

Health Implications from Lead in Drinking Water

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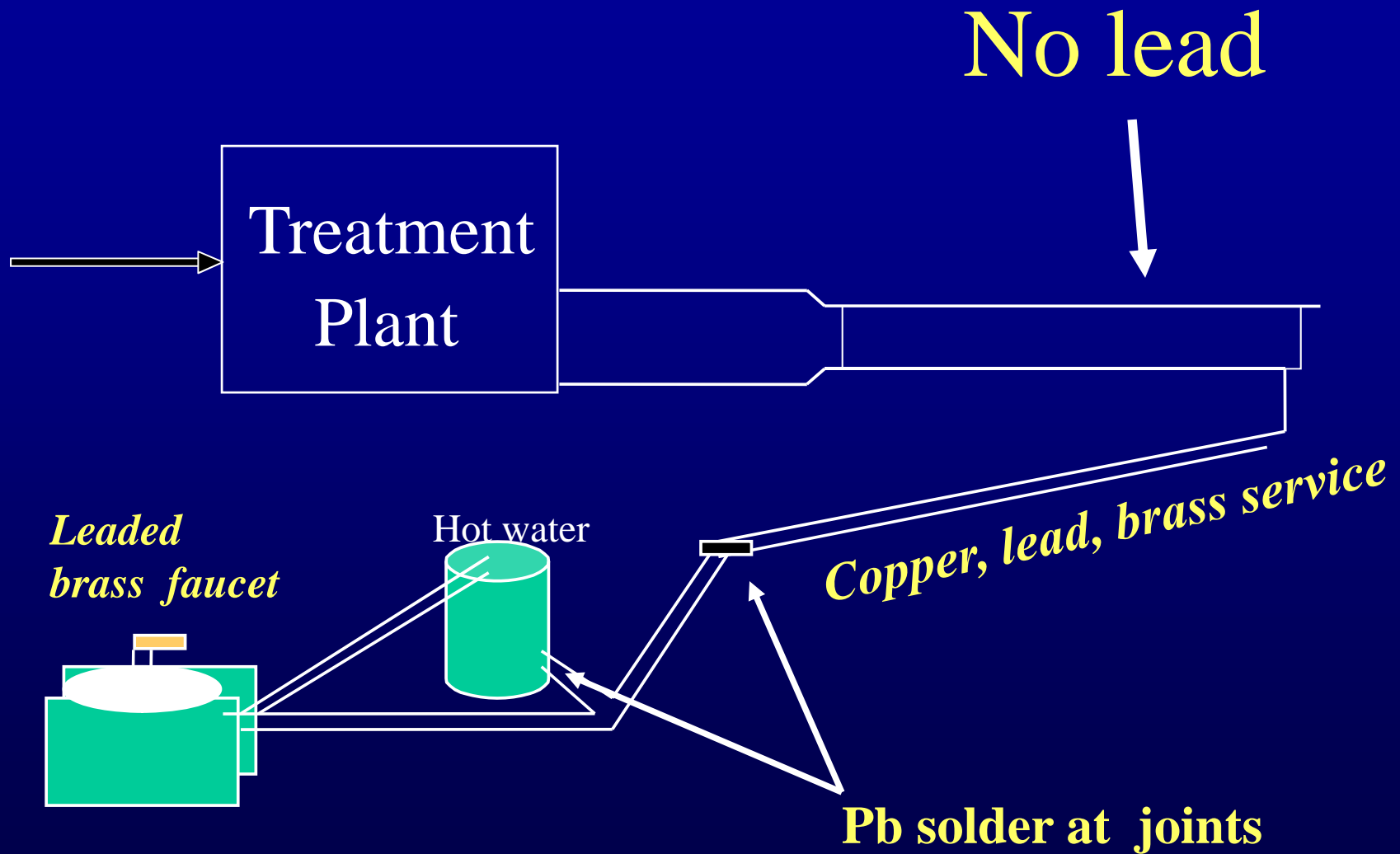
VirginiaTech

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Where does the
lead come from?

Lead Sources





Lead Solder



Cut lead service line from D.C.
Photo from Mike Schock..



Brass with Up to 8%
Lead By Weight
(Still Allowed)

Key Points

Lead in water poses an acute health concern

Our sampling methods miss many hazards

Public health officials do not understand the problem

Acute Health Effects

- 4 year old ate lead jewelry
- Mis-diagnosed with viral gastroenteritis
- returned 2 days later with a “sore tummy”
- went into respiratory arrest and died



CPSC (2005) established 175 ug Pb as a dose triggering acute health concerns, fines and product recalls

'Thomas' Toys Recalls



June 14, 2007

Consumer Product Safety Commission

If 175 ug lead will trigger fines and recalls in a product not supposed to be consumed then....

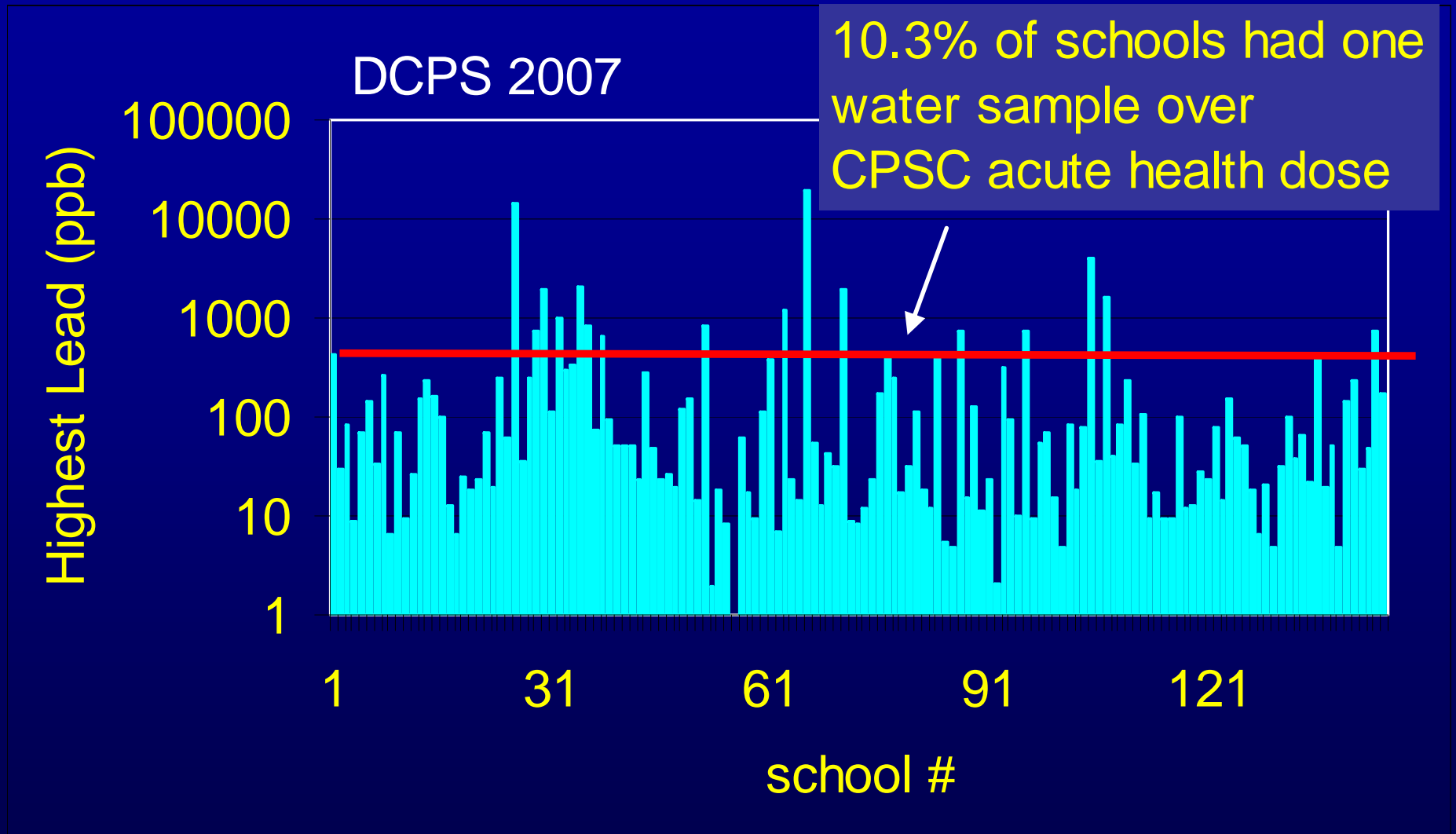
a dose of 175 ug lead in potable water is also unacceptable

% schools with at least 1 sample
exceeding CPSC acute Pb health criteria

| <u>% schools</u> | <u>Date/Place</u> |
|------------------|----------------------------------|
| 10.3 | 2007 Washington, DC [#] |
| 4.5 | July 2004 Seattle, WA |
| 20 | Oct. 2005 B-burg, VA |
| 57 | Feb 2005 MC, MA* |

[#]after 45 minute+ pre flush the night before sampling

175 ug lead = 700 ppb lead in a 250 mL sample



Highest sample contained 20,000 ppb lead

Pb in water vs. Pb in paint



250 mLs at 20,000 ppb Pb



14 dime size paint chips 1% Pb

Both have 5,000 ug lead

Acute health
concerns from
lead in water
are real.

Our sampling is
missing the
worst of the
lead.

The Problem of Particulate Lead

- The sampling protocol for the EPA Lead and Copper Rule is based mostly on the assumption that lead in water is soluble
 - Sampling protocols were not designed to accurately measure particulate lead

*The real danger from lead in water is
from lead particles*

Generation of Pb Particles

**Corrosion
or Rusting**

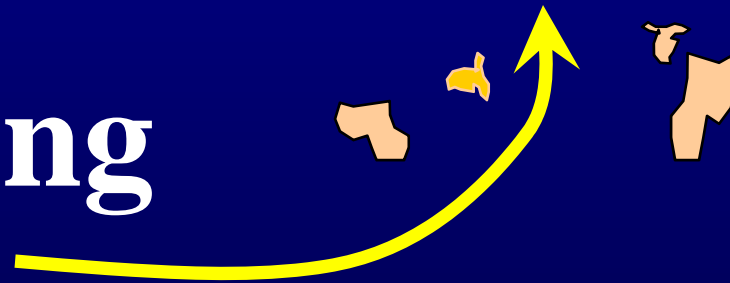


Lead Solder, Lead Scale or “Rust” layer

Lead Solder, Lead Pipe or Brass

Detachment During Flow

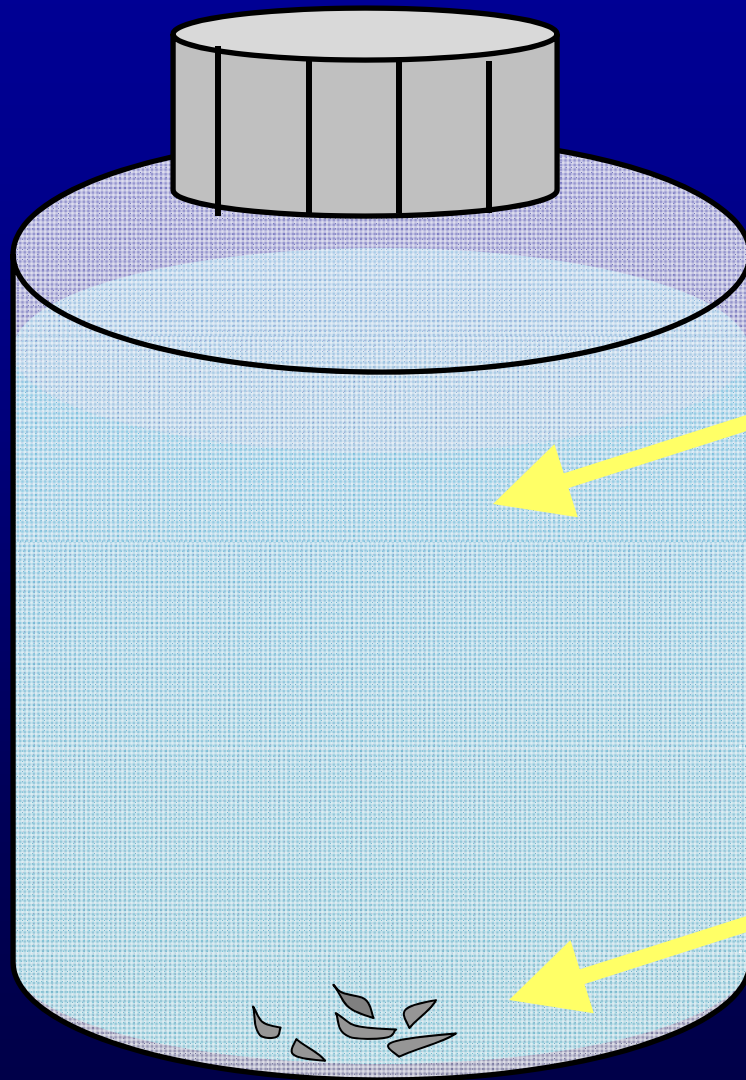
Scouring



Lead Solder, Lead Scale or “Rust” layer

Pb Plumbing Material

How Particulate Lead is Missed.

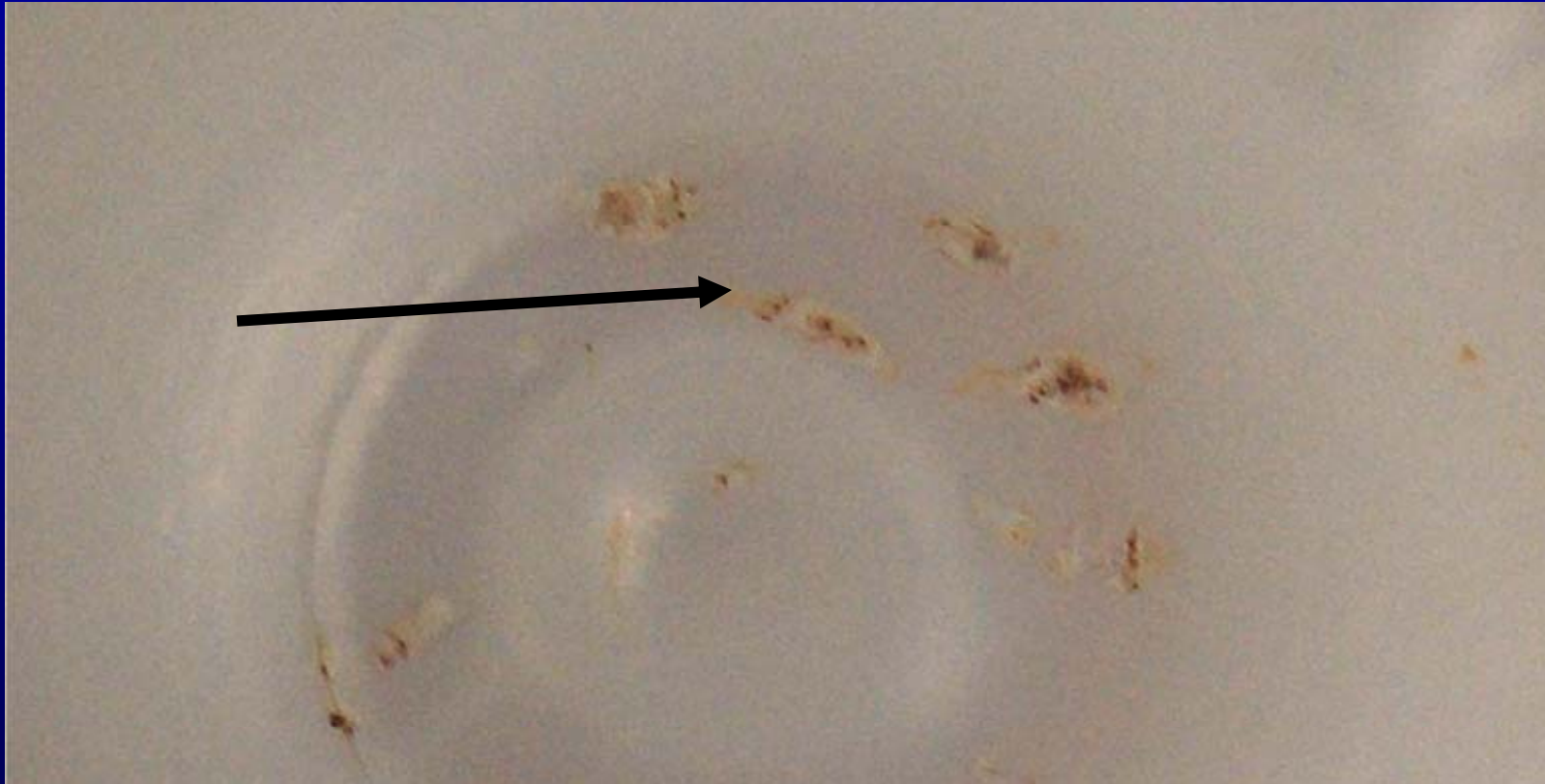


**Water poured
out for analysis,
“misses” lead**

**Particles sink
to bottom and
do not dissolve
at pH 2**

JAWWA June 2007

Weak pH 2 acidification can miss lead in some samples



up to 80% lead in DC water was missed

(Edwards JAWWA, 2004)

More Recent Data

Lead in water sample collected that measured
3 ppb using EPA protocol

Using stronger acid the sample was shown to
actually contain 1560 ppb lead

99.8% of the actual lead was missed

But the particulate lead is
in large part bioavailable

DETECTION OF
PARTICULATE LEAD
HAZARDS CRITICALLY
DEPENDENT ON DETAILS
OF SAMPLING

*Spikes of lead more likely
at higher flow rates*

Instructions to Consumers: “Slowly and gently turn on the COLD WATER TAP to fill up the bottle in approximately 45 seconds.”



Lower lead



Higher lead

Using tall
bottles with
small
opening
lowers
detection of
lead relative
to normal
use



Some other sampling issues

- Cleaning aerators, or extensive flushing, done the night before sampling...minimizes lead sampled
- Never even sample hot water for lead...

we told you never ever drink hot water or use it for cooking because it probably has high lead



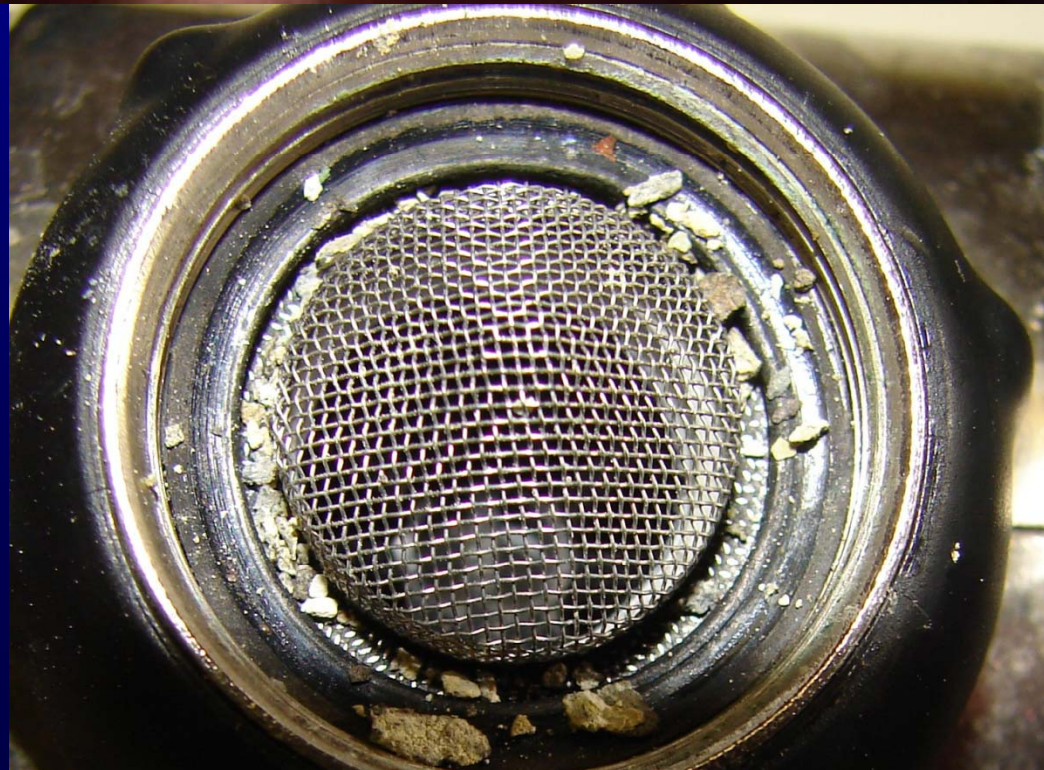
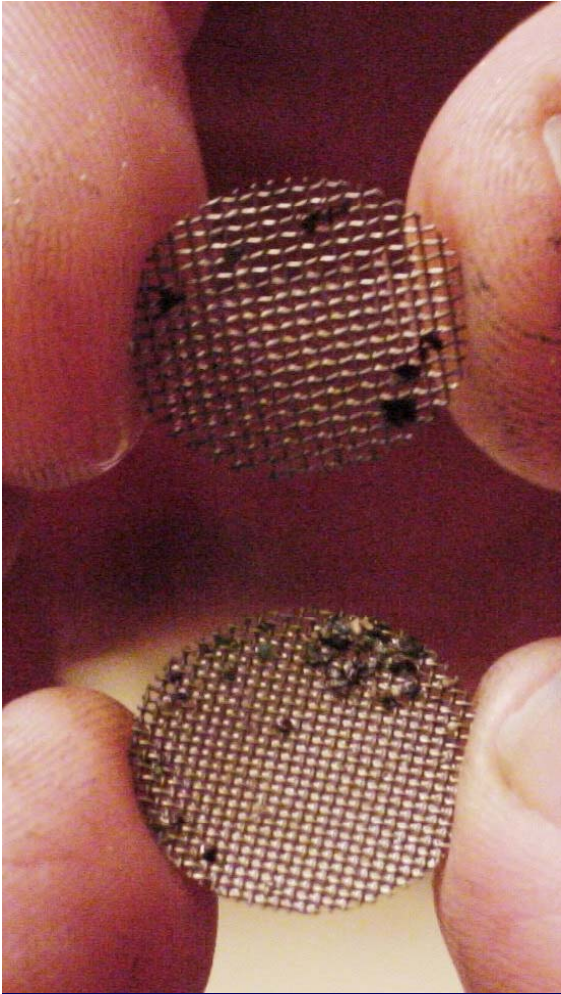
Potential exposure from
food preparation has
been underestimated.

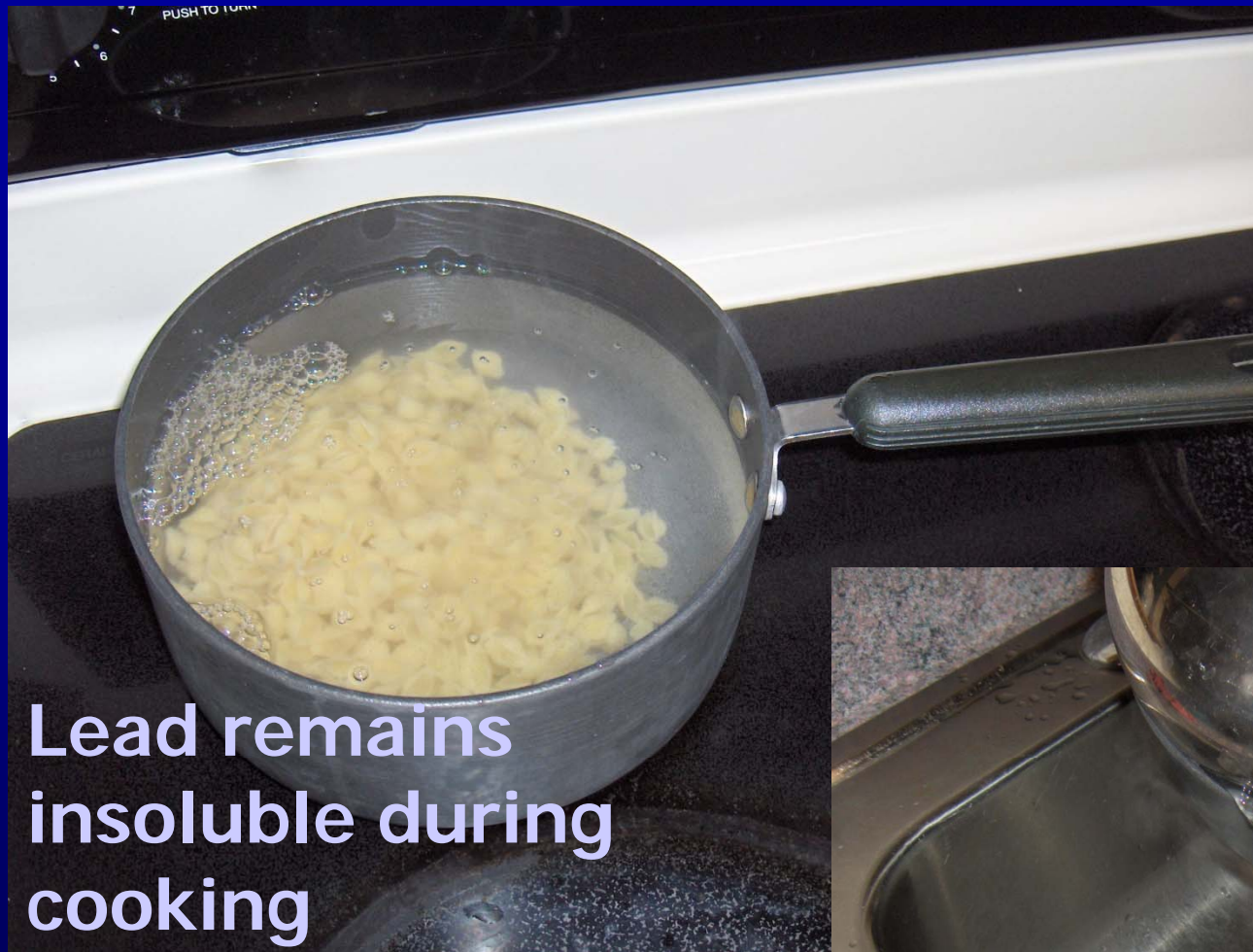
Lead Poisoning from Water, When the Water is Not Directly Consumed?

Blood and Water: The long Search for the Source of a baby's Lead Poisoning

Washington Post, 2004

“The strange thing about the case is that the child had never been given tap water to drink...Rice, pasta, potatoes, everything was cooked with tap water”





Lead remains insoluble during cooking



< 5% particulate lead poured off



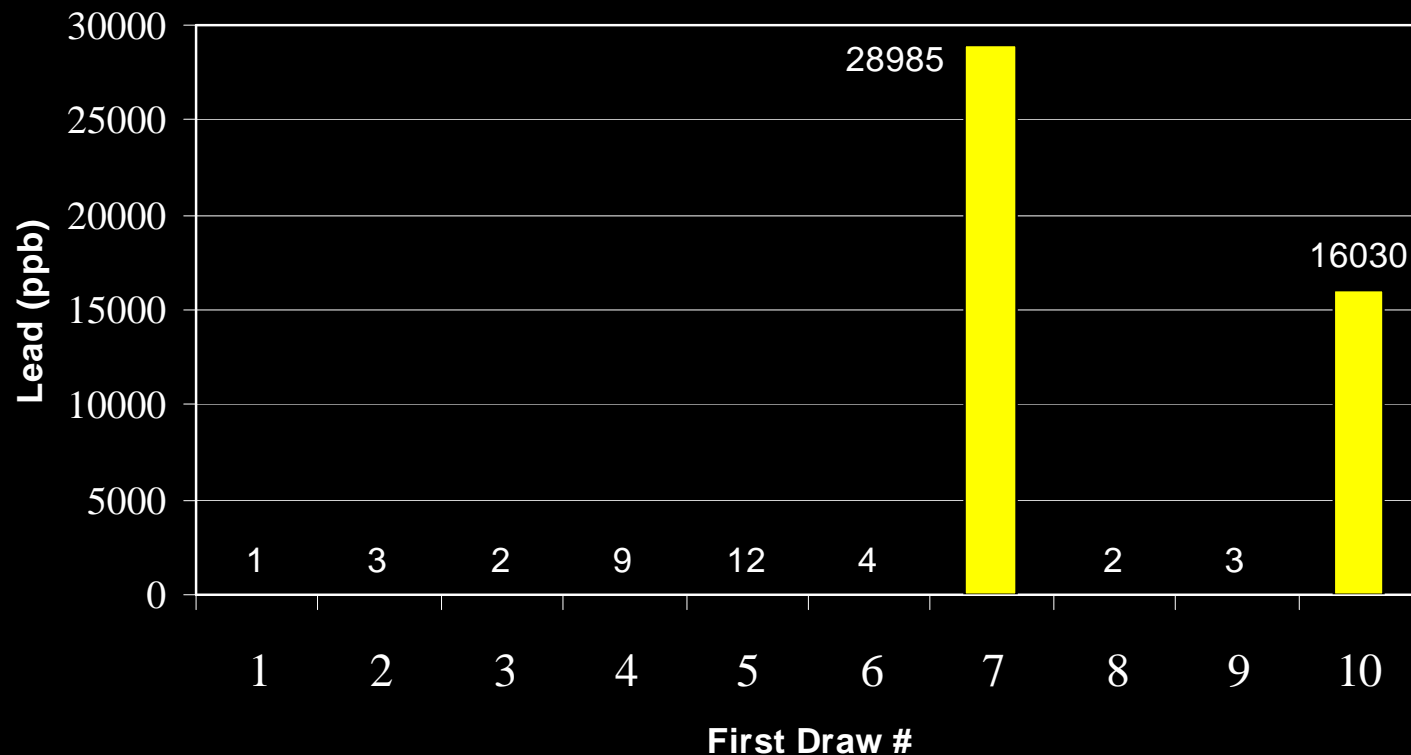
381 ug Pb



310 ug Pb

Extreme variability in lead
sampling data at some
hazardous taps.

Sporadic Lead Spikes



Avg. w/o = 2.5 ppb

Avg. with = 4505 ppb

Repeated 2nd Draw WASA/DC DOH Sample Data From Home of Lead Poisoned Child via FOIA

- 7/26/2003 75 ppb (WASA)
- 3/23/2004 19 ppb (WASA)
- 3/23/2004 11 ppb (DC DOH)
- 10/8/2004 21 ppb (WASA)
- 11/2/2004 583 ppb (WASA)

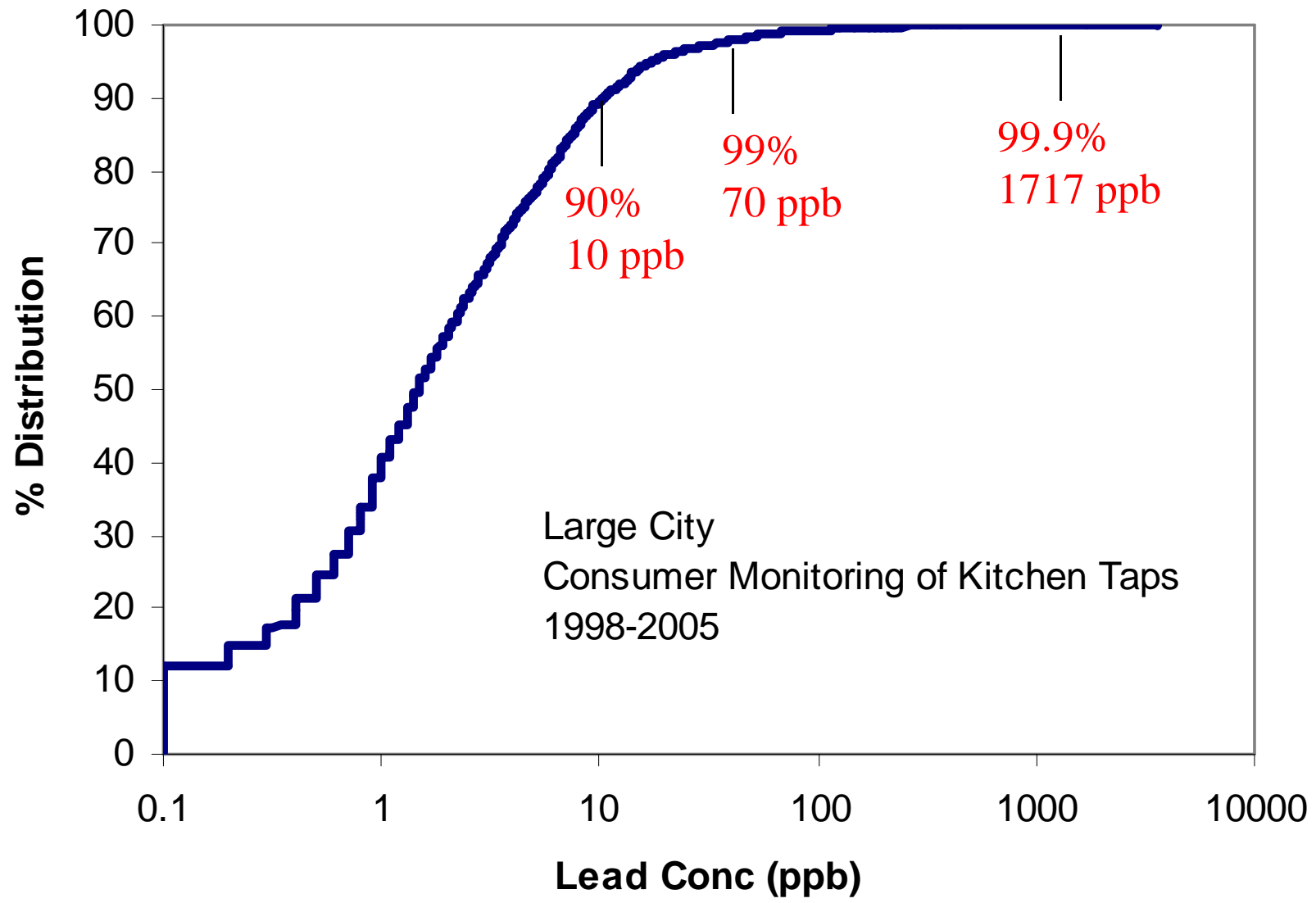
**DC DOH concluded water was safe
based on their one sample 3/23**

If lead in water was
causing health
problems, wouldn't our
public health agencies
tell us?

The CDC starts with a false assumption.

“EPA limits lead in drinking water to 15 μg per liter.”

<http://www.atsdr.cdc.gov/tfacts13.html>



≈1% of children in this city would
be predicted to have elevated
blood lead from tap water
consumption alone (> 70 ppb)

in a city with 100,000 children that
would be 1,000 cases

CONCLUSIONS

- Lead in water poses an acute human health risk.
- The higher levels of lead sampled in many U.S. schools exceed thresholds that would trigger fines/product recalls if found in toys by the CPSC
- There is no evidence that elevated blood lead from contaminated tap water does not occur with fairly high frequency ($\approx 0.1-1.0\%$) in some cities and simply goes undetected.
- We are sometimes missing the lead hazards
- Public health agencies do not understand hazards associated with lead exposure from drinking water.

CONCLUSIONS

- Hypocritical double standard applied to lead in water vs. lead from paint/toys
 - One problem we have shared direct responsibility for
 - One we can blame on someone else



Marc Edwards received his bachelor's degree in Bio-Physics from SUNY Buffalo in 1986. He received his M.S. and Ph.D. in Environmental Engineering from the University of Washington, in 1988 and 1991, respectively. In 2004, Time Magazine dubbed Dr. Edwards "The Plumbing Professor" and listed him amongst the 4 most important "Innovators" in water from around the world. The White House awarded him a Presidential Faculty Fellowship in 1996. In 1994, 1995 and 2005, Edwards received the Outstanding Paper Award in the Journal of American Waterworks Association and he received the H.P. Eddy Medal in 1990 for best research publication by the Water Pollution Control Federation (currently Water Environment Federation). His M.S. Thesis and PhD Dissertation won national awards from the American Water Works Association (AWWA), the Association of Environmental Engineering and Science Professors and the Water Environment Federation (formerly the Water Pollution Control Federation). In 2003 he was awarded the Walter Huber Research Prize from the American Society of Civil Engineers. In 2007 Edwards was awarded a MacArthur Fellowship and was also named Outstanding Faculty Member in the State of Virginia.

Edwards is currently the Charles Lunsford Professor of Civil Engineering at Virginia Tech, where he teaches courses in environmental engineering and applied aquatic chemistry. Since 1995, undergraduate and graduate students advised by Edwards have won 22 nationally recognized awards for their research work on corrosion and water treatment. Edwards has published more than 88 peer reviewed journal articles, made more than 100 national and international conference presentations, and delivered 4 keynote addresses. Edwards was president of the Association of Environmental and Engineering Science Professors from 2003-2005 and he testified to the United States Congress on the issue of lead in Washington DC drinking water. His research group is currently emphasizing research on internal corrosion processes in home plumbing-- a problem costing consumers in the U.S. billions of dollars each year and which also can endanger the safety of potable water. The National Science Foundation, individual water utilities and homeowners' groups, the AWWA Research Foundation, the United States Environmental Protection Agency (U.S. EPA), and the Copper Development Association support that research. His research groups' work has been featured in Time Magazine, Materials Performance, National Public Radio, Prism, Salon, Good Housekeeping, Environmental Science and Technology, Public Works, Earth and Sky, and in newspaper articles around the country.