An air quality-focused personnel intervention to improve health among skilled nursing facility (SNF) residents

August 17, 2022

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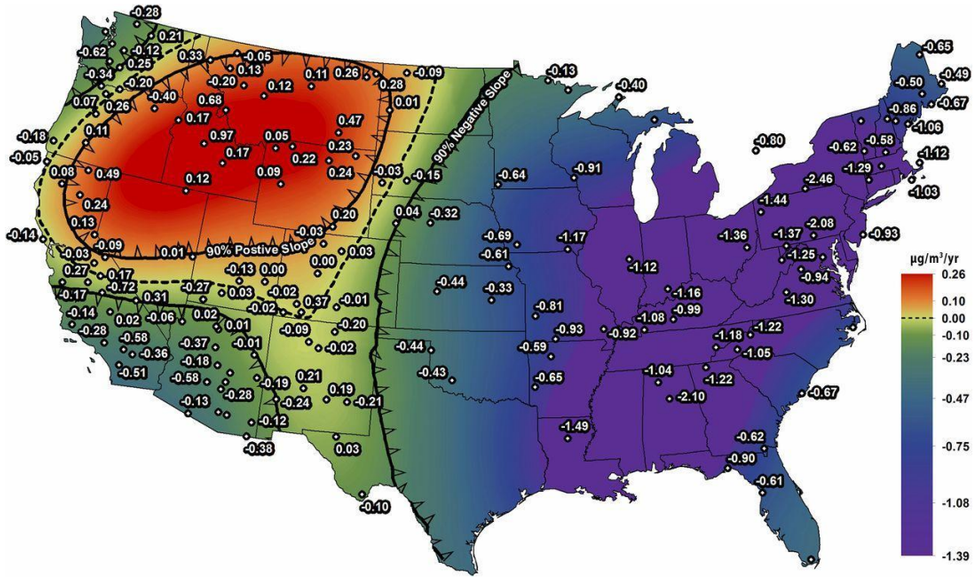
Wildfires activity is increasing in the Western US
…..and where there's fire, there's smoke

US particulate matter air quality improves except in wildfire-prone areas

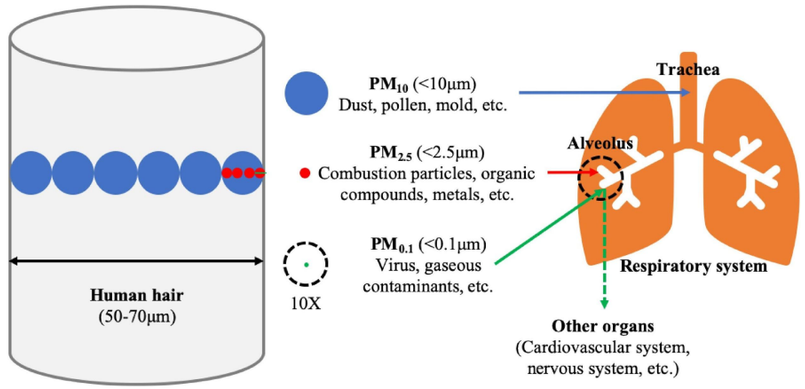
Crystal D. McClure and Daniel A. Jaffe

PNAS July 31, 2018 115 (31) 7901-7906; first published July 16, 2018 https://doi.org/10.1073/pnas.1804353115



Wildfire smoke is a complex mixture of 100's of constituents/compounds, including:

- **Particulate matter**
- CO
- VOCs
- CO_2
- NOx
- Hydrocarbons



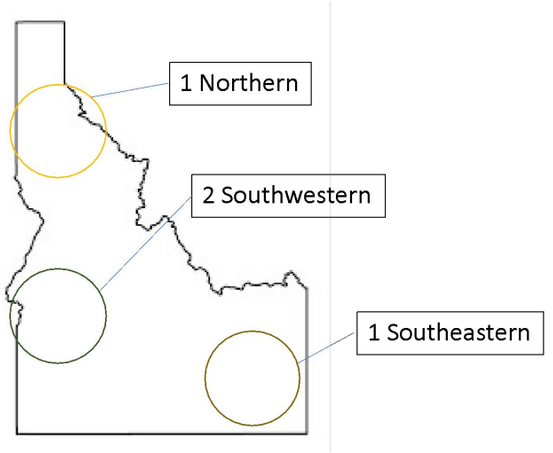
An air quality-focused personnel intervention to improve health among SNF residents

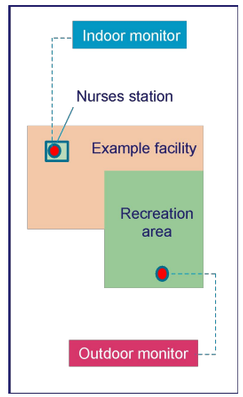
Goals of project

- Determine the feasibility of deploying low-cost sensors to measure outdoor and indoor air quality
  - Attempt to associate air quality with health data at skilled nursing facilities
- Design and implement an educational workshop focused on air quality, health and HVAC management
  - Survey the utility of the workshop material
  - Explore opportunities to develop a smoke readiness plan and assess potential barriers/challenges

Citing low-cost sensors within SNFs in a Mountain West state

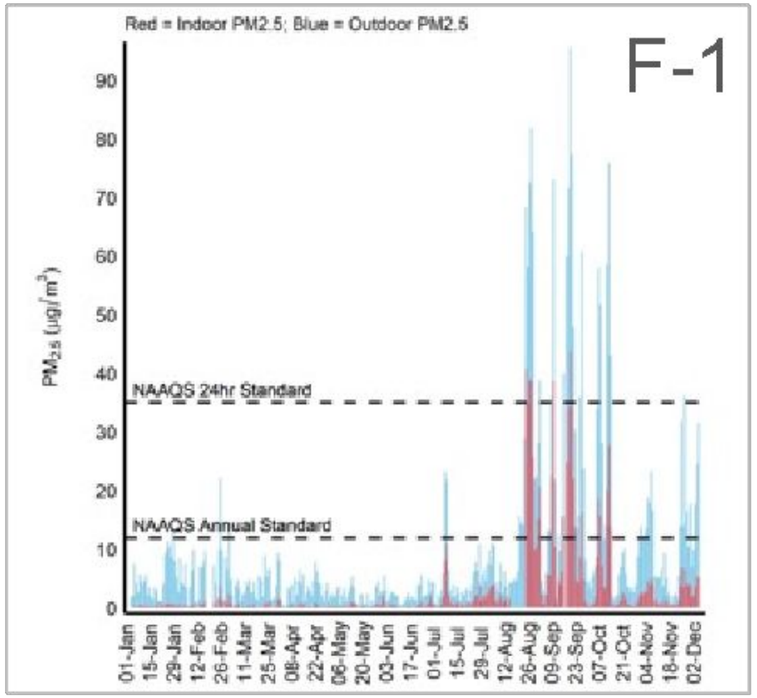
- Participating facilities (n=4) are geographically dispersed and topographically unique
- Three different airsheds are represented

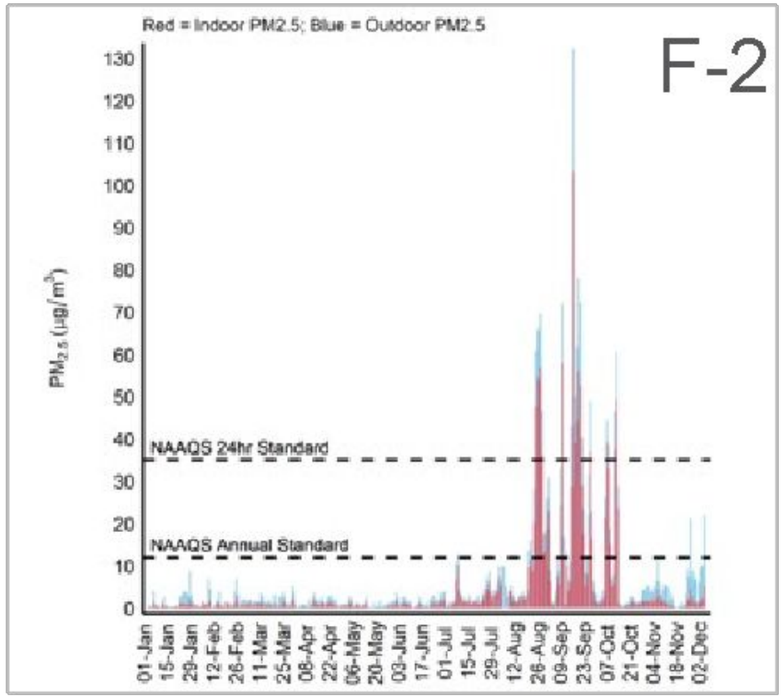


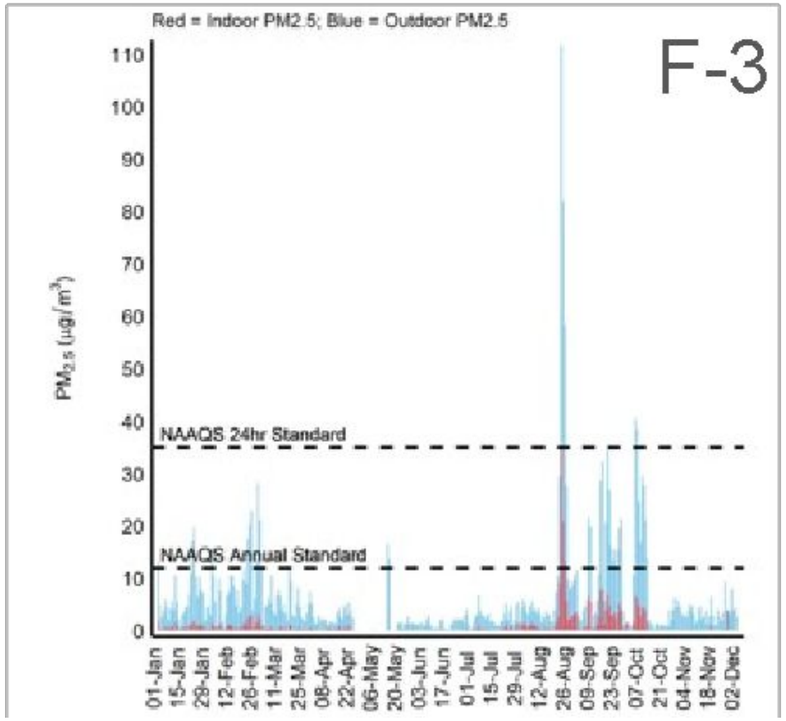


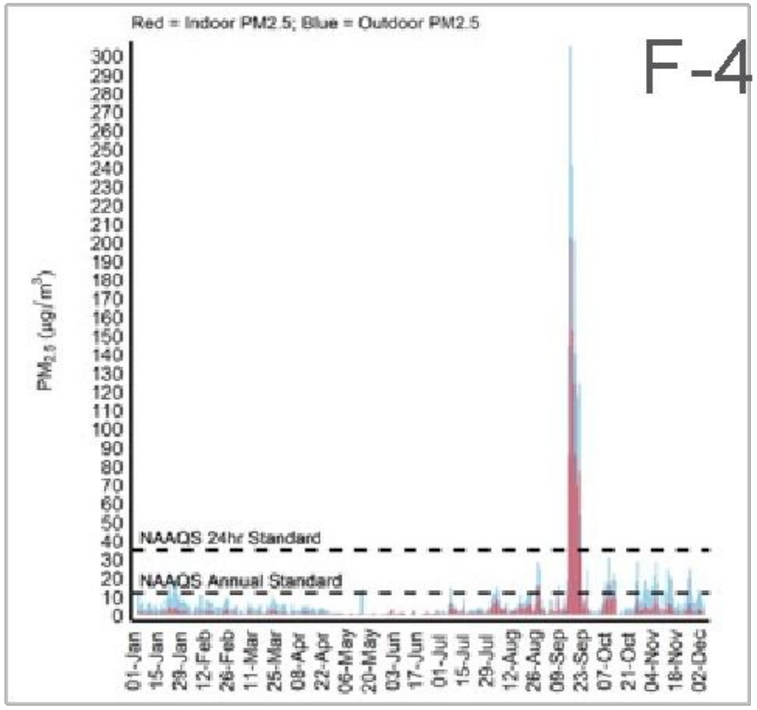
Facility characteristics

Facility	Approximate Building age	Approximate Square feet	Approximate number of beds	Approximate age of original HVAC (years)	Approximate age of HVAC update (years)	HVAC filter rating
SNF 1	50	30,000	80	50	Unknown	MERV 13
SNF 2	10	15,000	15	10	NA	MERV 13
SNF 3	50	15,000	40	15	NA	MERV 13
SNF 4	45	15,000	35	45	15	MERV 13









Results

- Approximately 300 days of sampling inside & outside at 4 facilities
- Missing data occurred due to power/WiFi outage and sensor failure
- Minimal indoor effects in non-wildfire season
- Smoke events varied by geographic region
- Extreme indoor spikes are possible

Outdoor to indoor comparison demonstrates variability in infiltration across facilities

This pilot data indicates that neither age of facility nor filter type are good predictors of wildfire smoke infiltration

Table 3. Outdoor vs Indoor $PM_{2.5}$ Comparison

	Sampling Days	Outdoor – Indoor $PM_{2.5}$ Difference ($\mu g/m^3$) mean (sd) min, median, max	Outdoor/Indoor $PM_{2.5}$ ratio	Infiltration Efficiency (95% CI)	Outdoor-generated indoor $PM_{2.5}$ ($\mu g/m^3$) mean (sd) min, median, max	Percent (%) indoor $PM_{2.5}$ generated outdoors mean (sd) min, median, max
Facility 1	321	6.5 (8.8) -0.2, 3.5, 52.7	0.3	0.38 (0.35, 0.41)	2 6 (5.6) 0 0, 0.6, 36.8	97.6 (9.1) 29.2, 100.0, 100.0
Facility 2	321	2.3 (3.7) -1.4, 1.0, 29.1	0.7	0.76 (0.72, 0.79)	4 6 (11.4) 0 0, 0.9, 100.6	97.4 (11.8) 5.2, 100.0, 100.0
Facility 3	311	5.5 (7.9) -1.5, 3.2, 76.3	0.2	0.22 (0.21, 0.23)	1 0 (2.8) 0 0, 0.2, 35.4	99.7 (4.1) 47.3, 100.0, 100.0
Facility 4	273	6.2 (11.2) -0.1, 3.5, 102.4	0.5	0.61 (0.57, 0.64)	5 6 (19.4) 0 0, 1.6, 202.5	99.8 (2.6) 56.5, 100.0, 100.0

$PM_{2.5}$ = fine particulate matter; sd = standard deviation; CI = confidence interval; Wildfire Season = July through October; Wildfire Day = Day with mean 24-hour $PM_{2.5} > 21$ $\mu g/m^3$ during Wildfire Season

Only Sampling Days with >12hrs of hourly data for both indoor and outdoor $PM_{2.5}$ are included in table.

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Summary of health data collection and challenges

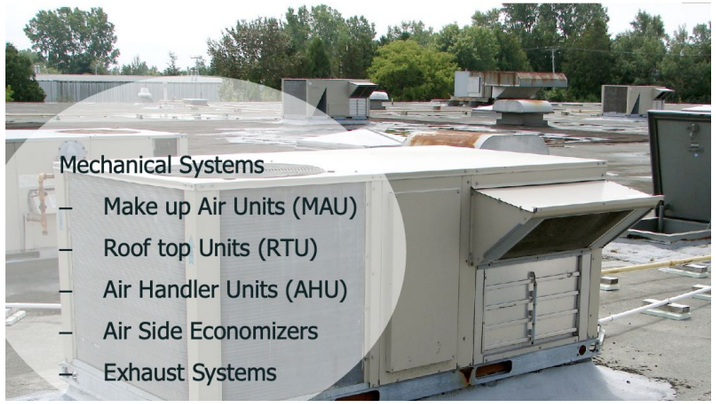
- Planned to leverage quality assurance and performance improvement (QAPI) data
- Received aggregated QAPI data relevant to respiratory health from two facilities
- COVID 19 impacted data collection at the SNFs
- Non-COVID adverse respiratory occurrences were not as numerous as anticipated
- Statistical evaluation was limited and a visual assessment of the data did not identify any trends

in maintaining good indoor air quality at SNFs

HVAC maintenance and operation

Building Envelope Maintenance

Identifying sources of Infiltration



An intervention targeting maintenance personnel

December 2021
Virtual workshop

April 2022
Interviews

July – October 2022
Anticipated wildfire season

Virtual workshop to increase awareness about air quality and health effects

Description:
This presentation was be broken into three sections

- Smoke and health
- Industrial hygiene
- HVAC operation and maintenance

Recruitment:

- Partnered with Idaho and Montana Health Care Associations

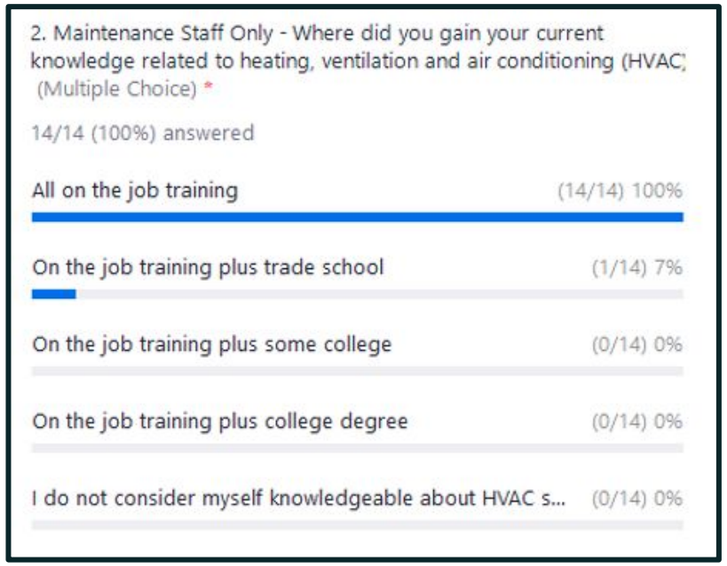
Attendance:

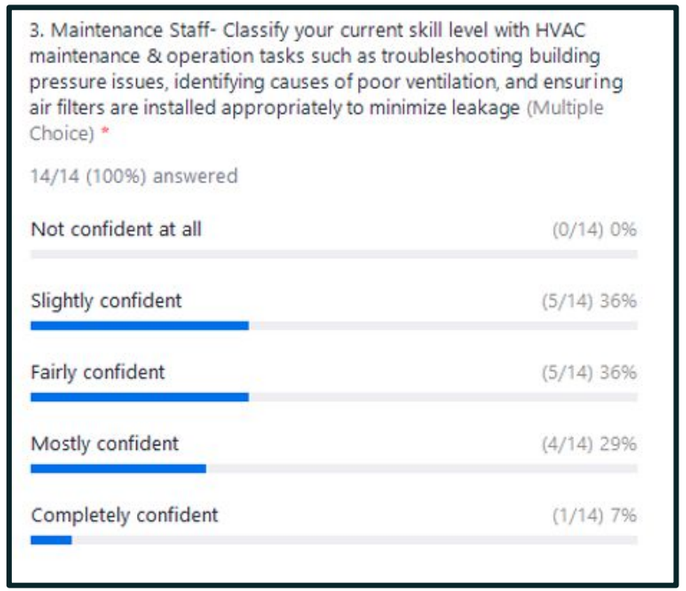
- 34 maintenance personnel registered
- 24 attended

Participation:

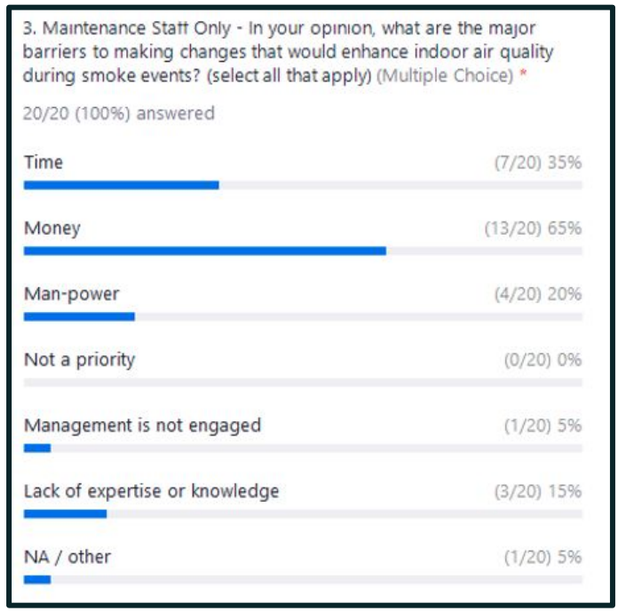
- 20 took part in polling questions

Selected **introductory** polling questions





Selected **concluding** polling questions



Key informant interviews 6 months after virtual workshop

- Four skilled nursing facility maintenance personnel participated in a ~30-minute session

*"**I was only running MERV 8 filters and I definitely plan on purchasing some MERV 13s** as well as I've added a kind of corner to corner attic look to my monthly to do list and in the process found about three exhaust belt fans that were broken and ordered and replace those."*

*"I definitely had an **enhanced perspective of how the indoor air quality was different and sometimes even worse than the outdoor** air quality and the sense that I felt like I had a bit more protection indoors versus outdoors and came to realize that I needed to enhance the kind of filtration in order to protect the residents…"*

*"My goal was making sure that the filtration is changed out monthly instead of you know, every couple three months if the filter look good and yeah I've been **making sure they are truly changed out monthly** and not just saying oh, it looks good."*

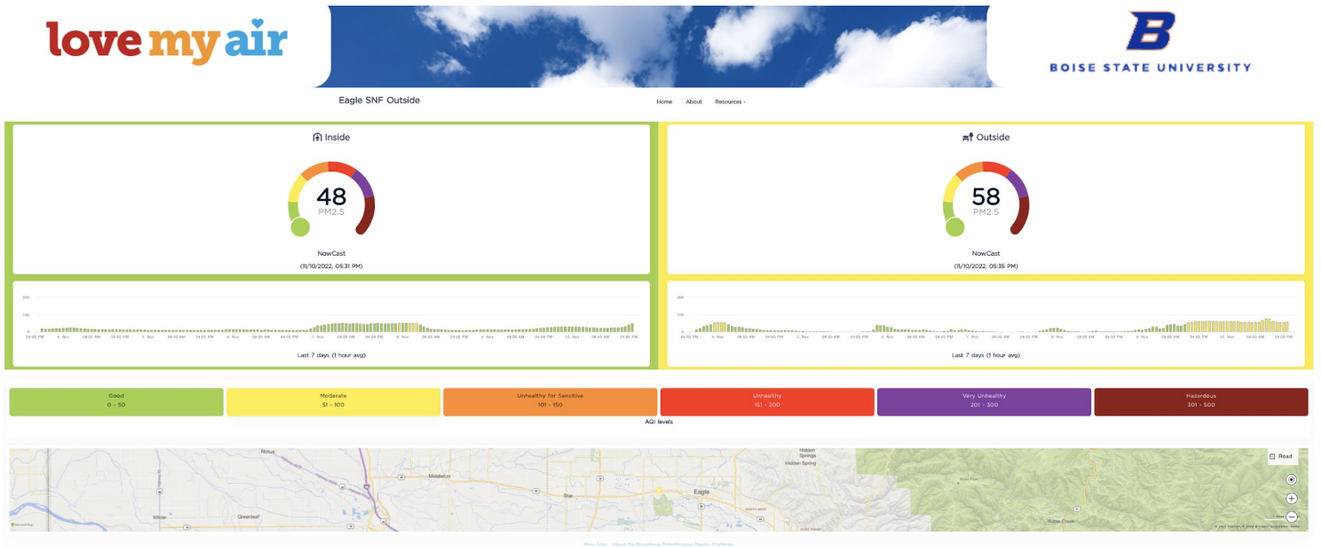
*"…kind of feel like I've been in this one man show, so it was just really **nice to know that there was a professional outreach happening that was able to help me digest some of this stuff and guide me in the right direction and actually left me really thirsty for more**…"*

Extension of originally planned intervention efforts

Onsite wildfire smoke readiness planning

- Smoke preparedness planning
  - Leveraging a SNF corporate structure
  - Site visit with external and internal stakeholders
  - Building tour
  - Draft and discuss a plan
  - Identify pros and cons of planning process

Piloting the delivery of actionable and timely air quality data



On-site dashboard

Thank you

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