

Methods for Tracking: From Emissions to Exposure

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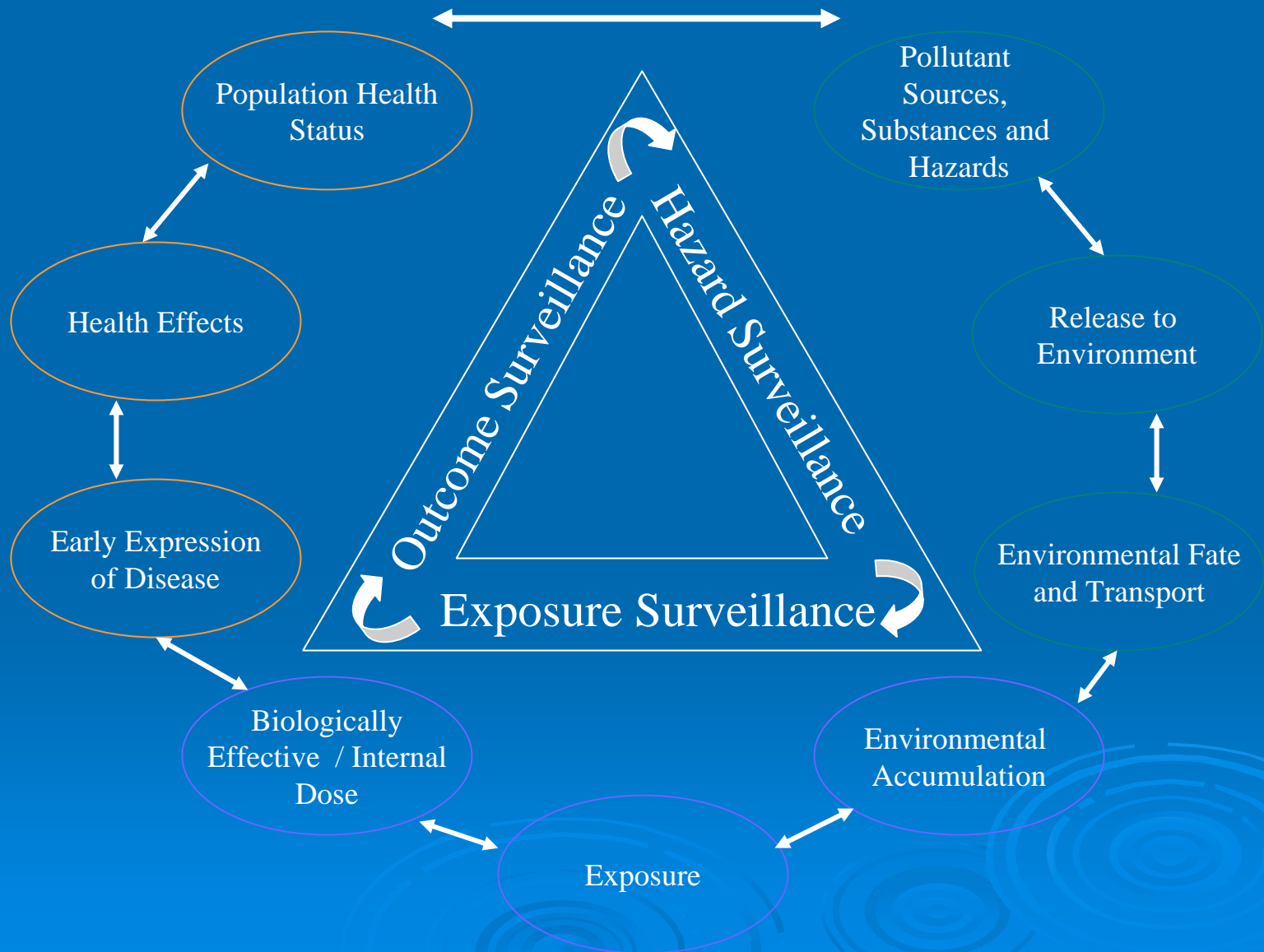
July 2004



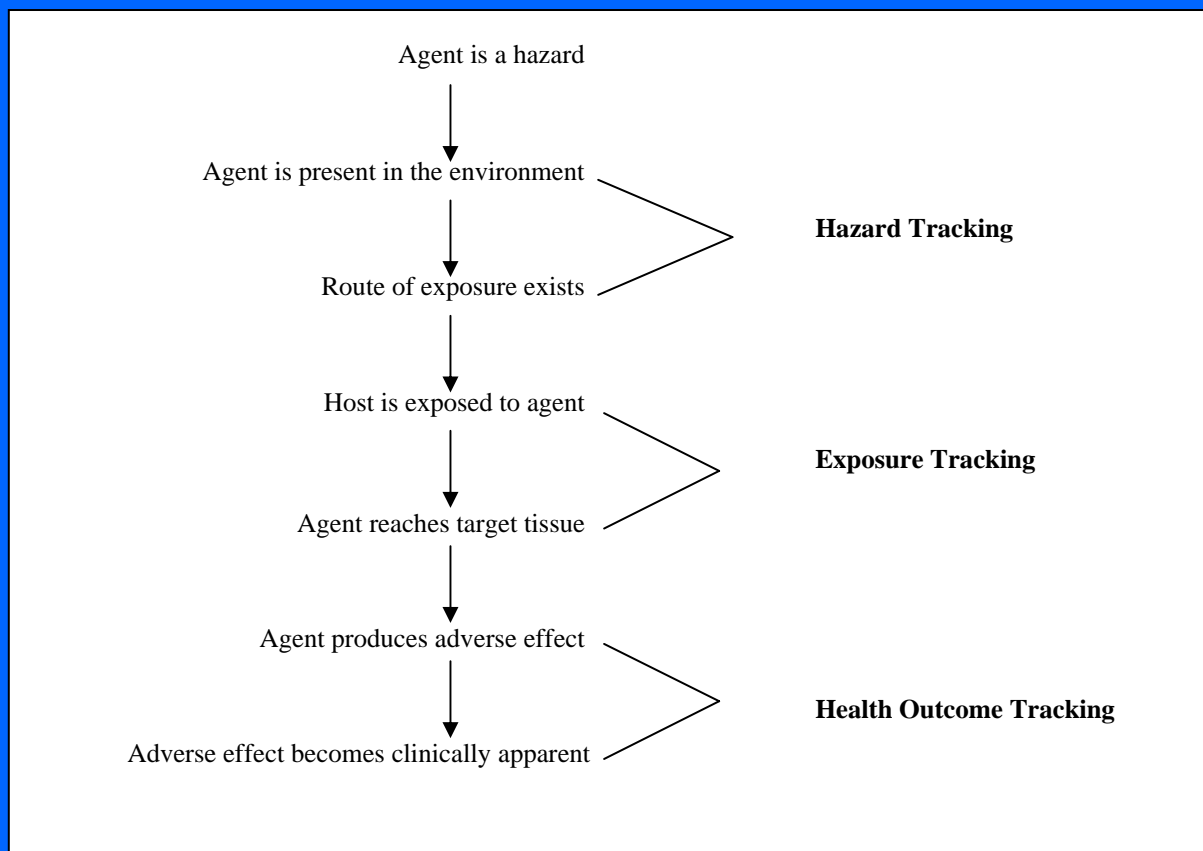
The Need for Exposure Tracking



Environmental Health Paradigm




Environmental Health Tracking



Priorities for Exposure tracking

High Exposure High Toxicity (Health Effects)	Low Exposure High Toxicity
High Exposure Low Toxicity	Low Exposure Low Toxicity

Characteristics of Exposure

- Route – inhalation, ingestion, absorption
 - Magnitude - what is the concentration
 - Duration – minutes, days, lifetime
 - Frequency – daily, seasonally
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Exposure Estimators

- Production volume
- Emissions
- Environmental concentration
- Human contact
- Internal dose

The “National” Databases

- Term “national” can be misleading
- Statistically representative sample?
- Representing geographic variation?
- Representing national population?
- Not... therefore there is significant uncertainty

Goals for Tracking Exposure

- Collect data over time (trends, baseline)
- Standard methods and quality
- Representative sampling
- Human exposure and dose measures (personal sampling, biomonitoring)
- Match timeframe to concerns
- Population Exposure distribution
- Characterize total exposure (types, pathways, relative contributions)
- Exposure to mixtures
- High risk, vulnerable populations

Databases

- Question: Do databases provide adequate information for the estimation of population exposure?
- Answer: It depends upon the use and interpretation.

Exposure Tracking: Asking the Right Questions

- Sampling Issues
- Population Issues
- Data Issues


Sampling Questions

- Are valid methods used?
- Adequate number of samples?
- Level of detection appropriate?
- Laboratory methods assured?

Population Questions

- Highly exposed subpopulations identified?
- Sensitive subpopulations?
- Variability in exposure measured?
- Representative sample of the population?

Exposure Data Questions

- Are data geographically relevant?
 - Are data temporally appropriate?
 - Relevant pathways measured?
 - Do data measure trends in exposure?
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- The background of the slide is a solid blue color. In the bottom right corner, there are several faint, concentric circles that resemble ripples in water, creating a decorative effect.

Emissions, Hazard, Exposure Databases

- Water Quality
- Air Monitoring
- Emissions – permits, TRI
- Site specific (RCRA, Superfund)
- Individual exposure measures (NHEXAS)
- Biomonitoring (NHANES)

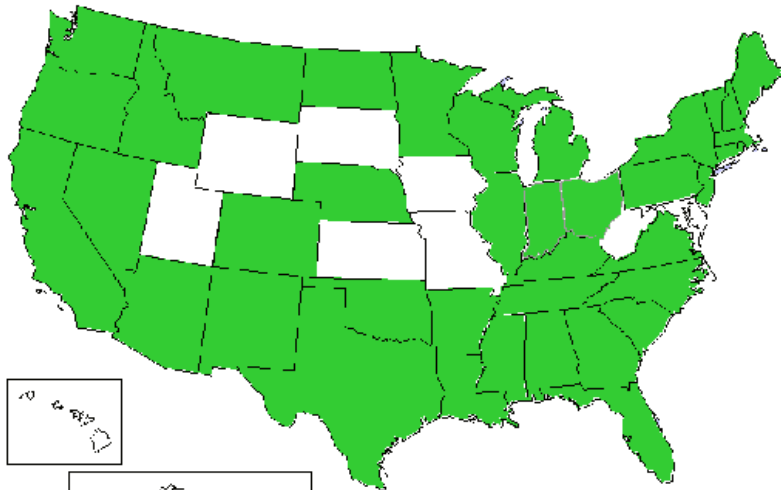
Health Effects of Mercury



A National Public Health Priority



Fish Consumption Advisories in the United States

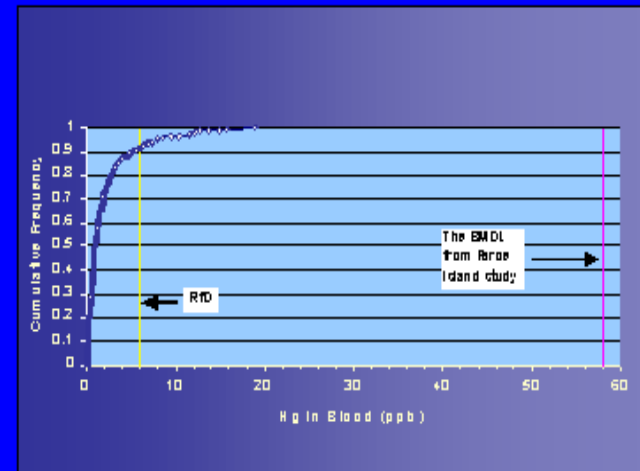


EXPLANATION

At least one advisory

Source: US EPA Fact Sheet, Update: Listing of Fish and Wildlife Advisories, EPA-823-F-98-009

Blood Mercury levels



Mercury Concentrations, Potential Population Exposures, and Hazard Index Scores for Maryland Waterways

Region	Mean Fish Tissue Concentration (ppm)	Average Consumer Dose	Average Hazard Index Dose/RfD	High Consumer Dose	High Consumer Hazard Index Dose/RfD
Chester	0.063	0.02205	0.2205	0.126	1.26
Choptank	0.042	0.0147	0.147	0.084	0.84
Elk River	0.003	0.00105	0.0105	0.006	0.06
Gunpowder	0.435	0.15225	1.5225	0.87	8.7
Lower Susquehanna	0.149	0.05215	0.5215	0.298	2.98
Nanitoke/Wicomico	0.172	0.0602	0.602	0.344	3.44
Patapsco	0.233	0.08155	0.8155	0.466	4.66
Pocomoke	0.009	0.00315	0.0315	0.018	0.18

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Newborns at Risk

Newborns at risk = (Number of US Women age 15-44) * (Percent U.S. population reporting fish consumption) * (individual in top 5% of consumers) * (birth rate)

=60.2 million * 30.5% * 5% * 65.6/1,000

=60, 232 newborns at risk

CDC Mercury Blood Levels

➤ Females 16-49

Geometric mean = 1.2 (0.9-1.6) ug/L

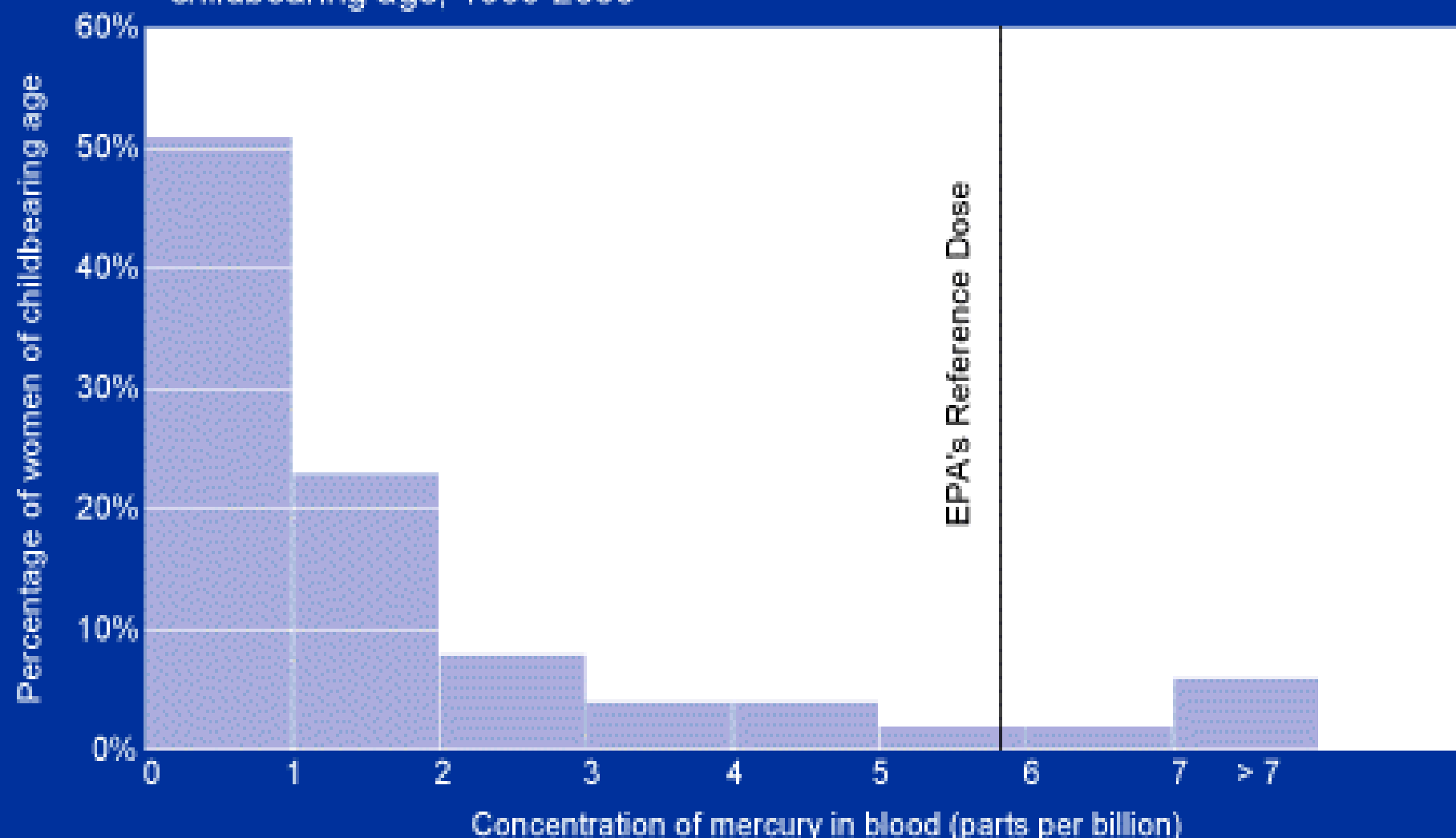
90th % = 6.2(4.7-7.9) ug/L

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Distribution of concentrations of mercury in blood of women of childbearing age, 1999-2000



SOURCE: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health and Nutrition Examination Survey

Note: EPA's reference dose (RfD) for methylmercury is 0.1 micrograms per kilogram body weight per day. This is approximately equivalent to a concentration of 5.8 parts per billion mercury in blood.

Mercury Example

- What's missing?
- What are key Tracking needs?
- How do we get there?

Needs and Next Steps

- Understand the links between:
- emissions,
- environmental concentrations,
- exposure,
- and internal dose



Weaknesses of Hazard and Exposure Tracking Databases

- Not “true” measures of exposure
- Don’t characterize full range and routes of exposure
- Inadequate info on sensitive populations
- Limited number of agents included
- No mixture data
- Limited range of potential health endpoints
- Inconsistent quality
- Inaccessible to users?
- Expensive to maintain
- Not kept current

Strengths of Hazard and Exposure Tracking Databases

- Provide “baseline” information on potential exposures
- Provide insights for identifying emerging public health problems
- Assist modeling approaches for estimating exposures
- Enable evaluation of trends in potential and actual population exposure

Ideal Exposure Tracking Data

- Measures individual exposure, dose
- Delineates distribution of population exposure
- Characterizes highly exposed subpopulations
- Measures total exposure
- Apportions information by source
- Provide longitudinal data on trends

Ideal Exposure Tracking Data (2)

- Measures cross media transport
- Tracks environmental fate
- Allows archiving of biological and environmental samples
- Links to other databases
- High accessibility
- Flexibility to include new parameters
- **Strong public health connection!**

Conclusions

- The news ain't all bad!
- There are many applications for existing databases in developing exposure tracking
- The tools are improving
- There is a great potential for prevention

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