Improving in-home standalone air filtration for ultrafine particle exposure and health

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A L E X A . K A R N E R , D O U G L A S S . E I S I N G E R , A N D D E B A . N I E M E I E R. Near-Roadway Air Quality: Synthesizing the Findings from Real-World Data. ENVIRONMENTAL SCIENCE & TECHNOLOGY, 2010

# Growing evidence for associations of UFP with adverse health outcomes



POSTER R2



## **HEPA** air filtration Interventions

- 2015 Los Angeles city ordinance requires high grade filtration in near-highway homes and schools (1)
- Mechanical ventilation filtration can reduce indoor UFP (2,3), but more difficult to reduce UFP in low-income households without mechanical ventilation (4,5)
- To date, few studies testing the health benefits of reducing indoor UFP from traffic (6,7,8).
- 1) http://clkrep.lacity.org/onlinedocs/2015/15-1026\_ORD\_184245\_6-4-16.pdf
- 2) Stephens, 2013. Indoor Air.
- 3) Polidori, 2013. Indoor Air.
- 4) Padró-Martínez, 1994. Atmospheric Environ.
- 5) Batterman, 2012. Indoor Air.
- 6) Bräuner, 2008. Am J Respir Crit Care Med.
- 7) Padró-Martínez, 2015. Int J Environ Res Public Health.
- 8) Brugge, 2017, Building and Environment

# Randomized Cross-Over Study Design



## **Study 1: Somerville public housing**



#### Public housing development next to Interstate 93 (~150,000 vehicles per day) in Somerville, Massachusetts, USA. 21 participants in 20 homes.

Padró-Martínez et al. *International Journal of Environmental Research and Public Health*, 2015, 12: 7814-7838. FUNDED bt US Housing and Urban Development

## **Study 2: Boston Puerto Rican Health Study**



Brugge et al., 2017, Building and Environment FUNDED by US National Heart Lung and Blood Institute

# **Equipment and Filters**





#### **Sham Filter**



**HEPA Filter** 

### HEPAiR<sub>x</sub> Air Filtration Unit (Air Innovations, Inc.)

# Apartment Blueprint & Set Up



For this apartment the window in which the HEPA unit was installed faced the highway. Unit was within 100m from the highway.

## Particle Number Concentration – by Filter Group and Order



Filter order does not seem to have an impact on particle reduction. In apartments 1-11 (sham first group) consistent particle reductions were observed compared to apartments 12-20 (HEPA first group).

## Study 2. Reduction by HEPA

	% reduction in PNC	% indoor spikes
	(indoor)	
Participant ID	%	Total
P01	43%	15.9%
P02	86%	9.0%
P03	56%	10.3%
P04	64%	5.7%
P05	75%	11.4%
P06	69%	6.4%
P07	49%	8.3%
P08	54%	6.6%
P10	41%	10.8%
P11	-5%	16.7%
P12	56%	15.1%
P13	77%	11.6%
P14	52%	10.9%
P16	69%	9.8%
P17	82%	8.2%
P19	76%	8.3%
P20	72%	14.1%
P21	59%	7.8%
P22	86%	8.6%
P23	77%	11.9%
P24	33%	8.7%
P25	60%	9.1%
P26	38%	12.1%

## Sham reduces PNC

## Indoor spikes in PNC



# No consistent or statistically significant trend in biomarkers



### Lessons (new grant proposal):

- 1) Need larger sample sizes
- 2) Need a wash out period
- 3) Sham filtration?
- 4) Window opening focus on cold months
- 5) Have to assess indoor sources
- 6) Health of participants
- 7) Personal exposure/time activity
- 8) Measure multiple PM types

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Lessons from in-home air filtration intervention trials to reduce urban ultrafine particle number concentrations

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We are seeking to do a large intervention trial incorporating lessons we learned









#### Doug Brugge Particles in the Air The Deadliest Pollutant is One You Breathe Every Day

The book covers the three largest sources of particulate matter pollution in five chapters. These sources constitute three of the top ten public health problems in the world to day and far outstrip any other environmental health threats in terms of health impact. The book begins with indoor solid fuel combustion for cooking in lower income countries and tells the story of how this problem was identified and recent efforts to eliminate it. The book next looks at tobacco smoking and second hand smoke, again reviewing the history of how these problems were identified scientifically and the florce industry push back against the science. The last two chapters cover a mbient particulate matter in the outdoor air. They address fine and ultrafine particles, describing the pioneering work on the FM, the subsequent industry attacks on the scientifits and then the emerging interest and concern about ultrafine particles, an area of research in which the author has participated. This book is geared towards aon-scientists, including high school and college students. Brugge

# Particles in the Air



Particles in the Ai

You Breathe Every Day By Doug Brugge Foreword by Kenneth Olden

The Deadliest Pollutant is One





Popular Science/ Nature and Environment



https://www.springer.com/us/book/9783319895864

Thank you Any questions?

#### CRP, mg/L

# Meta analysis of both studies

