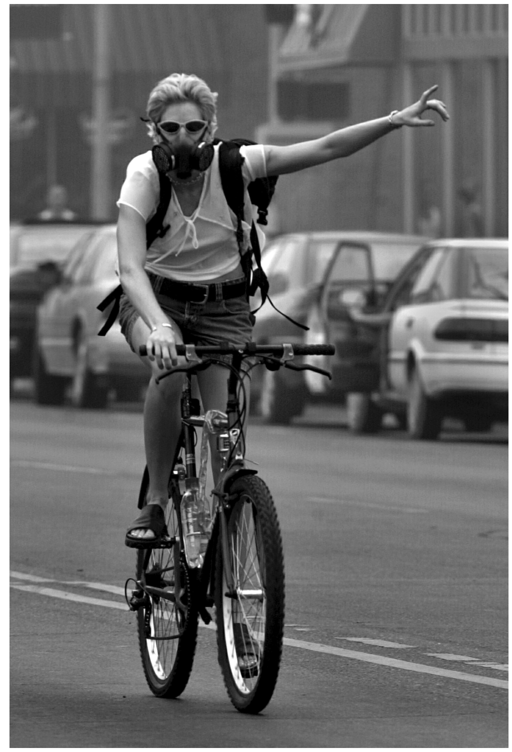
Wildfire Smoke: A Local Health Department Meets the Challenge

Shannon Therriault
Benjamin Schmidt



On the afternoon of August 3, 2000, thick smoke rolled into Missoula, Montana, blanketing the city, turning on streetlights, and creating an eerie and choking fog. Missoula, like the rest of western Montana, had been on heightened fire watch since mid-July, but no one thought smoke would become the town's greatest threat from the fires.

Missoula, home to about 69,000 people, lies in a valley completely surrounded by mountains. Because of its topography and weather, the town is extremely susceptible to poor air quality. Frequent wintertime temperature inversions trap pollutants and have caused Missoula to exceed the National Ambient Air Quality Standards for particulate and carbon monoxide.

Because of its air pollution problems, Missoula was better equipped than most Montana counties to deal with a wildfire smoke event. Missoula has had an air program within the Health Department since 1969. The Department has a long history of issuing health advisories, predicting winter air pollution trends, and tackling air pollution problems. In the 1970s and 1980s, Missoula's main source of air pollution was residential wood burning, giving the Health Department experience in dealing with wood smoke and its health effects. Now that woodstove emissions are greatly reduced, most of Missoula's "air pollution events" can be attributed to outdoor burning, be it prescribed fires or wild fires. Even with this history, the Health Department was unprepared for the thick smoke that obscured nearby landmarks, sent residents scurrying for masks, and sent us, the Department's two air quality specialists, looking for answers.

Assessing the problem

On August 3rd, in between calls from the press and the public, we tried to determine where the smoke was coming from and how long Missoula would suffer from its influence. The Forest Service and the local National Weather Service office could not provide definitive answers. And we found, neither could we. Over the years, the Health Department has developed methods for predicting air pollution levels under wintertime inversion conditions. But summertime wildfire smoke was an entirely different story. In the winter, wind clears out the valley, but last summer it often just blew in more smoke. Also unlike winter, the smoke levels changed constantly, sometimes drastically, as is evidenced by the hourly particulate data from the Missoula monitor (see graph on page 16). As a result, we had to look for different resources to help predict pollution levels. Several Internet sites provided useful weather and fire information that made short-term predictions possible, but not always accurate. Twenty-four hour predictions were nearly impossible. Too many factors influenced the smoke, including fire behavior, fire containment, fire starts, wind patterns, temperature, and precipitation.

Constantly changing conditions were not the only challenge. Visual observations and satellite images clearly showed that smoke concentrations varied significantly over the region. Smoke levels announced on the Air Pollution Hotline reflected what was going on in the middle of town but might not be very accurate for outlying communities. Even in town, we could tell that the smoke levels were usually denser near the rivers than at our monitor. These changing conditions, paired with a lack of monitors throughout the state, prompted the Department

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of Environmental Quality to develop a visibility chart in mid-August that linked how far a person could see with smoke particulate concentrations (see chart on page 16). This chart proved invaluable for the public and local public health officials in counties without monitors, but it also proved useful in Missoula. It gave us a way to respond to the outlying communities, who sometimes complain that our efforts are too focused on the urban area. We distributed the information widely to people who called and to the media. It was also available on the state's Web site (www.deq.state.mt.us). The chart, combined with health statements, allowed people to make informed decisions on what activities to pursue based on their own smoke level observations. In Frenchtown, a small community about 15 miles west of Missoula, for example, the school coaches used the visibility chart with known landmarks to make decisions about high school sports practice.

Advising the public

At the same time that we were trying to figure out how to predict smoke levels, we struggled with just what advice we should give the public. During an air pollution episode, the Department normally recommends actions to reduce particulate levels: limit driving, use the bus system, apply extra dust control at construction sites. But in this circumstance the smoke completely overwhelmed any other source of air pollution. If every single person in Missoula started carpooling, it would not have noticeably reduced the particulate levels on a smoky day. We still suggested these actions, but felt they were not entirely appropriate for the situation.

We also had to figure out what health advisories to give. Typically, we would identify sensitive populations and urge them to take precautions to reduce their exposure to air pollution. The most common suggestion is to stay inside and reduce physical activity. Frankly, we weren't sure how much staying inside was going to help. Studies indicate that this strategy can usually reduce air pollution by about a third, especially in a tightly closed, air-conditioned house. In Missoula, however, few people have air conditioning; the majority of Missoula homes depend on open windows and doors for cooling. In these situations, the smoke levels inside the house would soon equal that outdoors. Another problem with closing up non–air-conditioned homes in the middle of summer was the possibility of heat stress, which for some people could have much more immediate, dire results than smoke exposure.

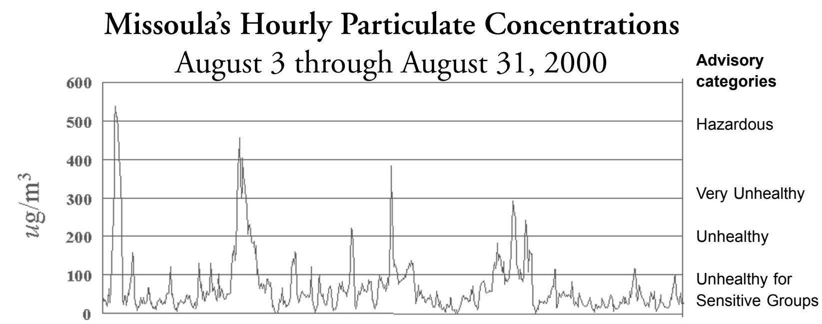
We knew that decreasing physical activity would reduce the dose of pollutants to the lungs. During exercise, people increase their air intake by as much as ten times their resting level, bringing more air pollution into the lungs. This is exacerbated by the fact that most people breathe through their mouths while exercising, bypassing the natural filtering ability of the nasal passages. They also tend to breathe more deeply, causing particulates to lodge deeper in the lungs where they can cause more damage. (Incidentally, one of the most frequent types of calls the Health Department got was from athletes wanting to know *exactly* when they could exercise. We were never able to give them very satisfactory answers, both because of the difficulty in predicting smoke and the uncertainty of how much smoke is bad for one particular person. Usually, we explained the visibility chart to them and urged them to use common sense.)

The question of masks

In early August, a lot of different sport teams start practicing. On one particularly smoky day, where the one-hour particulate readings peaked at 457 micrograms per cubic meter (ug/m^3), the local news showed pictures of a soccer team wearing dust masks as they practiced outside. This simple picture captures all the issues surrounding mask use. For a mask to provide protection during a smoke event, it must be able to filter very small particles (around 0.3 to 0.1 microns), and it must fit, providing an airtight seal around the wearer's face. Such masks are available, but the public is often confused about which masks to buy. Widely available dust masks will give the wearer little, if any, protection: the pores are just too big to trap the tiny smoke particles. Surgical masks can capture these small particles, but in general are not able to provide an airtight seal. Even if the public is well instructed on what masks to use, most people won't use the masks correctly and won't understand the importance of having a good fit. In addition, it is impossible to get a good seal on individuals with beards, and masks, which are typically intended for use in occupational settings, are not designed for the small faces of children.

Masks can give the wearer a false sense of protection.

Masks can give the wearer a false sense of protection. Take the soccer players, for instance. They thought they were breathing filtered air, when in reality their masks offered them little protection from the smoke. If they were not using masks, the coaches and players might have altered their practice to reduce strenuous physical activity and smoke exposure. In this case, the masks probably did more harm than good. If players had been using



*The Federal Standard is 150 *ug*/m3 (24 hour average), not to be exceeded more than one day a year. Prior to August 2000, the standard was last exceeded in 1989.

the appropriate, tightly fitting masks, they may have been faced with another problem: Masks increase resistance to airflow, making breathing more difficult. This leads to physiological stresses, such as increased respiratory and heart rates. Masks can also contribute to heat stress.

All that being said, there are some instances where masks can be beneficial, as long as they fit and can capture the tiny smoke particles. They are a good strategy for people, such as construction workers, who are going to be outside regardless of the smoke. They can provide protection for people who are generally staying indoors, but need to go outside briefly. And, finally, masks can be used in conjunction with other strategies for minimizing smoke exposure. However, because of the physiological stresses associated with their use, people with heart and lung diseases should use masks only under a doctor's supervision.

People asked if air cleaners were a good idea. We really didn't have much experience with indoor air issues, but told people the cleaners would have to filter out very small particles (0.3 to 0.1 microns) and suggested that they check with a retailer or manufacturer for more information. Under the pressure of the smoke event, that was about the best possible advice at the time. Since then, we have found that air cleaners can be of value, especially when sized appropriately for the space to be cleaned.

One problem with air cleaners is that they tend to be expensive, which limits their use. Another problem is with how they are rated. The effectiveness of an air cleaner is usually reported in terms of efficiency, which can be misleading, as it only tells half the story. The other important factor is airflow. Together, these two factors equal the Clean Air Delivery

Wildfire Smoke Visibility Index

Categories	Visibility in Miles	Particulate levels in ug/m3 1 hour average	Health Effects	Cautionary Statement
Good	10 and up	0 – 40	None	None
Moderate	6 to 9	41 – 80	Possibility of aggravation of heart or respiratory disease.	People with heart or lung disease should pay attention to symptoms.
Unhealthy for Sensitive Groups	3 to 5	81 – 175	Increasing likelihood of respiratory symptoms and aggravation of lung disease, such as asthma.	People with respiratory or heart disease, the elderly, and children should *limit* prolonged exertion and stay indoors when possible.
Unhealthy	1 ½ to 2 ½	176 – 300	Increased respiratory symptoms and aggravation of lung and heart diseases; possible respiratory effects to general population.	People with respiratory or heart disease, the elderly, and children should *avoid* prolonged exertion and stay indoors when possible; everyone else should *limit* prolonged exertion.
Very Unhealthy	1 to 1 ¼	301 – 500	Significant increase in respiratory symptoms and aggravation of existing lung and heart disease; increasing likelihood of respiratory effects in general population.	People with respiratory or heart disease, the elderly, and children should *avoid* any outdoor activity; everyone else should *avoid* any outdoor exertion.
Hazardous	¾ or less	over 500	Serious aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in general population.	Everyone should *avoid* any indoor and outdoor exertion; everyone should remain indoors whenever possible.

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Rate (CADR), which is a better measure of how a device will actually perform. For example, 99.99% efficiency sounds great, but if the flow were only 20 cubic feet/minute (cfm), one would be better off at 90% efficiency and 100 cfm (CADR: 20 vs. 90 cfm).

And then there is the issue of ozone generators. These devices intentionally produce ozone gas to react with pollutants in the air. However, the Environmental Protection Agency has found that ozone is generally ineffective at controlling indoor air pollution at concentrations that do not greatly exceed public health standards. Ozone, even at relatively low levels, can cause chest pain, coughing, shortness of breath, and throat irritation. It may also worsen chronic respiratory disease and compromise the body's ability to fight respiratory infections. In addition, these devices do not remove particles from the air, so they would not be effective during smoke events.

As August progressed, so did the fires. No large fires burned close to Missoula, but frequent dry thunderstorms and maxed-out firefighting resources increased Health Department concern about a large, uncontrollable fire starting and getting a foothold closer to Missoula. The beginning of school loomed closer. What if smoke levels got worse? Should the Department close schools and businesses or curtail industry? Missoula's air pollution program gave us the authority to take these actions, but it was uncertain if such extreme measures would protect public health. In many cases, the air-conditioning and filtration systems in businesses and schools were better than those of most homes in Missoula. In schools, teachers could restrict physical activity by keeping kids inside. Stopping all commerce in Missoula would not noticeably affect the amount of pollution, since smoke was the overwhelming contributor, but it could have a tremendous economic effect on the community.

At the end of August, the Air Pollution Control Board decided to amend Missoula's Emergency Episode Plan so that schools, businesses, and industries could stay open. Instead, they targeted high-risk activities and groups, by requiring cancellation of all indoor and outdoor athletic activities and events when the smoke reached extreme levels. Two days later, the rains brought an end to the 2000 fire season. It didn't, however, bring an end to our learning process.

Sharing lessons learned

In June 2001, federal, state, and local scientists and public health officials gathered in Seattle to talk about how wildfire smoke affects health. They established a list of important research questions and are putting together information needed by public health officials and the public during a smoke episode. At a follow-up meeting in Missoula, the Health Department distributed the first copy of "Wildfire Smoke, a Guide for Public Health Officials," a compilation of all the information we wish we'd had last August. This document is available at www.firesmokehealth.org. The Department urges people to look at the Guide and send suggestions and comments. It's a working document, one that will continue to change as the collective knowledge about forest fire smoke and health improves.

Western Montana will undoubtedly experience wildfires and smoke in the future—next time we hope to be better prepared.

Authors

Shannon Therriault, M.S. and Benjamin Schmidt, M.S. are air quality specialists and registered sanitarians at the Missoula City-County Health Department in Missoula, Montana.

Resources Online

As a special service to Northwest Public Health readers, the Northwest Center for Public Health Practice lists learning and teaching materials related to some of the articles in this issue. Look for the list at http://healthlinks.washington.edu/nwcphp/

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