

# **IMPACTS OF A WILDFIRE EVENT – HEALTH EFFECTS OF SMOKE EXPOSURE**

PNWER Summit  
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# WILDFIRES INCREASING

- Increasing in numbers of fires<sup>1</sup>
  - ~140/yr in the 1980's
  - ~160/yr in the 1990's
  - ~250/yr in the 2000's
- Increasing in duration – avg of 5 months (1970's) to 7+ months (2000's)<sup>1</sup>
- Increase in average temperatures:
  - Melts snowpack earlier (up to 4 weeks)
  - Drier forests
- Montana is perennial top 10 state for wildfire exposures
- Summer of 2017:
  - Rice Ridge fire >150,000 acres
  - Lolo Peak fire ~54,000 acres

<https://www.carbonbrief.org/factcheck-how-global-warming-has-increased-us-wildfires>

<https://www.ucsusa.org/global-warming/science-and-impacts/impacts/infographic-wildfires-climate-change.html>



# POTENTIAL FOR HEALTH EFFECTS

- Air pollution
  - PM<sub>2.5</sub>
  - Not all PM<sub>2.5</sub> is created equal
- At risk populations (respiratory, cardiovascular, elderly, pediatrics)
- Previous studies focus on historical data
  - ED visits
  - Hospital admissions
  - ICD-10 codes



# Sizing up particulate matter

Pollution particles of soot and other specks called PM-10 and PM-2.5 are microscopic, yet they are thousands of times larger than ultrafine particles.

Ultrafines are measured in nanometers, and can be 100 nanometers and smaller.

A typical germ measures about 1,000 nanometers.

## PM-10

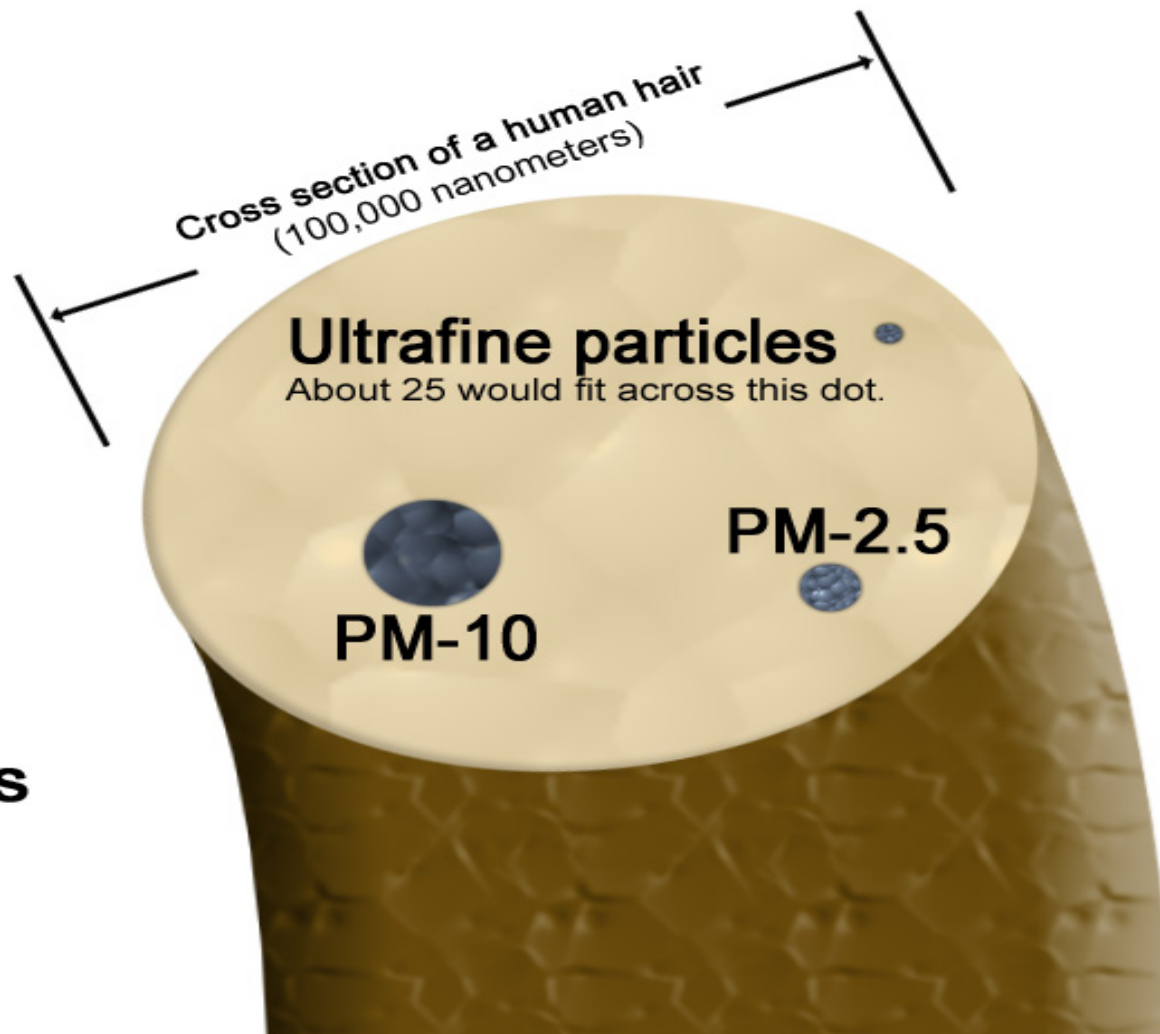
About six would fit across the width of a human hair.

## PM-2.5

About 30 would fit across the width of a human hair.

## Ultrafine particles

About 1,000 would fit across the width of a human hair.



# HISTORICAL FINDINGS

- A majority of studies have found that wildfires are linked to health outcomes (Liu 2015)
  - Hospital admission rates
  - Increase contact with hospitals or clinics
- Hospital/clinic/provider visits (Wettstein 2018, Alman 2012)
  - Respiratory (asthma, wheeze, COPD)
  - Cardiovascular, cerebrovascular
- Increase asthma visits in the ED during wildfire event (Haikerwal 2016)
- While some studies suggest increased mortality, difficult to correlate



# HEALTH COSTS

- Hospitalizations
- Medications
- Lost wages
- Study: Health Costs of Wildfires (Richardson 2011)
  - \$84.42 = amount for reduction of symptoms for 1 day
  - California Station Fire of 2009
  - Defensive behavior not historically in the calculations
    - Averting actions
    - Mitigating actions



# COST-BENEFIT STUDY

- Fisk and Chan 2017
- Reduction of household PM<sub>2.5</sub>
  - HVAC – continuously vs on demand
  - HVAC filter upgrade
  - Portable continuous filters
- Potential health benefits
  - 11-63% of hospital admissions
  - 7-39% of deaths attributable to wildfire particles
- Added interventions cost/benefit
  - all potential households: cost > benefit
  - Target ≥65 year olds: decreases costs by 80%, while benefits are same magnitude



# THE SEELEY LAKE STUDY

- Opportunity to assess in real time
- Unprecedented exposure
- Relatively local
- History of wildfires and smoke





# SEELEY LAKE STATISTICS 2017

□ Rice Ridge Fire - >150,000 acres

□ July 31<sup>st</sup>-September 18<sup>th</sup>

□ 24-hr average: 220.9  $\mu\text{g}/\text{m}^3$

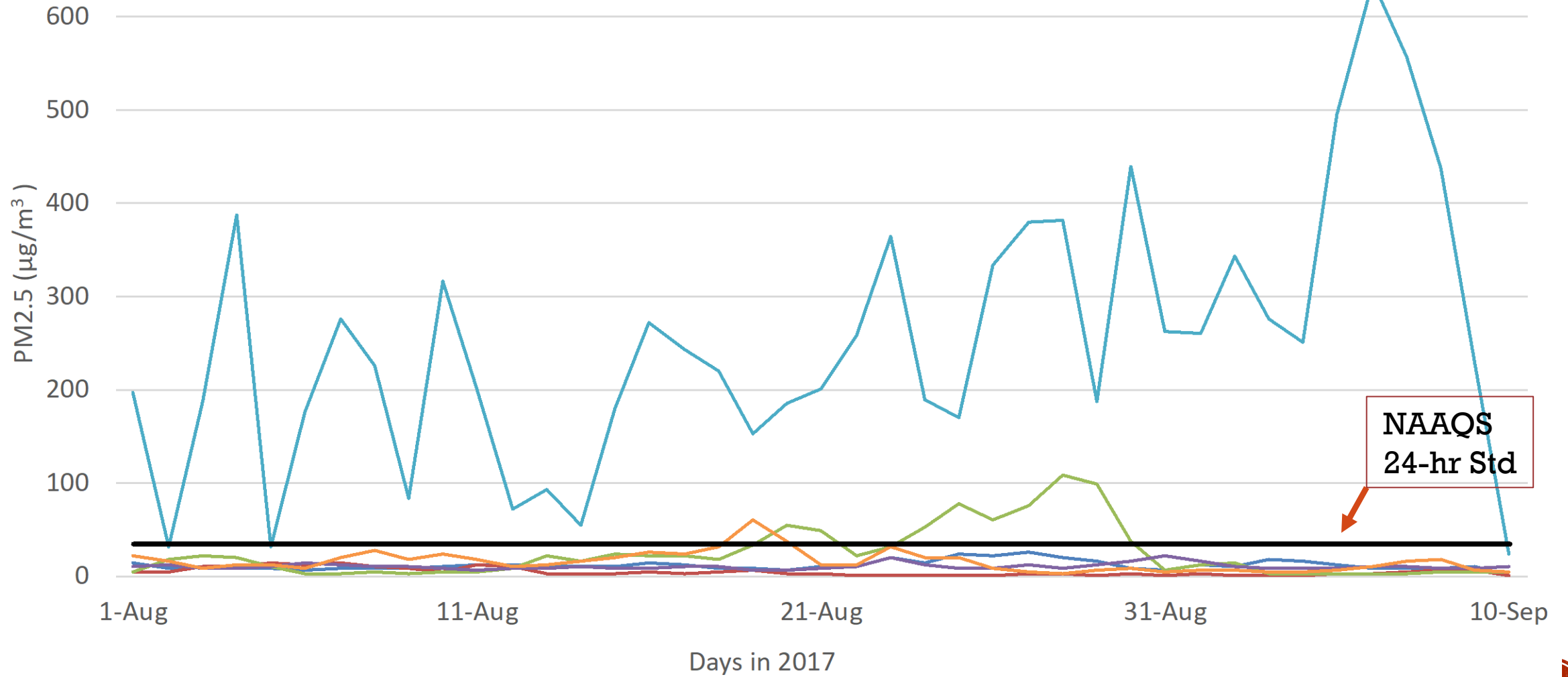
□ 35/50 days “very unhealthy” or “hazardous”

PM <sub>2.5</sub>	Healthy
0 to 12.0	Healthy
12.1 to 35.4	Moderate
35.5 to 55.4	Unhealthy for Sensitive Groups
55.5 to 150.4	Unhealthy
150.5 to 250.4	Very Unhealthy
250.5 to 500.4	Hazardous



# Last 5 yrs - PM<sub>2.5</sub> Daily Averages

— 2013 — 2014 — 2015 — 2016 — 2017 — 2018 — EPA standard



NAAQS  
24-hr Std



# SPIROMETRY – LUNG FUNCTION

## Tests/Units

## Definition

## Measurement Significance

**FVC**

Forced Vital Capacity (L)

The Maximum volume of air exhaled

Decreased in restrictive disorders and severe obstruction

**FEV1**

Forced Expiratory Volume in 1 second (L)

Volume of air exhaled over one second

Decreased in obstruction of large to mid sized airways

**FEV1/FVC**

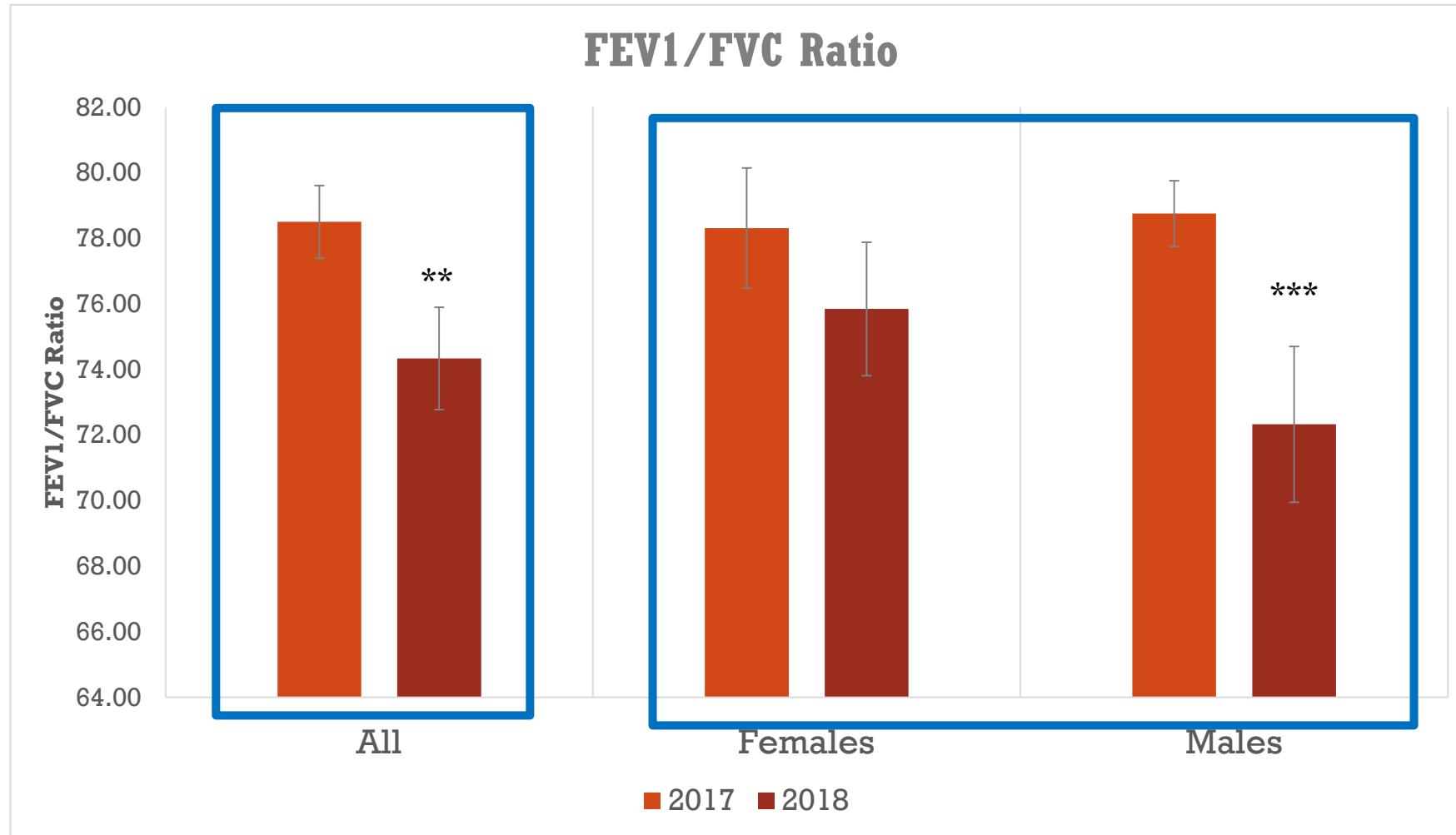
Forced Expiratory Volume Ratio %

A ratio of FEV1 to the Forced Vital Capacity expressed as a percentage

Decreased in small airway obstruction. Also used to grade severity of obstruction. Increased with restrictive disorders



# SPIROMETRY RESULTS:



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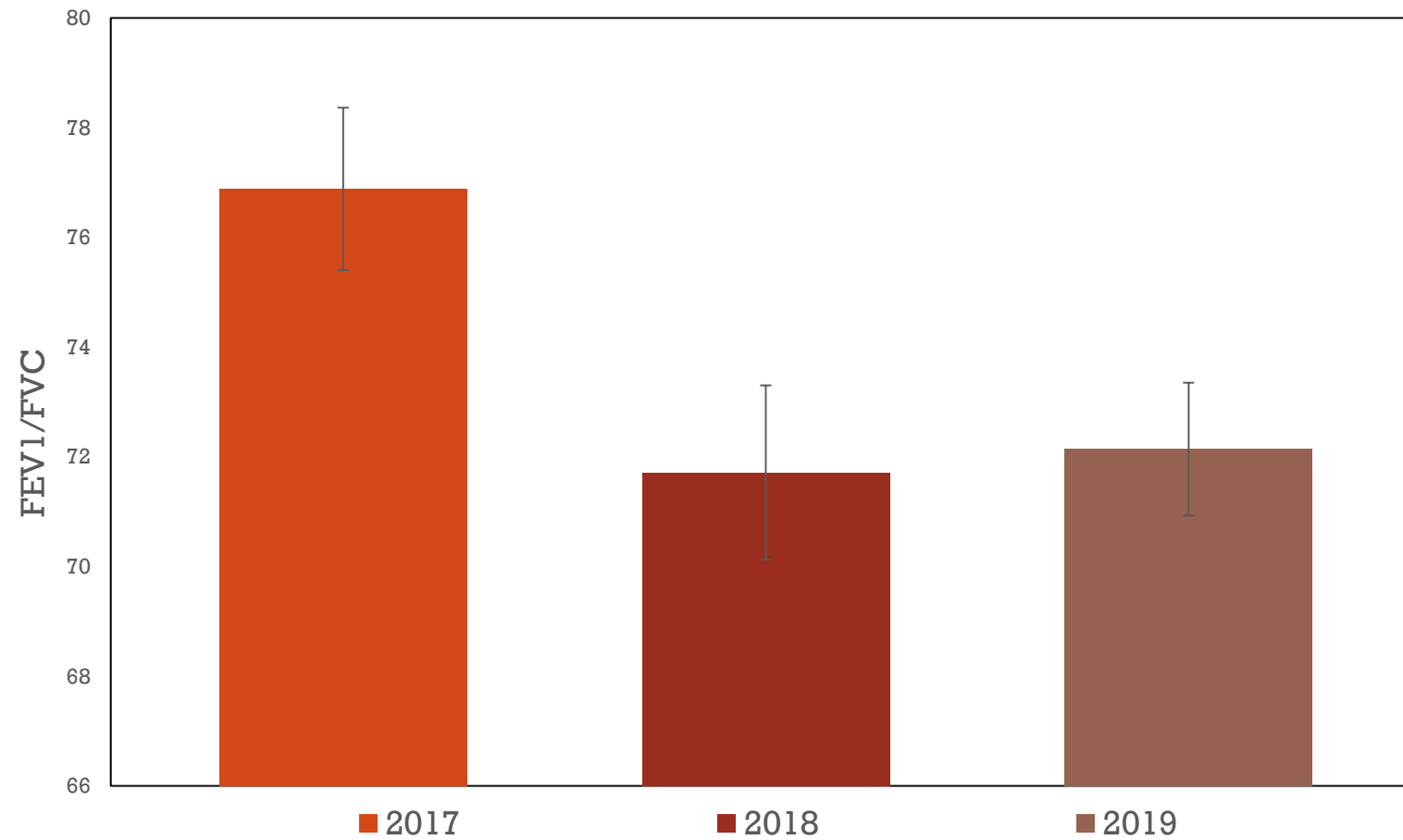
## Percent change of individuals

All	-6.30%
Females	-3.86%
Males	-8.91%

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# 2019 UPDATE: RESPIRATORY EFFECTS



# WHAT IS NORMAL?

Normal FEV <sub>1</sub> Ranges		Decreased lung function (FEV <sub>1</sub> /FVC)	
Age	FEV <sub>1</sub> /FVC	Year	Below age-range
8-19	85%		
20-38	80%	2017	6
40-59	75%	2018	15
60-80	70%	2019	14

\*EPR-3 Guidelines



# FUTURE

- Fires will continue
- Need to understand other long- and short-term health effects
  - Cardiovascular
  - Behavioral
  - Community
- Mitigation and defensive strategies
  - What should be done
  - What can be done
- Continue to expand and follow our cohort
- Additional cohorts in western Montana





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**QUESTIONS?**



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# RESULTS: PUBLIC HEALTH

- 54% used a plug-in HEPA unit
- 34% “evacuated”
  - Avg of 59.3 miles
  - Range of 1-59 days
  - 17% > 100 miles
  - 62%  $\leq$  32 miles



# DEMOGRAPHICS

Year	Participants	Age (yrs)	#Females	#Males
2017	95	63	51	44
2018	42	64	25	17
2019	60	64	34	26

