Risk Assessment for Hexavalent Chromium (Cr6)

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Office of Environmental Health Hazard Assessment

• **Mission:** to protect and enhance public health and the environment by scientific evaluation of risks posed by hazardous substances.

• **Water-Related Programs:** Development of Public Health Goals, some Notification Levels, Fish Advisories, Ecotox guidelines and database, SF Bay oil-spill response.
Chromium Toxicology - Basic Facts

• **Trivalent chromium (Cr3):**
  - Essential element in diet
  - Very low toxicity

• **Hexavalent chromium (Cr6):**
  - Well-known carcinogen by inhalation route
  - Cytotoxic, genotoxic, corrosive to skin
  - Mostly converted to Cr3 in the stomach when taken orally
Chromium Evaluation

The Big Question:
Because Cr6 can be changed in the stomach to Cr3, what effects can be expected from oral exposure to Cr6 at low environmental levels?
Chromium Toxicology Evaluation

- Very few good toxicology studies for Cr6 were available
- Weak evidence of Cr6 carcinogenicity by ingestion, good evidence by inhalation
- OEHHA completed PHG risk assessment for total chromium in 1999, driven by presumed oral carcinogenicity of Cr6
- PHG rescinded in 2001 because of this controversial assumption
New Chromium Study

- OEHHA, DHS, and the California legislature requested new Cr6 cancer study by the National Toxicology Program (NTP) in 2001
- NTP conducted two-year rat and mouse studies of Sodium Dichromate Dihydrate in drinking water – their draft report released May 2007
NTP Chromium Study

• Exposure concentrations:
  – M/F rats and F mice: 0, 14.3, 57.3, 172, or 516 ppm; M mice: 0, 14.3, 28.6, 85.7, or 258 ppm

• Rats: mouth and tongue tumors (combined)
  – Males: 0/48, 1/46, 0/47, 0/49, 7/49
  – Females: 1/50, 1/48, 0/49, 2/49, 11/50

• Mice: small intestine tumors (combined)
  – Females: 1/40, 1/40, 4/47, 17/41, 22/47
NTP Chromium Study

- NTP conclusion:
  - Male Rats - Clear evidence of cancer
  - Female Rats - Clear evidence of cancer
  - Male Mice - Clear evidence of cancer
  - Female Mice - Clear evidence of cancer
OEHHA Risk Assessment

• Tumor potency calculation based on male mouse data, because of best dose response
• Estimated human cancer potency: 0.6 / mg/kg-day
• PHG proposed to be based on this value, using linear extrapolation to one in one million risk level
Other Toxicity Considerations

• OEHHA evaluation of Chinese cancer study concludes that the data are consistent with increased stomach cancer risk in people exposed to Cr in drinking water (*Epidemiology* 19(1):12-23, Jan 2008)

• Risk assessment for non-cancer effects, divided by appropriate uncertainty factors, results in relatively low drinking water values
Because Cr6 can be changed in the stomach to Cr3, what effects can be expected from oral exposure to Cr6 at low environmental levels?
Next Steps for PHG

- Release for 45-day public comment period, including public workshop
- Potential additional external peer review
- Revisions in response to comments
- Posting for 30-day comment period
- Revisions in response to comments
- Posting of final PHG and the responses to comments.
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Useful websites:

OEHHA: www.oehha.ca.gov
DPH: www.cdph.ca.gov/certlic/drinkingwater/Pages/MCLs andPHGs.aspx
U.S. EPA: www.epa.gov/safewater/mcl.html