Handout H11-1: Reading and Questions from “Wildfire Smoke: A Guide for Public Health Officials”

Introduction: Smoke rolls into town, blanketing the city, turning on streetlights, creating an eerie and choking fog. Switchboards light up as people look for answers. Citizens want to know what they should do to protect themselves. Schools officials want to know if outdoor events should be cancelled. The news media want to know how dangerous the smoke really is. Smoke events often catch us off-guard. This handout is intended to provide you and local public health officials with the information you need when wildfire smoke is present so you can adequately communicate health risks and precautions to the public. It is the product of a collaborative effort by scientists, air quality specialists and public health professionals from Federal, state and local agencies.

Composition of Smoke: Smoke is composed primarily of carbon dioxide, water vapor, carbon monoxide, particulate matter, hydrocarbons and other organic chemicals, nitrogen oxides, trace minerals and several thousand other compounds. The actual composition of smoke depends on the fuel type, the temperature of the fire, and the wind conditions. Particulate matter is the principal pollutant of concern from wildfire smoke for the relatively short-term exposures (hours to weeks) typically experienced by the public.

Particulate Matter (PM): Particulate matter is a generic term for particles suspended in the air, typically as a mixture of both solid particles and liquid droplets. Particles from smoke tend to be very small - less than one micrometer in diameter. For purposes of comparison, a human hair is about 60 micrometers in diameter. Particulate matter in wood smoke has a size range near the wavelength of visible light (0.4 – 0.7 micrometers). Smoke particles efficiently scatter light and reduce visibility. Moreover, such small particles can be inhaled into the deepest recesses of the lung and are thought to represent a greater health concern than larger particles.

Health Effects of Particulate Matter: The effects of smoke range from eye and respiratory tract irritation to more serious disorders, including reduced lung function, bronchitis, exacerbation of asthma, and premature death. Studies have found that fine particles are linked (alone or with other pollutants) with increased mortality and aggravation of pre-existing respiratory and
cardiovascular disease. In addition, particles are respiratory irritants, and exposures to high concentrations of particulate matter can cause persistent cough, phlegm, wheezing and difficulty breathing. Particles can also affect healthy people, causing respiratory symptoms, transient reductions in lung function, and pulmonary inflammation. Particulate matter can also affect the body’s immune system and make it more difficult to remove inhaled foreign materials from the lung, such as pollen and bacteria. The principal public health threat from short-term exposures to smoke is considered to come from exposure to particulate matter.

**Health Effects of Carbon Monoxide:** Another pollutant of concern during smoke events is carbon monoxide. Carbon monoxide is a colorless, odorless gas, produced by incomplete combustion of wood or other organic materials. Carbon monoxide levels are highest during the smoldering stages of a fire. Carbon monoxide (CO) enters the bloodstream through the lungs and reduces oxygen delivery to the body’s organs and tissues. The CO concentrations typical of population exposures related to wildfire smoke do not pose a significant hazard, except to some sensitive individuals and to firefighters very close to the fire line. Individuals who may experience health effects from lower levels of CO are those who have cardiovascular disease: they may experience chest pain and cardiac arrhythmias. At higher levels, as might be observed in a major structural fire, carbon monoxide exposure can cause headaches, dizziness, visual impairment, reduced work capacity, and reduced manual dexterity, even in otherwise healthy individuals. At even higher concentrations (seldom associated solely with a wildfire), carbon monoxide can be deadly.

**Health Effects of Other Air Pollutants:** Other air pollutants, such as acrolein, benzene, and formaldehyde, are present in smoke, but in much lower concentrations than particulate matter and carbon monoxide. Wildfire smoke also contains significant quantities of respiratory irritants. Formaldehyde and acrolein are two of the principal irritant chemicals that add to the cumulative irritant properties of smoke, even though the concentrations of these chemicals individually may be below levels of public health concern.

**Long-Term Effects:** One concern that may be raised by members of the general public is whether they run an increased risk of cancer or other long-term health impacts of exposure to wildfire smoke. People exposed to toxic air pollutants at sufficient concentrations and durations may have slightly increased risks of cancer or of experiencing other chronic health problems. However, in general, the long-term risk from short-term smoke exposure is quite low. Epidemiological studies have shown that urban firefighters exposed to smoke over an entire working lifetime have about a three-fold increased risk of developing lung cancer (Hansen 1990). This provides some perspective on the potential risks. The major carcinogenic components of smoke are polycyclic aromatic hydrocarbons (PAHs). Although the carcinogens benzene and formaldehyde are also present in smoke, they are thought to present a lesser risk.

**Overall:** Not everyone who is exposed to thick smoke will have health problems. The level and duration of exposure, age, individual susceptibility, including the presence or absence of pre-existing lung or heart disease, and other factors play significant roles in determining whether or not someone will experience smoke-related health problems.

Answer these on a separate sheet of paper. Keep the handout for the table at the bottom.
1. What groups are mentioned in the first paragraph and what questions do they have?
2. Think of another group that isn’t mentioned, what question do you suppose they’d have?
3. What is the purpose of this guide?
4. Of what is smoke composed?
5. Describe particulate matter.
6. Describe three health effects of smoke particulate matter?
7. What are two long-term effects of smoke exposure?
8. Now apply your knowledge to this problem:
   a) Access Air Now’s Air Quality Index chart, at this webpage: https://www.airnow.gov/index.cfm?action=airnow.mapcenter&mapcenter=1
   b) Click on “Current AQI” tab. AQI stands for Air Quality Index. It incorporates PM and O₃.
   c) Find the current unhealthiest area in your state. Use the color key at the bottom of the map to answer: What is the current AQI? Use the table below to describe associated health risks.
   d) In the table below, read the cautionary statements for “very unhealthy” air. Describe some challenges that would be associated with implementing the cautionary statements.

EPA’s Air Quality Index (AQI) for 24-hour Fine Particle Pollution (PM₂.₅)

<table>
<thead>
<tr>
<th>24-hr PM₂.₅ (µg/m³)</th>
<th>AQI Categories</th>
<th>AQI Values</th>
<th>AQI Cautionary Statements</th>
<th>AQI Health Effects Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 12.0</td>
<td>Good</td>
<td>0 - 50</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>12.1 – 35.4</td>
<td>Moderate</td>
<td>51 - 100</td>
<td>Unusually sensitive people should consider reducing prolonged or heavy exertion.</td>
<td>Respiratory symptoms possible in unusually sensitive individuals, possible aggravation of heart or lung disease in people with cardiopulmonary disease and older adults.</td>
</tr>
<tr>
<td>35.5 – 55.4</td>
<td>Unhealthy for Sensitive Groups</td>
<td>101 - 150</td>
<td>People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.</td>
<td>Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease and older adults.</td>
</tr>
<tr>
<td>55.5 – 150.4</td>
<td>Unhealthy</td>
<td>151 - 200</td>
<td>People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion; everyone else should reduce prolonged or heavy exertion.</td>
<td>Increased aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease and older adults; increased respiratory effects in general population.</td>
</tr>
<tr>
<td>150.5 – 250.4</td>
<td>Very Unhealthy</td>
<td>201 - 300</td>
<td>People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.</td>
<td>Significant aggravation of heart and lung disease and premature mortality in people with cardiopulmonary disease and older adults; significant increase in respiratory effects in general population.</td>
</tr>
<tr>
<td>Greater than 250.5</td>
<td>Hazardous</td>
<td>Over 300</td>
<td>Everyone should avoid all physical activity outdoors; people with heart or lung disease, older adults, and children should remain indoors and keep activity levels low.</td>
<td>Serious aggravation of heart and lung disease and premature mortality in people with cardiopulmonary disease and older adults; serious risk of respiratory effects in general population.</td>
</tr>
</tbody>
</table>

Who is “SENSITIVE” to PM₂.₅? “People with heart or lung disease, older adults, children, and people of lower socioeconomic status are the groups most at risk.” See EPA’s Technical Assistance Document (link below). Also at higher risk: prenatal children (low birth weight, pre-term birth, and IQ reduction), diabetics, and people with higher exposures such as athletes exposed during exercise.

Sources:

2013 by Clean Air Fairbanks cleanairfairbanks@gmail.com http://cleanairfairbanks.wordpress.com