

The Wisconsin Children's Lead Levels and Educational Outcomes Project

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50 Sn 118.69	51 Sb 121.75
82 Pb 207.2	83 Bi 208.9804

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Wisconsin Department of Health Services

*Wisconsin Environmental Health
Association Meeting*

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Presentation

- Lead: Exposure and Etiology
- History of Lead in Wisconsin
- Epidemiology of Lead Poisoning in Wisconsin
- Lead Effects: Beyond the Medical Model
- Project Description
- Questions/Discussion

Lead: Exposure and Etiology

82

Pb

207.2



- Persistent, naturally-occurring metal
- Most abundant toxic heavy metal
- Insoluble in water
- Poor electrical conductor
- Good sound and vibration absorber
- Non-combustible
- Relatively impenetrable to radiation

Lead: Exposure and Etiology



How lead serves in your home

LEAD has never been prized for its beauty, as **LEAD** has gold and silver and other precious metals. With a reputation as one of the heaviest metals, lead has had few admirers.

Yet lead today, because of the many services it renders, is to be found in homes everywhere.

In the bathroom

Lead is an important ingredient in making the glass white enamel that covers the iron tub and toilet and the glass tile walls in your bathroom.

The lead oxides, color diluents or color-lead, are mixed with several other materials and melted. This makes a molten glass which changes into fine white particles when plunged into cold water. A mixture of these particles and water is spread on the iron body of tub and toilet and the coating is fired at high temperature. When cooled it presents the beautiful hard enamel surface with which we are familiar.

In the dining-room table

In practically the same way as lead enamel is put on the bathtub, the potter uses white-lead, lithium, or red-lead to help produce the smooth, hard glass on the fine china plates, cups, and saucers you have on your dining-room table. Certain bowls and dishes on your table are from a special lead-oxide glass.

Lead in the every room

Electric light bulbs throughout your home are made of fire-lead glass. Red-lead helps to seal vacuum tubes. Rubber stoppers in bath-tubs and basins have lead in them. The hard rubber of your comb contains lead.

On your desk may be collapsible pens and glass rulers made of lead alloy. If your table lamp has a "crystal" shade, a shade of crystallized glass, the bits of glass are held together by leaded solder.

Lead is in the hard rubber cover of your pipe. Your tobacco and your tea are often contained in heavy lead tin foil to keep them. There is lead in the hard rubber case of your fountain pen.

Lead on the walls

All these uses of lead are interesting and important. But its most important use is as paint. Manufacturers use white-lead as the principal ingredient in the paint they make. Professional painters use a mixture of pure white-lead and linseed oil so flaking will not occur when they cover. Peppers, corners everywhere are being rapidly converted to the necessity of protecting their houses with paint. The phrase, "have the surface and you have all," is recognized as a truth. For durable lead, in the form of white-lead, is your surface savior.

Lead for the Dutch Boy

NATIONAL LEAD COMPANY makes white-lead of the highest quality and sells it mixed with your favorite brand of Dutch Boy white-lead. The Agent of the Dutch Boy is produced on every bag of white-lead and is a guarantee of exceptional purity.

Dutch Boy products also include red-lead, heavy oil, flaring oil, habitin enamel, and rollers.

More about lead

If you use lead, or think you might use it in any form, write us on for specific information.

NATIONAL LEAD COMPANY
 One Room, 21 Broadway, Newark, N.J. 07102, U.S.A. or 100 Broad Street, New York, N.Y. 10004, U.S.A. Telephone: (212) 312-1000. In New York, N.Y., call (212) 312-1000. In other parts of the U.S., call (212) 312-1000. In Canada, call (416) 593-1000. In Mexico, call (52) 55-5511-1000. In South America, call (54) 11-5511-1000.



It's not Peeling it On...but Taking it Off that makes "CHEAP" PAINT SO EXPENSIVE

No Burning and Scraping with Dutch Boy...it costs less by the year and sure the N.H.A. lets you pay for it by the month

"Every one painting your house? Sure, I'd be glad to. But I can tell you something else, the price will depend on what kind of paint you used last time."

"I hope it wasn't cheap paint, flaking and scraping costs money. But it has to be done when you add your lead cracked and sagged. Then I have to get out a new priming coat. That's an extra job."

"The Dutch Boy doesn't crack and sag. It stays on the weather... it won't show redness by gradual chipping which leaves a messy, spongy surface for a new coat foundation for repainting."

"The conscientious painter knows 'cheap' paint, and uses Dutch Boy White Lead, which he mixes to suit the requirements of your job and lets us the exact total you specify. He can know just like a painter."

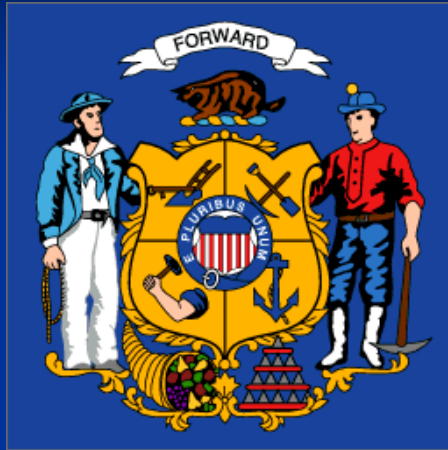
Dutch Boy... On the N.H.A.

Under the National Housing Act small monthly payments make the price of study easy. But whatever you use the Government plan or not, read and use the booklet which tells how to combine with paint and what to look for when buying a paint job. Included are clear and understandable

DUTCH BOY WHITE-LEAD
Good Paints Other Names



Lead History in Wisconsin

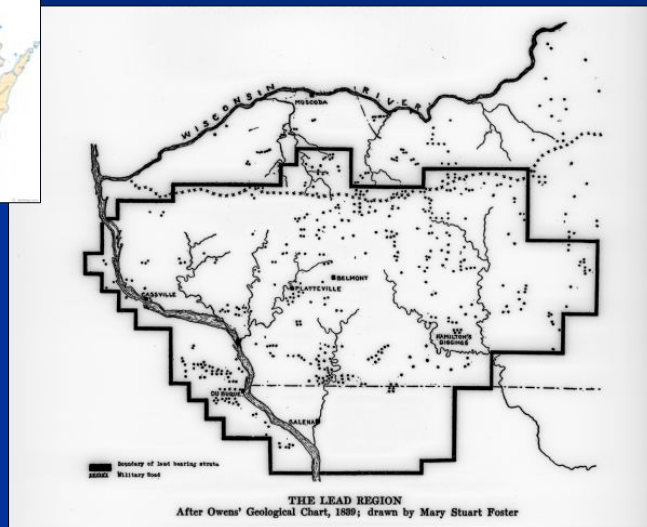


Lead History in Wisconsin



Area of Detail

Map courtesy of
Wisconsin Historical
Society



Lead: Epidemiology (WI)

Wisconsin Childhood Lead Poisoning Prevention Program

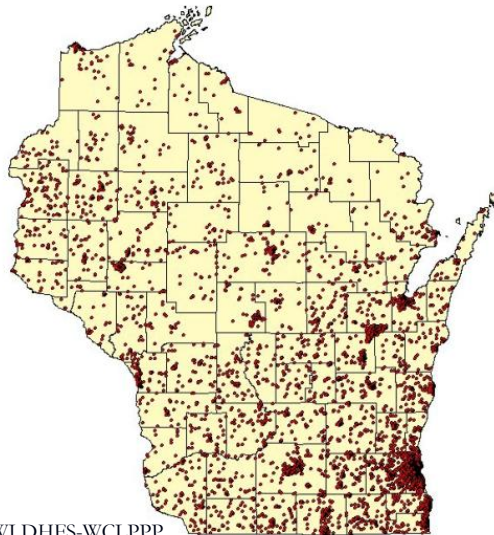
Initiatives

- Mandatory testing for Medicaid and WIC populations at 1st and 2nd birthdays (unfunded mandate)
- Interventions available for children with $\text{bll} \geq 20\mu\text{g/dL}$ (“elevated blood lead level”/ “severe poisoning”)
 - Home abatement
 - Family education
- No services for children with $10\mu\text{g/dL} \leq \text{bll} \leq 20\mu\text{g/dL}$ (“lead poisoned”)

Epidemiology

- WI childhood lead poisoning prevalence twice the national average
- Five percent of children entering WI public schools have been lead poisoned (2006)
- ~90% of all lead poisoned children in WI live in housing built prior to 1950
- < 1/3 of WI children at greatest risk of lead poisoning have been tested at ages 1 and 2

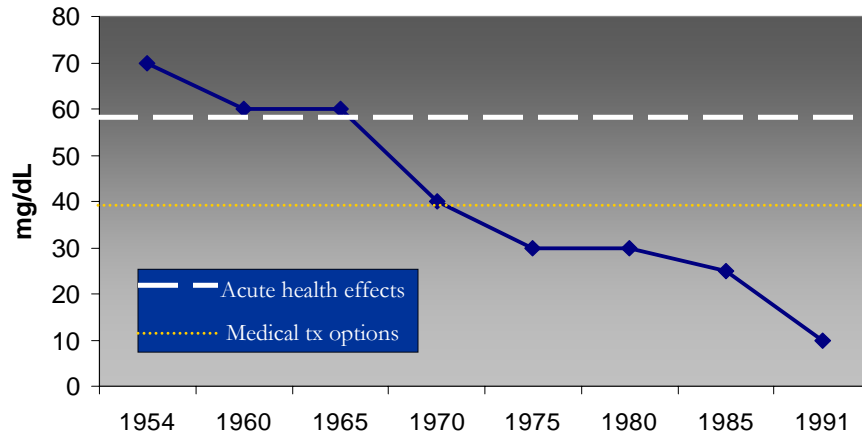
Lead: Epidemiology (WI)



Courtesy of WI DHFS-WCLPPP

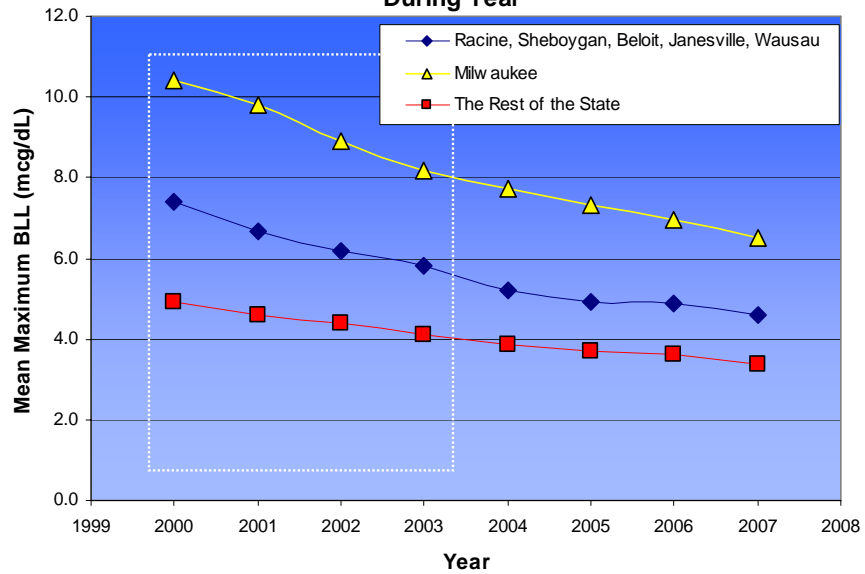
Lead: Beyond the Medical Model

Toxic thresholds for lead poisoning in children

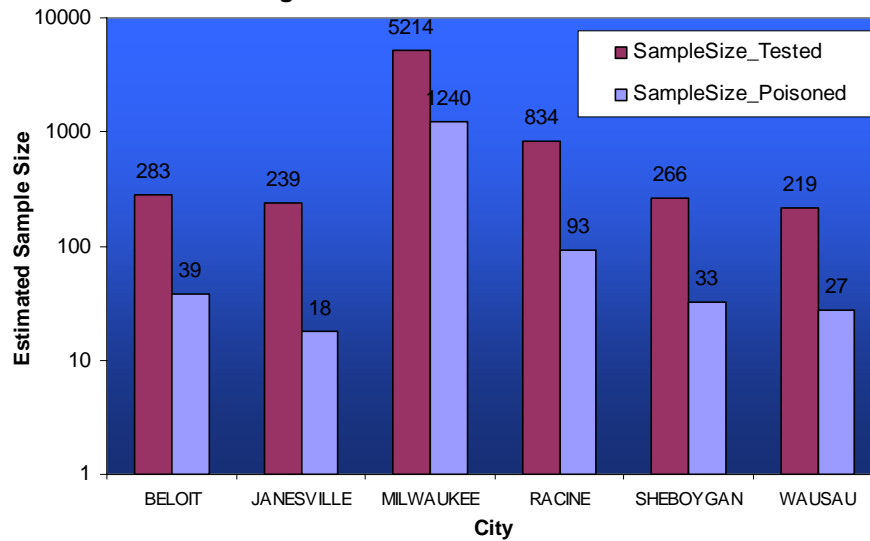


Source for toxic threshold data: Pueschel *et al.* 1996

Mean Maximum BLLs for Children Entering School System During Year



Estimated Sample Size for Children Tested and Children Poisoned Children Born During 1996 Top Six Cities Having Highest Mean Blood Lead Levels



Lead: Beyond the Medical Model

- No medical treatment options for lead poisoning at levels commonly found in WI
- Lead-related sequelae:



Lead: Beyond the Medical Model

Table 1. Cognitive Effects of BLL < 10 µg/dL

Study	Measure	BLL	Cognitive Effect (pts)
Lanphear <i>et al.</i> 2005	IQ	2.4 – 10 µg/dL	- 3.9 (-5.3, -2.4)
Kordas <i>et al.</i> 2006	Math	+1 µg/dL	-0.17 (-0.28, -0.06)
Bellinger <i>et al.</i> 1992	IQ	+10 µg/dL	-5.8 (-9.9, -1.7)
Canfield <i>et al.</i> 2003	IQ	+10 µg/dL	-8.0 (-12.9, -3.2)
Jusko <i>et al.</i> 2008	IQ	5 - 9 µg/dL	-4.9*
Surkan <i>et al.</i> 2007	IQ	5 - 10 µg/dL	-5.0 (SD: 2.3)
Lanphear <i>et al.</i> 2000	Math	+1 µg/dL	-0.7

Lead: Beyond the Medical Model

Miranda *et al.* (2007):

- Educational testing data (4th grade end-of-grade exams) linked to blood lead levels collected at ages 1 & 2 for students in a 7 county region in North Carolina
- Findings:
 - Effects of bll as low as 2 µg/dL found to have an impact on testing
 - Bll of 2 µg/dL negatively impacts reading scores, somewhat impacts math scores

Lead/Ed Outcomes: Motivation

- Epidemiologic research as the basis for public health practice
 - “Consequential epidemiology”
- Addressing health disparities through the built environment
- Inclusion of non-traditional public health partners in a research and intervention endeavor
 - Population Health Model
- Data relevant to local issue – constituents of decision-makers

Project Funding

Wisconsin Partnership Program

“We are targeting research that has the greatest potential to translate quickly to beneficial outcomes for the state’s populations.”

Medical and Education Research Committee

Collaborative Health Sciences Program

“The CHSP was developed by MERC to support novel ideas and new approaches to research and education that will benefit the health of the people of Wisconsin. Innovative collaborations across the traditional boundaries of basic science, clinical science, population health science and/or social science are required.”

CLLEO Key Personnel



State Street
←→



UW School of Medicine
and Public Health

*Department of Population
Health Sciences*

Wisconsin Department of
Health Services

*Bureau of Environmental and
Occupational Health*

UW College of Letters &
Science

Department of Psychology

Wisconsin Department of
Public Instruction

Data Management Team

Study Proposal

Primary Hypothesis: Reduced levels of educational achievement can be partially explained by early childhood exposure to lead.

Study Design: Case-control study (1:1 ratio)

CASES:

Report of $10\mu\text{g}/\text{dL} \leq$
 $\text{bll} \leq 20\mu\text{g}/\text{dL}$

CONTROLS:

No detectable bll at
time of test

OTHER COVARIATES OF INTEREST:

Age, sex, race/ethnicity, program enrollment, school district

OUTCOMES:

4th grade scores on the Wisconsin Knowledge and
Concepts Exam (WKCE)

CLLEO Protocol

Step 1:

Parents of children born between 1996 – 1999 in targeted communities complete questionnaire and consent to have educational information released

Step 2:

Wisconsin DPI releases WKCE scores and demographic covariates to Wisconsin DHS for data matching

Step 3:

UW SMPH/Wisconsin DHS conducts analysis

Recruitment Plan

Milwaukee

Milwaukee Public Schools

WIC Clinics

Health Systems/Providers

Racine

Racine USD

Kenosha

Kenosha USD

Recruitment Plan II

- Eligible study participants for six WI communities with highest lead poisoning rates

	Eligible Cases	Eligible Controls
Children tested from 1996 – 99 (4 th grade completed during study period)	14,719	4,601
Estimate a 20% attrition rate	11,775	3,680
Estimate a 50% response rate to invitation	5,887	1,840
Target sample size	1,000	1,000
Target study population percentage of eligible	17.0%	54.3%

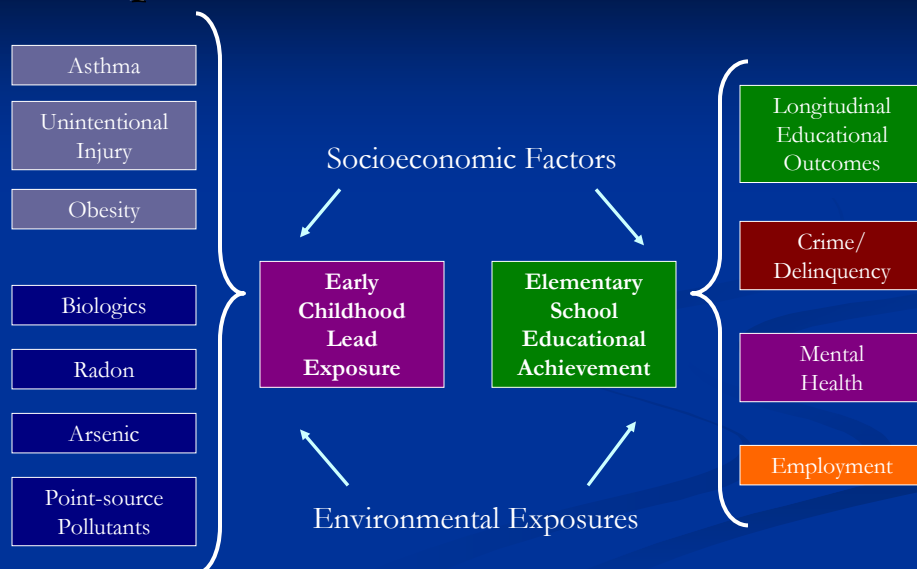
Secondary Outcomes

- Association between moderate blood lead levels [10µg/dL – 20µg/dL] and enrollment in **Special Education** for Wisconsin elementary school students
- Association between moderate blood lead levels [10µg/dL – 20µg/dL] and **classroom behavioral problems** among Wisconsin elementary school students.
- Association between **detectable blood lead levels under current threshold for poisoning** [5µg/dL – 10µg/dL] and educational outcomes for Wisconsin elementary school students

Additional Projects

- Patterns of residential mobility among lead poisoned children in Wisconsin
- Results of physician report card initiative on lead testing rates in Wisconsin
- Invited application for UW Institute for Clinical and Translational Research Grant: *“Inter-community translational-research: The case of lead poisoning.”*

Population Health Research Model



Discussion/Questions

Epidemiologic Questions for Project:

- Number of demographic variables used as matching criteria: thoughts on design strategies v. analytic strategies for dealing with confounding
- WI DPI has predefined scores for proficiency categories: thoughts on classification of outcomes
- Five components to 4th grade WKCE

Discussion/Questions

Population Health Questions:

- Collaboration with Education Partners on Population Health Projects
 - Cultural differences
 - Utility of research
 - Privacy concerns
 - Health exposures, non-health outcomes
 - Learning about learning
- If we *do* find something...
 - What are the educational implications of our research?

Thank You!

- UW RWJF H&SS Site Directors, Fellows, Seminararians and Staff
- UW Dept of Population Health Sciences: Marty Kanarek, Paul Moberg
- UW Dept of Psychology: Colleen Moore
- Wisconsin Department of Health Services: Jeff Havlena, Pam Imm, Margie Coons, and Henry Anderson
- Wisconsin Department of Public Instruction: Rod Packard

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Questions/Comments/Random Musings:

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