What's the Public Health Issue, and Why Is It Important?

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Key Public Health Issues

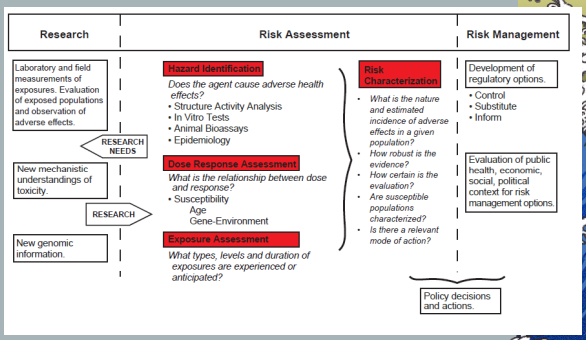
- *1. Recognize that fish are essential component of healthy diets*
- *2. Ensure that fish are safe to eat*
- *3. Ensure that we can make these statements based on regional knowledge about how our PNW residents eat and prepare fish*
- *4. Need to recognize the contaminants are present in our fish that have prevented our access to fish*
- *5. Need to acknowledge that we have been "warning" our residents about fish consumption*

Risk Assessment

Estimation of the association between an exposure to an agent/process and the incidence of some adverse outcome

Risk Management

Public policy developed to deal with hazards identified through risk assessment,process of evaluating alternative regulatory options and selecting among them



Faustman, E. M. and G. S. Omenn (2008). Chapter 4: Risk Assessment. Casarett and Doull's Toxicology: the Basic Science of Poisons, Ed: C. Klaasen.

Major toxic chemical laws in the US by responsible agency		
EPA	Air pollutants	Clean Air Act 1970, 1977, 1990
	Water pollutants	Federal Water Pollution Control Act 1972, 1977
	Drinking water	Safe Drinking Water Act 1974, 1996
	Pesticides	Fungicides, Insecticides, & Rodenticides Act (FIFRA) 1972, Food Quality Protection Act (FQPA) 1996
	Ocean dumping	Marine Protection Research, Sanctuaries Act 1995
		Ocean Radioactive Dumping Ban Act 1995
	Toxic chemicals	Toxic Substances Control Act (TSCA) 1976
	Hazardous wastes	Resource Conservation and Recovery Act (RCRA) 1976
	Abandoned hazardous wastes	Superfund (CERCLA) 1980, 1986
CEQ	Environmental impacts	National Environmental Policy Act (NEPA) 1969
OSHA	Work-place	Occupational Safety and Health (OSH) Act 1970
FDA	Foods, drugs, and cosmetics	FDC Acts 1906, 1938, 1962, 1977 FDA Modernization Act 1997
CPSC	Dangerous consumer products	Consumer Product Safety Act
DOT	Transport of hazardous materials	THM Act 1975, 1976, 1978, 1979, 1984, 1990(?)

Objectives of Risk Assessment

1. **Balance of Risks and Benefits**
   - Drugs
   - Pesticides
2. **Set Target Levels of Risk**
   - Food contaminants
   - Water pollutants
3. **Set Priorities for program activities**
   - Regulatory agencies
   - Manufacturers
   - Environmental/Consumer Organizations
4. **Estimate residual risks and extent of risk reduction after steps are taken to reduce risk**

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Risk Assessment

A. Identification-How do we identify hazards?

B. Characterization- How do we characterize the risks of a specific hazard?

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Contaminants in seafood

Microorganisms

- Bacteria (Vibrio)
- Algal toxins (PSP & domoic acid) — mostly shellfish

Viruses

- Very little is known about these contaminants

Persistent Bioaccumulative Toxicants

- Mercury, PCBs, dioxins, DDT
- More of a problem in older, larger fish — "bioaccumulates"

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Examples of Major Adverse Health End-Points

- *Carcinogenicity*
- *Mutations*
- *Teratogenicity*
- *Altered reproductive function*
- *Altered respiratory function*
- *Neuro-behavioral toxicity*
- *Other specific organ system effe*

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The Seafood Dilemma:

Health Benefits vs. Biological and Chemical Contaminants

What and how do we communicate?

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Characterization

1. *Nature of Exposure*
2. *Individual Susceptibility*
3. *Potency*
4. *Low-Dose Extrapolation*

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Factors Affecting Differences in Susceptibilty

- *Age*
- *Sex*
- *Strain*
- *Enzyme Induction*
- *Genetic Predisposition*
- *Hormonal Status*
- *Nutritional Status*
- *Disease*
- *Circadian Variation*
- *Stress*

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How do we set acceptably safe exposure levels?

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Risk = Hazard x Exposure

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What the World Eats: What's on family dinner tables around the globe?

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Japan: The Ukita family of Kodaira City

Food expenditures for one week: 37,699 Yen or $317.25
Favorite Foods: Sashimi, fruit, cake, potato chips.

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Germany: The Melander family of Bargteheide

Food expenditure for one week: 375.39 Euros or $500.07
Favorite foods: fried potatoes with onions, bacon and herring, fried noodles with eggs and cheese, pizza, vanilla pudding

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Mechanisms of susceptibility
EXPOSURE ASSESSMENT CONSIDERATIONS

- *Consumption*
- *Collection*
- *Preparation*

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P. Cirone 1996

Arsenic Mercury Intake Biometric Study

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&
Institute for Risk Analysis and Risk Communication

Washington State Department of Health

PI: Koenraad Mariën
Ami Tsuchiya
Tom Burbacher
Elaine Faustman

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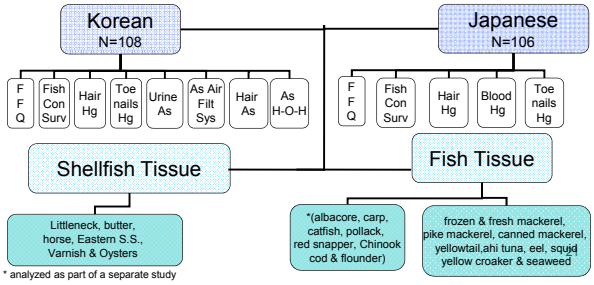
Study looked at seafood consumption and biomarkers of exposure in two high seafood consuming populations



* analyzed as part of a separate study

Fish Consumption Comparison:
to National Statistics

	Finfish			Shellfish			Finfish & Shellfish combined		
	Mean	50th%	95th %	Mean	50th%	95th %	Mean	50th%	95th %
Japanese (n=106)	60	43	159	14	9	59	**73**	55	188
Korean (n=108)	59	49	147	23	13	84	**82**	64	230
US General (CSFII[1])							14		**72**
US General (NHANES[2])							1.8*		**87**

g/person/day

1:Jacobs 1997, 2: Mahaffey 2004 , *geometric mean

Both populations consume fish in quantity as they have consumption rates that are near 95th percentile levels to the U.S. average.

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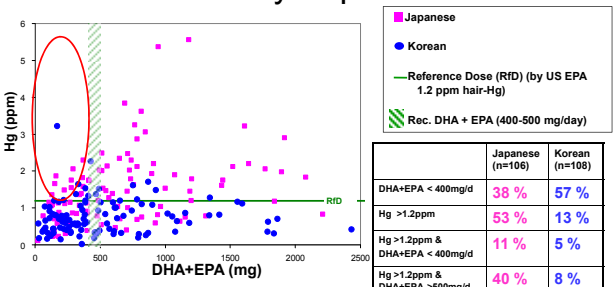
Tsuchiya, A., J. Hardy, et al. (2008). "Fish intake guidelines: incorporating n-3 fatty acid intake and contaminant exposure in the Korean and Japanese communities." American Journal of Clinical Nutrition 87(6): 1867-1875.

Omega-3 Fatty Acids intake & Mercury Exposure



	Japanese (n=106)	Korean (n=108)
DHA+EPA < 400mg/d	38 %	57 %
Hg >1.2ppm	53 %	13 %
Hg >1.2ppm & DHA+EPA < 400mg/d	11 %	5 %
Hg >1.2ppm & DHA+EPA >500mg/d	40 %	8 %
Hg < 1.2ppm & DHA+EPA <400mg/d	26 %	54 %

Both populations have a percentage of individuals not obtaining their daily dietary requirement of DHA/EPA (400-500 mg/d) even people who are over exposured to mercury.

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Tsuchiya, A., J. Hardy, et al. (2008). "Fish intake guidelines: incorporating n-3 fatty acid intake and contaminant exposure in the Korean and Japanese communities." American Journal of Clinical Nutrition 87(6): 1867-1875.

Informing risk management approaches

- *Benefits of fish consumption*
- *Developing intervention approaches with community*
- *Developing culturally appropriate risk communication tools*

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Number of crabs consumed by a small child to exceed PCB exposure guidelines

Item Consumed	Minimum number consumed to exceed Rfd	Number consumed to exceed cancer benchmark
Elliot Bay (urban, polluted site)		
Number whole crabs	<1	<1
Number crabs muscle only	5	<1
Number crabs, muscle only, if cooking water discarded	7	<1
Useless Bay (relatively pristine site)		
Number whole crabs	9	<1
Number crabs muscle only	103	3
Number of crabs, muscle only, if cooking water discarded	105	4

Judd, N. L., W. C. Griffith, et al. (2002). "Alternative strategies for PCB risk reduction from contaminated seafood: options for children as susceptible populations." Bull Environ Contam Toxicol **69**(6): 847-54.

Development of Cultural Specific Cookbooks

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Example of fish benefits described in a community recipe book

Fish are lowfat and high in protein.

Shellfish contain zinc and magnesium, which we all need to stay healthy.

Eating fish and shellfish helps keep our hearts healthy and reduces risk of heart attack.

Shellfish are very low in fat and high in protein.

Fishing and collecting shellfish are fun, low cost family activites.

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Fish Consumption Advisories:
Toxicological Risk and Nutritional Benefit Messages to Sensitive Populations

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Introduction

Fish consumption advisories are issued to warn the public of possible toxicological threats from consuming certain fish species

While developing fetuses and children are particularly susceptible to toxicants in fish, fish also contain valuable nutrients. Hence, formulating advice for sensitive populations poses challenges.

In July of 2007, the U.S. Environmental Protection Agency (EPA) made available online the 2005/2006 National Listing of Fish Advisories (NLFA), which reflects potential chemical risks only.

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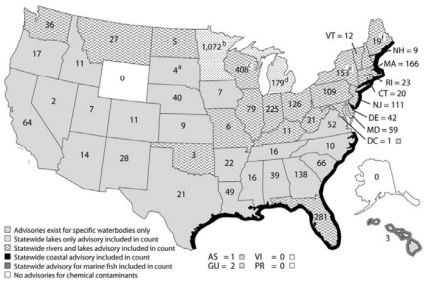
Fish Advisories in the United States

Figure 2. Total Number of Fish Consumption Advisories in 2006



Source: US EPA, 2007

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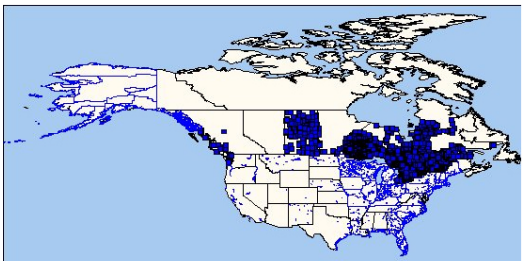
Fish advisories in Canada and the US



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US EPA

Objective

- Viewed comprehensively across states, do fish consumption advisories, which we recognize arise from a regulatory context, also address the public health questions that sensitive populations face?
- Specifically, do advisories sufficiently convey risk and benefit information on potential fish species eaten to provide context for the advice offered? Do they provide clarity for these complex risk issues?

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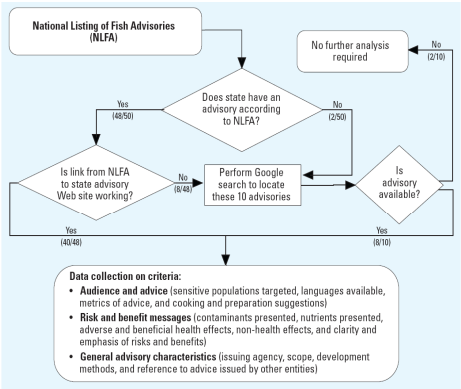

Figure 1. Flow diagram for the comparative analysis of the 48 state fish consumption advisory Web sites assessed.

Scherer, A. C., A. Tsuchiya, et al. (2008). "Comparative Analysis of State Fish Consumption Advisories Targeting Sensitive Populations." Environmental Health Perspectives 116(12): 1598-1606.

Audience and Advice
Sensitive Populations Targeted

- All Web sites contained at least some advice for sensitive populations.
- All but Hawaii and Nevada offered advice that was either more strict or more cautiously worded for sensitive populations than for the general population.
- Seventeen Web sites contained specific brochures or Web pages aimed exclusively at sensitive populations, whereas the rest of the Web sites intermingled advice aimed at sensitive populations with content aimed at members of the general population.

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Scherer, A. C., A. Tsuchiya, et al. (2008). "Comparative Analysis of State Fish Consumption Advisories Targeting Sensitive Populations." Environmental Health Perspectives 116(12): 1598-1606.

Audience and Advice
Metrics of Advice: Meal Frequency and Size

- All states, except Nebraska, offered meal frequency advice, given in terms of meals per week, month, year, or a combination thereof.
- Most states gave advice based on fish length (inches), and some based advice on the size of fish caught.

Cooking and Preparation Suggestions

- 56% of advisories gave advice about preparing and cooking fish, such as removing skin and trimming away fat before cooking.

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Scherer, A. C., A. Tsuchiya, et al. (2008). "Comparative Analysis of State Fish Consumption Advisories Targeting Sensitive Populations." Environmental Health Perspectives 116(12): 1598-1606.

Fish Advisories in the US

- 3,852 current fish advisories
- 38% of lake acres
- 26% of river miles
- 100% of Great Lakes
- 65% of the United States coastline

Source: US EPA, 2007

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Results:

Risk and Benefit Messages

This figure illustrates references to types of beneficial and adverse health effects in advisories and with which fish nutrients (Figure 3A) and contaminants (Figure 3B), respectively, they are associated.

There were over 4.5 times more references to adverse health effects compared to beneficial health effects associated with fish consumption.

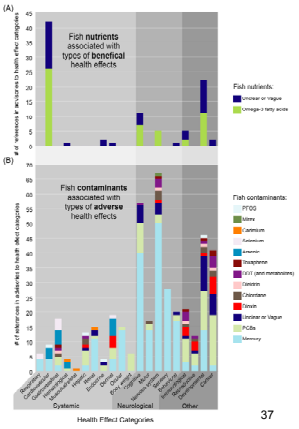
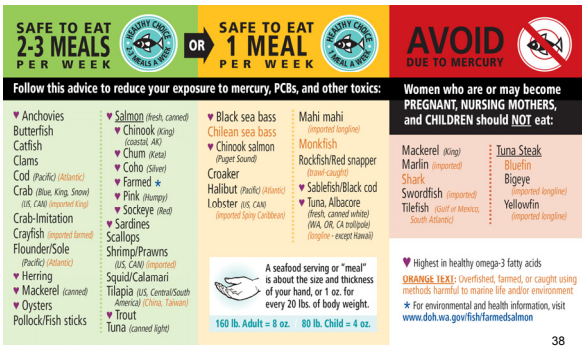
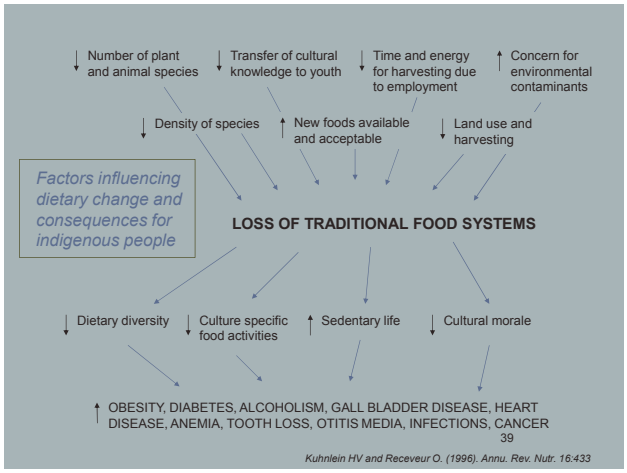


Figure 3. (A) Fish nutrients associated with beneficial health effects and (B) fish contaminants associated with adverse health effects in state fish consumption advisories.

Scherer, A. C., A. Tsuchiya, et al. (2008). "Comparative Analysis of State Fish Consumption Advisories Targeting Sensitive Populations." Environmental Health Perspectives 116(12): 1598-1606.

Washington State Healthy Fish Guide





Kuhnlein HV and Receveur O. (1996). Annu. Rev. Nutr. 16:433

Key Public Health Issues

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- *2. Ensure that fish are safe to eat*
- *3. Ensure that we can make these statements based on regional knowledge about how our PNW residents eat and prepare fish*
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Oregon Fish Consumption Rate Project's Human Health Focus Group Report

Table 3. Adult Fish Consumption Rates (grams per day) Recommended by the Human Health Focus Group for Oregon Human Health-Based Water Quality Criteria.

Group	Species included in consumption rate evaluation	N	Statistic					
					Percentile			
			Mean	Median	75th	90th	95th	99th
Tulalip Tribe	Anadromous and estuarine finfish and shellfish	73	72	45	85	186	244	312
Suquamish Tribe	Anadromous and estuarine finfish and shellfish	284	214	132	NA	489	NA	NA
Squaxin Island Tribe	Anadromous and estuarine finfish and shellfish	117	73	43	NA	193	247	NA
Columbia River Tribes	Freshwater and anadromous finfish	512	63	40	60	113	176	389
Asians & Pacific Islanders	Anadromous and estuarine finfish and shellfish	202	117	78	139	236	306	NA
U.S. General Population	Freshwater, anadromous, estuarine, and marine finfish and shellfish	2585	127	99	NA	248	334	519

N = Number of adults in survey NA= Statistical value not available. Adults are 18 years or older for all surveys except Suquamish; Suquamish adults were 16 years or older All values reported in this table are described in Table 1 (located at the end of this document) Tulalip Tribes and Squaxin Island Tribe from Toy *et al.* 1996. Suquamish Tribe from Suquamish. 2000. Columbia River Treaty Tribes from CRITFC. 1994. The Columbia River Tribes did not report marine fish consumption; The 75, 90, 95 and, 99th percentiles are interpolated from percentiles reported in CRITFC 1994 Asian Pacific Islanders from Sechena *et al.* 1999. US General Population from US EPA. 2002b.

Key Public Health Observations

- *1. PNW residents eat fish!*
- *2. PNW residents would eat more fish if we provide them with healthy , acessable sources*
- *3. PNW residents vary widely in how, when and where we eat fish*
- *4. Need to emphasize nutritional /cultural context for fish consumption*
- *5. Need to provide context to ensure that we can eat fish in the PNW*

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