



U.S. Public Health Agencies' Evaluations Relevant to Dental Amalgam Prior to 1997

Richard Canady, PhD DABT
Senior Health Scientist

Office of Science and Health Coordination
US Food and Drug Administration

US Public Health Agencies with Relevant Evaluations

- Environmental Protection Agency (EPA)
 - Related to clean air act, hazardous waste sites, etc
 - “Safety” values for environmental decisions
- Agency for Toxic Substances and Disease Registry (ATSDR)
 - Reviews related to hazardous waste sites
 - “Safety” values for environmental decisions
- U.S. Public Health Service (combined agencies)
 - Combined expertise across US Public Health Agencies
 - Input from experts from academia
 - Evaluated safety of amalgam use in 1993 and 1997

EPA

“The mission of the Environmental Protection Agency is to protect human health and the environment. Since 1970, EPA has been working for a cleaner, healthier environment for the American people.”

EPA Integrated Risk Information System (IRIS)

- Determines a dose or air level “likely to be without an appreciable risk of deleterious effects during a lifetime.”
 - Reference concentration (RfC) or Reference dose (RfD)
 - <http://www.epa.gov/iris/>
- Value for inorganic mercury derived ~1988
- Value for mercury vapor derived in ~1989

1997 EPA Mercury Study Report to Congress

- Primarily related to environmental evaluations
 - <http://www.epa.gov/mercury/report.htm>
- Detailed compendium and evaluation of mercury toxicity studies and data (~650 pages of exposure and health effects review text)
- Confirmed the late 1980's vapor and inorganic mercury reference values, the RfC and RfD
- Briefly reviewed amalgam exposure but did not do risk assessment for it

ATSDR

Agency created by Congress in 1980's to

“...assess the presence and nature of health hazards at specific Superfund sites, to help prevent or reduce further exposure and the illnesses that result from such exposures, and to expand the knowledge base about health effects from exposure to hazardous substances.”

<http://www.atsdr.cdc.gov/congress.html>

ATSDR Toxicological Profiles

- One of ATSDR's core mandates is to prepare "Toxicological Profiles" on environmental contaminants
- Mercury was profiled by ATSDR in the late 1980's.
- It was updated in 1990, 1994, and 1999
 - 1999 profile is 676 pages long (85 page reference list)
 - Each revision had peer review and public comment, as is done for all ATSDR profiles

ATSDR Minimal Risk Levels (MRLs)

- Minimal Risk Levels for mercury vapor and inorganic mercury were in each ATSDR Profile
- The MRLs go through interagency review and are peer reviewed and released for public comment with the full profile
- “... an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncarcinogenic)...”

ATSDR Mercury MRLs

- Based on same studies used by EPA to derive their reference values
- Like EPA, the ATSDR values first derived in the late 1980's are essentially the same as today – despite ongoing searches for new studies and updates of the profiles

Numbers used by ATSDR and EPA

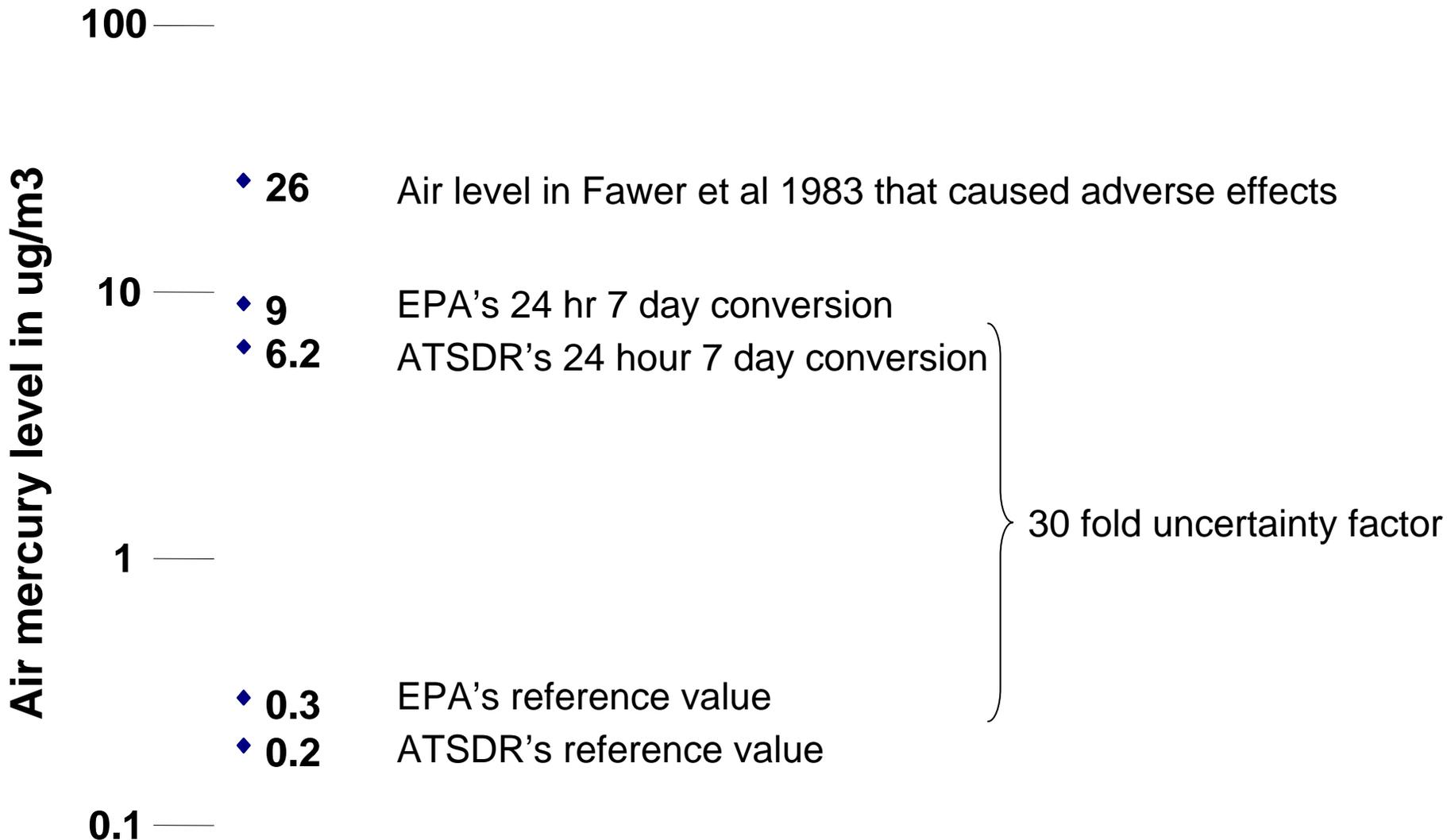
- ATSDR and EPA reference values for mercury are based on Fawer et al 1983
 - Lowest dose effect was increased velocity in hand tremors above about 26 micrograms per cubic meter (**26 ug/m³**)
- Both EPA and ATSDR converted the 40 hour work week in Fawer et al. to 24 hours, 7 days a week
 - EPA came to **9 ug/m³**
 - ATSDR came to **6.2 ug/m³**

Both EPA and ATSDR divided the converted exposure levels to reference values by dividing by 30 to protectively account for uncertainty

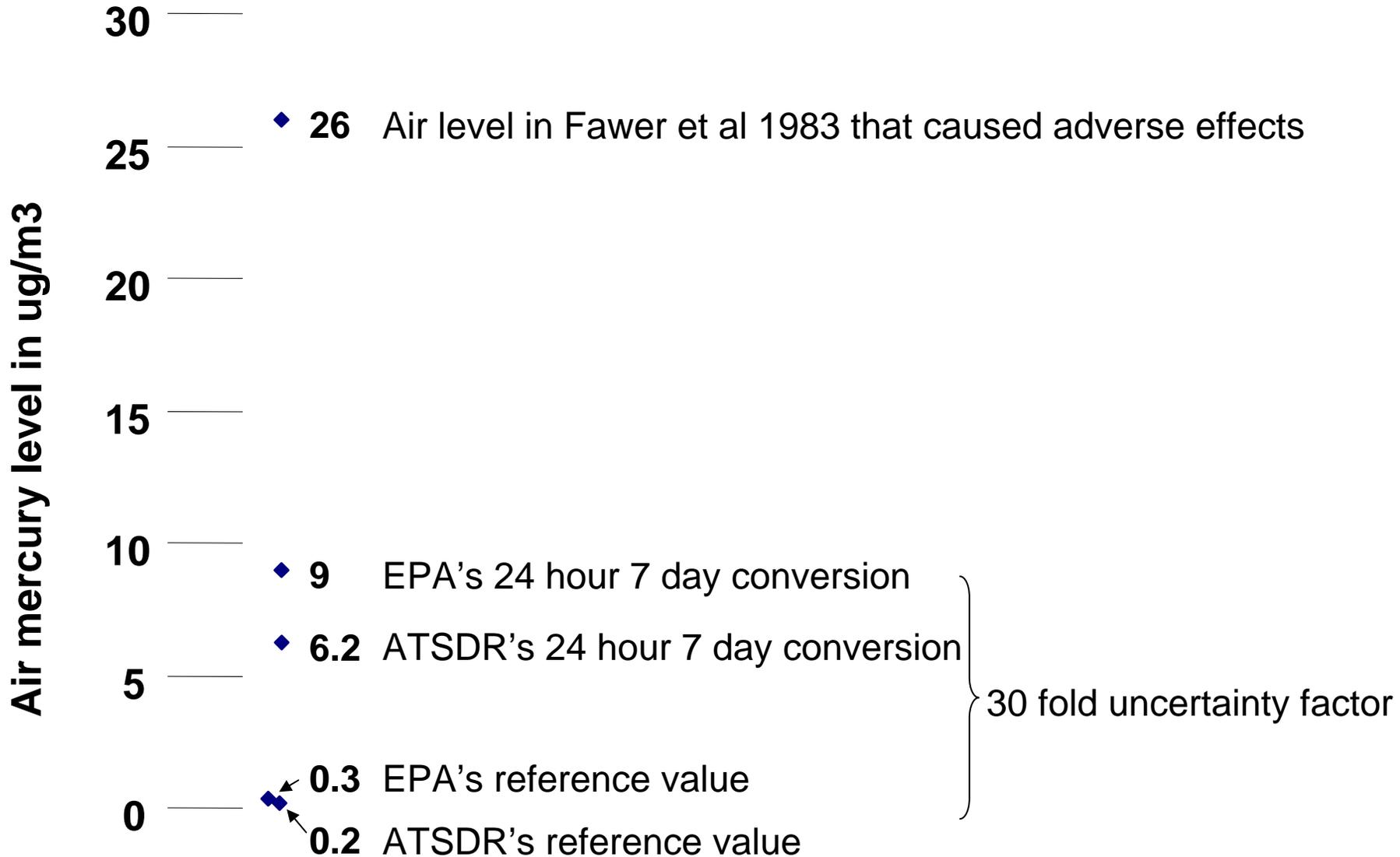
The EPA RfC is **0.3 ug/m³**

The ATSDR MRL is **0.2 ug/m³**

Log



Not Log



US Public Health Service Evaluations

- Several U.S. Public Health Service (USPHS) agencies reviewed studies of health effects related to exposures to dental amalgams and exposures to elemental mercury vapor
 - Participants: CDC, EPA, NIEHS, NIDR, NIOSH, FDA, academia
 - Expertise: toxicology, neurotoxicology, renal toxicology, immunotoxicology, epidemiology
- Findings published in the 1993 USPHS Report
- Update published in 1997

1993 USPHS Report Conclusion

“...current scientific evidence does not show that exposure to mercury from amalgam restorations poses a serious health risk in humans, except for an exceedingly small number of allergic reactions.”

<http://www.health.gov/environment/amalgam1/ct.htm>

(119 studies reviewed)

Exposure to mercury from amalgam

- USPHS 1993 reviewed the studies on exposure
“Measurements of mercury in blood among subjects with and without amalgam restorations (61) and subjects before and after amalgams were removed (64,71) provide the best estimates of daily intake from amalgam dental restorations. These values are in the range of 1 to 5 μg .”

61 Abraham, J.E., Svare, C.W., Frank, C.W. (1984): The effect of dental amalgam restorations on blood mercury levels. *J Dent Res* 63:71-73.

64 Snapp, K.R., Boyer, D.B., Peterson, L.C., Svare, C.W. (1989): The contributions of dental amalgam to mercury in blood. *Dent Res* 68:780-785.

71 Molin, M., Bergman B., Marklund, Schutz A., Skerfving S. (1990): Mercury, selenium, and glutathione peroxidase before and after amalgam removal in man. *Acta Odontol Scand* 48: 189-202.

Converting daily intake to air concentration

Roughly speaking, a given intake dose like 5 ug/day could be equated to an air concentration

$$\text{daily dose} \div \text{daily breathing rate} \\ = \text{air concentration}$$

Assuming a breathing rate of 15.2 cubic meters per day
(based on EPA Exposure Factors Handbook <http://www.epa.gov/ncea/efh/>)

Mercury air concentration at the intake doses would be

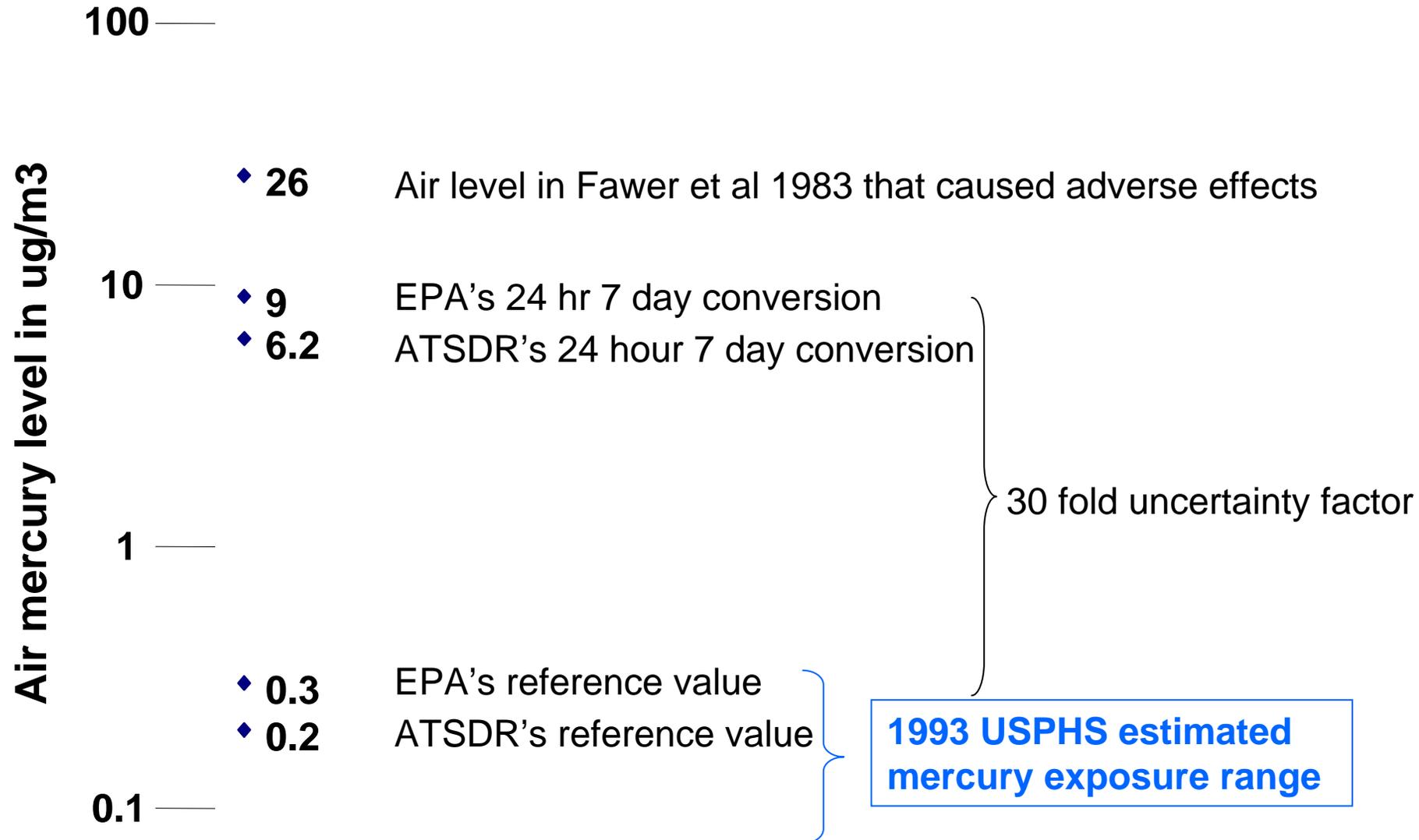
$$1 \text{ ug/day} \div 15.2 \text{ m}^3/\text{day} = 0.066 \text{ ug/m}^3$$

$$5 \text{ ug/day} \div 15.2 \text{ m}^3/\text{day} = 0.33 \text{ ug/m}^3$$

The 1-5 ug/day intake for mercury estimated by USPHS 1993 then corresponds to an air concentration range of

0.066 to 0.33 ug/m³

Log



1993 USPHS report research priorities

- whether low-level mercury effects are prevalent in the general population and whether they can be attributed to amalgam;
- which special population groups, (e.g., children, pregnant women, or people with renal disease), if any, might be especially sensitive to mercury effects;
- how human studies could be designed to assess the potential effects of dental amalgam;
- whether existing dental amalgam restorations should be replaced and, if so, under what circumstances;
- how the mercury in dental amalgam might be stabilized to minimize release into the body; and
- the safety and effectiveness of existing alternatives to dental amalgam.

1997 USPHS Update Conclusion

“...The analysis of the cited studies indicated that the current body of data does not support claims that individuals with dental amalgam restorations will experience adverse effects, including neurologic, renal or developmental effects, except for rare allergic or hypersensitivity reactions.”

<http://www.health.gov/environment/amalgam2/Contents.html>

(65 studies reviewed)

Research begun or in progress in 1997

Greater than \$30 million yearly through National Institute of Dental and Craniofacial Research (NIDCR)

– Safety

- “Ranch Hands” military cohort
- Two studies in children
- Immune function
- Changes in antibiotic resistance
- Relative contribution of amalgam mercury to overall mercury body burden

– Alternative materials

“...designed to produce clinically and commercially viable alternatives to amalgam.”



Thank you