the time. Up to 61 per cent of aneroid sphygmomanometers failed. Recently calibrated aneroid devices performed well. Oscillometric devices were less studied and their performance was variable. All three devices showed variable performance. They should be validated before purchase and calibrated on a regular basis.

*Corresponding author.

Physicians should:

• Explore eliminating mercury-containing products in their offices and clinical practices,

• Encourage local hospitals and medical facilities to phase out mercury-containing products and switch to non-mercury equivalents.
Types of Non-Mercury Thermometers

- Thermistor-based digital thermometers
- Phase-change (dot matrix) thermometers
- Tympanic infrared thermometers
- Temporal artery infrared thermometers
Types of Non-Mercury Thermometers

- Galinstan-in-glass thermometers
- Alcohol-dye thermometers
- Thermocouple-based and platinum resistance thermometers
- Thermochromic (cholesteric) liquid crystal thermometers

→ FOCUS: thermistor-based digital thermometers
Key Specifications for Non-Mercury Digital Thermometers

All of the presented specifications and more are defined by two international standards:


ASTM E1112-00

The key specification: the digital thermometer must meets one or the other or both standards.
Affordability Varies by Country

A Comparison of Prices of Mercury and Digital Clinical Fever Thermometers in Selected Countries

<table>
<thead>
<tr>
<th></th>
<th>Argentina</th>
<th>Brazil</th>
<th>Mexico</th>
<th>India</th>
<th>China</th>
<th>Philippines</th>
<th>South Africa</th>
<th>USA</th>
<th>England</th>
<th>Czech Rep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury Thermometer</td>
<td>$1.33</td>
<td>$1.52</td>
<td>$1.24</td>
<td>$0.62</td>
<td>$0.41</td>
<td>$0.55</td>
<td>$0.80</td>
<td>Not available</td>
<td>$1.50</td>
<td>$1.00</td>
</tr>
<tr>
<td>Digital Thermometer</td>
<td>$4.00</td>
<td>$10.52</td>
<td>$3.77</td>
<td>$5.35</td>
<td>$4.65</td>
<td>$4.67</td>
<td>$4.37</td>
<td>$2.89</td>
<td>$7.00</td>
<td>$5.00</td>
</tr>
<tr>
<td>Price Ratio</td>
<td>3 : 1</td>
<td>6.9 : 1</td>
<td>3 : 1</td>
<td>8.6 : 1</td>
<td>11.3 : 1</td>
<td>8.5 : 1</td>
<td>5.5 : 1</td>
<td>0 : 1</td>
<td>4.6 : 1</td>
<td>5 : 1</td>
</tr>
</tbody>
</table>

Indonesia: $1.20

Indonesia: $4.00

Overall Ratio: 3 : 1
### TABLE 1

Monthly Mercury Thermometer Breakage at Federico Gomez Children's Hospital, Mexico City

<table>
<thead>
<tr>
<th>Services</th>
<th>broken per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive care unit</td>
<td>20</td>
</tr>
<tr>
<td>Postoperative recovery</td>
<td>20</td>
</tr>
<tr>
<td>Emergency Room</td>
<td>30</td>
</tr>
<tr>
<td>Out-patient studies recovery</td>
<td>6</td>
</tr>
<tr>
<td>Surgery</td>
<td>15</td>
</tr>
<tr>
<td>Pediatric ICU</td>
<td>15</td>
</tr>
<tr>
<td>Surgery ICU</td>
<td>15</td>
</tr>
<tr>
<td>Nephrology</td>
<td>30</td>
</tr>
<tr>
<td>External consultation</td>
<td>20</td>
</tr>
<tr>
<td>General consultation</td>
<td>30</td>
</tr>
<tr>
<td>Out-patient surgery</td>
<td>2</td>
</tr>
<tr>
<td>Pediatrics III, IV</td>
<td>15</td>
</tr>
<tr>
<td>Pediatrics I, II</td>
<td>30</td>
</tr>
<tr>
<td>Immunosuppressive illnesses</td>
<td>30</td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>2</td>
</tr>
<tr>
<td>Urological surgery</td>
<td>45</td>
</tr>
<tr>
<td>Special care</td>
<td>30</td>
</tr>
<tr>
<td>Orthopedics</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Approximate yearly total:</strong></td>
<td><strong>385</strong></td>
</tr>
</tbody>
</table>

Source: HCHWH/CAATA, 2007
Thermometer Breakage

- An example glass thermometer containing 1 gram of mercury

- A broken thermometer will release mercury which will evaporate and result in a concentration of **22.2 mg/m³** in the air measured in a 15 square meter, three meter high room.

- China's provision of mercury maximum allowable concentration in indoor air is **0.01 mg/m³** and in US workplaces the PEL is **0.1 mg/M³** & STEL is **0.03 mg/M³**.

  Xueyu Li, Global village of Beijing: 12-20-2007

- **Young Children have been poisoned after less than 2 weeks** exposure to mercury vapor from a bedroom carpet after a single thermometer broke.

  Poisindex, 2010
Don’t take mercury lightly

MERCURY CONTAINMENT KIT
Should always be available in each ward
Gloves, face mask, eye shield, a syringe, two stiff pieces of cardboard, two plastic bags, packing tape, a flashlight and a container

IN CASE OF A MERCURY SPILL:

▲ DO NOT TOUCH THE MERCURY
Remove any jewellery/watch. Put on all protective gear. Use a flashlight to locate the mercury.

▲ COLLECT THE MERCURY CAREFULLY
Use cardboard sheets to push beads of mercury together. Use the syringe to suck the beads of mercury. Carefully place the mercury in a container with some water. Pick up any remaining beads of mercury with sticky tape and place contaminated tape in a plastic bag along with the syringe, cardboard, and gloves. Label the bag as mercury waste. Place this bag and sealed container in the second bag. Label it as mercury waste.

▲ NEVER USE A VACUUM CLEANER OR BROOM

▲ DISPOSE THE MERCURY PROPERLY
The collected mercury is hazardous waste and should either be disposed off at a hazardous waste facility or given to a mercury equipment manufacturer.

For more information on mercury and its handling, please contact:
Nita Singh
Toxics Link - Delhi
H2 (Ground Floor), Jangpura Extension,
New Delhi 110 014.
Tel: +91-11-24323008, 24320711
E: info@toxiclink.org

Did you know that there is enough mercury in a typical thermometer to contaminate a lake with a surface area of about 20 acres, to the degree that fish would be unsafe to eat? Mercury is one of the most toxic substances known to mankind!

http://www.noharm.org/europe/issues/toxins/mercury/resources.php
Cost Issues

- **Hospital Posadas in Buenos Aires, Argentina**
  - Between April and June 2006, this 450 bed hospital purchased 3,152 mercury thermometers.
  - A year later, during the same period in 2007, it purchased 355 mercury thermometers and 188 digital devices.
  - The cost savings totaled nearly U.S. $3,000.

- **Federico Gomez Children’s Hospital in Mexico City**
  - It is estimated that this 250 bed institution will save a minimum of U.S. $10,000 over six years when replacing mercury thermometers.
  - This estimate includes the costs of digital device and battery replacement, as well as mercury and battery disposal.7
The largest amount of mercury is used in mercury sphygmomanometers (80 to 100g/unit)

The largest mercury reservoir in the health-care setting.
**Sphygmomanometers**

**Use:** Sphygmomanometers are manometers used to measure human blood pressure.

**Mercury content:** Content can vary from 20 to 60 grams of mercury.

**Alternatives:** Alternatives to mercurial sphygmomanometers are aneroid and digital products. Both are reliable, accepted as standard, and comparable to mercurial sphygmomanometers.
Recommendations for Blood Pressure Measurement in Humans
American Heart Association Council on High Blood Pressure Research

It is surprising that nearly 100 years after it was first discovered, and the subsequent recognition of its limited accuracy, the Korotkoff technique for measuring blood pressure has continued to be used without any substantial improvement.

*Circulation. 2005;111:697-716*
Gold Standard?

mm Hg = mm Hg
BP measurement with Hg = Accurate BP

??
Types of Non-Mercury Sphygmomanometers

- Mechanical dial aneroid sphygmomanometer
- Digital display aneroid sphygmomanometer
- Electronic oscillometric sphygmomanometer
- Doppler-based plethysmographic blood pressure monitor
- Photocell-based blood pressure monitor
- Strain gauge-based blood pressure monitor

→ FOCUS: Aneroid sphygmomanometers
Calibration of Aneroid Sphygmomanometers

Mercury versus Electronic Standards

Typical Accuracy of Mercury Standard:
± 3 mmHg

Typical Accuracies of Electronic Pressure Standards:
± 0.1 to ± 1 mmHg
Key Specifications for Aneroid Sphygmomanometers

All of the presented specifications and more are defined by:

ANSI/AAMI/ISO 81060-1:2007

Therefore, the specifications could be that the aneroid sphygmomanometer should meet the above standard.
**Background:** The aneroid sphygmomanometer is commonly used for the indirect measurement of blood pressure despite significant concerns about its accuracy. Although the mercury sphygmomanometer is highly accurate, there are concerns about the environmental toxicity of mercury. In response to various external pressures to become essentially mercury free, the Mayo Clinic, Rochester, Minn, has replaced many mercury sphygmomanometers with aneroid devices. Since 1993, a maintenance protocol has been in place to ensure proper function and accuracy of these devices.
Lists of Validated Non-Hg Sphygmomanometers

Available lists of recommended aneroids, automated blood pressure devices for clinical use in hospitals, oscillatory automated blood pressure devices, etc. that have been validated using the AAMI and BHS protocols:

Global Initiative co-led by WHO and HCWH

Big Goal:
By 2017, to phase out the demand for mercury-containing fever thermometers and sphygmomanometers by at least 70% and to shift the production of all mercury-containing fever thermometers and sphygmomanometers to accurate, affordable, and safer non-mercury alternatives.

Component of the UNEP Products Partnership led by US EPA.
www.mercuryfreehealthcare.org
Intergovernmental negotiating committee in 2010, 2011, 2012

Elaborate a legally binding instrument by 2013
### Part I: Products subject to Article 4, Paragraph 1

<table>
<thead>
<tr>
<th>Mercury-added Products</th>
<th>Phase-Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticides, biocides and topical antiseptics</td>
<td>2020</td>
</tr>
<tr>
<td>The following non-electronic measuring devices except non-electronic measuring devices installed in large-scale equipment or those used for high precision measurement, where no suitable mercury-free alternative is available:</td>
<td>2020</td>
</tr>
<tr>
<td>(a) barometers;</td>
<td></td>
</tr>
<tr>
<td>(b) hygrometers;</td>
<td></td>
</tr>
<tr>
<td>(c) manometers;</td>
<td></td>
</tr>
<tr>
<td>(d) thermometers;</td>
<td></td>
</tr>
<tr>
<td>(e) sphygmomanometers.</td>
<td></td>
</tr>
</tbody>
</table>
Article 16: Health aspects

1. Parties are encouraged to:

(a) Promote the development and implementation of strategies and programmes to identify and protect populations at risk, particularly vulnerable populations, and which may include adopting science-based health guidelines relating to the exposure to mercury and mercury compounds, setting targets for mercury exposure reduction, where appropriate, and public education, with the participation of public health and other involved sectors;

(b) Promote the development and implementation of science-based educational and preventive programmes on occupational exposure to mercury and mercury compounds;

(c) Promote appropriate health-care services for prevention, treatment and care for populations affected by the exposure to mercury or mercury compounds; and

(d) Establish and strengthen, as appropriate, the institutional and health professional capacities for the prevention, diagnosis, treatment and monitoring of health risks related to the exposure to mercury and mercury compounds.
DENTAL AMALGAMS
Dental amalgam

- About 300 tonnes of mercury per annum
- Some countries, e.g., Denmark, Norway, and Sweden have imposed tight restrictions on dental amalgam.
- However most countries still use dental amalgam as alternatives are more expensive
- Potential alternatives include glass ionomers and composites
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