Wildfire Smoke is the Worst Kind of House Guest

BC Centre for Disease Control

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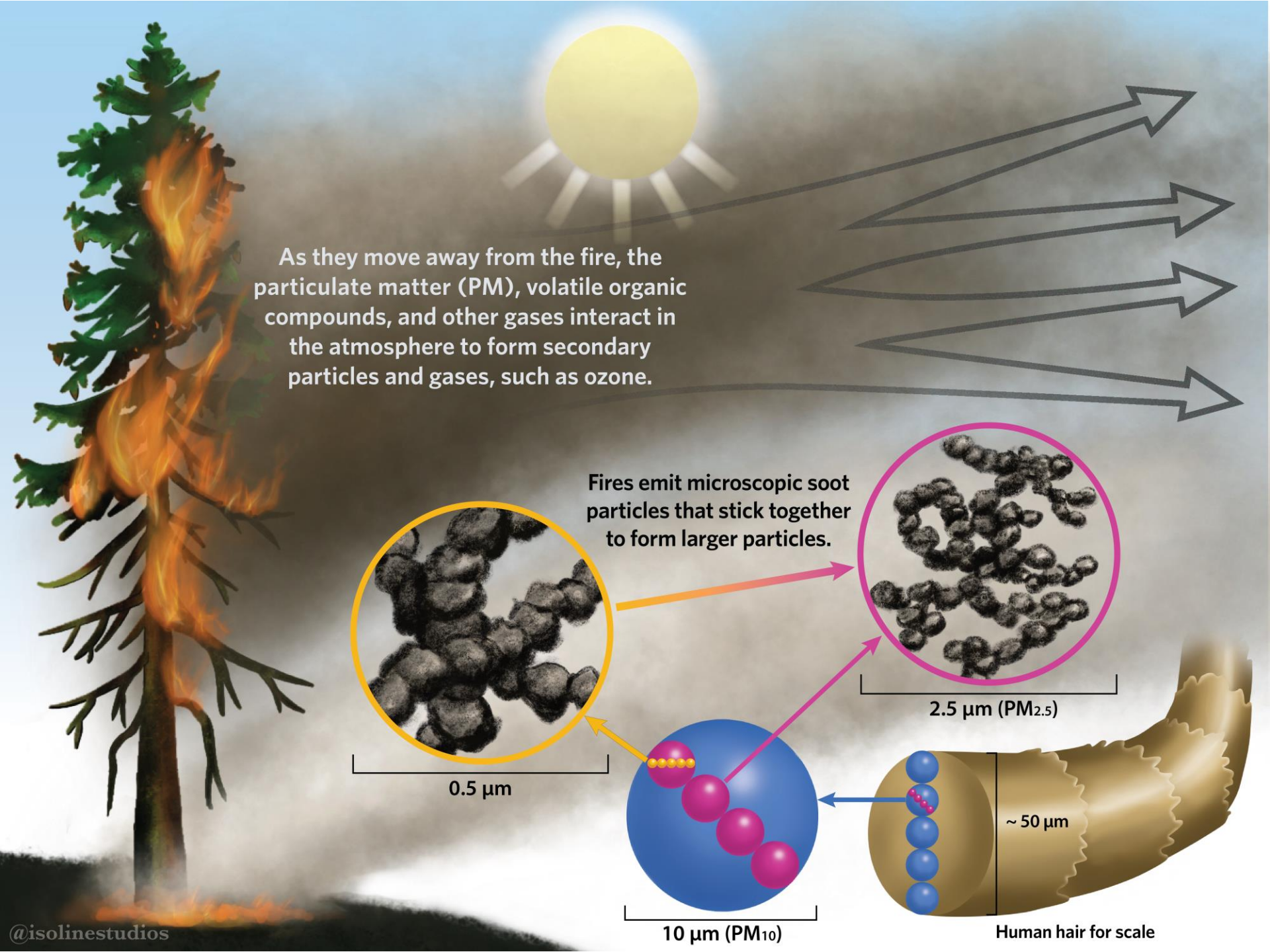
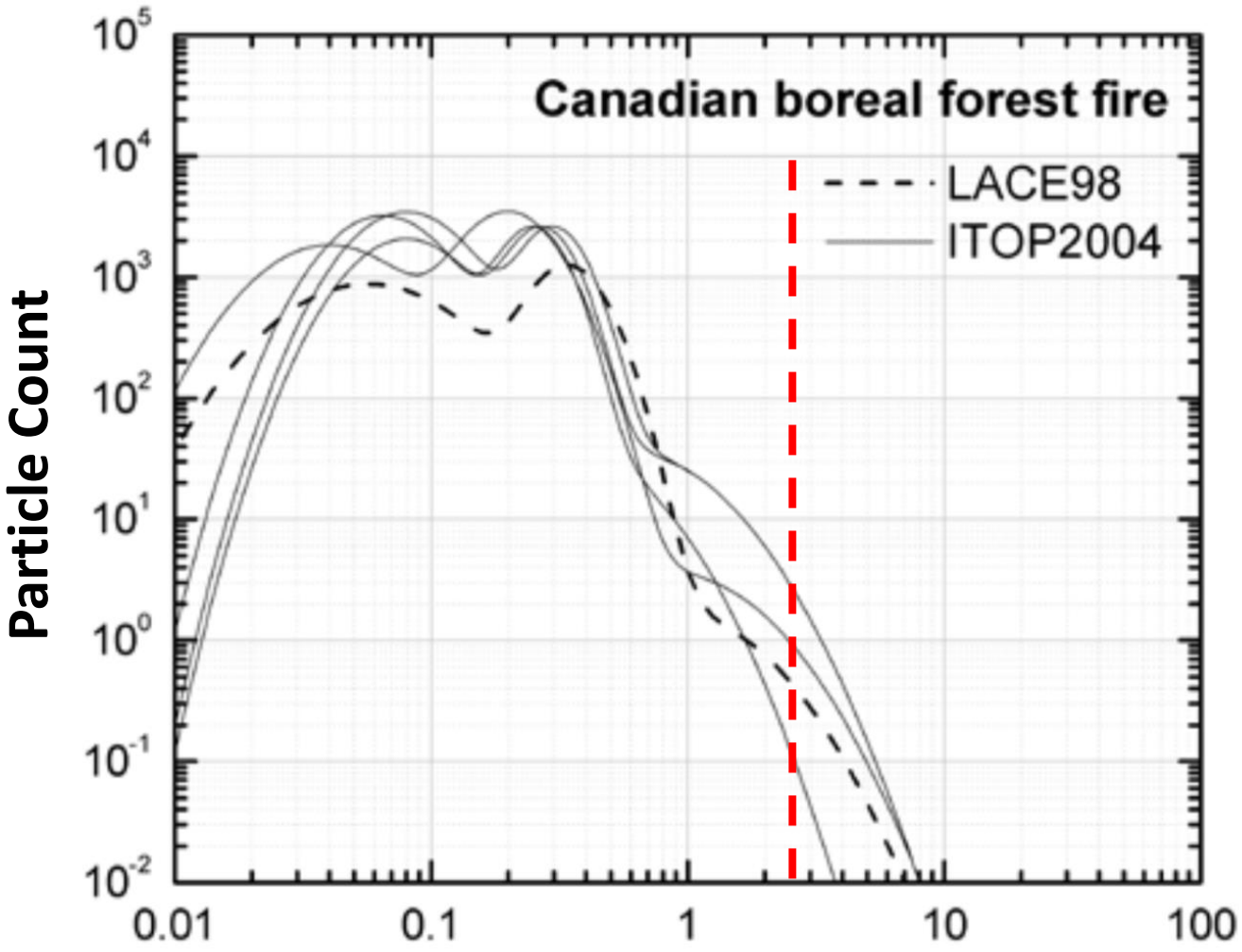
Outline

1. What is wildfire smoke?
2. How much smoke gets inside?
3. How much data do we have on infiltration?
4. What are the health effects of indoor smoke?
5. If we reduce indoor smoke, what are the expected health impacts?


As they move away from the fire, the particulate matter (PM), volatile organic compounds, and other gases interact in the atmosphere to form secondary particles and gases, such as ozone.
Fires emit microscopic soot particles that stick together to form larger particles.
0.5 µm
2.5 µm (PM2.5)
10 µm (PM10)
~ 50 µm
Human hair for scale
@isolinestudios

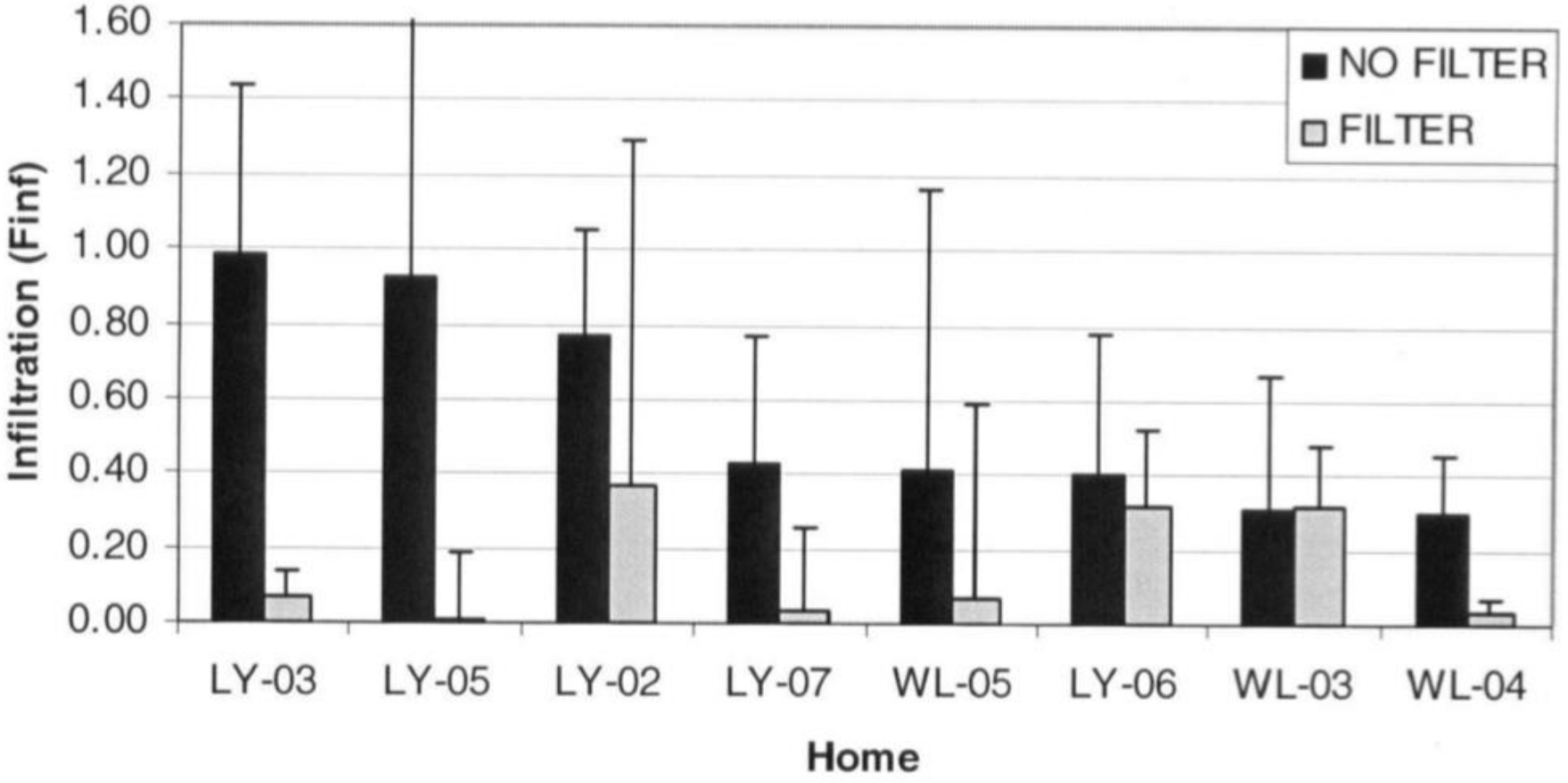
Most Smoke $PM_{2.5}$ <<< 2.5 mm



Atmos. Chem. Phys., 10, 8065–8076, 2010
www.atmos-chem-phys.net/10/8065/2010/
doi:10.5194/acp-10-8065-2010

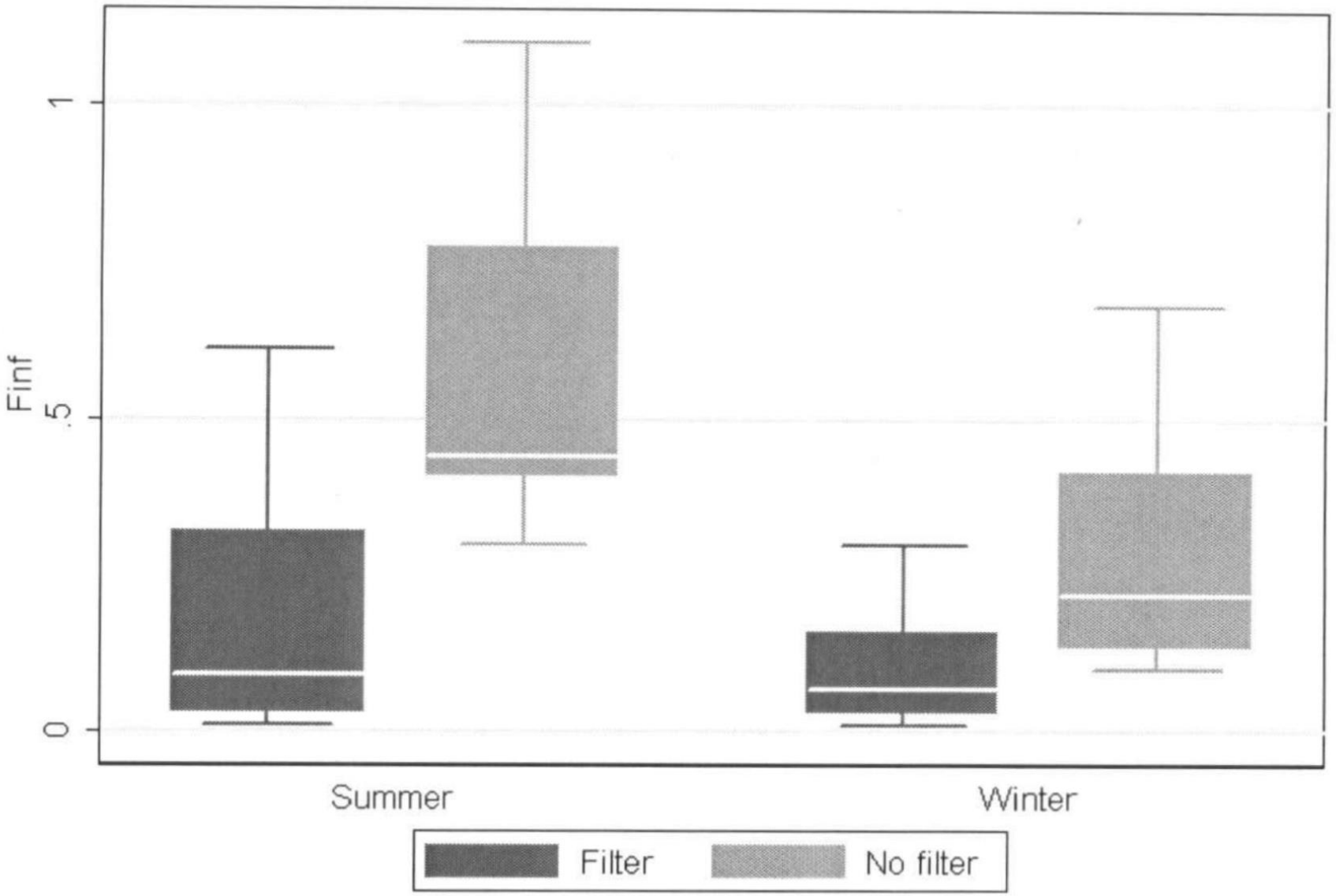
Indoor Smoke is Variable

Infiltration from 36-99% with no filtration

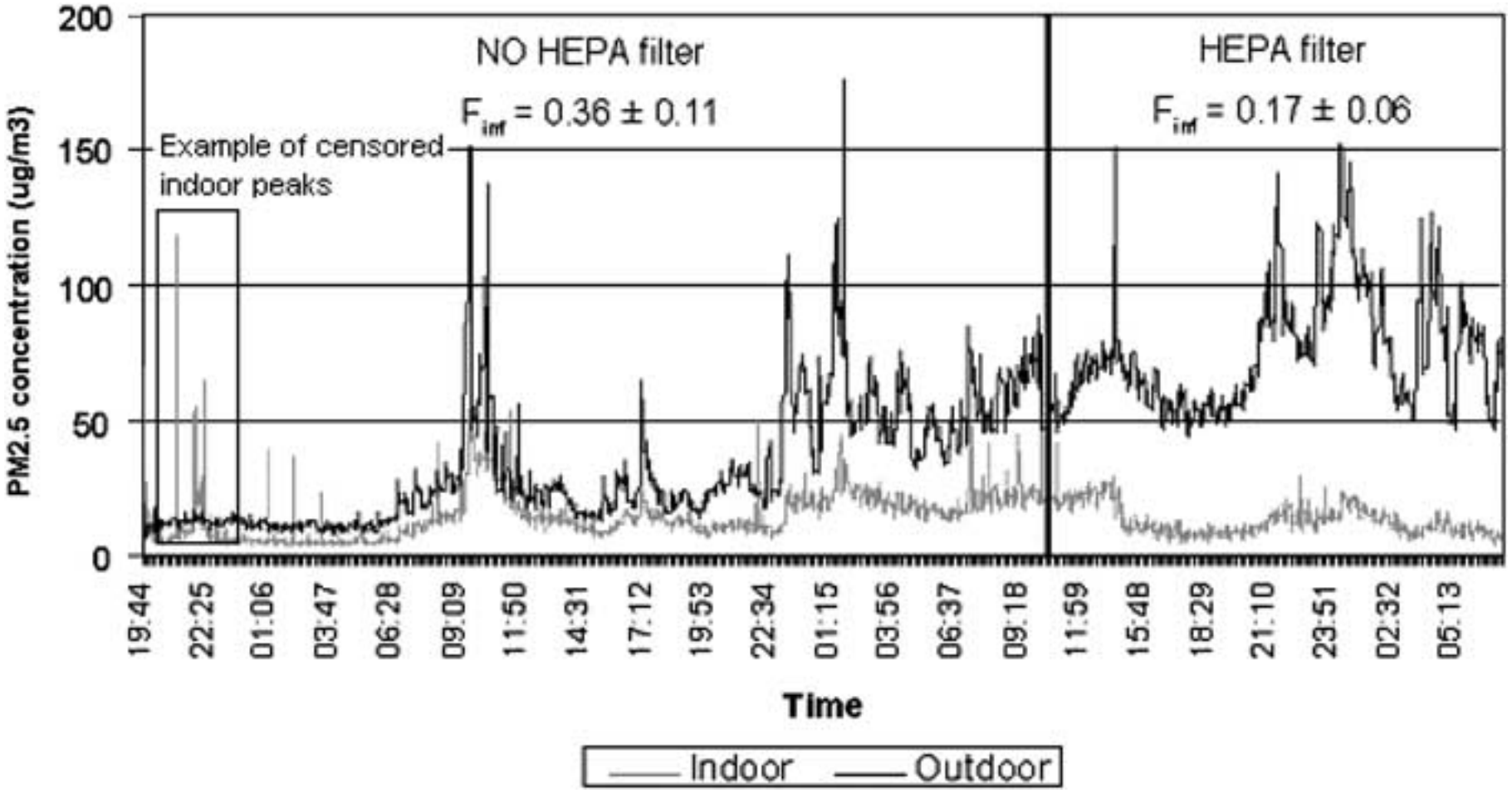


https://open.library.ubc.ca/cIRcle/collections/ubctheses/831/items/1.0100824

Overall, Portable Air Cleaners Work



Time Series Data are Useful



Barn et al (2008), JESEE
Barn et al (2016), Environmental Health

There’s More Data Than We Know

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Wildfire Indoor Air Quality: Managing Smoke in Occupied Buildings

Course Type: Complimentary Session
Course Length: 2 hrs
Province:
Location:
Price: 0.00

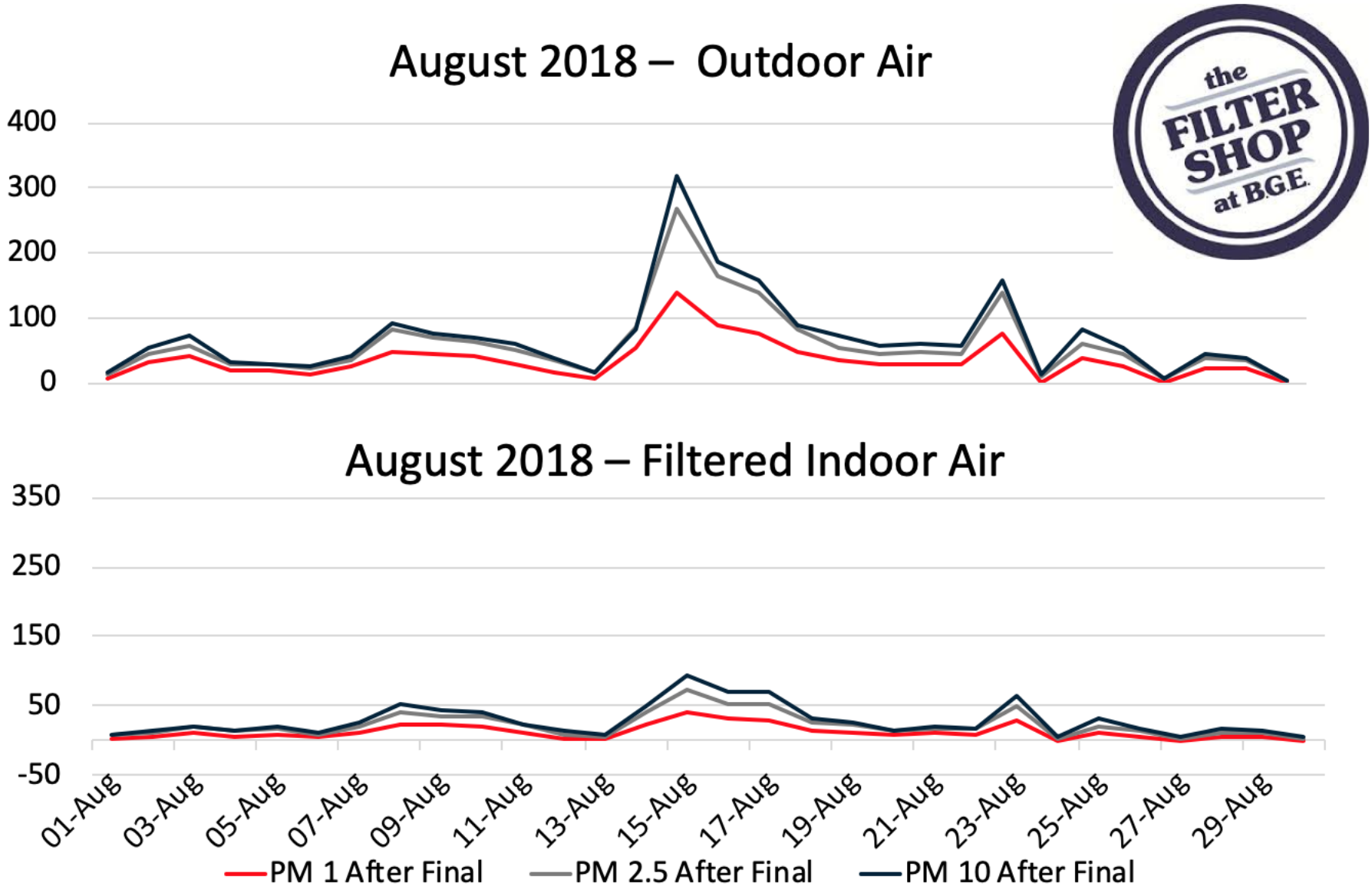
Seminar Overview

Wildfires have become more common and aggressive over the last 5 summers in Canac
The smoke from wildfires has become a significant indoor health hazard. Managing ind
very poor is a real challenge.

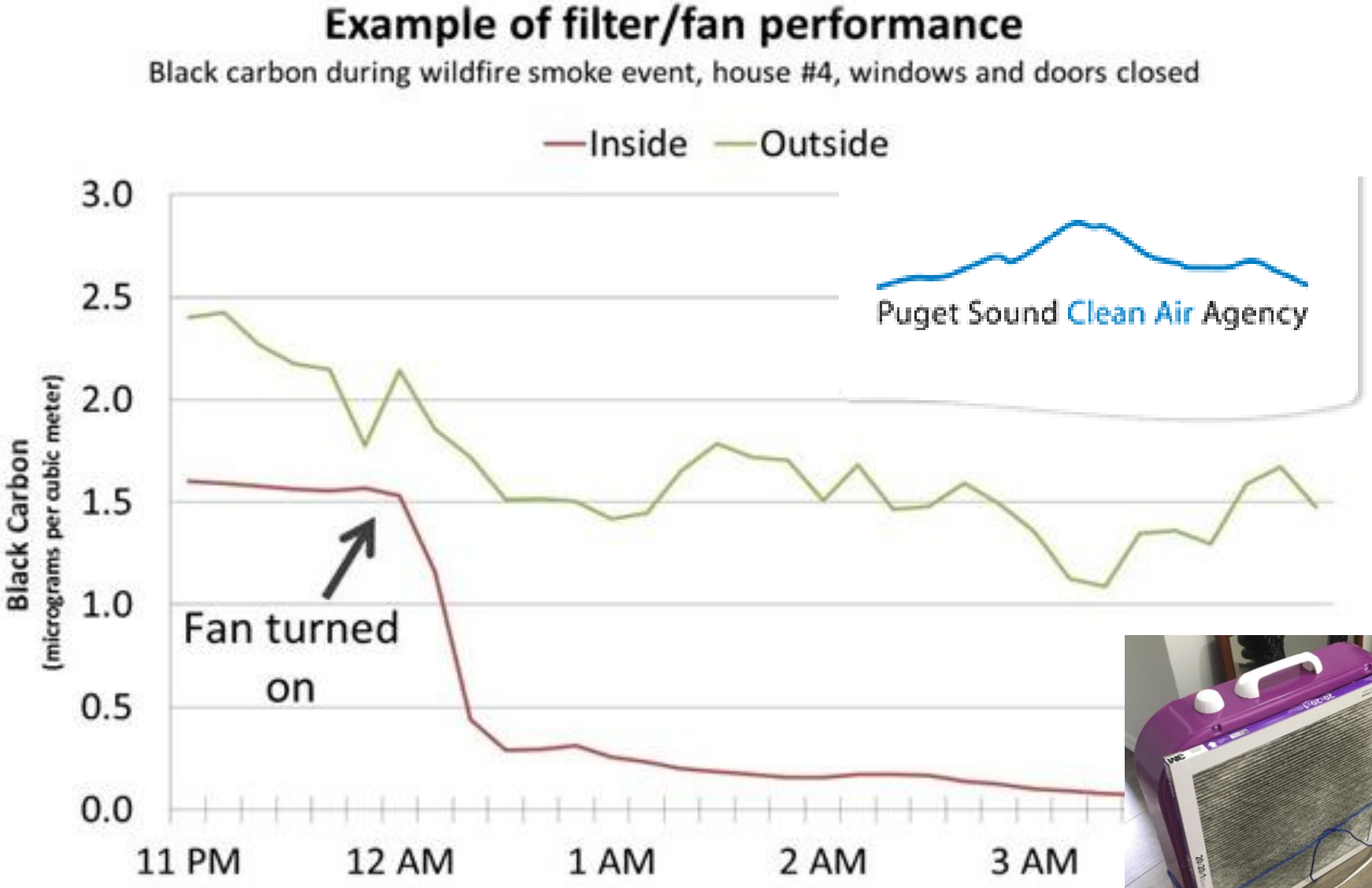
Having an adaptive plan to respond to wildfire smoke is the best method of pro-active p
building operators can optimize occupant comfort, and reassure staff that their health ar

Join us as our Director of Indoor Environmental Quality, David Shearer and our Project Technologist, M
importance of having a plan for wildfire smoke, what a plan looks like, who needs to be part of the plan & how to implement the plan with your team quickly and efficiently.

Private Sector is at the Forefront



The Public Sector Has Data Too

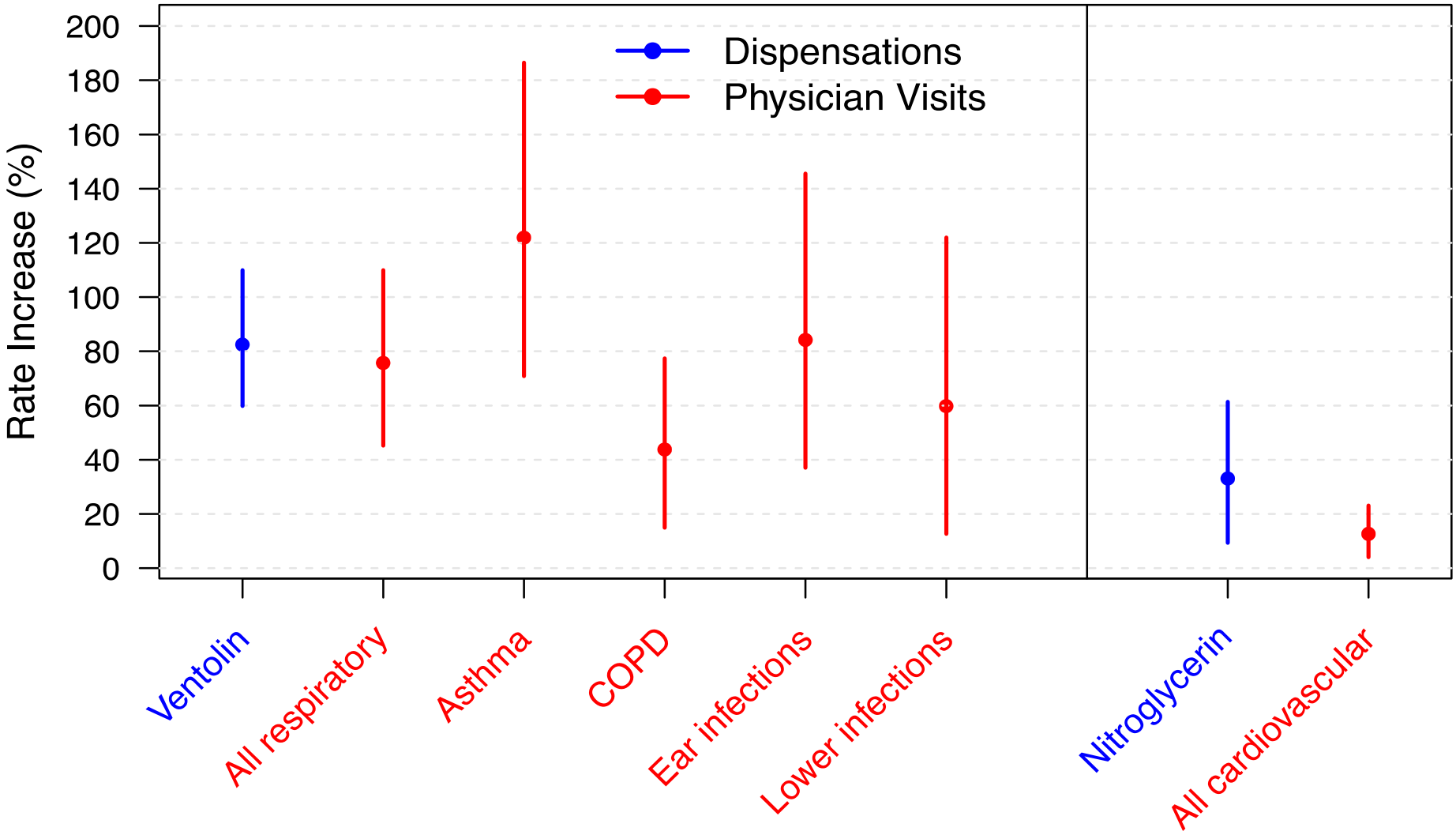


We Spend Most of Our Time Indoors

Location	Canada	U.S.	*p*
A. Percent time spent in major locations (with 95% CI), all respondents			
	n=2381	n=9386	
Indoor at home	65.94 (±0.83)	64.97 (±0.42)	0.0423
Outdoor at home	1.41 (±0.18)	2.50 (±0.13)	<0.0001
School/public building	4.21 (±0.40)	3.87 (±0.20)	0.1353
Indoors — other	7.95 (±0.59)	8.39 (±0.30)	0.1968
Bar/Restaurant	1.79 (±0.23)	1.91 (±0.12)	0.3622
Outdoors — other	4.60 (±0.41)	4.23 (±0.20)	0.1054
In vehicles	5.33 (±0.28)	5.74 (±0.12)	0.013
Near vehicles — outside	0.04 (±0.02)	0.19 (±0.04)	0.0002
Office/Factory	5.99 (±0.52)	5.90 (±0.27)	0.7634
Mall/Store	2.73 (±0.27)	2.30 (±0.13)	0.0033
INDOORS / CAR	94%	93%	
OUTDOORS	6%	7%	

https://www.nature.com/articles/7500244/tables/3

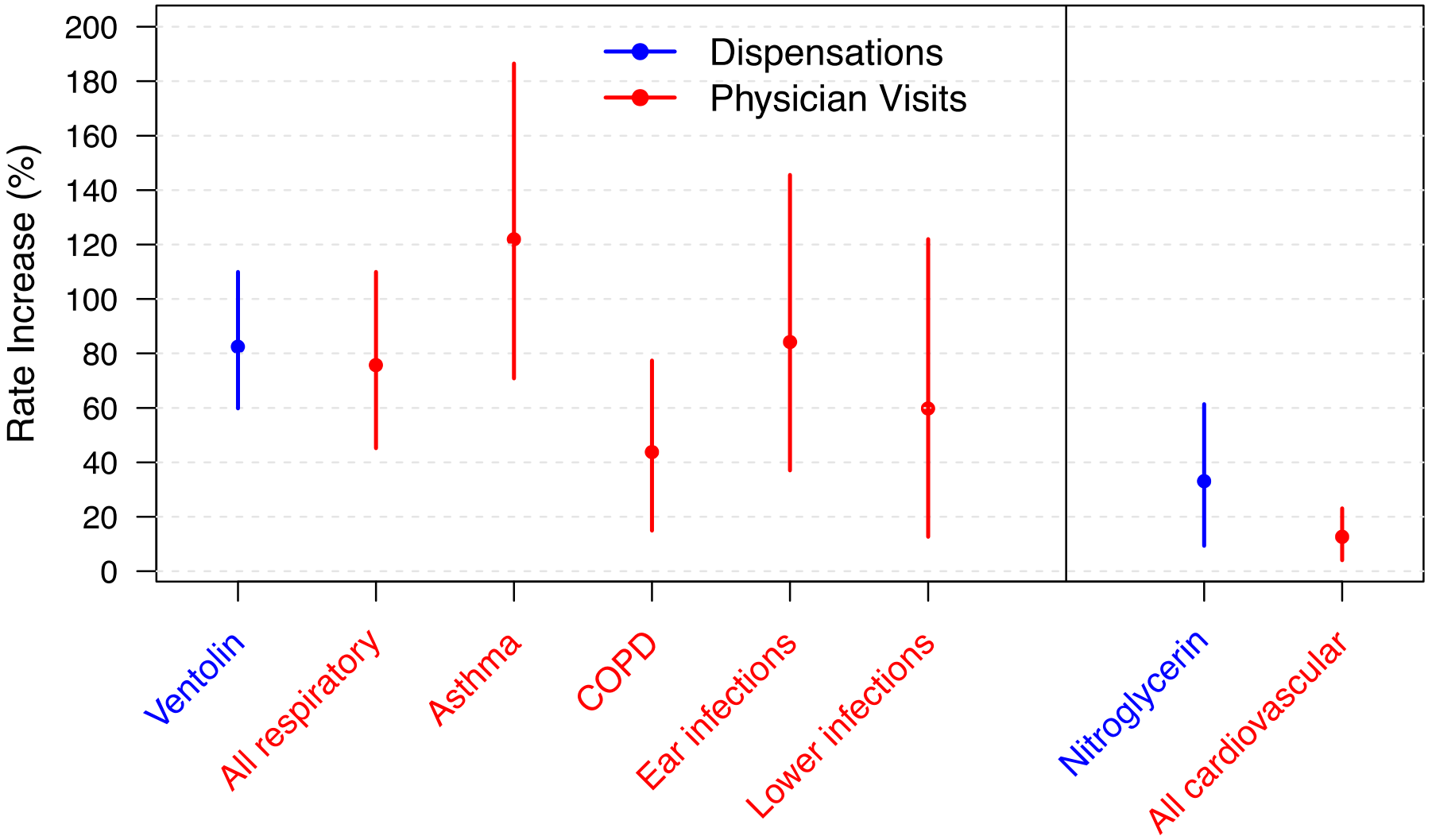
Outdoor Concentration = 100 μg/m^3



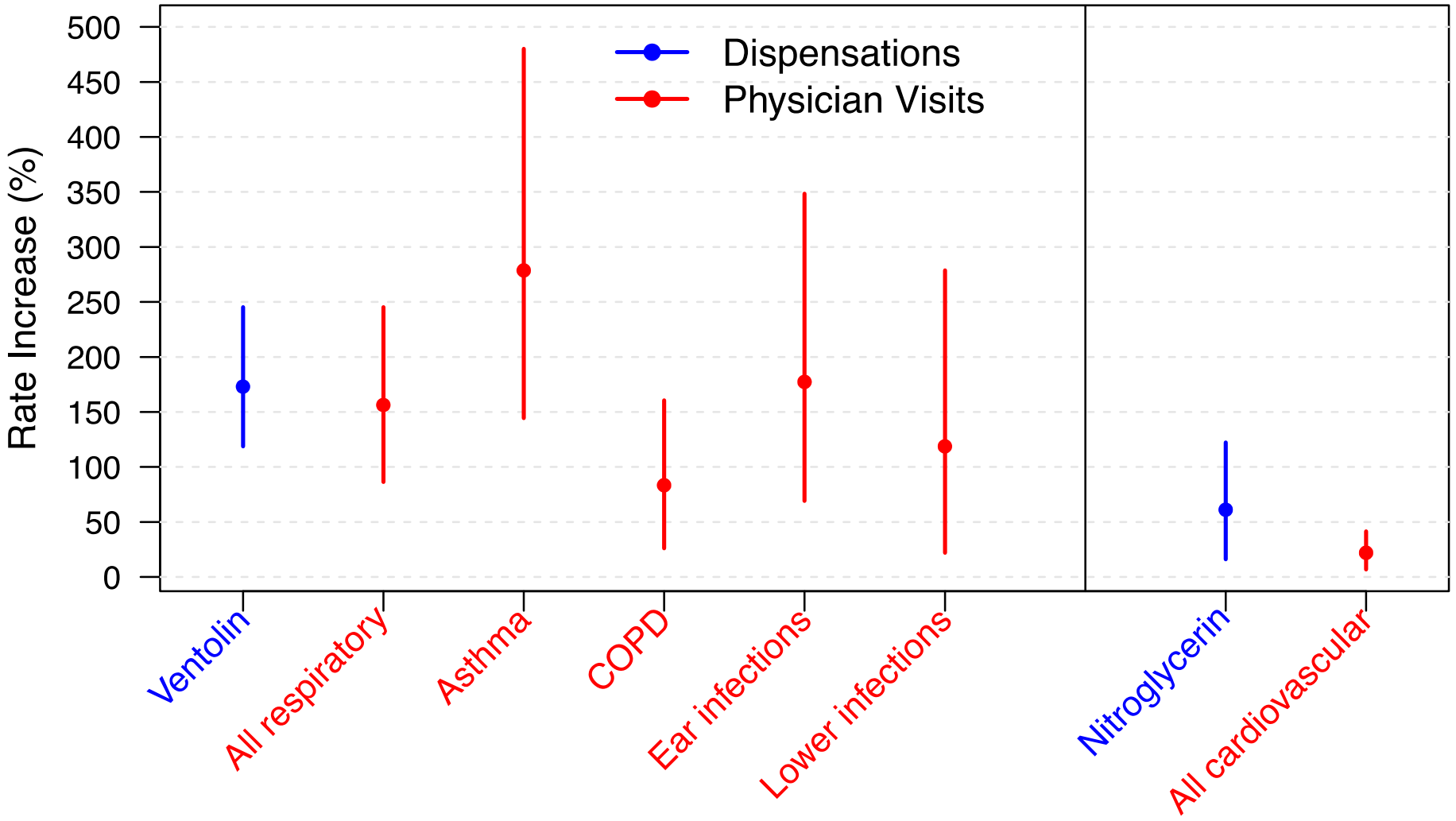
Either everyone is experiencing health effects in the **1-2 hours** they spend outdoors daily, or the true effects of wildfire smoke $PM_{2.5}$ are being **underestimated** by the outdoor proxy.

Assume average infiltration is **60%**...

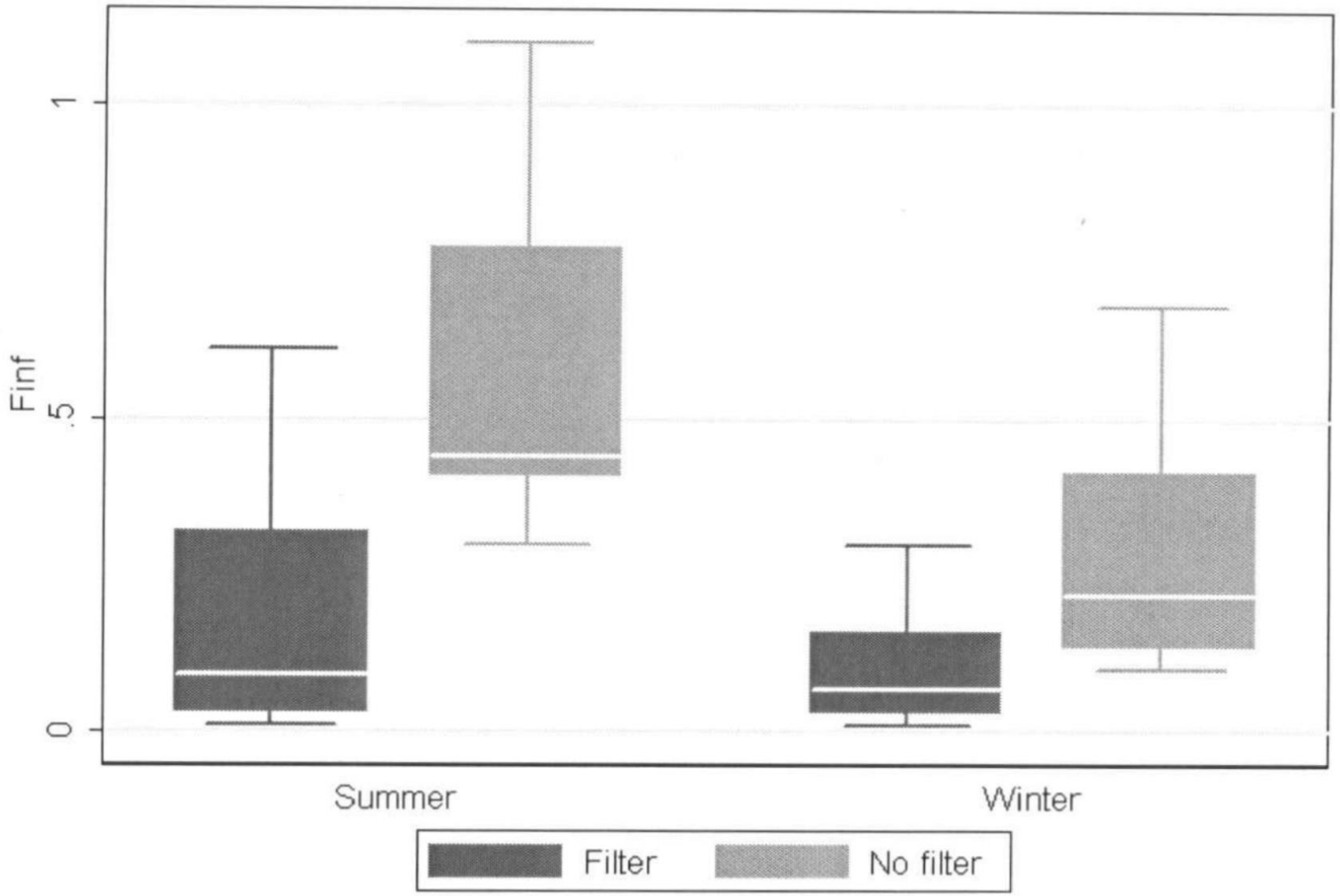
Indoor Concentration = 60 µg/m³



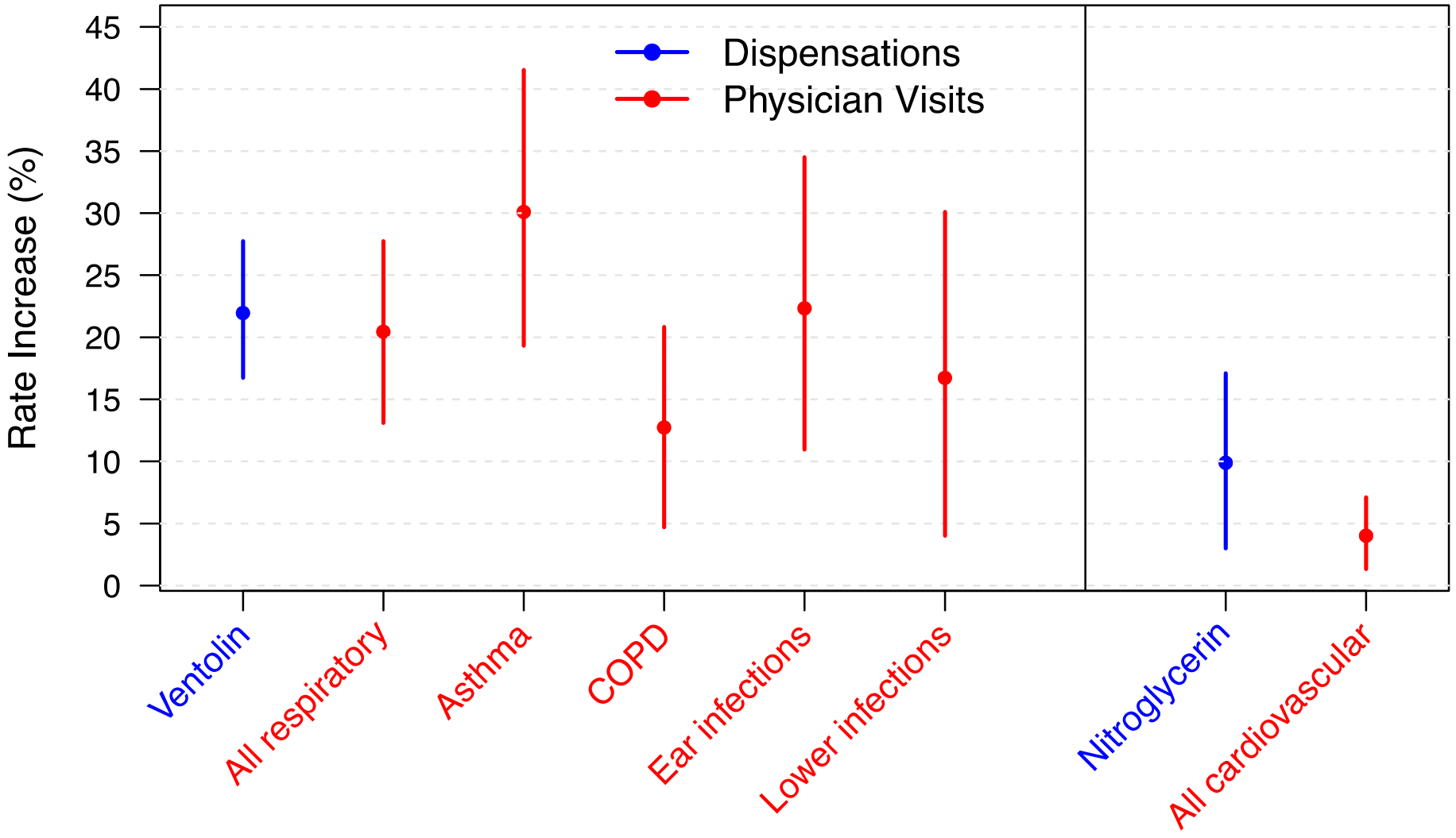
True Effects of 100 µg/m³ Exposure?



Wildfire Smoke Has Higher Infiltration



Indoor Concentration = 20 µg/m³?



Conclusions

1. Wildfire smoke $PM_{2.5}$ infiltrates indoors with highly **variable efficiency**
2. Indoor air filtration reduces $PM_{2.5}$ from wildfire smoke with **variable efficacy**
3. Ambient $PM_{2.5}$ **must** be a proxy for indoor exposure based on time-activity patterns
4. Therefore studies must **underestimate** the true effect of wildfire smoke $PM_{2.5}$
5. Reducing infiltration **should** reduce effects