BC Centre for Disease Control
An agency of the Provincial Health Services Authority

National Collaborating Centre for Environmental Health

Centre de collaboration nationale en santé environnementale

Appreciating and applying metal in drinking water guidelines

Tom Kosatsky (Reza Afshari, Linda Dix-Cooper)
Medical Director, Environmental Health Services;
Scientific Director, National Collaborating Centre for Environmental Health

Dead fish, leaded water

The local school board first became aware of issues with water quality at school 1 after testing was conducted by a Department of Fisheries and Oceans (DFO) employee. The DFO employee had been contacted by a school staff member concerned that salmon eggs displayed in a classroom aquarium were not surviving. The DFO employee tested a sample of water from the classroom sink for copper, a known aquatic toxicant and found a concentration of 8.36 mg/L.

Additional sampling was conducted at the school to assess the extent of both copper and lead contamination. Potential leaching of lead from household plumbing had previously been raised as an issue by the HA to the City’s Public Works Department due to the aggressiveness of the community's water supply, including a low pH level. The following day, pre-flush and two-minute post-flush samples were collected from a classroom sink and a drinking water fountain at the opposite end of the school. Results showed that all four samples (pre- and post-flush) exceeded the drinking water guidelines for both metals.

Estimated daily lead intakes from water consumed at school based on mean pre- and post-5 minute school water flush samples

Type of school	Number of samples	Lead concentrations (µg/L)				Lead intake from school water (µg/day) using mean pre-flush values*
		Pre-flush		Post-flush		
		Mean	Range	Mean	Range	
Elementary ($n = 3$)	40	71.1	5.9–306	5.0	0.9–20.8	24.2
Secondary ($n = 2$)	8	94.5	12–191	12.3	1.2–21.0	44.4

**Water intakes of 0.34 L per day and 0.47 L per day for elementary and secondary students, respectively, were used. These values were based on the assumption that one-half of total daily water intake comes from school water; daily intake rates for all water of 0.68 L per day for children between 6 and 11 years (used here as an estimate for elementary school aged children) and 0.93 L per day for children between 16 and 18 years (used here as an estimate for secondary school aged children) were used (U.S. Environmental Protection Agency, 2011).*

Barn, 2014

Estimated daily intakes of lead by pathway for elementary and secondary school children

Pathway	Lead concentration	Elementary school aged child: Health Canada estimates* µg/day (%)	Elementary school aged child: Case study† µg/day (%)	Secondary school aged child: Health Canada estimates* µg/day (%)	Secondary school aged child: Case study† µg/day (%)
Air	0.06 µg/m³	1.9 (4.4)	1.9 (2.2)	3.5 (5.5)	3.5 (2.4)
Water	‡Reference: 4.8 µg/L Case study: Elementary: 71.1 µg/L Secondary: 94.5 µg/L	3.3 (7.8)	48.5 (55.4)	4.6 (7.2)	87.9 (60.0)
Food	Various	30.1 (71.3)	30.1 (34.4)	48.4 (76.2)	48.4 (33.0)
Soil and dust	140 µg/g	7.0 (16.5)	7.0 (8.0)	7.0 (11.1)	7.0 (4.6)
Total Daily Lead Intake (µg per day)		42.2	87.5	63.5	146.8

**Values for lead intakes from air, food, and soil–dust were taken directly from Health Canada estimates (Health Canada, 1992b). Lead intakes from water were estimated using Health Canada's assumption of lead concentrations in water (4.8 µg/L) and estimates on daily water consumption rates. Rates of 0.68 L per day and 0.93 L per day for children aged 6–11 years (elementary school aged) and 16–18 years (secondary school aged), respectively, were used; these values represent 75th percentiles of the recommended values for drinking water ingestion rates for these age groups, as listed in the Child-Specific Exposure Factors Handbook by the US EPA (U.S. Environmental Protection Agency, 2011).*

†Lead intakes from air, food, and soil–dust were kept constant with Health Canada scenario conditions. Lead intakes from water were estimated using mean pre-flush lead concentrations (71.1 µg/L and 94.5 µg/L for elementary and secondary schools, respectively) and estimates of daily water consumption rates (same as Health Canada conditions).

‡For water, a reference concentration of 4.8 µg/L was used, this is the value used by Health Canada. In this case study, two values were used, the average lead concentration found in elementary schools and the average concentration found in secondary schools.

Barn, 2014

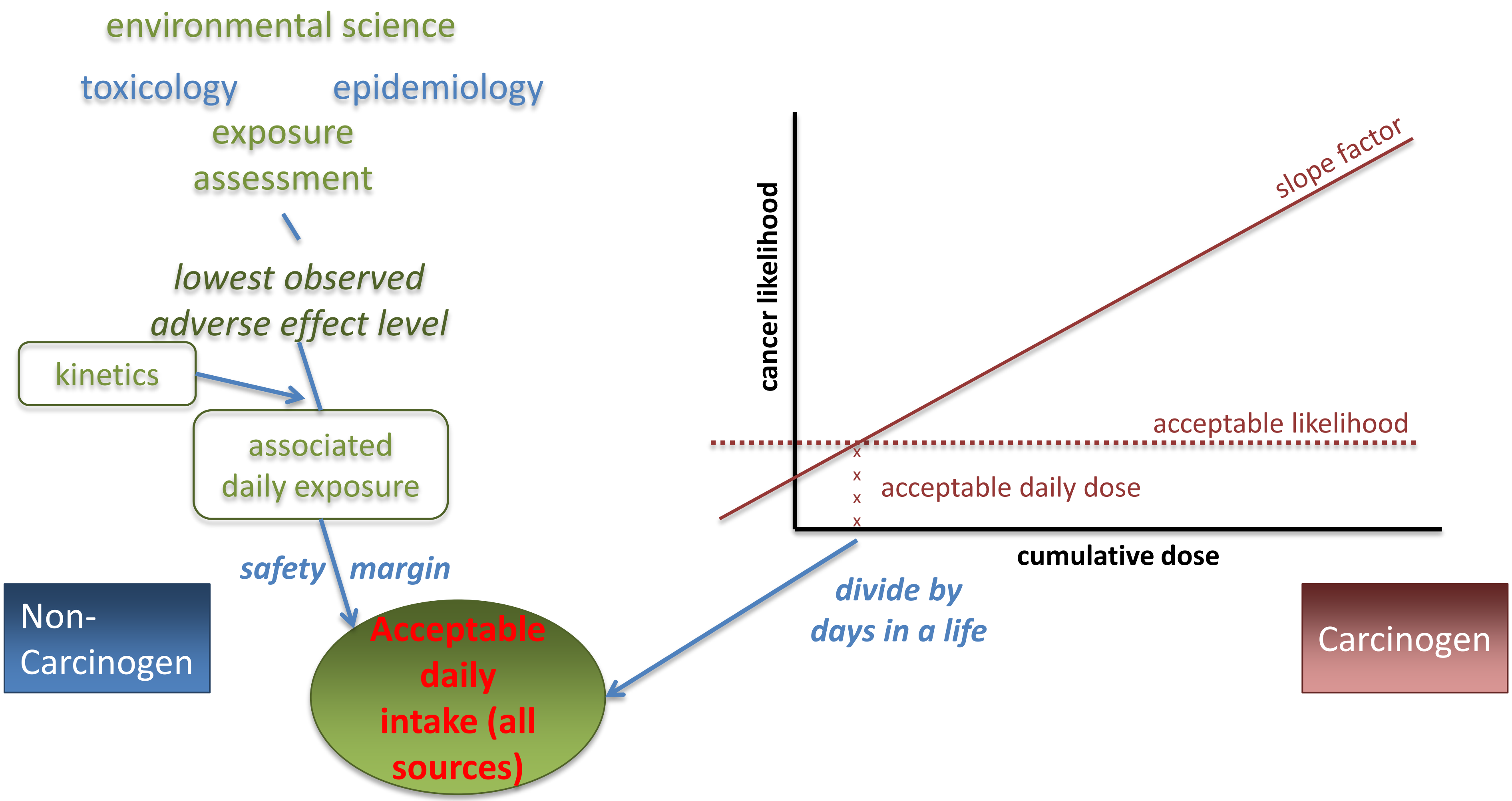
Chemical safety of drinking-water: Assessing priorities for risk management

WHO 2007

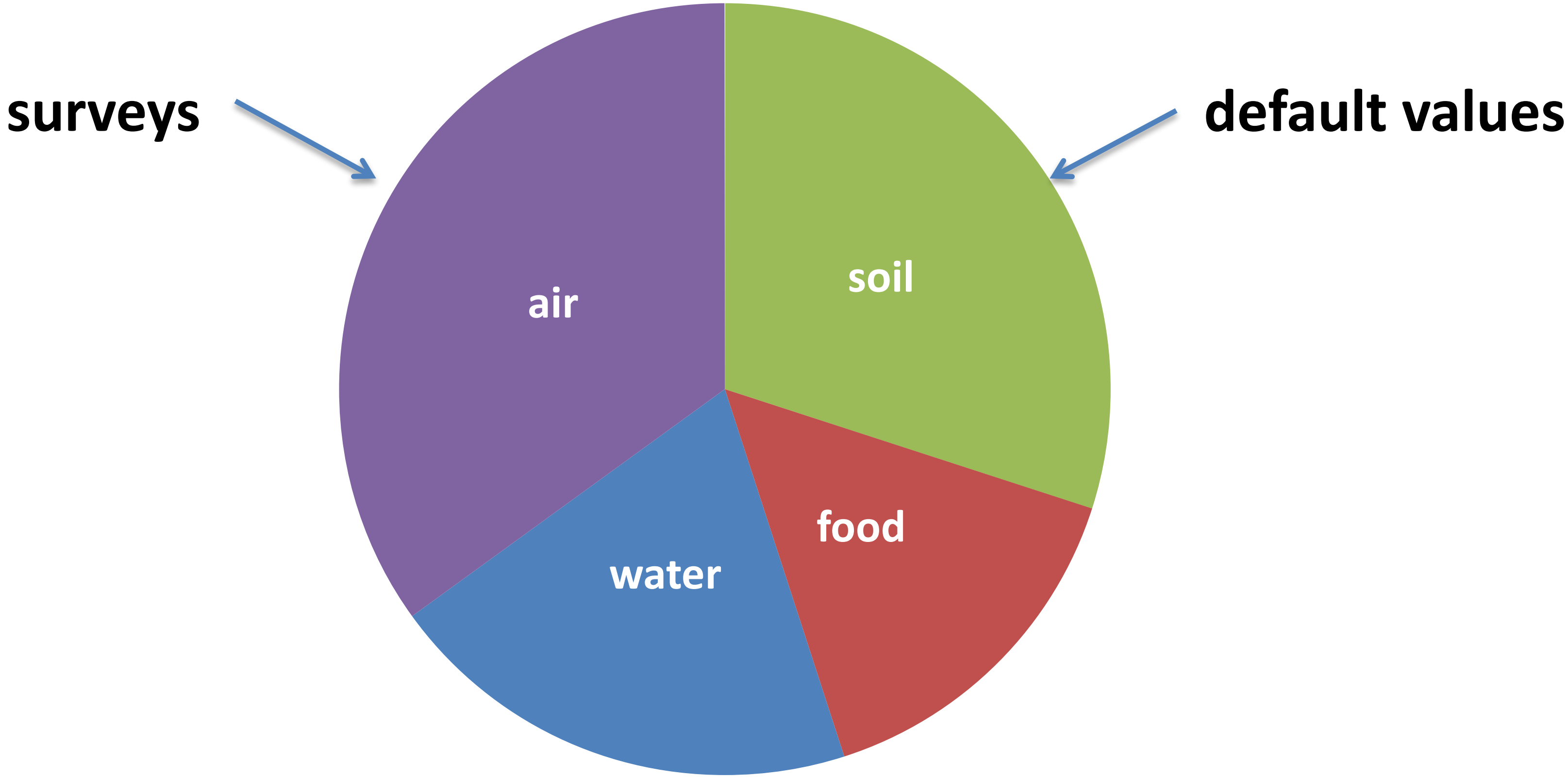
Risk management strategies for chemicals in drinking-water should also take into account the broader context. For example, if drinking-water is not the main route of exposure for a chemical, then controlling levels in water supply systems may have little impact on public health. Thus, risk management strategies need to consider alternative routes of exposure (e.g. food) that equal or surpass the importance of exposure through drinking-water.

Establishment of tolerable metal concentrations in drinking water

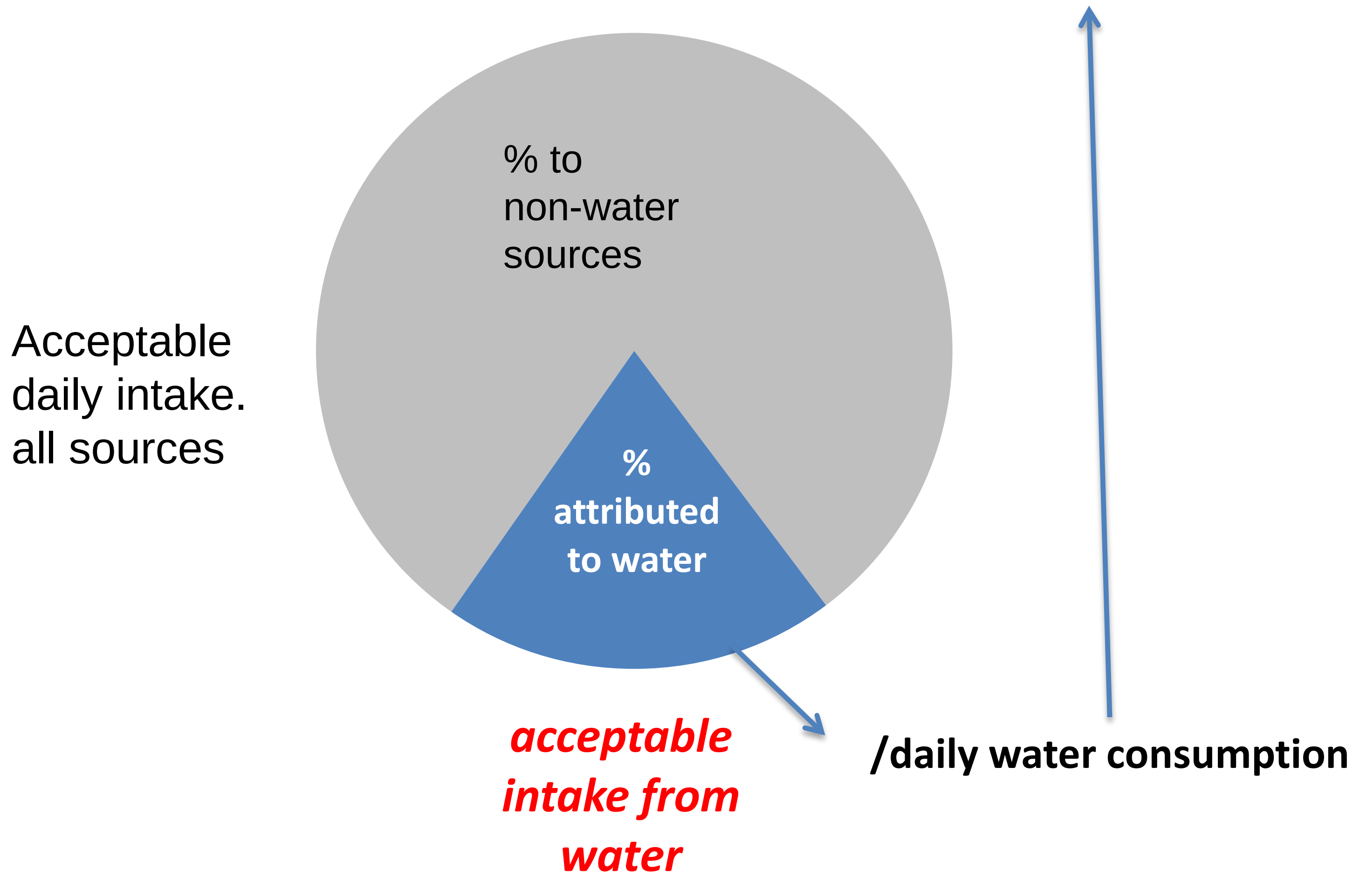
1. Fixing Acceptable Daily Intake



2. exposure attribution, multiple sources



3. fixing X in water guidance concentration



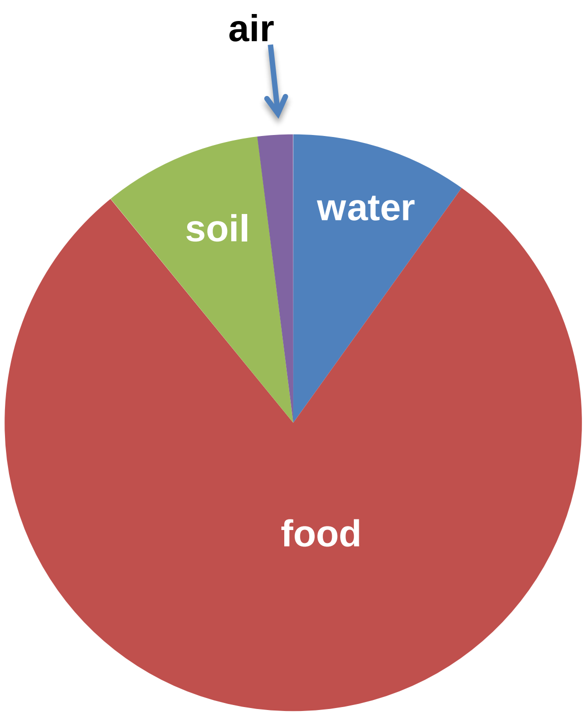
Establishment of tolerable metal concentrations in drinking water

exceptions

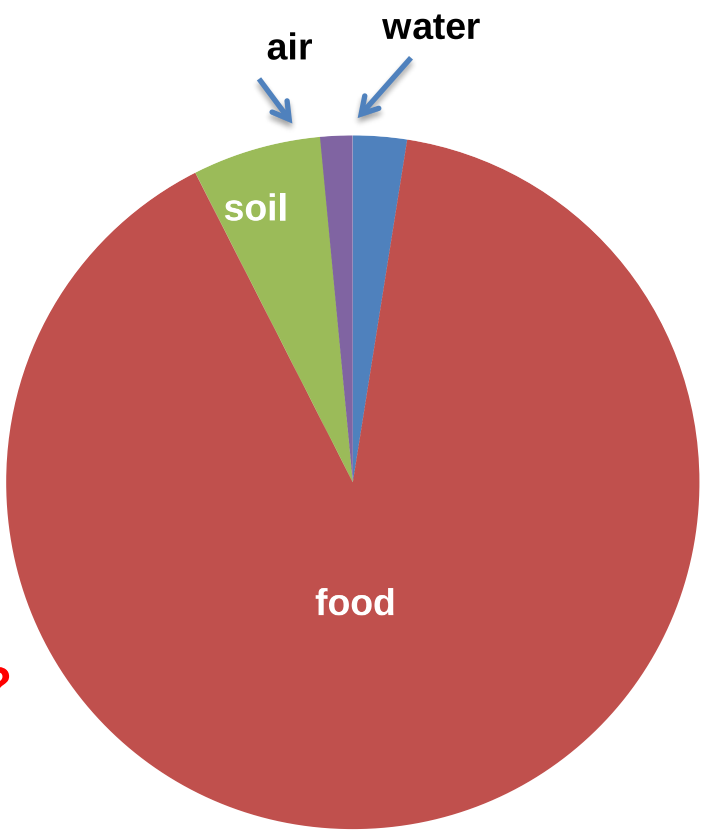
Se in water standard for BC

A survey indicated that BC residents have higher consumption of selenium in food than the Canadian average. Assuming this is true, should Se in water be set at a lower guidance level in BC?

Exposure attribution and re-attribution



If Se in food intake increases, should/can permissible Se in water be reduced?

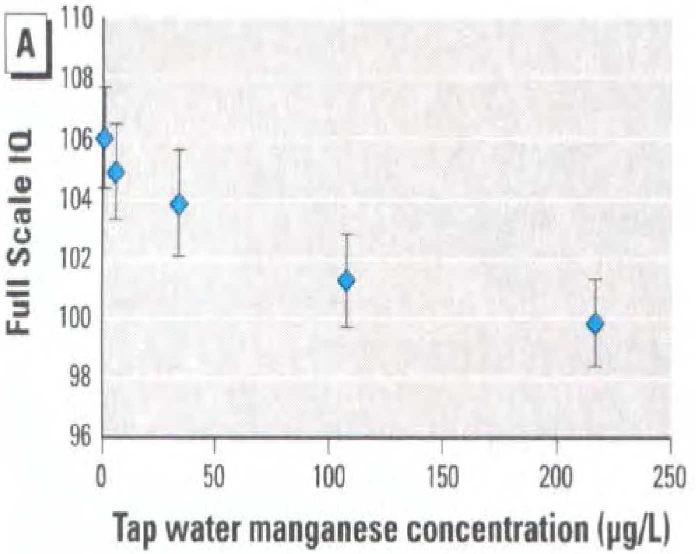


Consequences???

A more conservative Mn standard??

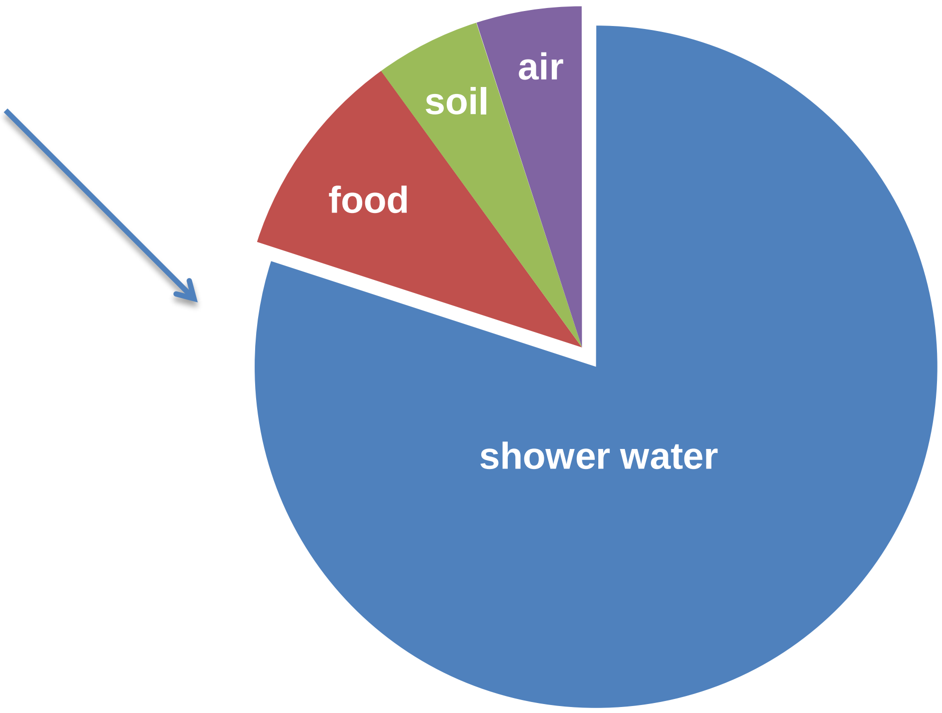
While manganese does have health effects, the current (US, European, Canadian) Mn in water standard is based on taste and water conduit integrity. Recent Quebec population health studies indicate that below guidance Mn exposure may be associated with effects on childrens' intelligence.

This is surprising, in that almost population Mn intake is from food. Worker and animal studies suggests that nasal (**shower water**) exposure may have specific neurological effects.



Bouchard, 2013

Shower water exposure attribution



Based on Mn toxicity through nose uptake to brain

guideline???

Situational (exceptional) metal in water guidance: when

- (unusual exposure routes)
- (high level intake other than from water)
- essential metal (Fe, Se, Mn)
- unusually high water consumption (environmental, individual)
- high susceptibility (dialysis, chronic renal failure)
- acute versus long-term exposure

BC Centre for Disease Control
An agency of the Provincial Health Services Authority

National Collaborating Centre for Environmental Health
Centre de collaboration nationale en santé environnementale

Thank you

tom.kosatsky@BCCDC.CA