



# **Quantitative Assessment of Risk to Infants from Environmental Contaminants in Human Milk**

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## **Overview**

- **Risk assessment approach**
- **DEQ guidance**
- **Health Department involvement**
  - **Benefits of breastfeeding**

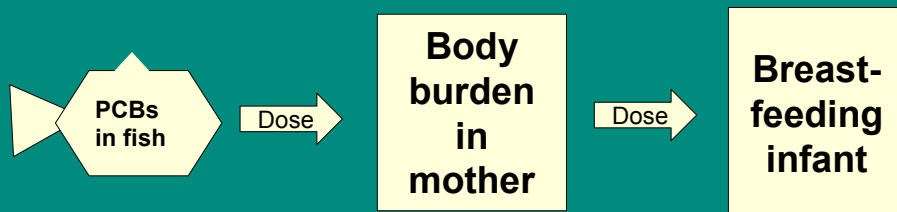


## Introduction

- Environmental regulations are risk based
- A risk assessment is being performed for the Portland Harbor federal superfund site
- Fish consumption is the main exposure pathway
- Breastfeeding is being added as an exposure pathway



## Conceptual model





## Risk characterization

Exposure

▪

Toxicity



Risk



## Risk characterization

- Relatively easy for adult exposure from fish consumption
- More complicated for infant exposure, but methods are available



## Risk calculations for infant

- Equations taken from EPA risk assessment guidance for combustion facilities (Sept 2005)
- Previously applied at one major river site and some northwest sites



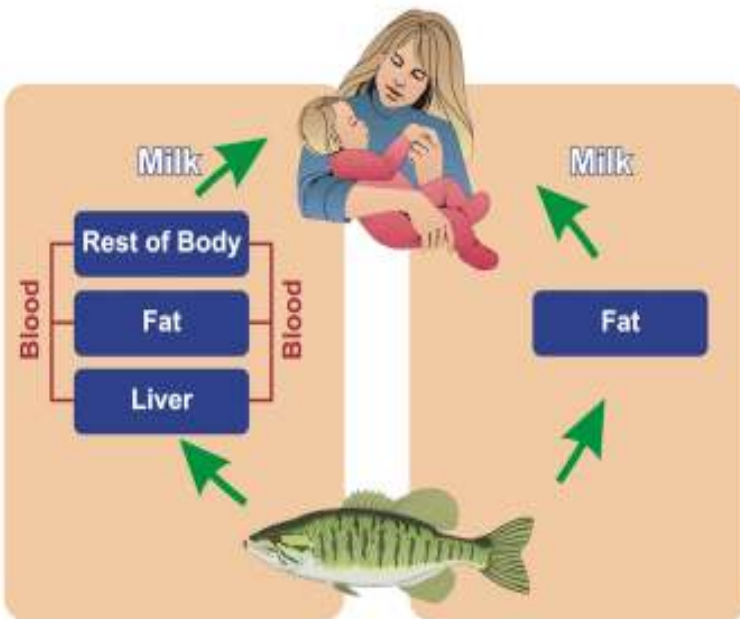
## Risk characterization results (Portland Harbor example)

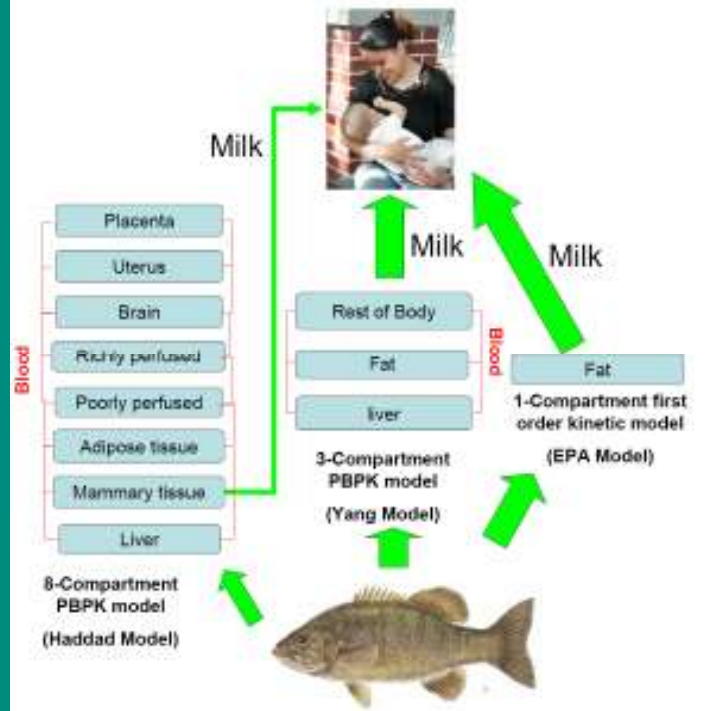
- Non-cancer risks to adults are high
- Risks to infants are a lot higher for PCBs



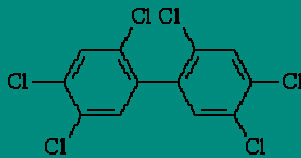
## Now what?

- Time to call Health Department
- Need to consider benefits of breastfeeding
- Need to be confident about our modeling
  - Compare results with other models





## Focus on Polychlorinated Biphenyls -- PCBs



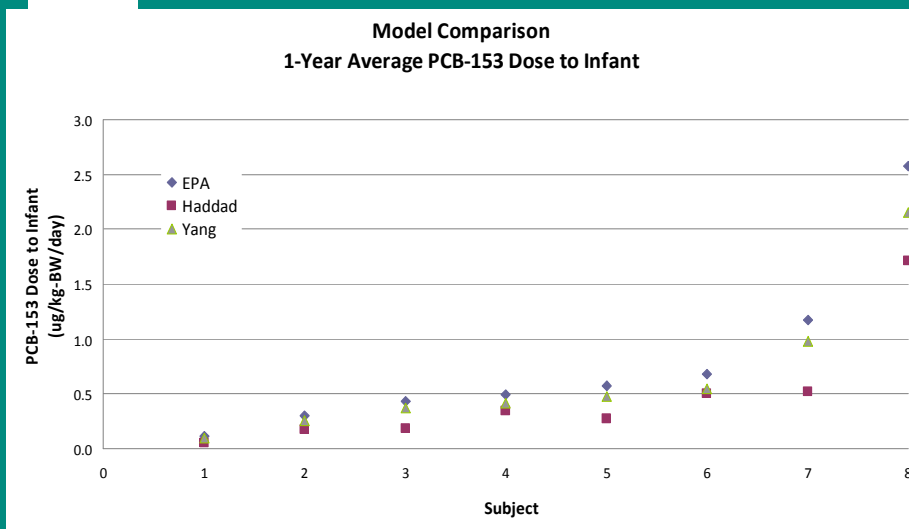


## Comparison of Models

- **Eight Inuit mother-infant pairs selected from larger study (75 pairs)**
  - Breastfed for at least 11 months
  - Equal number male and female infants
  - Full range of milk concentrations
- **Calculated milk concentrations of PCB-153 and dose to infant**
- **Haddad model was validated with observed data**

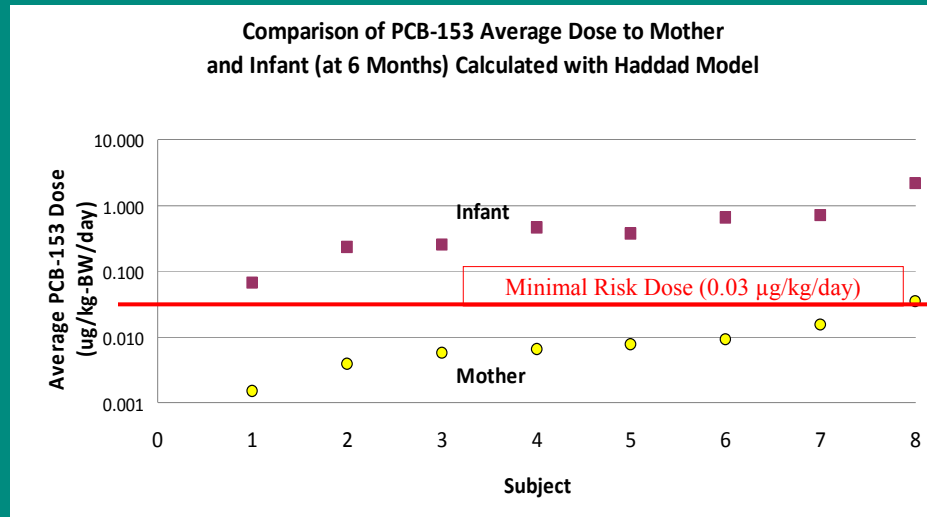


## Calculated doses were similar





## Infant dose v. maternal dose



## Infant pathway added to DEQ guidance

- DEQ guidance provides details on evaluation approach
- We developed a simple method to calculate risk to infants based on risk to adults
- DEQ screening values will incorporate infant pathway



## Infant Risk Adjustment Factor

$$\text{IRAF} = \text{HQ}_{\text{infant}} / \text{HQ}_{\text{mother}}$$

$$\text{HQ}_{\text{infant}} = \text{HQ}_{\text{mother}} \times \text{IRAF}$$



## DEQ table of IRAFs

Chemical	IRAF
PCBs	25
Dioxins	2
DDTs	2



## **Breastfeeding benefits**

- **Boosts immune function**
- **Reduces risk of several chronic health conditions**
- **Improves IQ and neurocognitive function**
- **Provides perfectly balanced and inexpensive nutrition**
- **Lowers mortality rates**



## **Message from OHA**

- **In the absence of individual breast milk PCB measurements, the best option is to continue promoting breastfeeding as the healthiest option for infants**
- **Public health message should focus on encouraging compliance with fish advisories already in place**



**DHS** Oregon Department of Human Services

**NOTICE!**

**OREGON FISH ADVISORY**

Fish from these waters may be harmful to eat, especially for children and pregnant or nursing women.  
For more information, call DHS at 503-731-4012.

**Atención:** Los peces de estas aguas pueden ser dañinos al comerlos, especialmente a mujeres embarazadas, mujeres que están lactando (amamantando) y a niños.

**Chú ý:** Ăn cá từ những vùng nước này có thể gây hại, nhất là cho trẻ em, phụ nữ đang mang thai hoặc đang cho con bú.

**注意:** 食用这些水域的鱼种，可能会使怀孕、正在哺乳、或正在喂奶的母亲和小孩受害。

**Внимание:** Рыба из этих вод может быть вредной для употребления, особенно для детей, беременных и кормящих женщин.

**Түгәтә:** Бу балыклардан алынган балыкларны ачуу һәм ачуу өчен ярамсыз.

**PROHIBIT CONSUMPTION**

**AVOID** Evite comer. Tránh. 避免. **HIGETARTE** 高麗魚. 高麗魚

Carp, Bass, Catfish, Sturgeon



## Conclusions

- Environmental cleanup regulations focus on risk
- We have risk assessment tools to evaluate risks by breastfeeding route
- There are potentially significant risks to breastfeeding infants of high fish consumption mothers



## Conclusions

- DEQ guidance now specifically addresses the infant exposure pathway
- Revised screening levels will incorporate infant exposure



## Conclusions

- Calculated risks are not intended to advise women about whether or not to breastfeed
- Benefits outweigh the risks
- Women/girls should reduce exposure to contaminants to optimize benefits of breastfeeding
- The earlier maternal exposure to contaminants is reduced, the better for the future infant



## Collaboration

### Research

- Oregon DEQ
- Oregon Health Authority
- U.S. ATSDR
- U.S. EPA Region 10
- Colorado State University
- University of Montreal

### Application

- DEQ
- OHA
  - Office of Environmental Public Health
  - Office of Family Health
- ATSDR
- EPA



## DEQ risk assessment guidance

<http://www.deq.state.or.us/lq/cu/health.htm>

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## Equation for calculating concentration in milkfat

$$C_{\text{milkfat,avg}} = \frac{\text{DAI}_{\text{mat}} \times f_f}{k_{\text{elim}} \times f_{\text{fm}}} \times \left[ \frac{k_{\text{elim}}}{k_{\text{elac}}} + \frac{1}{k_{\text{elac}} \times t_{\text{bf}}} \left( 1 - e^{-k_{\text{elim}} t_{\text{pn}}} - \frac{k_{\text{elim}}}{k_{\text{elac}}} \right) \left( 1 - e^{-k_{\text{elac}} t_{\text{bf}}} \right) \right]$$



## Factors used to calculate concentration in milkfat

$$C_{\text{milkfat,avg}} = C_{\text{milkfat,ss}} (1 - e^{-k_{\text{elim}} t_{\text{pn}}}) \left( \frac{1 - e^{-k_{\text{elac}} t_{\text{bf}}}}{k_{\text{elac}} t_{\text{bf}}} \right)$$

Average concentration in milkfat

Steadystate concentration in mother

Factor to account for non-steady state concentration

Factor to account for chemical loss during breastfeeding