Exposure reduction strategies in wood stove heated homes

Montana Asthma Advisory Workgroup Meeting

Missoula, MT

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Curtis W. Noonan, Ph.D.

Associate Professor of Epidemiology

Center for Environmental Health Sciences

The University of Montana

Overview

- Community-scale intervention
  - Evidence of effect on ambient air quality
  - Evidence of effect on children's respiratory health
- Impact of interventions on indoor air quality
  - Wood stove interventions
  - Air filter interventions
  - What are the behavioral factors associated with these interventions?
- Are there educational interventions that could function with equal or greater efficacy and achieve better compliance and sustainability?

Community scale wood stove intervention: Libby, MT

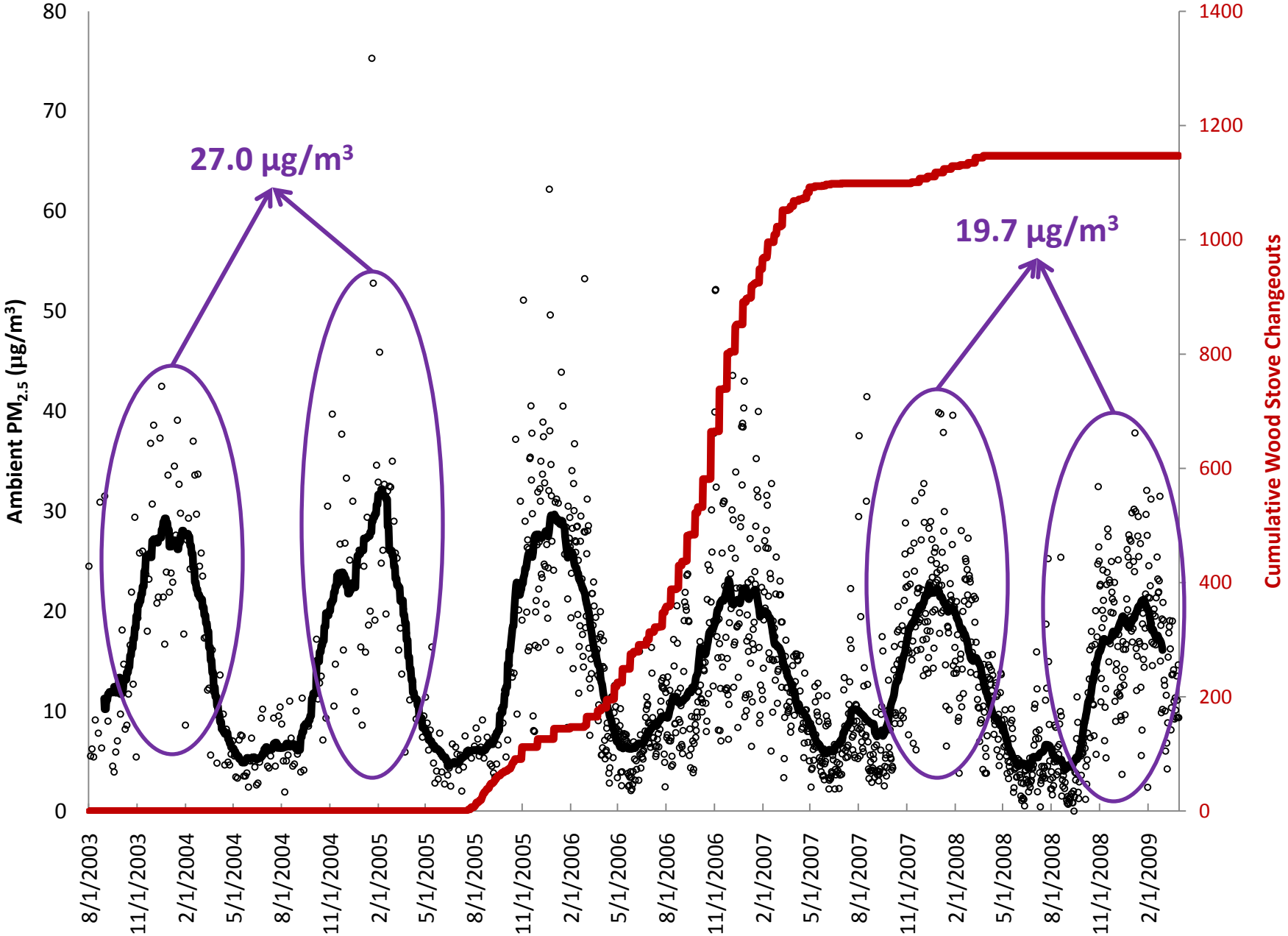
- June 2005 to June 2007:
  - Initial phase, 260 old woodstoves replaced <u>for free</u> with new woodstoves

- January 2006 to March 2008: Voucher program
  - Approved appliance: $700
  - Installation: $300
  - Stove removal: $200
  - Early incentive: $100

  <u>Other</u>
  Furnace : $1,400
  MT tax credit: $500

- Total funding: $2.1 million
  - Grant and equipment from HPBA: $1 million
  - Senate appropriation: $1 million
  - EPA grant: $100,000

Ambient $PM_{2.5}$ and cumulative changeout of wood stoves in Libby, MT 2003 – 2009



Noonan et al., 2011. Report #162. Health Effects Institute.

Table 2 Proportion (%) of respondents by survey year according to selected characteristics

	2006, n=381	2007, n=459	2008, n=430	2009, n=430
Sex				
Boy	53.8	49.5	47.8	52.0
Girl	46.2	51.5	52.2	48.0
Grade				
1–2	20.2	18.5	17.9	21.6
3–4	22.6	19.6	19.1	23.0
5–6	24.4	16.6	22.6	19.8
7–8	32.8	19.2	15.3	11.9
9–10	–	26.1	17.9	13.0
11–12	–	–	7.2	10.7
Type of heating				
Wood	43.3	42.2	43.3	41.6
Propane	29.9	24.2	27.0	24.9
Gas	3.7	3.9	4.4	3.5
Oil	20.5	21.4	21.2	16.0
Electricity	38.9	43.4	43.0	39.5
Tobacco use in home	36.7	32.9	30.8	33.6
Also responded in 2006	–	43.6	38.1	28.4

Noonan et al., 2012. Occupational and Environmental Medicine, 69:354-360.

Adjusted odds ratio (95% CI) for effects of $PM_{2.5}$ and wood stove on parent-reported symptoms and infections over a four winter period.

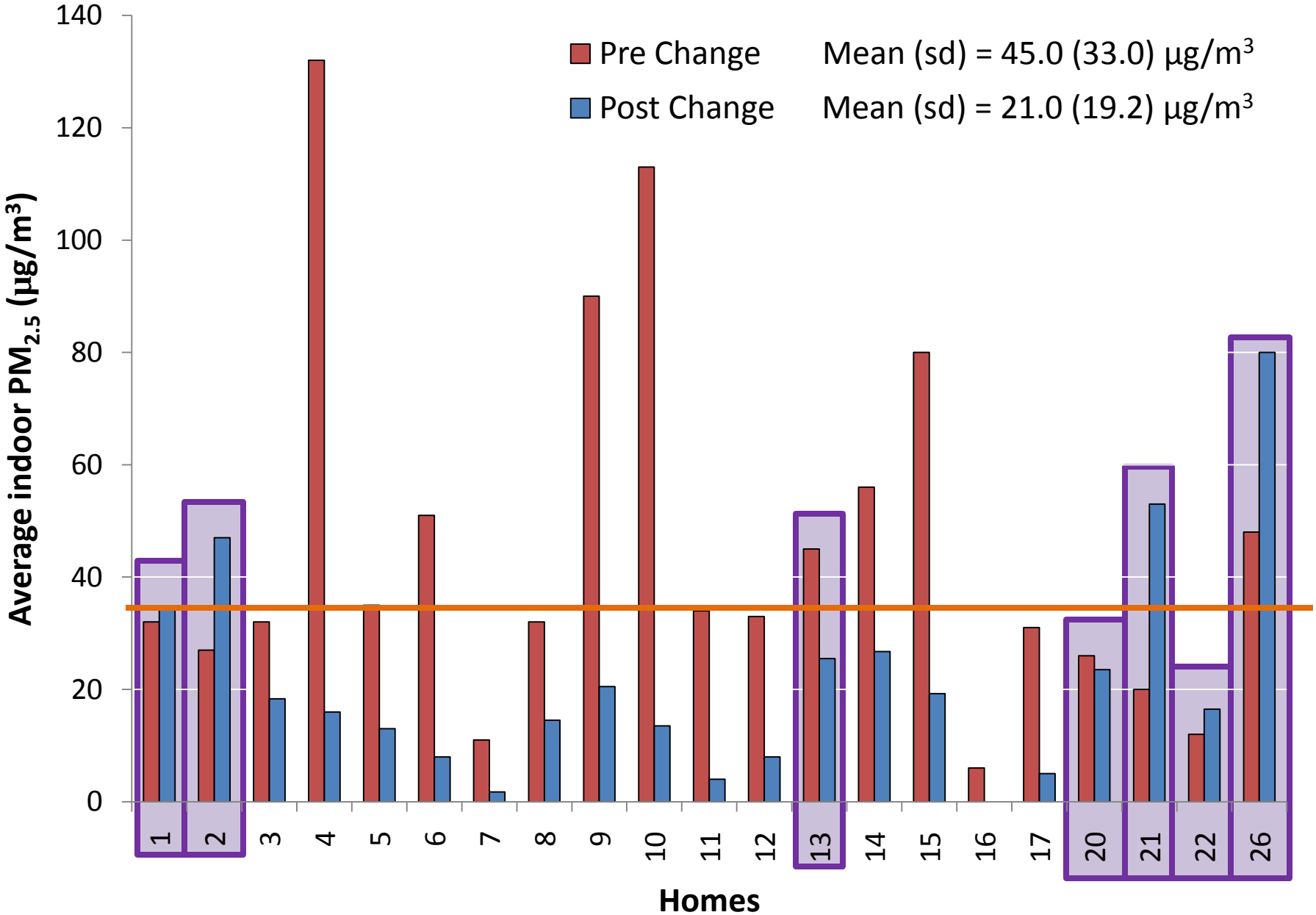
Outcome	Ambient $PM_{2.5}$ reduction† OR (95% CI)	Wood stove in home‡ OR (95% CI)
Respiratory symptoms		
Wheeze	0.73 (0.55 to 0.97)	1.04 (0.72 to 1.51)
Morning tightness of chest	0.93 (0.66 to 1.32)	0.63 (0.41 to 0.96)
Attack of shortness of breath	0.80 (0.54 to 1.17)	0.84 (0.52 to 1.35)
Shortness of breath after exercise	1.03 (0.77 to 1.38)	0.98 (0.68 to 1.40)
Wake up at night by an attack of shortness of breath	1.03 (0.61 to 1.71)	0.96 (0.50 to 1.86)
Wake up at night by an attack of coughing	0.90 (0.75 to 1.08)	1.05 (0.83 to 1.32)
Other symptoms and infections		
Itchy/watery eyes	0.67 (0.55 to 0.81)	0.96 (0.76 to 1.22)
Sore throat	0.68 (0.57 to 0.82)	0.96 (0.78 to 1.18)
Cold	0.75 (0.60 to 0.92)	0.93 (0.74 to 1.18)
Bronchitis	0.45 (0.27 to 0.76)	1.60 (0.85 to 3.03)
Influenza	0.48 (0.40 to 0.57)	0.98 (0.78 to 1.22)
Throat infection	0.55 (0.42 to 0.71)	0.83 (0.61 to 1.13)
Middle-ear infection	0.71 (0.49 to 1.03)	1.30 (0.81 to 2.07)

*Adjusted for age and community influenza rate. Two-year grade groupings are used as a surrogate for age.
†Per 5 $\mu g/m^3$ decrease in average winter $PM_{2.5}$.
‡Absence of wood stove in home was used as the reference category.

Noonan et al., 2012. OEM, 69:354-360.

How did the stove changeout program impact indoor air quality?

Indoor $PM_{2.5}$ Following Wood Stove Change



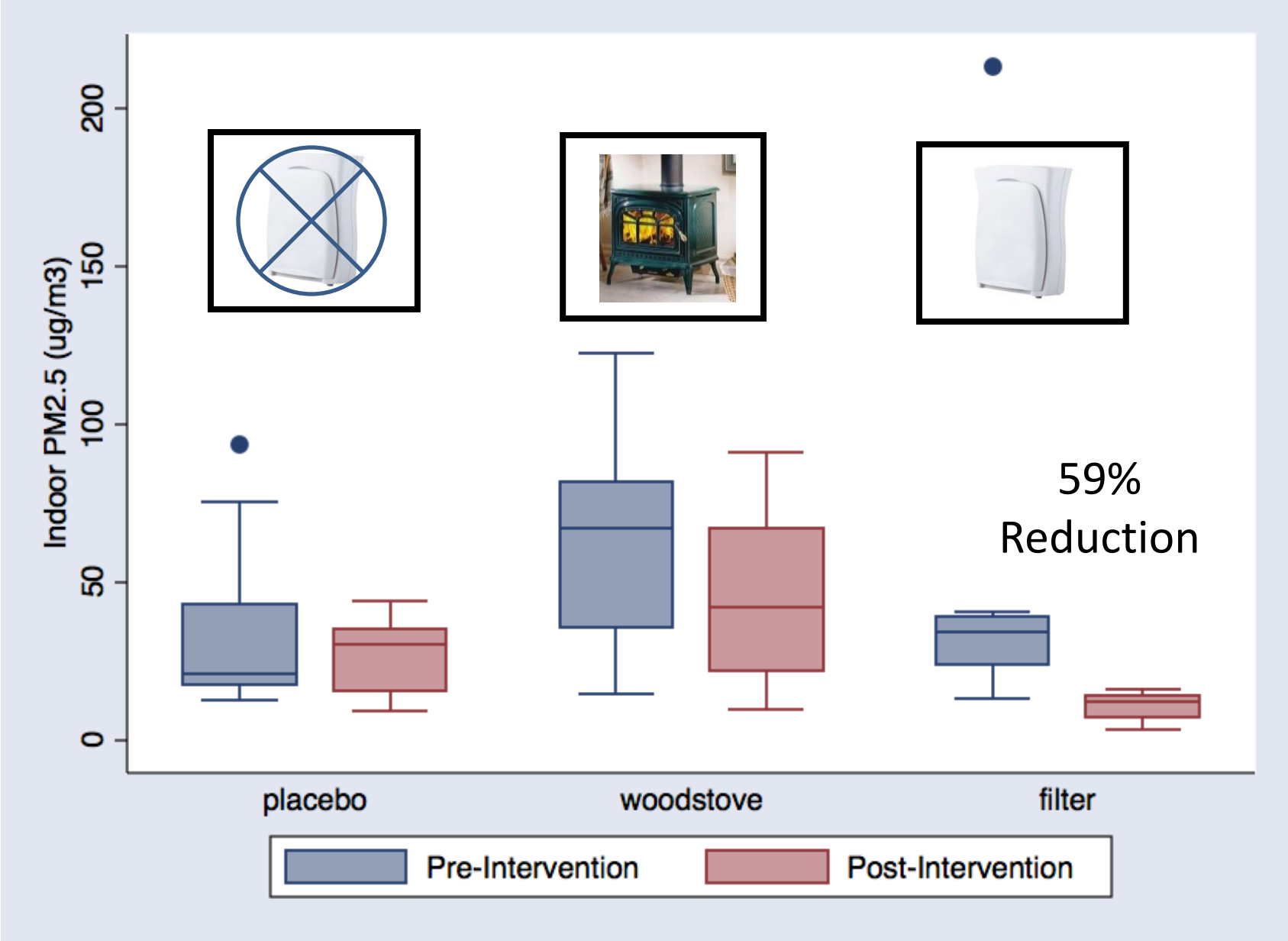
Inconsistent impact of wood stove upgrade on indoor air quality

Study Area	No. Homes	Pre-change median $PM_{2.5}$	Post-change Median $PM_{2.5}$	Proportion of Homes with No Reduction
Libby, MT[1]	21	33	14*	33%
Nez Perce Reservation[4]	15	29	17*	33%
Northern BC[2]	15	13	12	40%
Western MT and Idaho[3]	11	54	34	45%

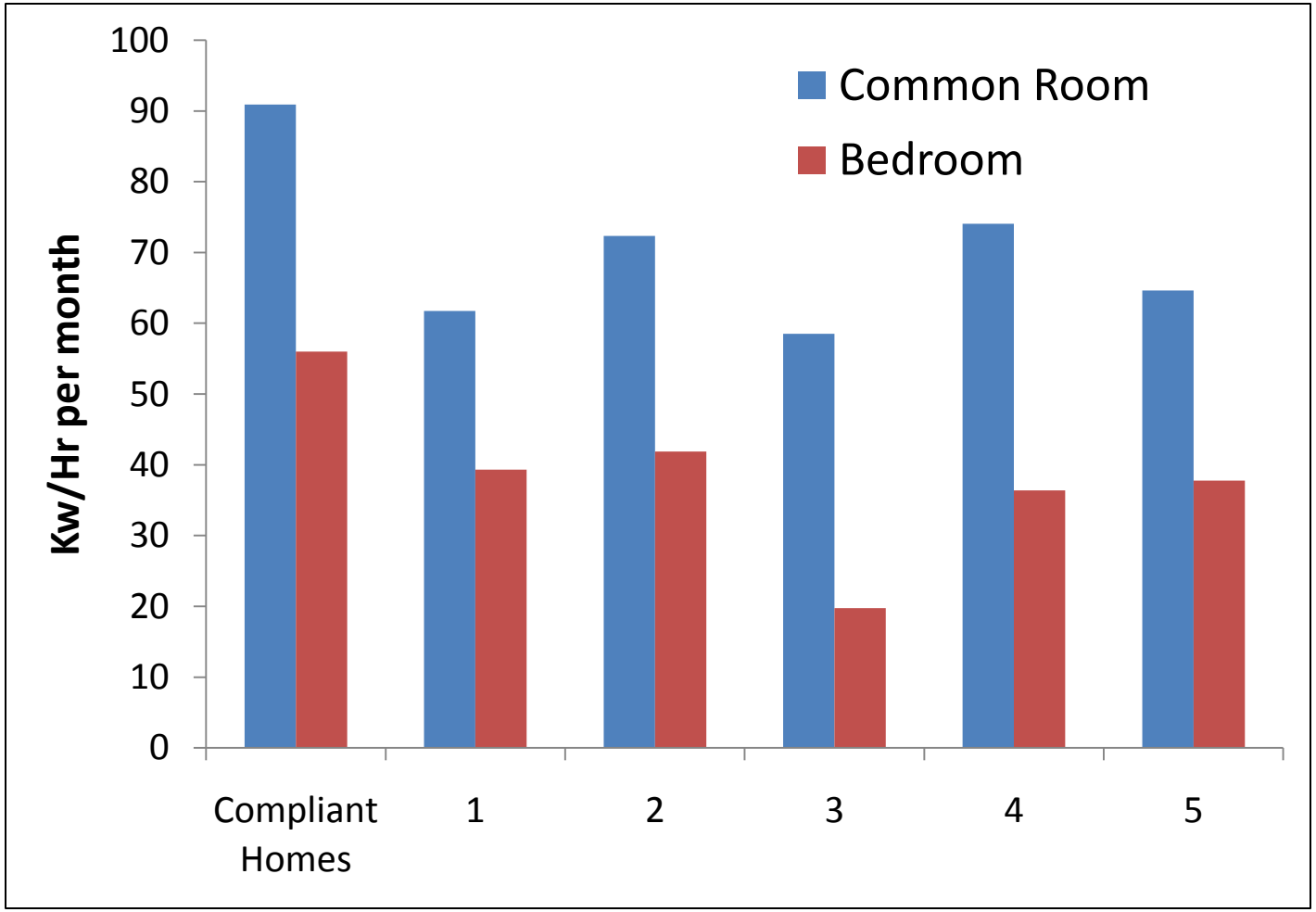
* Significant average reduction.

1 Noonan et al., Indoor Air 2012.
2 Allen et al., Atmos Environ 2009.
3 Semmens et al., ISEE 2011.
4 Ward et al., Sci Total Environ 2011.

What about in-home filter interventions?



Air Filter Intervention: Cost and Compliance



Survey of usage in winter following participation (n=17)

- 9/17 still using continuously
- 5/17 partial use
- 3/17 no use
- Main complaints
  - Noise
  - Cost
- Poor compliance with rec. filter replacement

What other interventions could be considered in wood stove homes?

Washington State Phone Survey, Summer 2010

- 25,406 calls to all 39 WA counties
- 8,003 contacts (answered phone)
- 3,427 (43%) declined interview
- 4,527 began interview
- 1,098 with wood burning appliance
- 400 adult head of households who burn wood at least 4X/week in fall and winter months

Northwest Air Quality Communicators, Washington Sub-group. Wood Smoke Awareness and Behavior. July 2010.

Washington State Phone Survey, Summer 2010

INDEX	n=	%	Definition
FUEL COMPLIANT	317	79%	Burn No Scrap [A6-7]
STORAGE COMPLIANT*	274	69%	5 Variables [Q3,4,11,12,13,14]
BURNING COMPLIANT*	67	17%	8 Variables [Q8]

Northwest Air Quality Communicators, Washington Sub-group. Wood Smoke Awareness and Behavior. July 2010.

Washington State Phone Survey, Summer 2010

Barriers to using seasoned firewood

- Think already doing it right
- Don’t want to or can’t wait 6-12 months
- The wood they purchase is already seasoned (or so they think)

Northwest Air Quality Communicators, Washington Sub-group. Wood Smoke Awareness and Behavior. July 2010.

Washington State Focus Group, September 2010

Messages

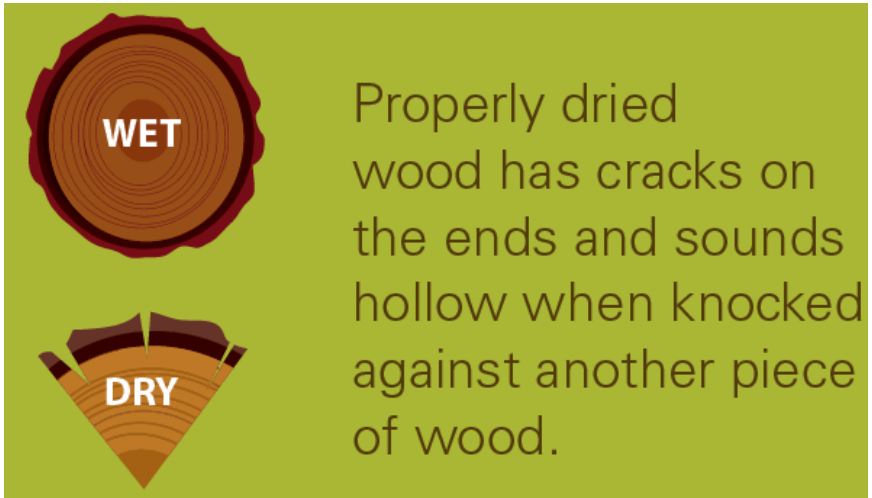
- Focus on heat and less work, versus health/air quality
- Find credible partners to share message
- Storage for six-12 months is probably the biggest gap
- Educating on health is barrier to information acceptance

Northwest Air Quality Communicators, Washington Sub-group. Wood Smoke Awareness and Behavior. July 2010.

Components of a “Best-Burn Practices” Education Intervention

1. Preparing your wood supply
2. Using your wood stove
3. Maintenance
4. What and when to burn

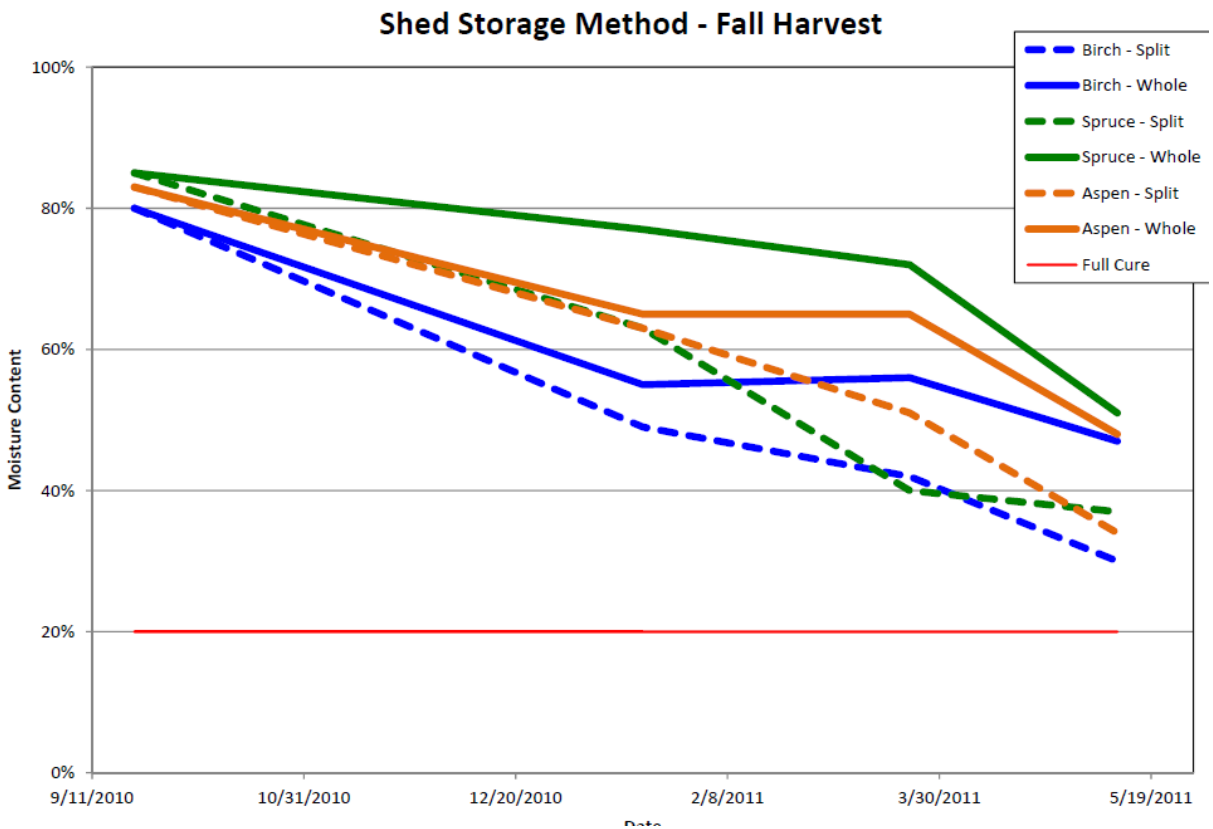
Wood supply



CONTACT INFO
Nez Perce Tribe
ERWM Air Quality

208-621-3821
woodsmoke@nezperce.org

Wood supply



Cold Climate Housing Research Center. Wood Storage Best Practices in Fairbanks, AK. June 2011.

Burn Temperature

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Nez Perce Tribe
ERWM Air Quality

208-621-3821
woodsmoke@nezperce.org

"Burning your stove without a thermometer is like driving without a speedometer."

- Jerry Marquez, Libby, MT

“Best-Burn Practices” Education Intervention

Can efficacy be tested?

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- Cold Climate Housing Research Center. Wood Storage Best Practices in Fairbanks, AK. June 2011.
- Northwest Air Quality Communicators, Washington Sub-group. Wood Smoke Awareness and Behavior. July 2010.
- http://www.epa.gov/burnwise/