

Pediatric Lead Poisoning in Milwaukee

*What Providers
Need to Know*

January 2026



Disclosure Statement

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Learning Objectives

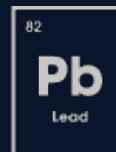
- Describe the health consequences of lead poisoning.
- Discuss the burden of lead hazards in the city of Milwaukee and the importance of testing children.
- Identify basic clinical protocols for pediatric lead care management.
- Review the role of the City of Milwaukee Health Department in addressing elevated lead levels in children and properties with lead hazards.
- Explain state lab reporting requirements.

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Lead
82
Pb
207.20
1.8

2

Clinical Health Effects





Gonzalo Azumendi/Photolibrary

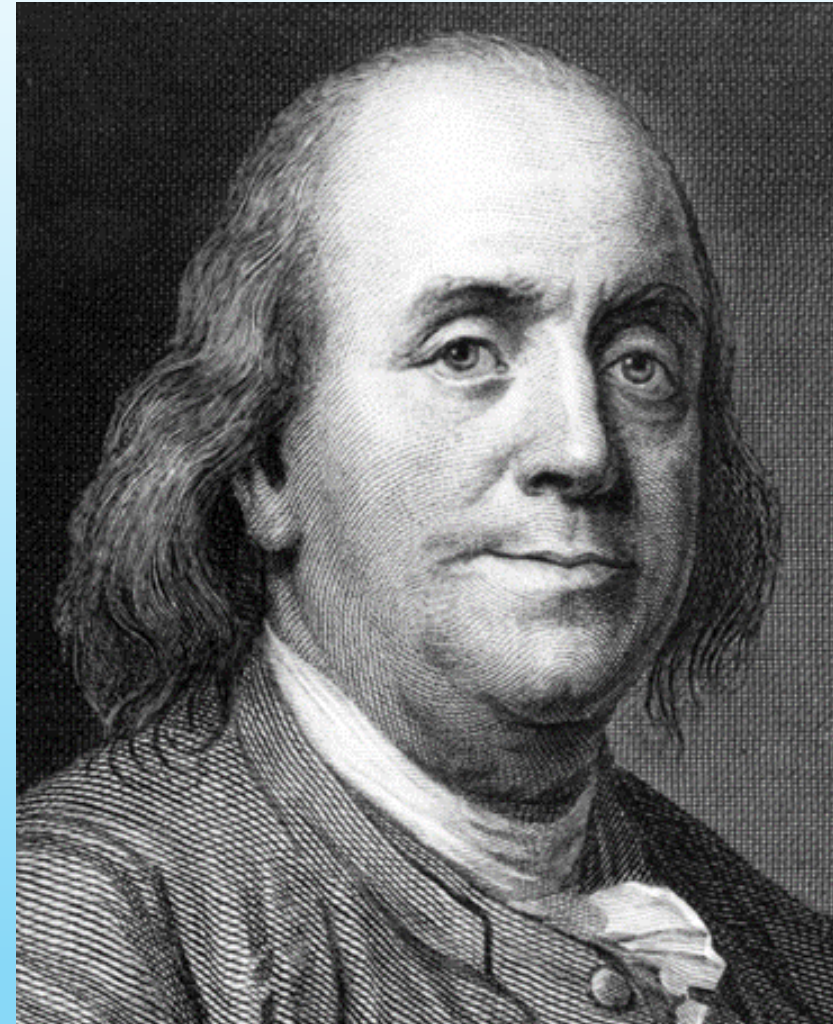
A third-century Roman mosaic, in the House of the Amphitheater in Mérida, Spain, depicts three men jauntily crushing wine grapes by foot.

Long known throughout history to be a poison

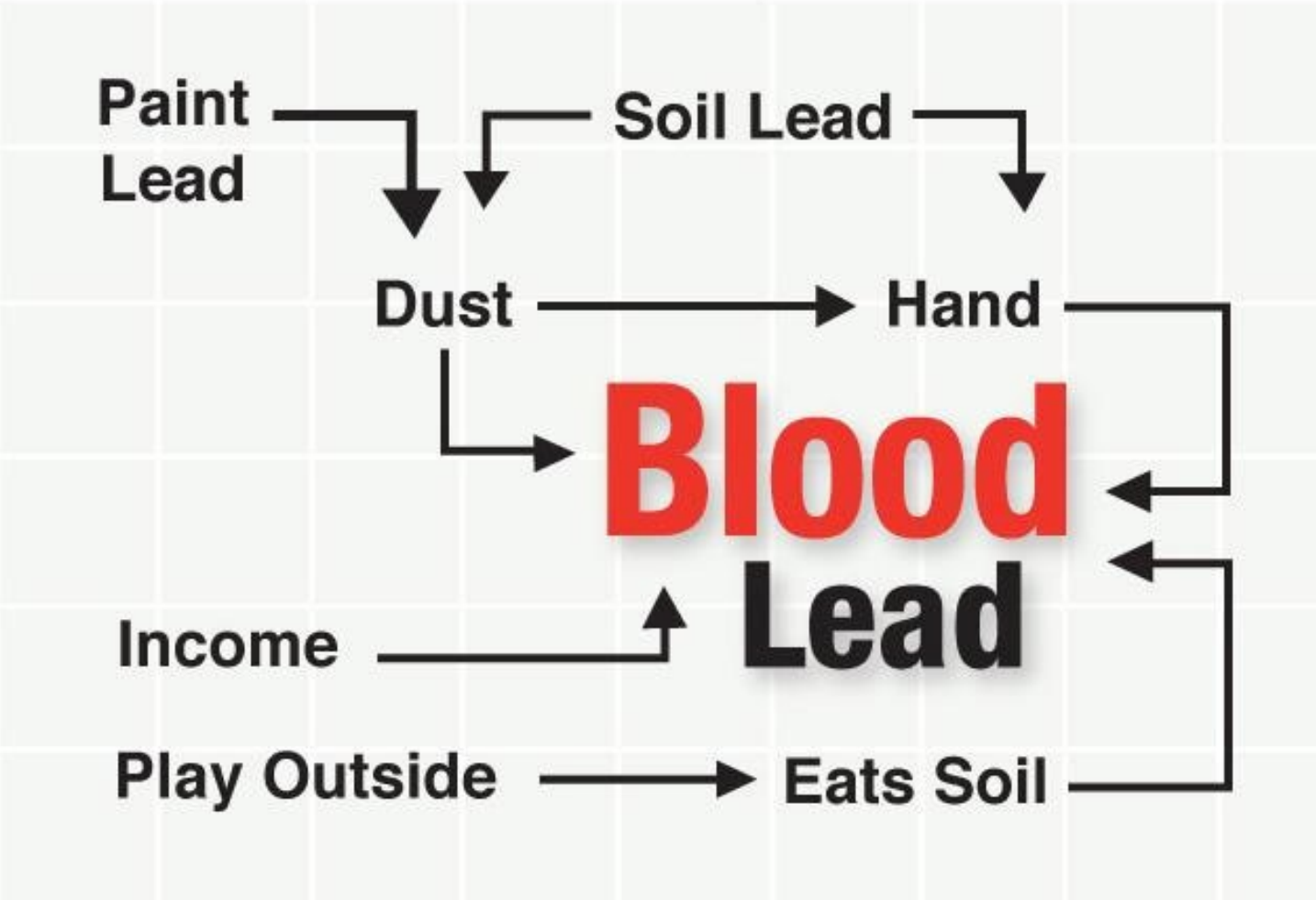
- 2nd century BC –
Dioscorides “lead makes the mind give way”
- 3000 BC – widespread use in Roman, Egyptian, Phoenician society (sapa)¹

“I have long been of the opinion that that distemper [dry gripes] proceeds always from a metallic cause only, observing that it affects among tradesmen those that use lead, however different their trades, as glazers, type-founders, plumbers, potters, white lead-makers and painters.”²

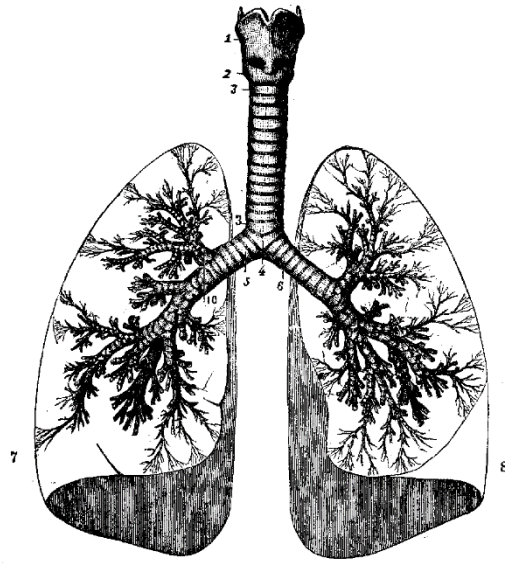
-Benjamin Franklin



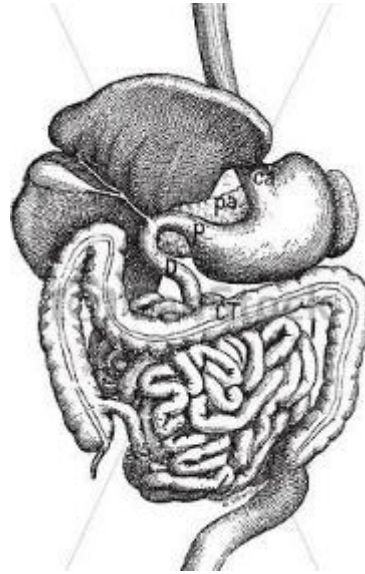
Children can be exposed to lead in many ways



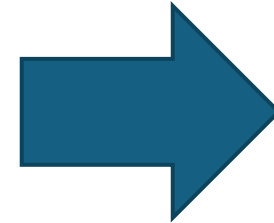
Once its in, where does it go?³



**95% of
inhaled
Pb is
absorbed**



**Kids: 40-50%
Adults: 3-10%
of ingested Pb
absorbed**

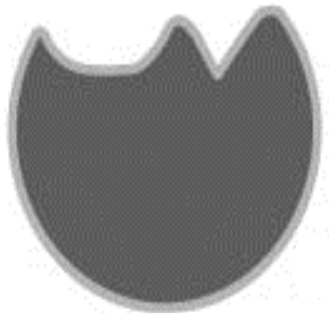
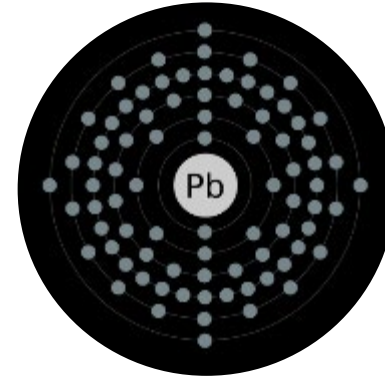
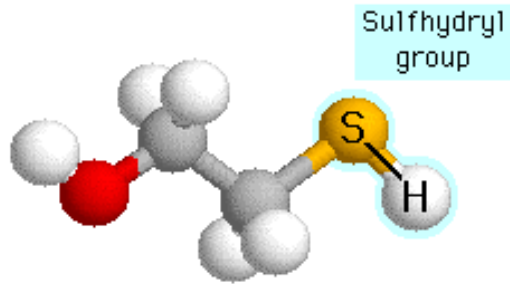


30 days



**27
years**

Mechanism of Lead Toxicity⁴



ENZYME

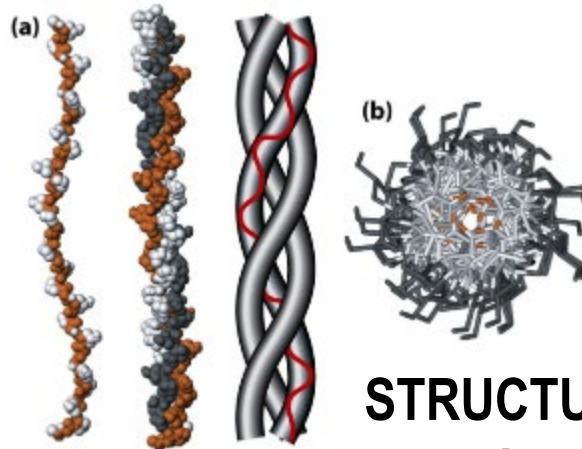
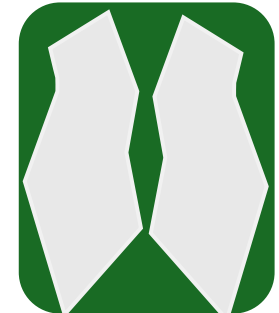


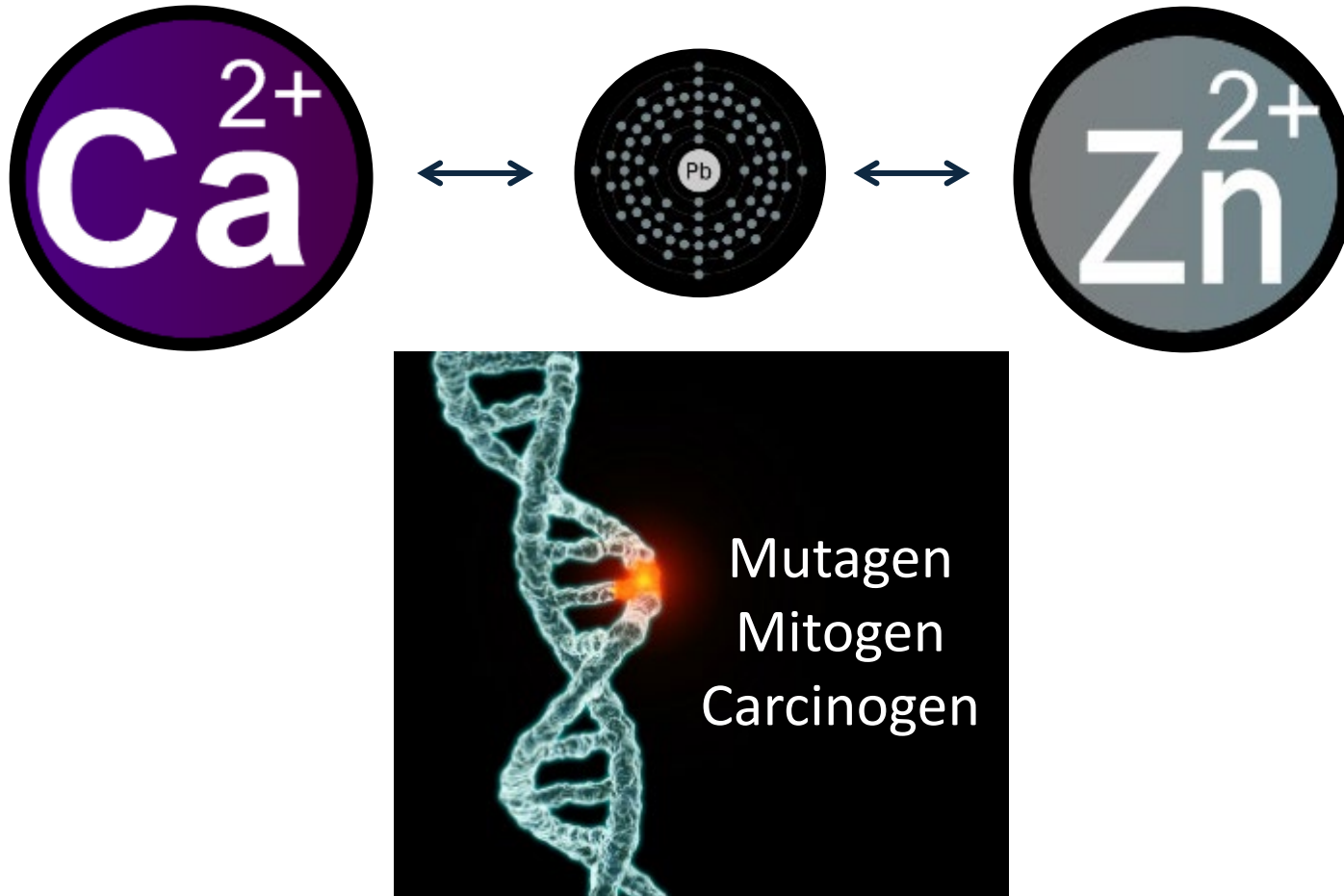
Figure 19-22
Molecular Cell Biology, Sixth Edition
© 2008 W. H. Freeman and Company

STRUCTURAL
PROTEINS

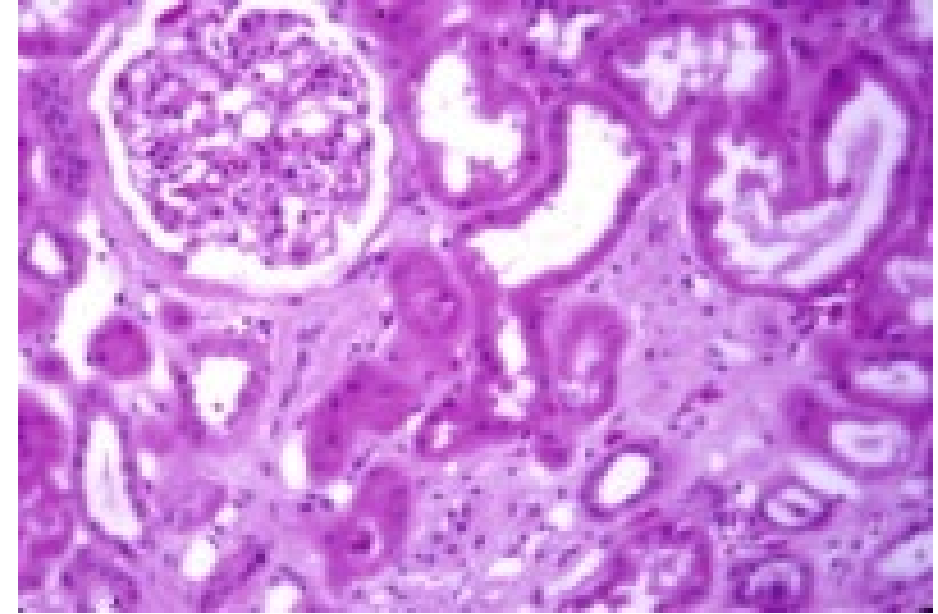
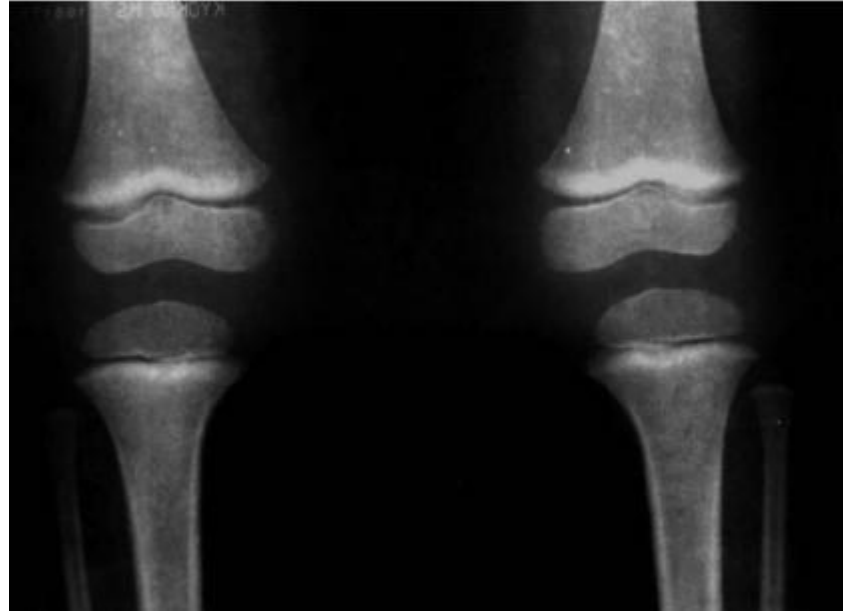


RECEPTOR
PROTEINS

Mechanism of Toxicity⁵



Effects of Lead⁶⁷⁸



- Hypertension
- Increased CV-related mortality
- Anemia

- Impaired bone growth – reduced vitamin D concentrations
- Short stature

- Causes direct renal tubular damage
- Decreases excretion of uric acid - gout

Effects of lead on the Nervous System⁹

- **Encephalopathy**
- **Peripheral neuropathy “the dangles” in adults**
 - Motor > sensory
- **Decreased IQ**
 - Effect of lead on IQ may be more at lower levels
- **Developmental delay**
- **Increased likelihood of criminal behavior**

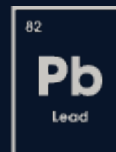


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Population Health Effects



Burden of Lead: How We Measure

NO SAFE LEVEL OF LEAD

- Blood test results $<5\mu\text{g/dL}$ have been associated with lower IQs¹⁰
- CDC Blood Lead Reference Value (BLRV)¹¹
 - Represents 97.5th percentile of the blood lead distribution in U.S. children
 - **NOT a health-based standard or a toxicity threshold**
 - it does change!

Burden of Lead: How We Measure

CDC Blood Lead Reference Value (BLRV)

- Used to identify children with blood lead levels that are **higher than most children's levels** to guide follow-up
- Currently set at 3.5µg/dL - dropped most recently from 5µg/dL to 3.5µg/dL in 2021, and will likely drop again in our careers

When BLRV drops it's a win for children's health – but are we keeping up?

Burden of Lead: What We Know

Thousands of Wisconsin's children, adults, and families live with the effects of lead poisoning

More than **1 in 10 children** under age 6 tested in the City of Milwaukee are **above** CDC BLRV of $3.5\mu\text{g}/\text{dL}$ ¹²

Burden of Lead in Milwaukee: What We Don't Know

Likely hundreds of cases undetected:

- Since 2020, on average only 63% of Milwaukee children under age 2 received a blood lead test!¹²
- Our goal: **100%**

***Consider the costs of blood lead testing
vs benefit of early detection and prevention***

Burden of Lead in Milwaukee: Why?

The older the home, the greater the potential danger from lead hazards

- Higher concentrations of lead were used in pre-1950s paint
- More layers of lead-based paint may be present beneath newer surfaces
- More wear and tear over time means paint is more likely to chip, crack, or turn into dust
- Older plumbing, soil history
- Midwest winters!

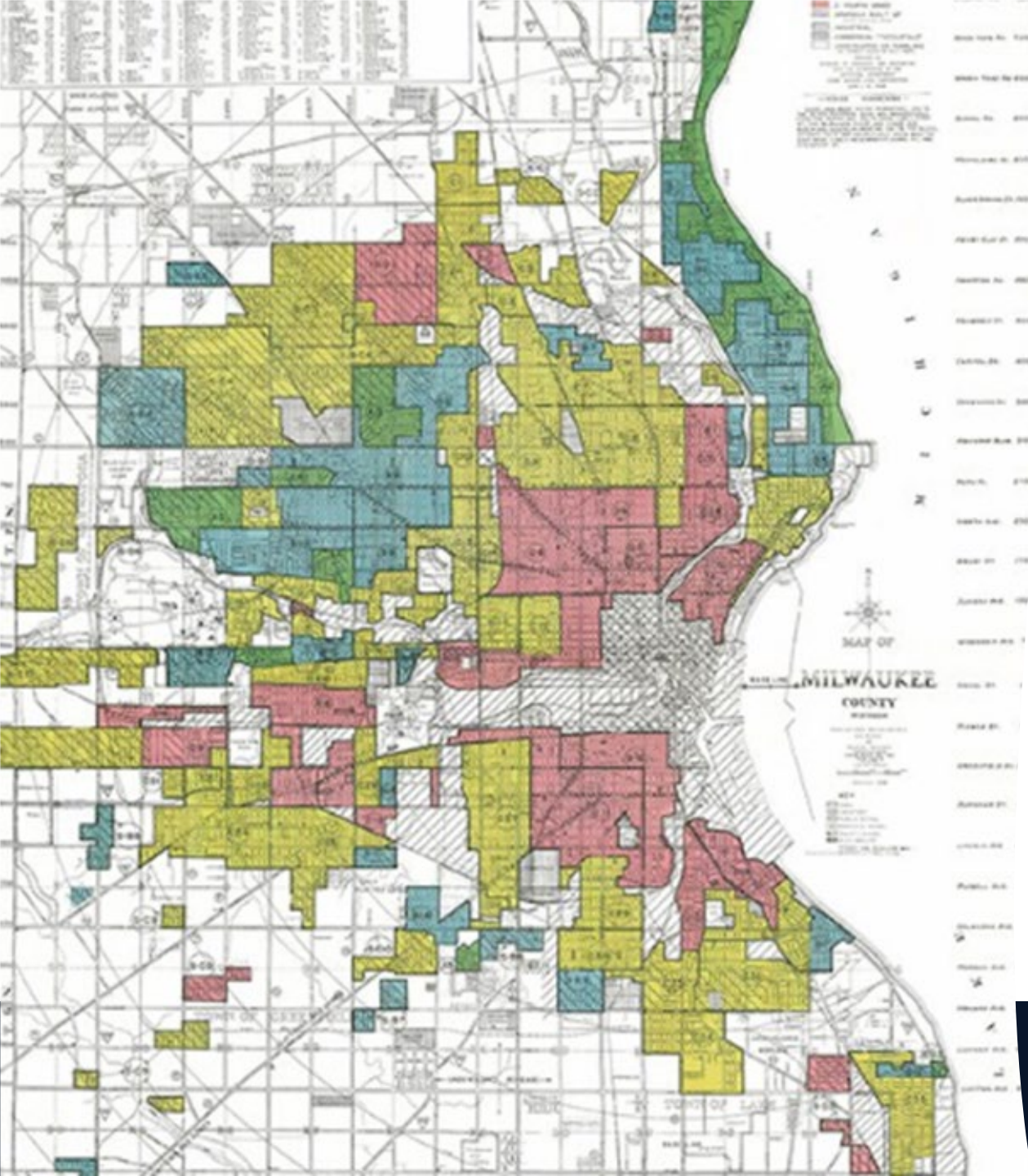
Burden of Lead in Milwaukee: Why?

Milwaukee is an old city!

2023: Milwaukee census tracts had an average of **49.6%** housing built before 1950.....**some areas even higher.**¹³

Even if child lives in a newer house – what about daycare, friend or relative's house, church or school?





This 1938 map of Milwaukee shows grades of neighborhoods by the Home Owners' Loan Corporation.¹⁴

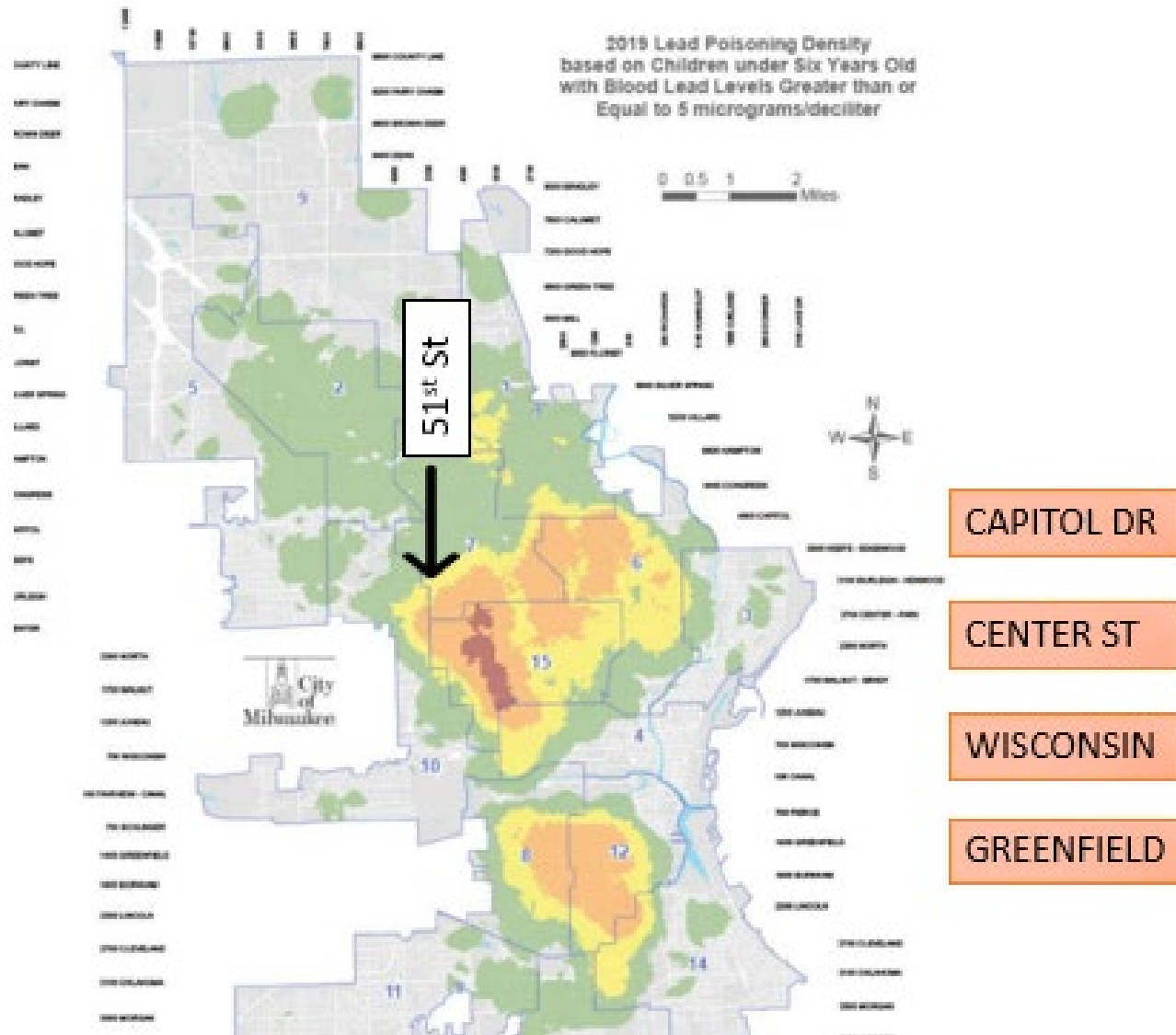
- Green/Grade A – “best” for investment
- Red/Grade D – “hazardous”

Redlining was a common practice that limited bank loans in black and brown neighborhoods.

Lead poisoning in Milwaukee is also often associated with:

- Poverty
- Crime
- Lack of affordable housing
- Fewer grocery stores
- Lower level of education

...social determinants of health matter^{13, 15}

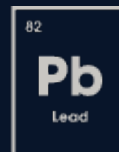


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Blood Lead Testing



Testing recommendations – City of Milwaukee

The City of Milwaukee Health Department recommends blood lead testing for all children in Milwaukee as follows:

12 months

18 months

24 months

And then annually at ages 3, 4 and 5



Testing recommendations – Wisconsin

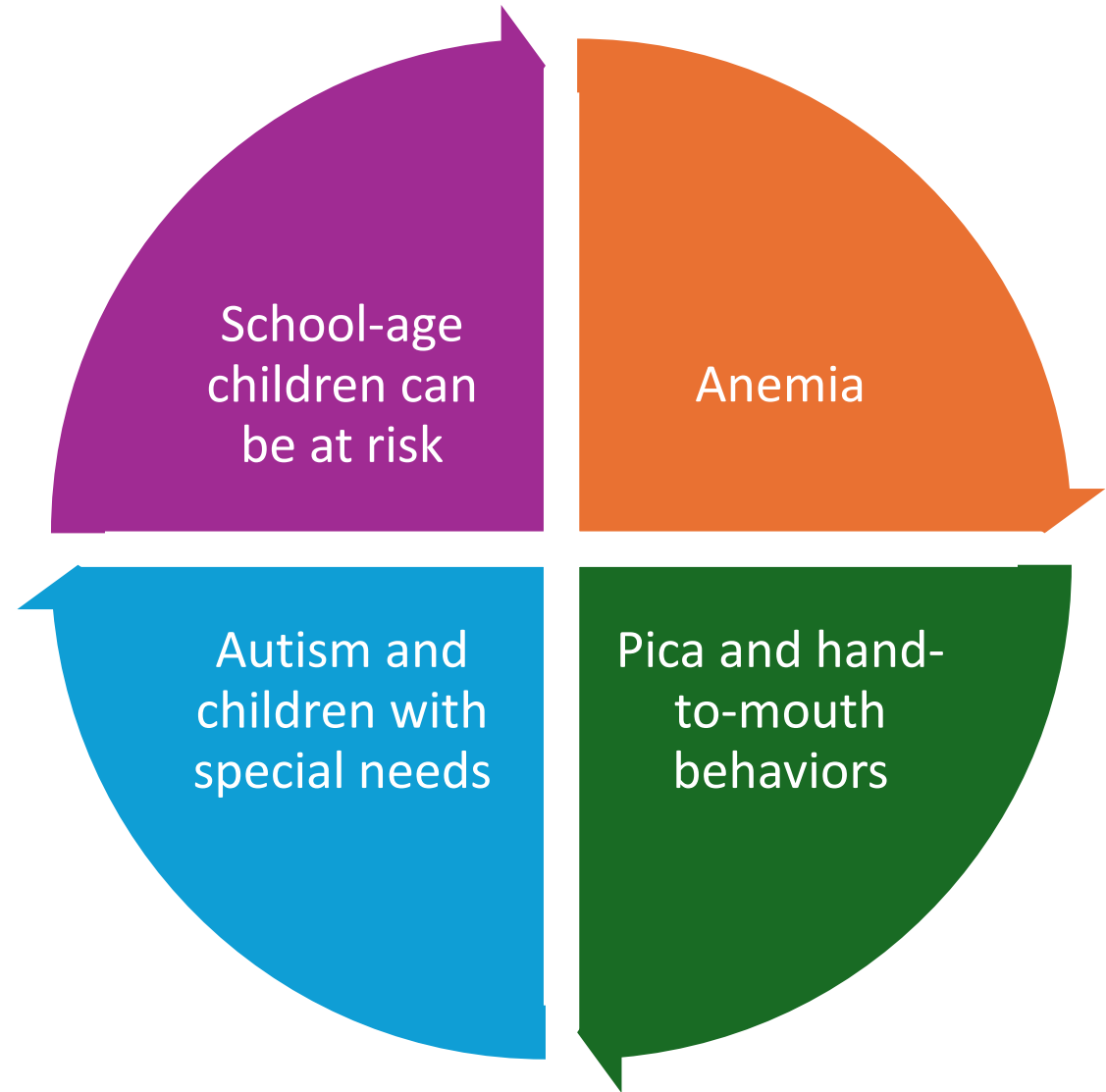
Universal blood testing for children statewide

All children at age 1
All children again at age 2

Any children ages 3 to 5 without a previous test



Other indications for lead testing



Special considerations

- Most WIC offices no longer provide lead tests.
 - City of Milwaukee Health Department does not provide lead tests.
 - Children over the age of six may need a lead test – assess risk factors. ***When in doubt, test for lead.***
 - Childhood lead poisoning can become a chronic health problem in adulthood.
-
- **Minimize care gaps!** Primary care providers should provide ALL necessary pediatric medical care – review record for lead level, hgb, immunizations, etc.

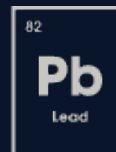


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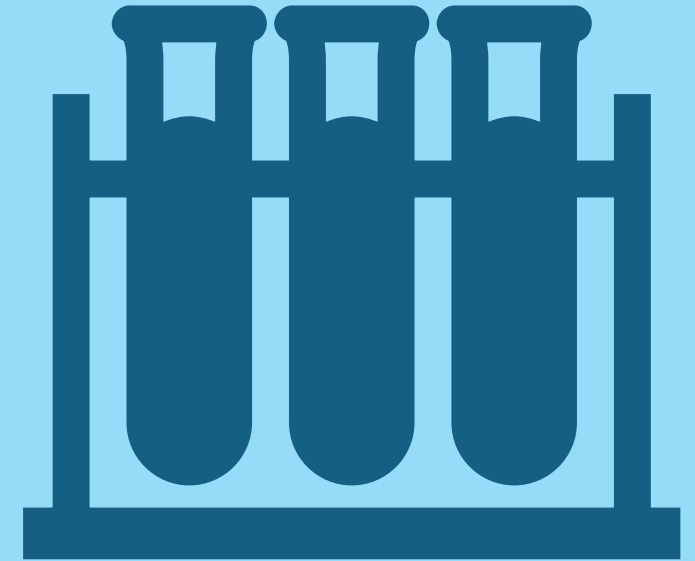
Blood Lead Test Reporting



DHS 181

Reporting of Blood Lead Test Results

All blood lead tests performed on Wisconsin residents SHALL be reported to the Department.



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Who's responsible for reporting test results?

The PROVIDER is responsible if either:

- Analysis is done in the office (Leadcare II)
- Analysis is done at an out-of-state laboratory*

The LABORATORY is responsible if:

- The laboratory is in Wisconsin
- *The laboratory is out-of-state but has provided written assurance to the provider they will report the results

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DHS 181

Reporting of Blood Lead Test Results

Timetable for reporting

Blood lead level (micrograms/deciliter)	Reporting timeframe
$\geq 45 \mu\text{g/dL}$	24 hours of analysis
$\geq 3.5^*$ and $<45 \mu\text{g/dL}$	48 hours of analysis
$< 3.5^* \mu\text{g/dL}$	10 days of analysis

*Refers to the lead poisoning definition in Wis. Admin. Code § DHS 254.11 (9).

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Required demographic information for lab reporting

Patient

- Full name
- Date of birth
- Sex
- Race
- Ethnicity
- Address (current residence with apartment or unit number)

Guardian

- Full name
- Telephone number

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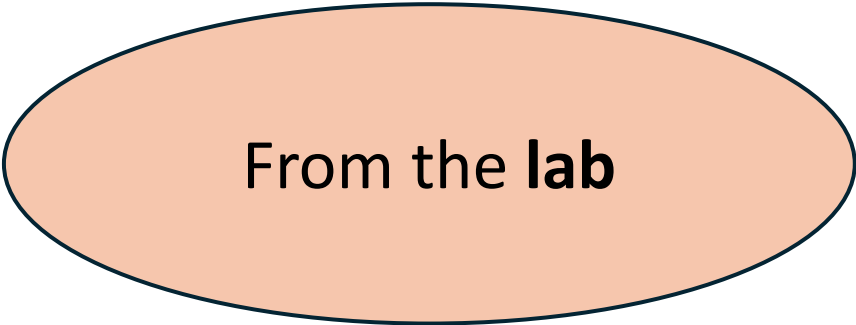
Required test information

From the **provider**

- Date collected (month, day, year)
- Method of collection (venous or capillary)
- Name and address of patient's physician
- Submitting provider information:
 - Name, phone number, facility/practice, and address

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Required test information



From the **lab**

- Date analyzed (month, day, year)
- Test result (micrograms per deciliter)
- Analyzing lab information:
 - Name, phone number, address, and clinical laboratory improvement amendments (CLIA) number

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DHS 181

Reporting of Blood Lead Test Results

Accurate information is important

- Demographic information is used to contact family
- Address is associated with blood lead test
 - Used when inspection is statutorily required
 - Used to locate family
 - Assigns local health department jurisdiction

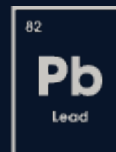
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Milwaukee Health Department



Wisconsin Statute 254.11

Lead investigation in the state of Wisconsin is required for a child with the following result:

- ≥ 20 mcg/dL - one **venous** test OR
- ≥ 15 mcg/dL - two **venous** tests at least 90 days apart

Case-making for the City of Milwaukee Health Department is one venous test ≥ 15 mcg/dL

Lead Investigation

Public Health Nurse is assigned to the child



Home Environmental Health Inspector is assigned to the house



Public Health Nurse

- Child health history and assessment
- Developmental assessment
- Parent education
- Care coordination with PCP
- Referral for family support services as needed

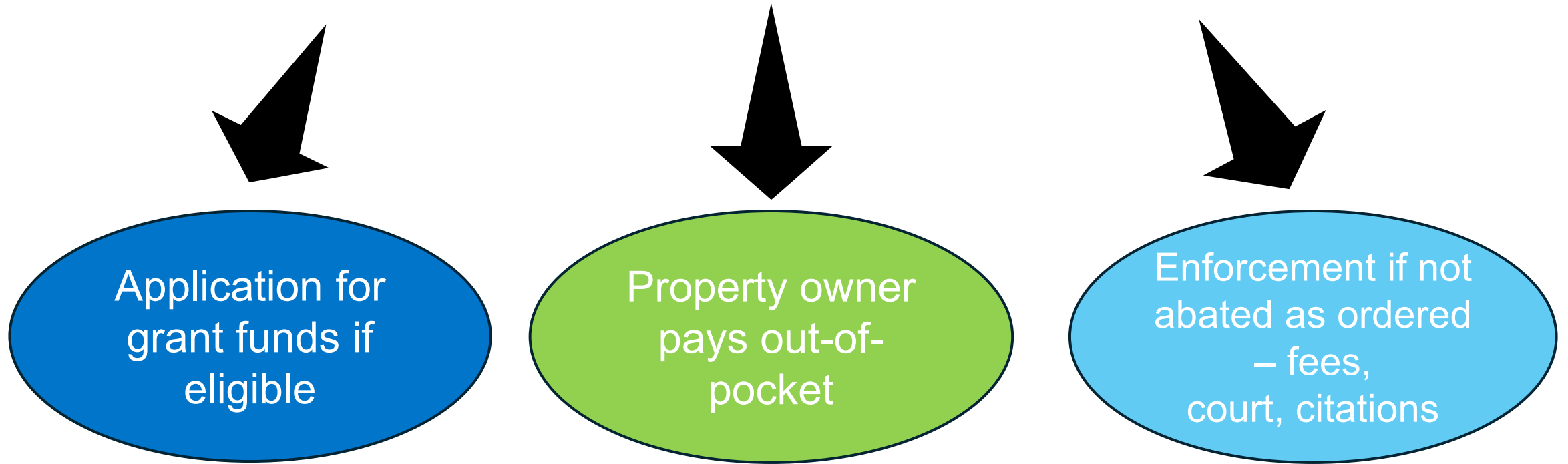


Home Environmental Health Inspector

- Assessment of occupational and hobby hazards
- X-ray fluorescence to measure lead in paint
- Dust wipes of windowsills and floors
- Exterior soil samples
- Interim controls to minimize lead hazards



When lead hazards are identified:



Ultimately lead abatement is the OWNER'S RESPONSIBILITY

Renting or buying a home built before 1978?

Property owners **must disclose any known lead hazards**¹⁶
But what if the property owner has not identified the lead hazards?

Lessor's Disclosure

(a) Presence of lead-based paint and/or lead-based paint hazards (check (i) or (ii) below):

(i) _____ Known lead-based paint and/or lead-based paint hazards are present in the housing (explain).

(ii) _____ Lessor has no knowledge of lead-based paint and/or lead-based paint hazards in the housing.

NO PRE-RENTAL INSPECTION IS REQUIRED



88%

**of residential properties in
MKE were built before 1978
(likely contain lead)¹³**

City of Milwaukee Master Property Record, 2023

Tenants may not feel they can advocate for themselves – ***even when housing is unsafe***

- Prior evictions
- Recent loss of income
- Language barrier
- Immigration status
- Lease violations – such as too many people living in the rental
- Month-to-month lease
- Unaware of free legal resources and tenants' rights
- No family or emergency shelter available







Evaluation of possible sources



Hashmi Surna Special



Pure kohl from the



Hashmi Kohl Arwad



Hashmi Kajal

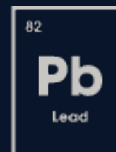
Four products with high lead



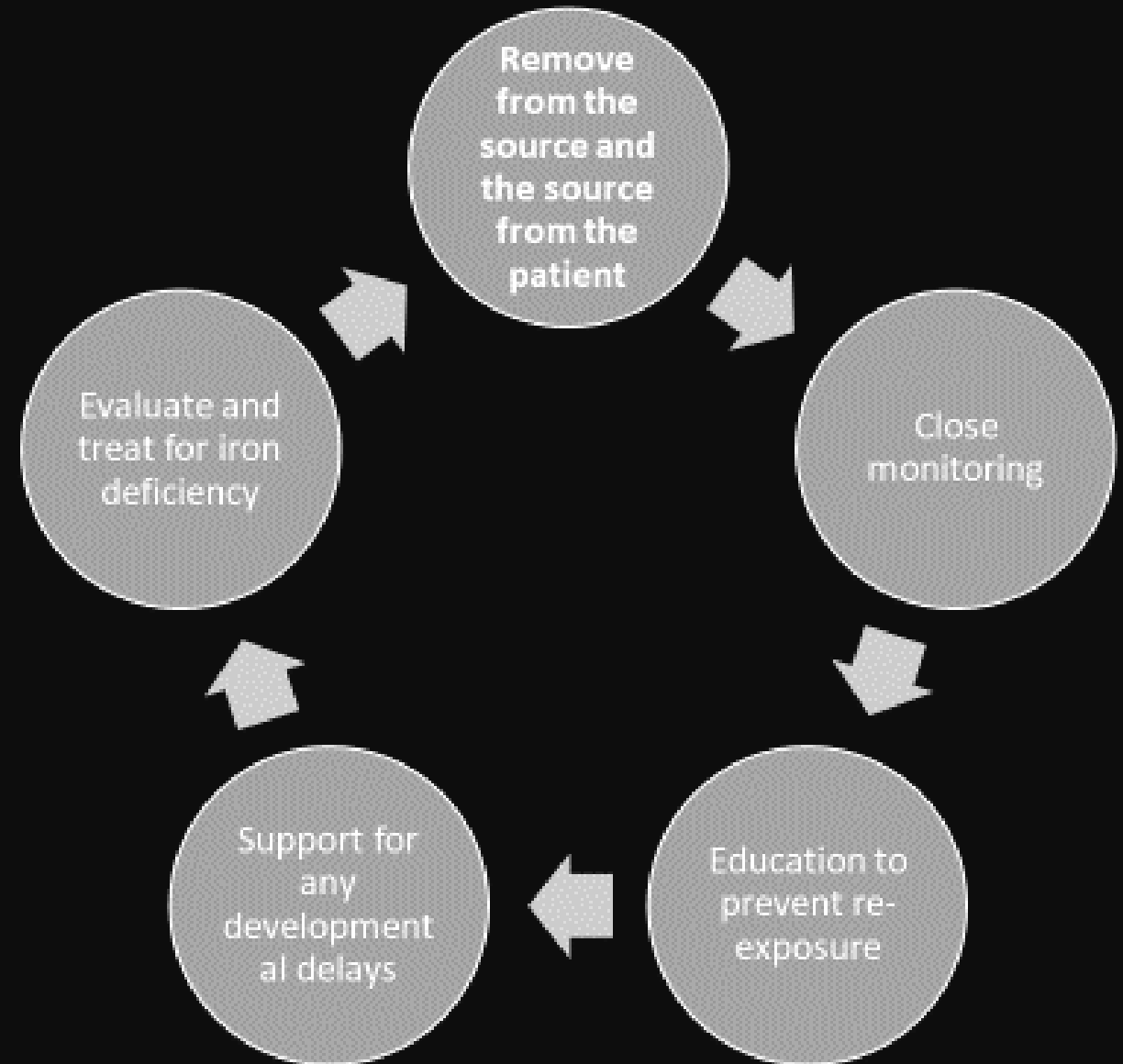
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Clinical Case Management



Treatment for BLLs below 45¹⁷



THE EFFECT OF CHELATION THERAPY WITH SUCCIMER ON NEUROPSYCHOLOGICAL DEVELOPMENT IN CHILDREN EXPOSED TO LEAD

WALTER J. ROGAN, M.D., KIM N. DIETRICH, PH.D., JAMES H. WARE, PH.D., DOUGLAS W. DOCKERY, PH.D., MIKHAIL SALGANIK, PH.D., JERILYNN RADCLIFFE, PH.D., ROBERT L. JONES, PH.D., N. BETH RAGAN, B.A., J. JULIAN CHISOLM, JR., M.D., AND GEORGE G. RHOADS, M.D., FOR THE TREATMENT OF LEAD-EXPOSED CHILDREN TRIAL GROUP*

ABSTRACT

Background Thousands of children, especially poor children living in deteriorated urban housing, are exposed to enough lead to produce cognitive impairment. It is not known whether treatment to reduce blood lead levels prevents or reduces such impairment.

Methods We enrolled 780 children with blood lead levels of 20 to 44 μg per deciliter (1.0 to 2.1 μmol per liter) in a randomized, placebo-controlled, double-blind trial of up to three 26-day courses of treatment with succimer, a lead chelator that is administered orally. The children lived in deteriorating inner-city housing and were 12 to 33 months of age at enrollment; 77 percent were black, and 5 percent were Hispanic. Follow-up included tests of cognitive, motor, behavioral, and neuropsychological function over a period of 36 months.

Results During the first six months of the trial, the mean blood lead level in the children given succimer was 4.5 μg per deciliter (0.2 μmol per liter) lower than

the mean level in the children given placebo (95 percent confidence interval, 3.7 to 5.3 μg per deciliter [0.2 to 0.3 μmol per liter]). At 36 months of follow-up, the mean IQ score of children given succimer was 1 point lower than that of children given placebo, and the behavior of children given succimer was slightly worse as rated by a parent. However, the children given succimer scored slightly better on the Developmental Neuropsychological Assessment, a battery of tests designed to measure neuropsychological deficits thought to interfere with learning. All these differences were small, and none were statistically significant.

Conclusions Treatment with succimer lowered blood lead levels but did not improve scores on tests of cognition, behavior, or neuropsychological function in children with blood lead levels below 45 μg per deciliter. Since succimer is as effective as any lead chelator currently available, chelation therapy is not indicated for children with these blood lead levels. (N Engl J Med 2001;344:1421-6.)

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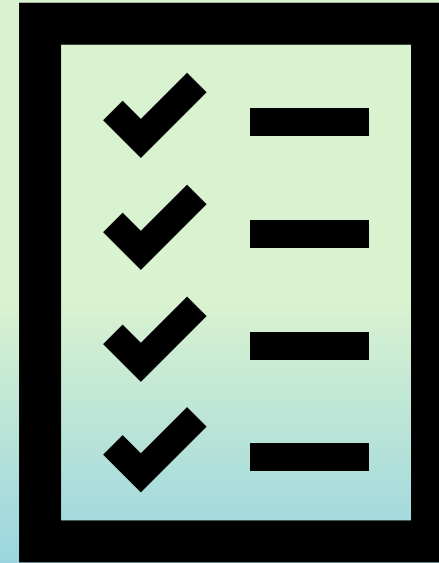
The study that established the threshold for chelation

Results held upon reevaluation at age 7¹⁸

Levels Above 45µg/dl

- If POCT confirm with a venous level
- Abdominal XR
- Evaluate for iron deficiency
- Chelation Therapy – succimer if Abdominal XR clean
- Admit if needed (bowel clean out, Succimer tolerance, environment control)
- Please consult your friendly toxicologist or the Wisconsin Poison Center

General guidelines and systems- level clinical management



General Guidelines for Clinical Management

Venous Lead Level**	Next Test	Decreasing Trend	Other Notes
3.5-9.9 µg/dL	1-3 months	Repeat every 6 months until < 3.5 µg/dL	Ensure adequate Fe status
10-14.9 µg/dL	1 month	Repeat every 3 months until < 10 µg/dL	Consider abdominal x-ray if history of pica behavior or known paint chip ingestion
15-19.9 µg/dL	1 month	Repeat every 3 months until < 10 µg/dL	Needs abdominal x-ray and may need iron supplementation
20-44.9 µg/dL	1-2 weeks	Repeat every 2-4 weeks until < 20 µg/dL	Needs abdominal x-ray. If positive for paint chips, may require admission
≥45 µg/dL	Likely admission to hospital – consult Poison Center		

**** Confirmatory venous is indicated for any POCT result ≥ 3.5 µg/dL**

Lead Care Management Guidelines

Comprehensive revision

- Developed by subject matter experts from Children's Medical Group (CMG), Poison Center / Medical Toxicology, City of Milwaukee Health Department CLPPP, and Children's Health Management
- Provides care guidance by level and type of test performed

External-facing document

- Able to disseminate to key partners and regulatory bodies (i.e., WI DHS, City of Milwaukee CLPPP, other health systems, etc.)

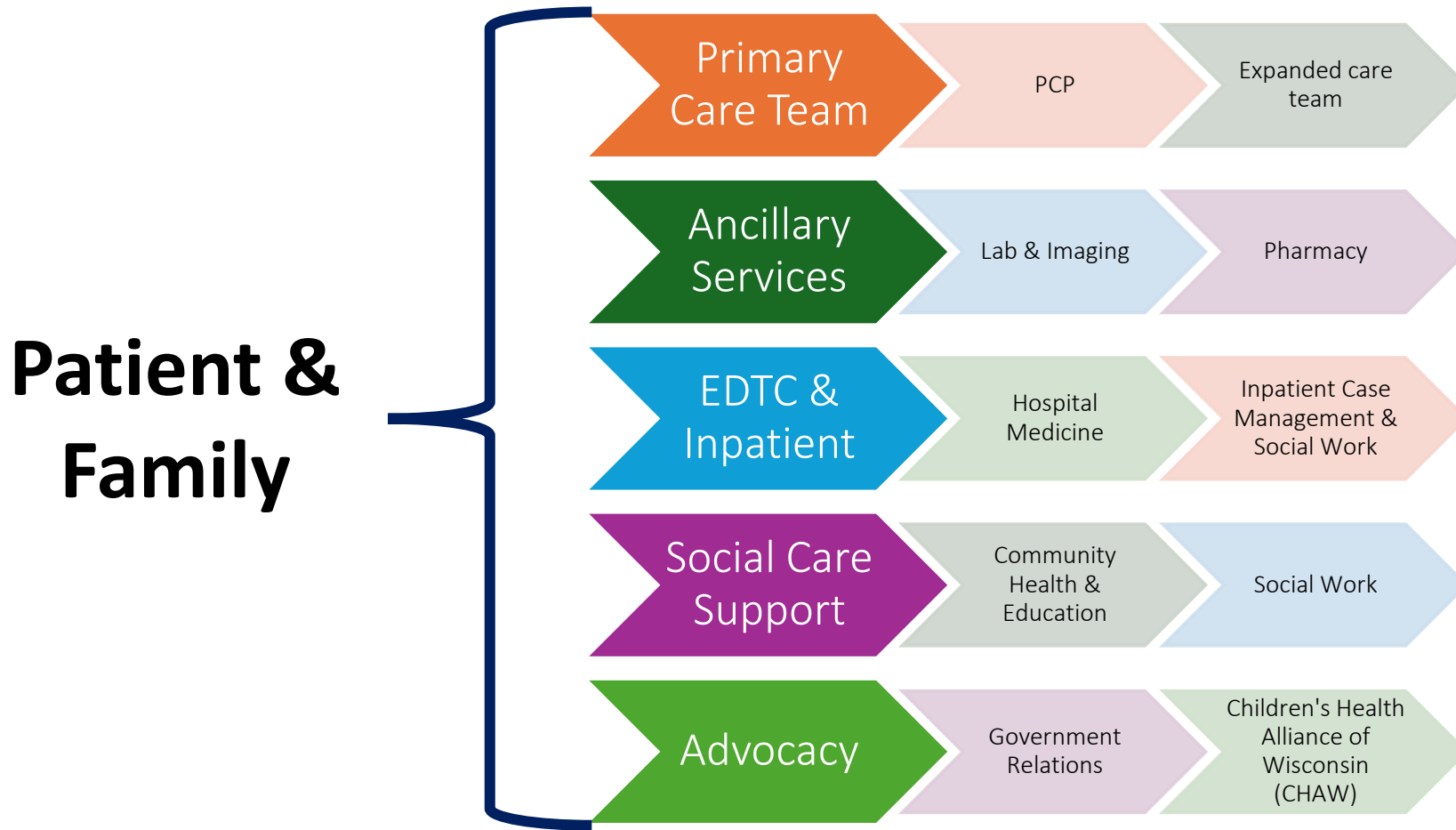
Foundation for Epic Lead Care Gaps Clinical Decision Support

- Smart sets and documentation tools

Clinical Decision Support Opportunities

- Leverage the Electronic Health Record to make it easy for front line staff to
 1. Know that a lead care gap exists at any care opportunity – ideally across the care continuum
 2. Provide clear clinical decision support based on lead care management guidelines
 3. Include optional referrals to social care support teams based on patient / family situation
- Develop robust population surveillance metrics to enable continuous quality improvement and innovative intervention design

Health Systems Approach – Who is involved in care for a lead poisoned child?



Lead Care Continuum – Adding a Centralized Care Management Team

For a child with confirmed lead poisoning at case criteria level

Primary Care Medical Home

- Identification of lead poisoning (regular screening and testing)
- Ongoing medical monitoring and management

Local Health Department

- Public Health Nurse Case Management
- Home Environmental Health Inspection & Abatement

Community Based Organizations

- Contractors and teams for abatement process
- Mediation and legal support
- Parent-to-parent education, support, and advocacy

Centralized Lead Care Management Team

- Care Coordination for defined panels across system and community care team members
- “Quarterback” in care for the child, family, and care team across the Lead Care Continuum

Key Functions of Centralized Team

- Streamline communication between expanded care team and family
- Anticipate barriers to care such as transportation needs or multiple appointments that can be scheduled in tandem
- Support adherence to plan of care with reminders of upcoming encounters

Key Takeaways

- Clinical management for a lead poisoned child is complex
- Utilize Lead Care Management Guidelines to support your practice
- Consider developing clinical decision support in your electronic health record to optimize care
- Identify key role(s) to support longitudinal care management of your population

Summary

- **Lead poisoning is a serious, ongoing problem in Milwaukee**
- **Find more opportunities to test**
 - Lead is **everywhere** in Milwaukee and testing rates are **low**
- **For clinical care questions...call Poison Center!**
 - Develop plans of care for repeat levels, chelation regimens, and adjunctive treatments for any patient



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References

1. Nriagu JO. Saturnine gout among Roman aristocrats. Did lead poisoning contribute to the fall of the Empire? N Engl J Med. 1983 Mar 17;308(11):660-3.
2. The Conversation. Dr. Franklin, I presume? The founder who could have been our “founding physician”. Theconversation.com/us. <https://theconversation.com/dr-franklin-i-presume-the-founder-who-could-have-been-our-founding-physician-60754/>. Published: July 1, 2016
3. Committee on Potential Health Risks from Recurrent Lead Exposure of DOD Firing-Range Personnel; Committee on Toxicology; Board on Environmental Studies and Toxicology; Division on Earth and Life Studies; National Research Council. Potential Health Risks to DOD Firing-Range Personnel from Recurrent Lead Exposure. Washington (DC): National Academies Press (US); 2012 Dec 3. 3, Toxicokinetics of Lead. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK206976/>
4. Jomova K, Alomar SY, Nepovimova E, Kuca K, Valko M. Heavy metals: toxicity and human health effects. Arch Toxicol. 2025 Jan;99(1):153-209.
5. Silbergeld EK, Waalkes M, Rice JM. Lead as a carcinogen: experimental evidence and mechanisms of action. Am J Ind Med. 2000 Sep;38(3):316-23.
6. Pirkle JL, Schwartz J, Landis JR, Harlan WR. The relationship between blood lead levels and blood pressure and its cardiovascular risk implications. Am J Epidemiol. 1985 Feb;121(2):246-58.
7. Holz JD, Sheu TJ, Drissi H, Matsuzawa M, Zuscik MJ, Puzas JE. Environmental agents affect skeletal growth and development. Birth Defects Res C Embryo Today. 2007 Mar;81(1):41-50.
8. Perazella MA. Lead and the kidney: nephropathy, hypertension, and gout. Conn Med. 1996 Sep;60(9):521-6.
9. Needleman H. Lead poisoning. Annu Rev Med. 2004;55:209-22.
10. United States Environmental Protection Agency. The relationship between childhood blood lead levels below 5 µg/dL and childhood intelligence quotient (IQ): Protocol for a systematic review and meta-analysis. Epa.gov. <https://assessments.epa.gov/risk/document/&deid%3D362783>. Accessed October 1, 2025.

References

11. Centers for Disease Control and Prevention Childhood Lead Poisoning Prevention. CDC Updates Blood Lead Reference Value. Cdc.gov. <https://www.cdc.gov/lead-prevention/php/news-features/updates-blood-lead-reference-value.html>. Published April 2, 2024.
12. City of Milwaukee Health Department. (2025). 2024 Annual Report. Milwaukee, WI: City of Milwaukee Health Department.
13. Wisconsin Department of Health Services. Childhood Lead Poisoning Data Explorer. <https://dhsgis.wi.gov/dhs/clpde/>. Accessed October 1, 2025.
14. Foltman, L, Jones, M. How Redlining Continues To Shape Racial Segregation In Milwaukee. Apl.wisc.edu. <https://apl.wisc.edu/shared/tad/redlining-milwaukee>. Published February 28, 2019.
15. Wisconsin Department of Health Services. Milwaukee County Social Determinants Profile. Dhs.Wisconsin.gov. <https://www.dhs.wisconsin.gov/publications/p02659b.pdf>. Published May, 2020.
16. Wisconsin Department of Health Services. Lead-Safe Wisconsin: Know about Lead When Purchasing or Renting a Home. <https://www.dhs.wisconsin.gov/lead/home-purchase.htm>. Accessed October 1, 2025.
17. Tuttle MG, Montague AJ, Halmo LS, Burns MM. Prevention of Childhood Poisoning. Pediatr Clin North Am. 2025 Dec;72(6):1147-1161.
18. Dietrich KN, Ware JH, Salganik M, Radcliffe J, Rogan WJ, Rhoads GG, Fay ME, Davoli CT, Denckla MB, Bornschein RL, Schwarz D, Dockery DW, Aduato S, Jones RL; Treatment of Lead-Exposed Children Clinical Trial Group. Effect of chelation therapy on the neuropsychological and behavioral development of lead-exposed children after school entry. Pediatrics. 2004 Jul;114(1):19-26.

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