



Hazardous Waste Management Program



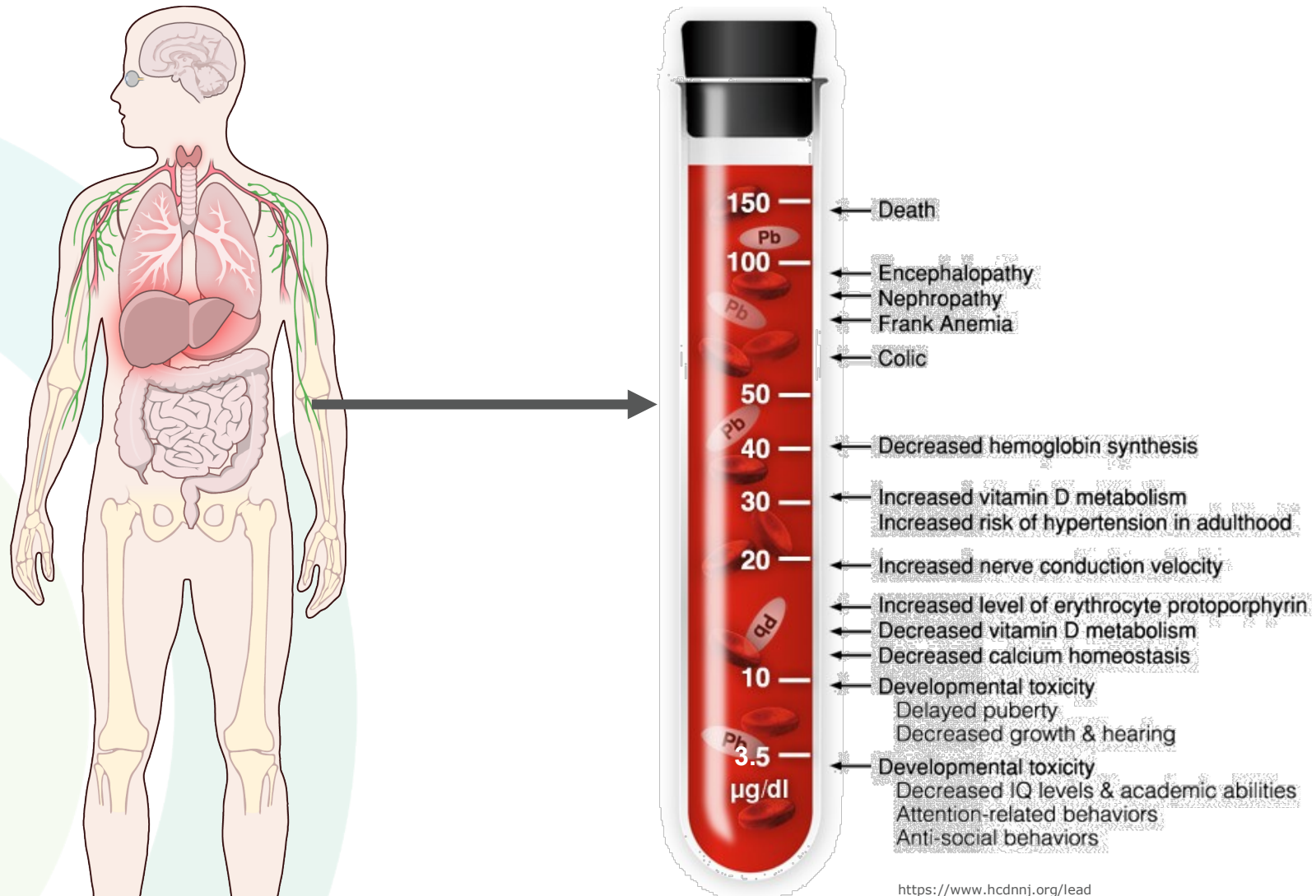
Lead and other Metals in Cast Iron Cookware

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WA Chemical Policy Forum

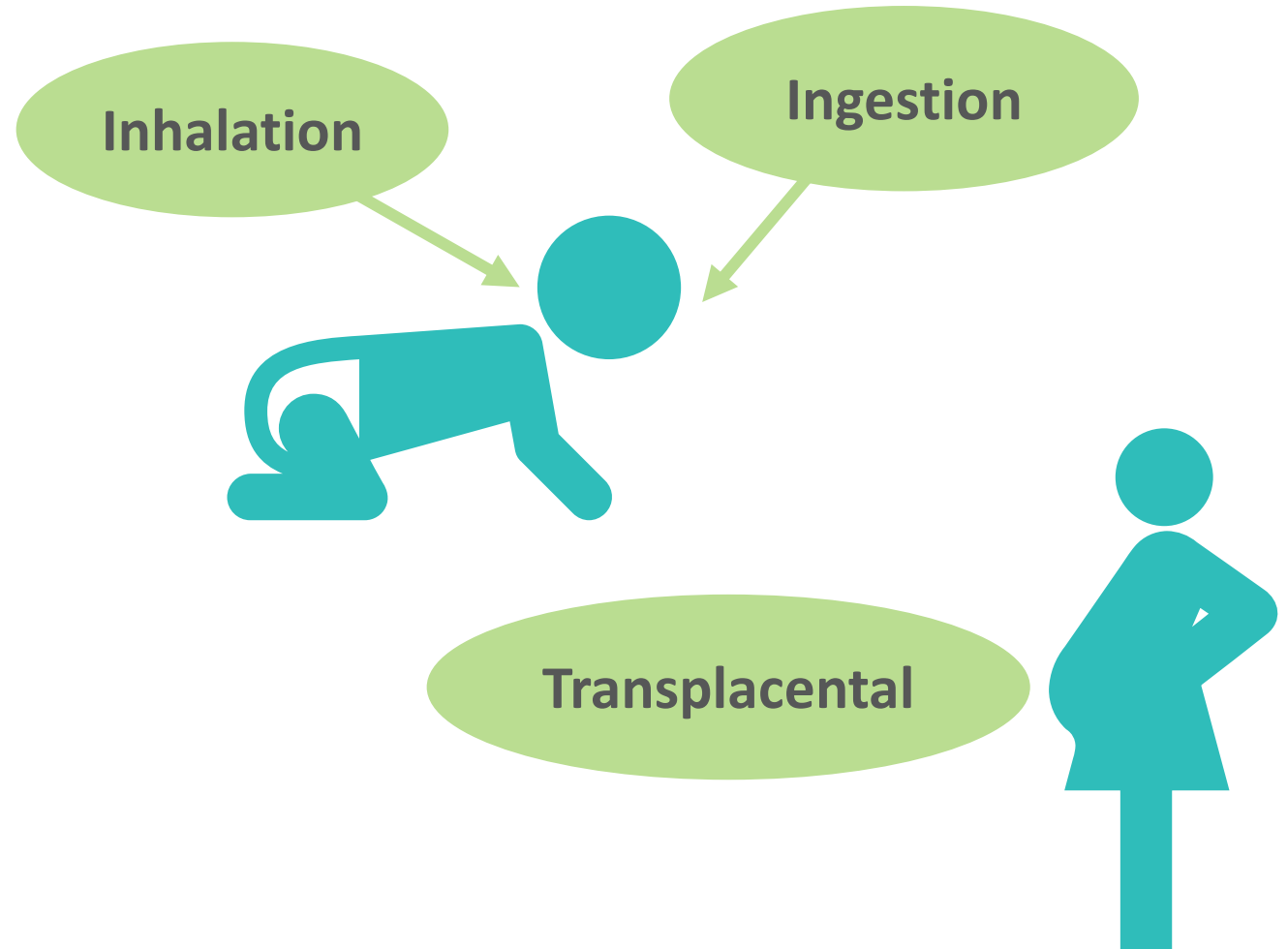
November 2025

Health Effects of Lead (Pb)



Pb Exposure Sources + Pathways

- Lead Paint
- Dust
- Soil
- Water from pre-1986 pipes
- Traditional medicine/home remedies
- Religious/ceremonial powders
- Keys
- Imported candy and spices
- Toys
- Jewelry
- Pottery/dishware
- Cosmetics (e.g. Kohl/surma)
- Leaded gasoline/exhaust
- Vinyl mini blinds
- Leaded bullets and fishing lures
- **Metal cookware**



Childhood Pb Exposure

- Childhood lead poisoning is 100% preventable
- Exposure to lead can seriously harm a child's health



Damage to the brain
and nervous system



Slowed growth
and development



Learning and
behavior problems



Hearing and
speech problems

- This can cause:

- Lower IQ
- Decreased ability to pay attention
- Underperformance at school

- Violence / future criminal activity
- Developmental problems with offspring

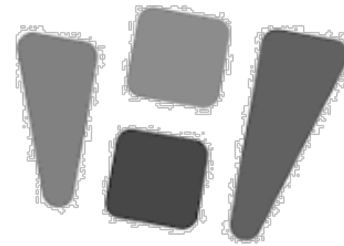
In-Home Investigations



PCP



LAB



DOH



Pb in Cookware Exposure Study

- Purchased aluminum, brass, cast iron, and stainless-steel cookware in local and online marketplaces; some items donated by Afghan community
- X-Ray Fluorescence: Non-destructive technique to determine elemental composition and quantification
 - Bruker S1 Titan; Restricted Materials Calibration
 - Each pot screened 25-40 times
- Leachate Study
 - 4% acetic acid
 - 15-minute simmer, 24 hours room temp
 - ICP-MS to quantify Pb in leachate
 - Pb, Al, Cr, Mn, Fe, Co, Ni, Cu, As, Cd
 - Estimated Pb/serving: 🍴🍷 250 mL leachate
 - FDA Interim Reference Level (IRL): 🐶 2.2 µg/day 🧑 8.8 µg/day
 - IRLs 'correspond' to a blood lead level (BLL) of 3.5 µg/dL; NOT a health-based limit



Cast Iron Cookware

- Grey cast iron is the most common alloy used in cookware
 - Intentionally includes manganese, sulfur, phosphorous, 2.5-4% carbon
 - May be trace elements included in the alloy
 - Popular brands report recycling cast iron materials and sand used for casting
- Opportunities for lead contamination in alloy (foundry sands)
 - EPA risk assessment found 5.1 – 13.6 mg/kg Pb in sands
 - Study in Argentina
 - Virgin sands contained on average 2.1 mg/kg Pb
 - Spent sands Pb content varied by binder type: "Green" – 8.54 mg/kg to AU – 163 mg/kg
- Opportunities for lead contamination in enamel coating
 - Sand blasted, then coating sprayed on
 - Historically, cast iron bathtubs used a lead-containing porcelain or enamel glaze
 - Few studies focus on enameled or porcelain-glazed cast iron cookware
- Cast iron does leach metals (mostly Fe), particularly in acidic solutions
 - Most studies have not detected lead in leachate
 - One study found lead leached out of **used** cookware
 - One study detected 1-10 ug/L lead in leachate, mostly in acidic solutions



How Cast Iron is Made



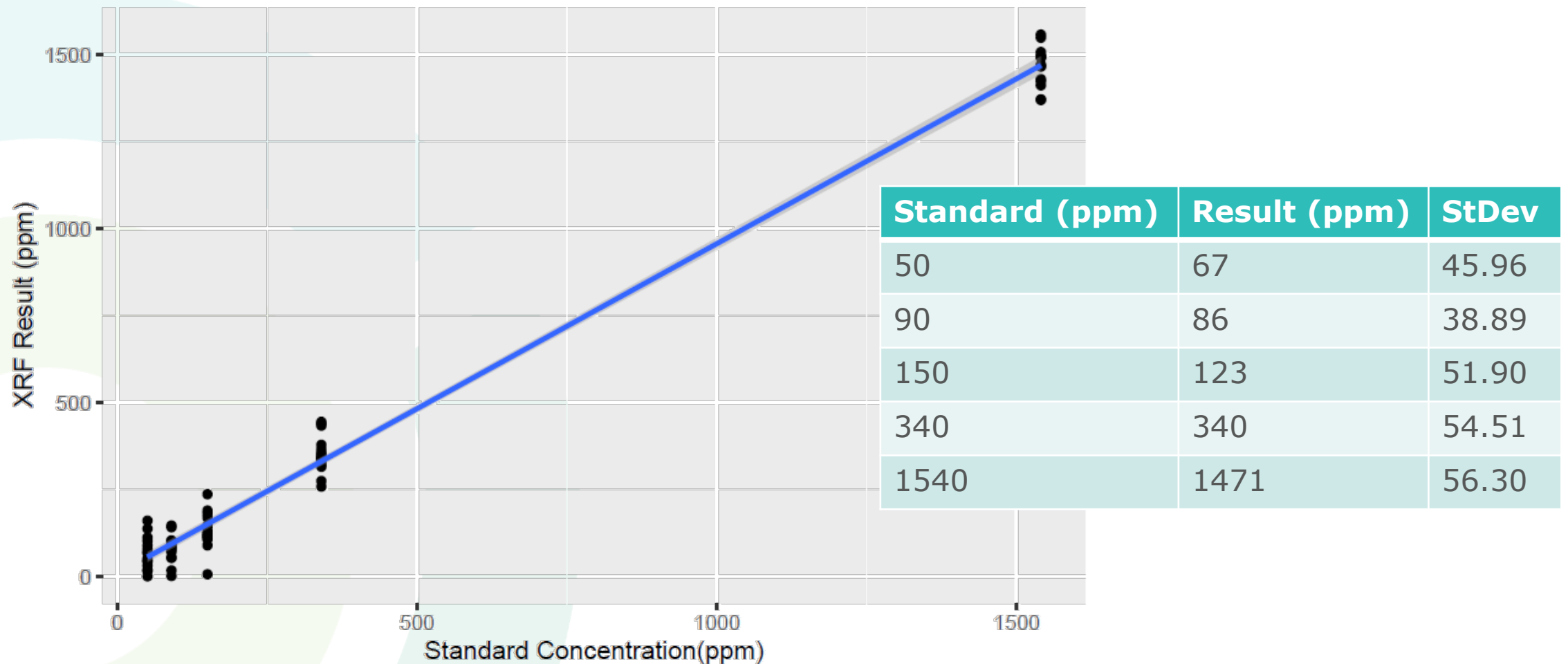
- [How a LODGE Skillet is made - BRANDMADE in AMERICA](#)
- [The Official Lodge Cast Iron Foundry Tour - Extended Version](#)
- Furnace to melt the metal is $\sim 2800^{\circ}\text{F}$
- Lead begins to vaporize at temperatures above 1800°F , and fully vaporizes around 3180°F (boiling point)
 - Even at temperatures below its boiling point, molten lead releases significant vapor
 - The temperatures used in foundries will cause most lead impurities to rapidly vaporize
 - It's possible for some to remain, particularly if the source metal was highly contaminated

Purchased Cast Iron Cookware

Price	Brand	Description	Store	Type	Coating
14.88	Ozark Trail	12" Cast Iron Skillet	Walmart	Skillet	Pre-Seasoned
39.97	The Pioneer Woman	5-Quart Enameled Cast Iron Dutch Oven; Timeless Beauty - Linen	Walmart	Dutch Oven	Enamel
27.97	Mainstays	5qt Cast Iron Pre-Seasoned Dutch Oven Black	Walmart	Dutch Oven	Pre-Seasoned
39.96	Beautiful	5 Quart Enameled Cast Iron Round Dutch Oven, White by Drew Barrymore	Walmart	Dutch Oven	Enamel
59.99	Rachael Ray	Premium Nitro Cast Iron Skillet 12" Red	Target	Skillet	"Nitro"
49.99	Hearth & Hand	Enameled Cast Iron Dutch Oven 5 qt	Target	Dutch Oven	Enamel
54.71	BrylaneHome	12 Inch Cast Iron Chicken Fryer Cookware	Target	Skillet	Pre-Seasoned
39.99	Lodge	Seasoned Cast Iron Skillet - 12 Inch, black	Amazon	Skillet	Pre-Seasoned
49.99	Backcountry Iron	12 Inch Round Large Pre-Seasoned Cast Iron Skillet	Amazon	Skillet	Pre-Seasoned
26.99	Utopia Kitchen	Pre-Seasoned Cast Iron Skillet - Frying Pan 12 Inch (Black)	Amazon	Skillet	Pre-Seasoned
49.99	Cuisinel	Cast Iron Skillet & Cast Iron Braiser Lid - 12" Pre-Seasoned Covered Frying Pan	Amazon	Skillet	Pre-Seasoned
42.99	Amazon Basics	Round Pre-Seasoned Cast Iron Dutch Oven Pot w Lid and Dual Handles, 7-Quart, Black	Amazon	Dutch Oven	Pre-Seasoned
45.50	Lodge	Cast Iron Dutch Oven with Dual Handles, Pre-Seasoned, 5-Quart	Amazon	Dutch Oven	Pre-Seasoned
45.59	Amazon Basics	Cast Iron Dutch Oven Pot with Lid, Enameled, Small, 4.3-Quart, Green	Amazon	Dutch Oven	Enamel
44.99	Hamilton Beach	Enameled Cast Iron Dutch Oven 3-Qt Navy	Amazon	Dutch Oven	Enamel
41.95	Uno Casa	Cast Iron Dutch Oven, 2-in-1 Lid, Large - 5 Qt	Amazon	Dutch Oven	Pre-Seasoned
38.99	Stansport	4 qt Pre-Seasoned Cast Iron Dutch Oven	Amazon	Dutch Oven	Pre-Seasoned
53.84	Crock Pot	Artisan 5 Quart Enameled Cast Iron Round Dutch Oven, Red	Amazon	Dutch Oven	Enamel
72.46	Lodge	6 Quart Enameled Cast Iron Dutch Oven with Lid - Blue	Amazon	Dutch Oven	Enamel
59.38	Martha Stewart	Gatwick 7 QT Enamel Cast Iron Dutch Oven, Red	Amazon	Dutch Oven	Enamel

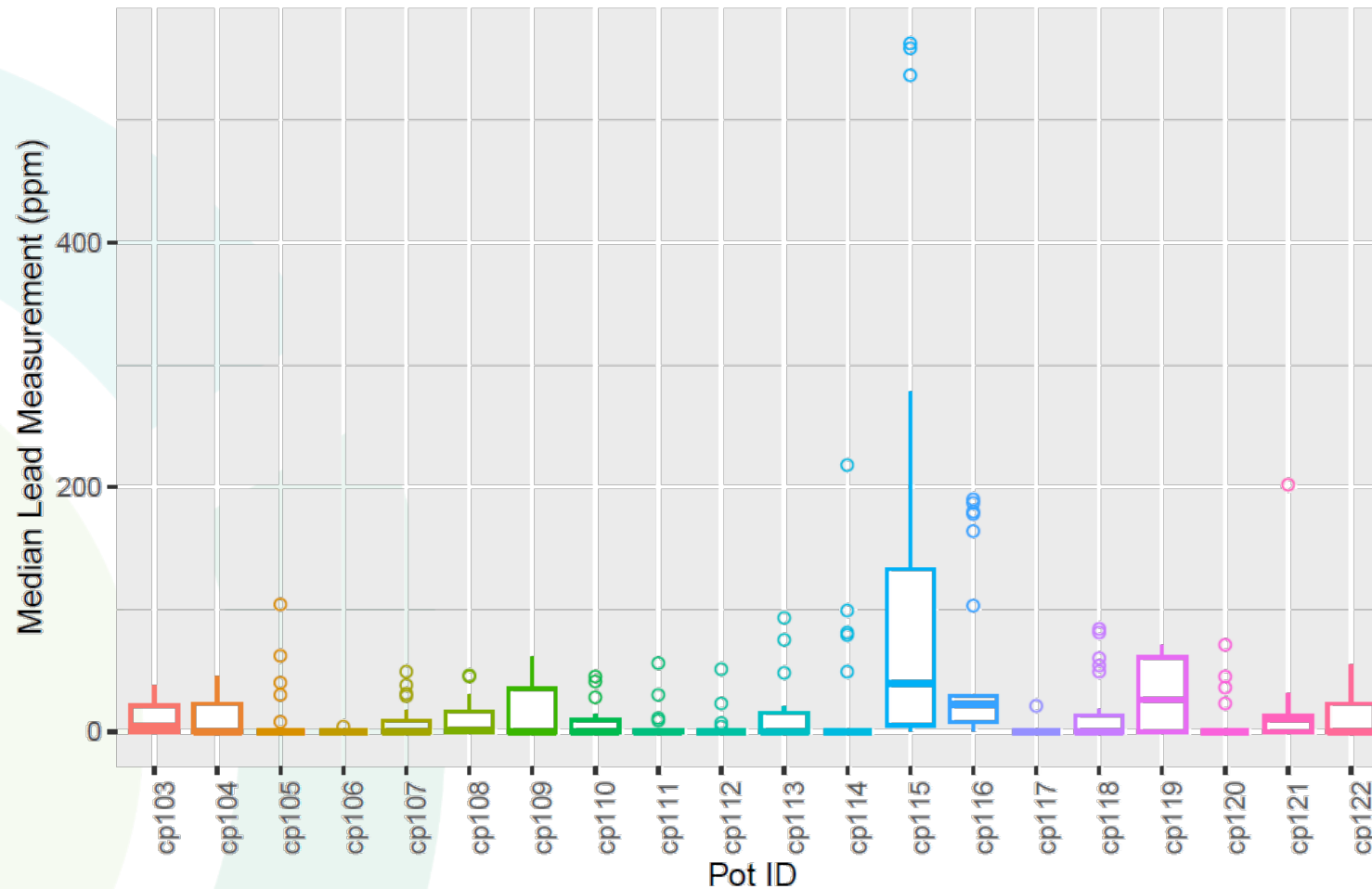
XRF Performance on Cast Iron

Figure 1: Cast Iron Lead Calibration Curve for XRF Measurements



Results: Raw XRF Data

Figure 2: XRF Lead Measurements by Cookpot (ppm)



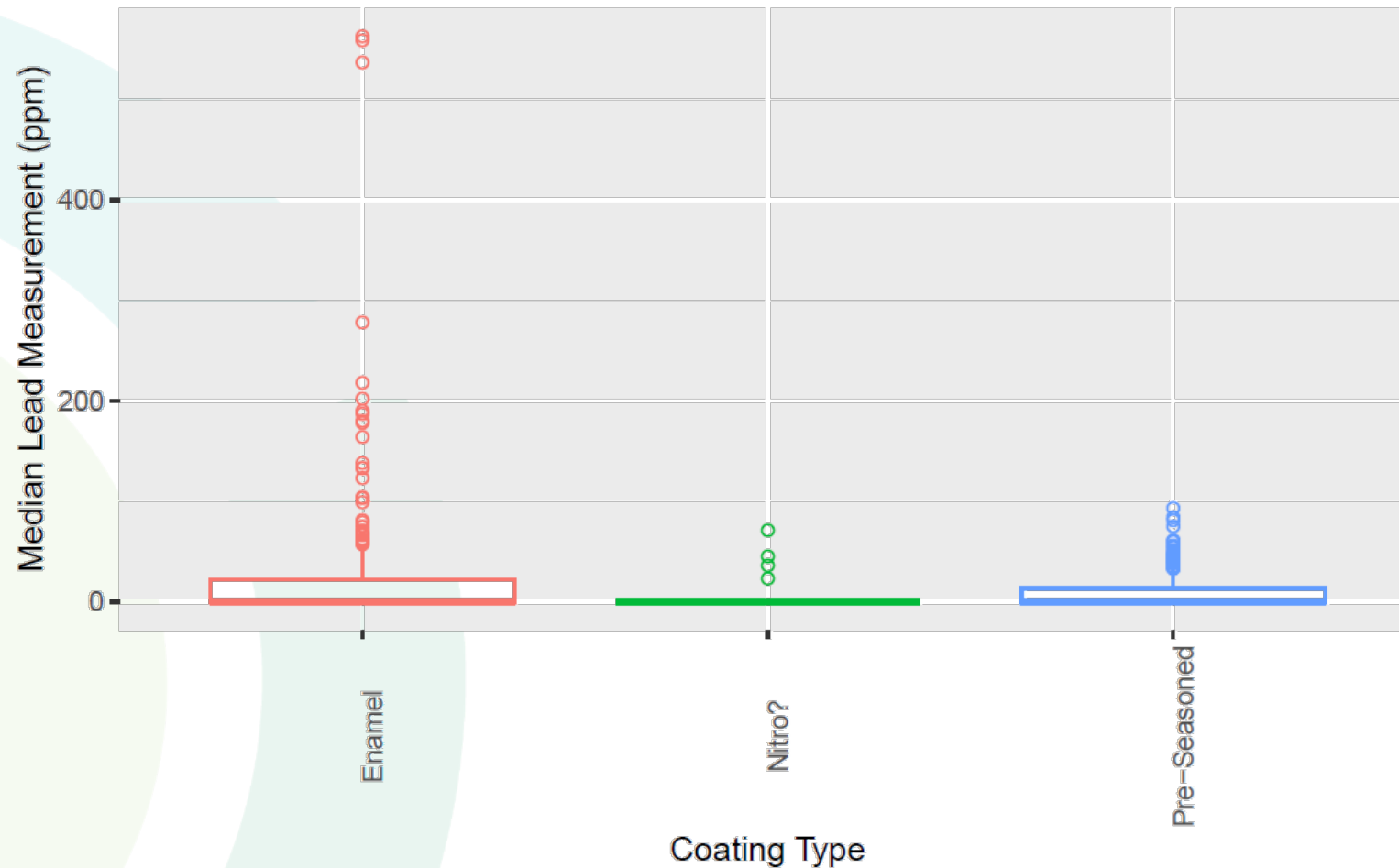
Results: XRF by Coating Type

Pot Coating	% Above LOD	Total # Pots	Median (ppm)	Range (ppm)	LOD (ppm)
Enamel	50	8	43	12-133	8
Nitro	100	1	18	18-18	12
Pre-Seasoned	9.1	11	21	21-21	10

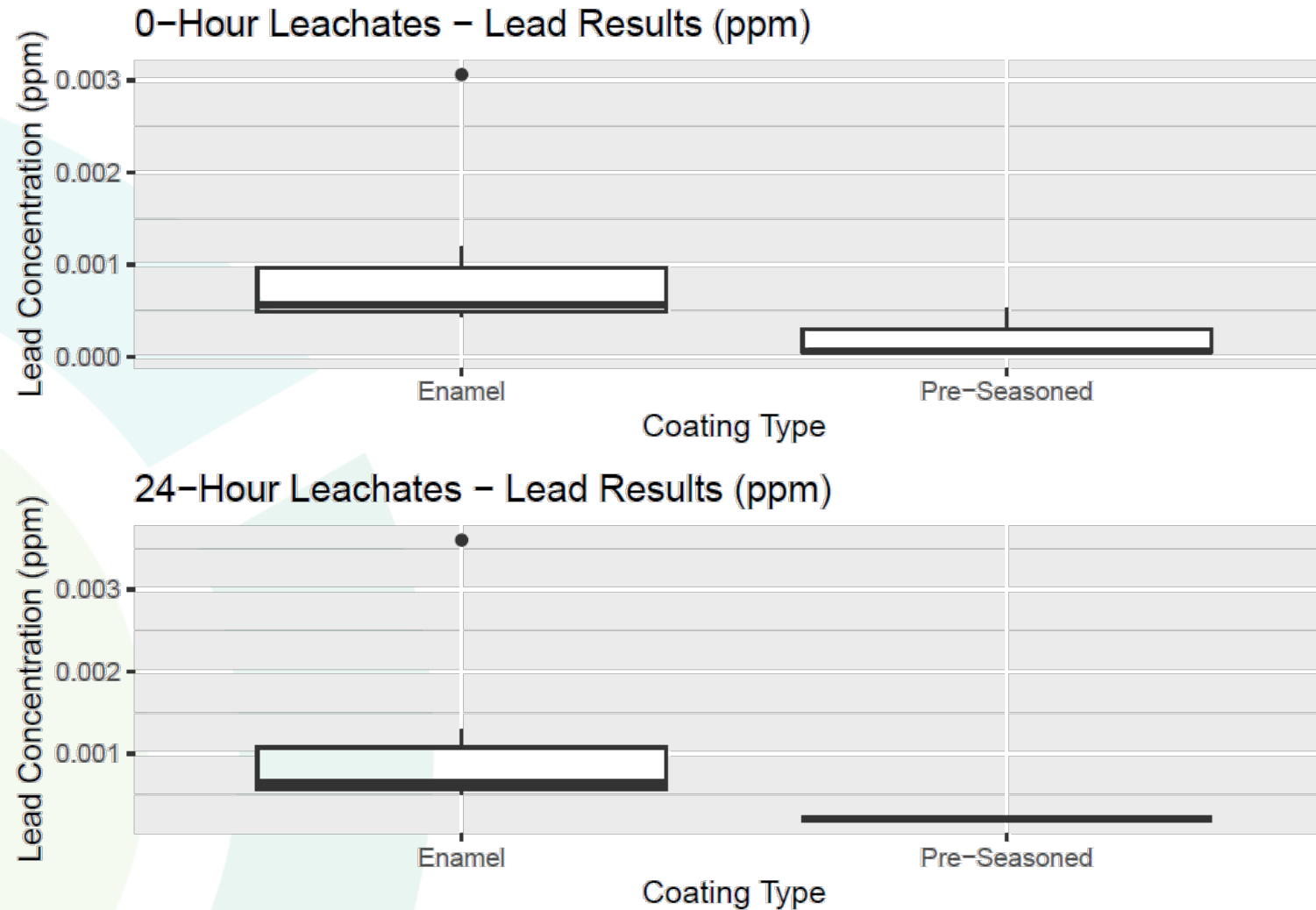


Results: XRF by Coating Type

Figure 3: XRF Lead Measurements by Coating Type (ppm)
Includes measures < LOD



Results: Leachate



Results: Leachate, Other Metals

Coating	Mn (T0)	Mn (T24)	Fe (T0)	Fe (T24)	As (T0)	As (T24)	Cd (T0)	Cd (T24)
Enamel	0.06785	0.274	5.765	38	0.0003	0.001	0.00066	0.02495
Pre-Seasoned	4.27	29.75	2140.0	12900	0.0008	0.0015	0.00021	<LOD
EPA Standards	0.05		0.3		0.010		0.005	
Tolerable UIL	11 mg/day		40-45 mg/day		FDA: 0.1 – 0.01		WHO: ~58 µg/day	

Values are in ppm, unless otherwise noted

Results: XRF and Leachate

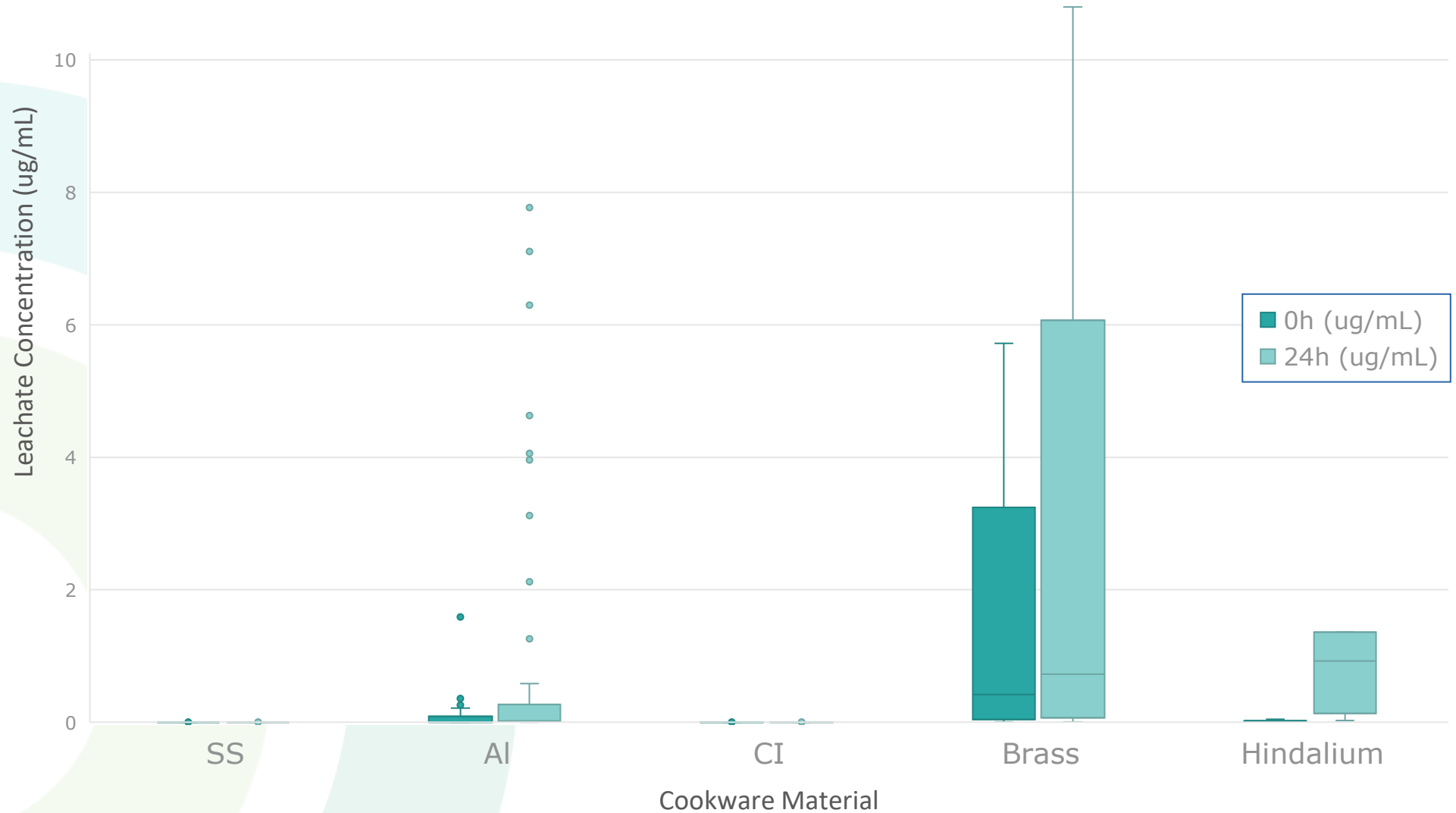
Material	Country	Type	XRF, ppm		Leachate 15 mins:	Leachate 24 hours:
			Median	(Range)	Dose, µg/250 mL	Dose, µg/250 mL
Enamel	China	Dutch Oven	0 ¹	(0,21)	0.11	0.13
		Dutch Oven	26 ¹	(0,71)	0.11	0.13
		Dutch Oven	0 ¹	(0, 104)	0.13	0.15
		Dutch Oven	0 ¹	(0, 218)	0.15	0.15
		Dutch Oven	0 ¹	(0,4)	0.15	0.18
		Dutch Oven	11 ¹	(0, 202)	0.22	0.25
		Dutch Oven	39 ¹	(0, 563)	0.30	0.33
		Dutch Oven	22 ¹	(0, 190)	0.77	0.90
Pre-Seasoned	China	Skillet	0 ¹	(0, 71)	0.31	0.05
		Dutch Oven	0 ¹	(0,49)	0.01	<0.025
		Dutch Oven	0 ¹	(0, 93)	0.06	<0.025
		Dutch Oven	0 ¹	(0, 84)	0.01	<0.025
		Dutch Oven	4 ¹	(0, 38)	0.01	<0.025
		Skillet	0 ¹	(0, 45)	0.13	<0.025
		Skillet	0 ¹	(0, 56)	0.10	<0.025
		Skillet	0 ¹	(0, 51)	0.04	<0.025
		Skillet	0 ¹	(0,55)	0.01	<0.025
	Pakistan	Skillet	0 ¹	(0,45)	0.09	<0.025
	USA	Dutch Oven	0 ¹	(0, 61)	<0.0025	<0.025
		Skillet	1 ¹	(0, 46)	0.02	<0.025

¹ More than 50% of XRF measurements <LOD

*Estimated dose ≥ child IRL (2.2 µg/day)

** Estimated dose ≥ adult IRL (8.8 µg/day)

Results: All Cookware



Previous Studies

- Fellows KM, Samy S, Rodriguez Y, Whittaker SG. Investigating aluminum cookpots as a source of lead exposure in Afghan refugee children resettled in the United States. J Expo Sci Environ Epidemiol 32, 451–460 (2022). <https://doi.org/10.1038/s41370-022-00431-y>
- Fellows KM, Samy S, Whittaker SG. Evaluating metal cookware as a source of lead exposure. J Expo Sci Environ Epidemiol (2024). <https://doi.org/10.1038/s41370-024-00686-7>

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