Public Health Issues Associated With Wildfires

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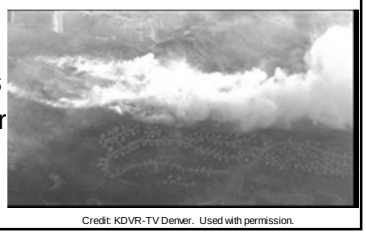
- Wildfires are uncontrolled fires in areas of combustible vegetation in wilderness areas
- In the US, 60,000-80,000 wildfires/year
- 3 to 10 million acres of land are affected
- Property loss can be extensive when fires occur in the wildland-urban interface

Credit: KDVR-TV Denver. Used with permission.

- Over 47 million homes are in areas at high risk for wildfires
- Cost of containment $3.5 billion (federal)
  - $1-2 billion local and state
- Insurance losses $1.3 billion/year



Credit: KDVR-TV Denver. Used with permission.

Causes of wildfire

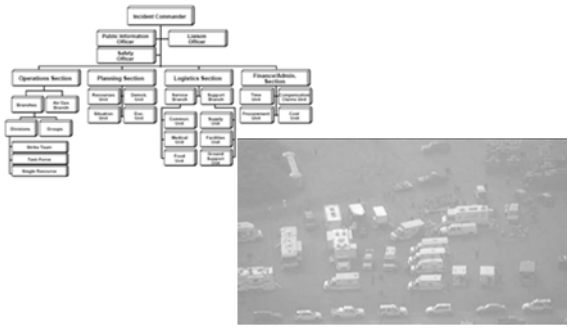
- Natural
  - Lightning, volcanic eruption
- Human-caused
  - Arson, discarded cigarettes, open burning

Wildfire management: key agencies

- National Wildfire Coordinating Group
  - Forest Service (USDA)
  - DOI (BLM, NPS, BIA, FWS)
- NIOSH
- OSHA
- Red Cross
- EPA
- US National Fire Protection Association

- State/local EMA and law enforcement
- State and local health departments

Incident Command



Credit: KDVR-TV Denver. Used with permission.

Public Health Roles

- Environmental Health
  - Air quality and medical effects of smoke
  - Inspection of evacuation shelters
- Occupational Health/Industrial Hygiene
  - Firefighters' health
  - General workplace issues
- Public Information

Medical effects of smoke

- Wildland fire smoke results from the combustion of wood and other vegetation
- Composed of:
  - Water vapor
  - CO_2
  - Particulate matter
  - CO
  - Hydrocarbons and other organic compounds
  - Nitrogen oxides
  - Trace minerals

Credit: US Forest Service, public domain

Particulate matter

- Particulates are small particles suspended in the air
- Health effects depend on particle size
- >10 µm do not enter the lungs but may irritate the eyes, nose, and throat
- 2.5-10 µm particles ($PM_{10-2.5}$) are coarse particles
- <2.5 µm particles ($PM_{2.5}$) are fine particles
- Most smoke particles measure 0.4-0.7 µm

- Sensitive populations may have more severe symptoms:
  - People with asthma or other respiratory illnesses
  - People with cardiovascular disease
  - Elderly
  - Children
  - Pregnant women
  - Smokers

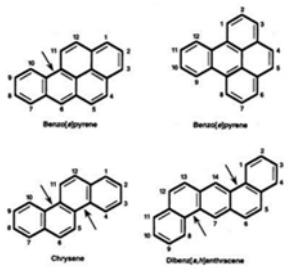
- Fine particles can aggravate pre-existing respiratory and cardiac disease, cause transient decrease in lung function, and affect the immune system
- Effects are mild and short-lived in most healthy people

Carbon monoxide

- Colorless, odorless gas
- Produced by incomplete combustion of organic material
- Highest concentration near fire during smoldering stages
- May cause health effects at low levels in people with cardiovascular disease

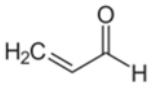
Benzene and polycyclic aromatic hydrocarbons

- Produced by combustion of organic material
- Benzene and many PAHs are carcinogenic



Aldehydes

- Respiratory irritants with a disagreeable odor
- Formaldehyde
  - Gas at room temperature
  - Classified as a human carcinogen
- Acrolein
  - Liquid at room temperature
  - Not carcinogenic



Air quality

- Determining where and how smoke will affect an area depends on
  - Weather
  - Terrain
  - Stage of the fire

Air Quality Index

- Scale of 0 to 500
- Calculated for ozone, particulates, CO, and SO_2
- Highest AQI value is reported
- Advisory issued if AQI exceeds 100
- Other levels are also reported if 100 or higher

Particle pollution

AQI value	Level of health concern	Actions to protect health from particle pollution
0-50	Good	None
51-100	Moderate	Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion
101-150	Unhealthy for sensitive groups	The following groups should reduce prolonged or heavy outdoor exertion: •People with heart or lung disease, children, and older adults Everyone else should limit prolonged outdoor exertion
151-200	Unhealthy	The following groups should avoid all physical activity outdoors: •People with heart or lung disease, children, and older adults Everyone else should avoid prolonged or heavy exertion
201-300	Very unhealthy	The following groups should remain indoors and keep activity levels low: •People with heart or lung disease, children, and older adults Everyone else should avoid all physical activity outdoors
300-500	Hazardous	

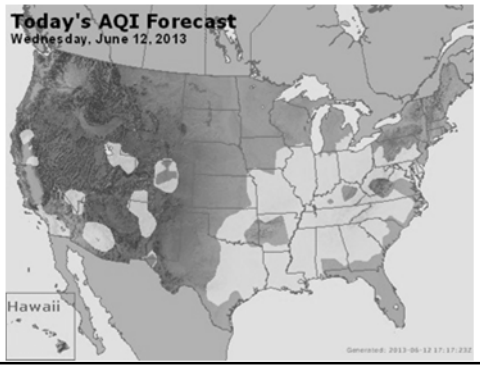
Particle pollution and visibility

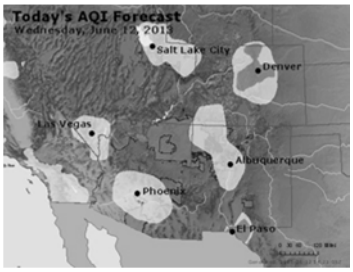
AQI value	Level of health concern	Visibility (miles)
0-50	Good	11+
51-100	Moderate	6-10
101-150	Unhealthy for sensitive groups	3-5
151-200	Unhealthy	1 ½-2 ¾
201-300	Very unhealthy	1-1 ¼
300-500	Hazardous	<1

← Visibility of less than 5 miles is a convenient indicator that smoke has reached levels that are unsatisfactory

Ozone

AQI value	Level of health concern	Actions to protect health from ozone
0-50	Good	None
51-100	Moderate	Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion
101-150	Unhealthy for sensitive groups	The following groups should reduce prolonged or heavy outdoor exertion: •People with lung disease, children, older adults, and people who are active outdoors
151-200	Unhealthy	The following groups should avoid prolonged or heavy outdoor exertion: •People with lung disease, children, older adults, and people who are active outdoors Everyone else should limit prolonged outdoor exertion
201-300	Very unhealthy	The following groups should avoid all outdoor exertion: •People with lung disease, children, older adults, and people who are active outdoors Everyone else should limit outdoor exertion
300-500	Hazardous	





Air quality forecast

Pollutant details

Current conditions

Pollutant details

OH issues for firefighters

- Many potential health risks
  - Exposure to smoke
  - Heat exposure/heat stress
  - Musculoskeletal injuries
  - Fatigue
  - Dehydration
  - High altitude
  - Serious injury/fatality

Credit: National Park Service, public domain

Fatalities among wildland firefighters

- 295 between 1995 and 2012
- Major fatality mechanisms
  - Entrapment
  - Gravity (falls, falling trees or rocks)
  - Transportation (vehicle and aircraft incidents)
  - Medical (heart attack, heat injury)

Acute and chronic effects of smoke

- Acute upper respiratory complaints are common
- Long-term effects of smoke exposure are unclear
- Exposure assessments among wildland firefighters have not shown exposure to pollutants frequently exceeds permissible exposure levels

Minimizing exposure to smoke

- Locate camps and incident command posts in areas that are not prone to inversions.
- Reduce dust by watering roads at the incident, on drier roads leading to the incident, and in the base camp.
- Rotate personnel out of heavy smoke areas.
- Use flank attack as opposed to head attack, where appropriate, in heavy smoke situations.
- Minimize mop-up when possible.
- Use time and patience instead of water to put the fire out. Use burn piles and allow areas to burn themselves out. Rely on burn-up instead of mop-up.
- In heavy smoke situations, remove crews from the line when possible.

Health maintenance

- Monitor personnel for signs of fatigue and illness.
- Ensure firefighters are properly equipped for anticipated conditions (cold nights, rain, etc.).
- Provide for good rest and sleeping conditions.
- Encourage a high fluid intake during and after work for all personnel.
- Provide for adequate nutrition and supplements (e.g. antioxidants) if needed.
- Allow sick firefighters time to recover.
- Provide washing facilities near food lines and toilets.
- Limit close contact among firefighters by providing personal sleeping tents.

- Discourage sharing of canteens except in emergencies.
- Encourage personnel to cover their mouth and nose when they cough or sneeze to avoid the spread of infection.
- Segregate infected personnel when possible.
- Demobilize crews that have a large number of sick personnel.
- When symptoms are above the neck (stuffy nose, sneezing, scratchy throat), it's safe to continue to work if personnel continue to practice health maintenance tips mentioned above. If symptoms include fever, aching muscles, nausea, or diarrhea, hard work should be reduced or curtailed.

http://firechief.com/preplan/breathless; Tennessee Division of Forestry

Other workplace issues

- Air quality in the workplace
- Schools/childcare centers/military
- Absenteeism
  - Traffic delays and road closures
  - Individuals or their family members directly affected by evacuation or property damage

Public information

- Team approach involving media, EMA, law enforcement, and public health
- Public needs information on current conditions and recommended actions
- Employers/schools want to know if they should close or cancel events

Sample public health message

- Smoke from wildfires is a mixture of gases and fine particles from burning trees and other plant materials
- Smoke can cause coughing, scratchy throat, irritated sinuses, shortness of breath, chest pain, headaches, stinging eyes and runny nose
- Most persons who are exposed to smoke for short periods will not have health problems

- Smoke may worsen symptoms for people who have pre-existing respiratory conditions, such as respiratory allergies, asthma, and chronic obstructive pulmonary disease (COPD)
- People who have heart disease might experience chest pain, rapid heartbeat, shortness of breath and fatigue
- If you are experiencing serious medical problems for any reason, seek medical treatment immediately

- The best thing to do is to limit your exposure to the smoke by
  - Limit outdoor activity and staying indoors in an air-conditioned building
  - If a/c not available, vulnerable groups should seek shelter elsewhere
  - Keeping windows closed when driving in a vehicle (air conditioner on recirculation)
  - Minimizing other sources of indoor air pollution (tobacco smoking, candles, etc)

- Air cleaners can be effective at reducing indoor particulate levels, provided the specific cleaner is adequately matched to the indoor environment in which it is placed. However, they tend to be expensive.
- Ozone generators are sold as air cleaners, but they are not recommended for use in occupied buildings
- Humidifiers or de-humidifiers are not technically air cleaners and will not significantly reduce the amount of particulate in the air during a smoke event

- Respiratory protection
  - Not recommended for the public in most situations
  - In order 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
  - Bandanas and paper dust/surgical masks commonly found at hardware stores are designed to trap large particles, such as sawdust and will not protect the lungs from smoke

- Some masks (technically called respirators, but they look more like paper masks) are good enough to filter out 95% of the particulate that is 0.3 microns and larger
- They are marked with one of the following: "R95", "N95", or "P95"
- Smoke particulate averages about 0.3 microns, so these masks will filter out a significant portion of the smoke if they are properly fit to the wearer's face
- They will provide less than optimal protection if not used correctly
- They do not protect from all harmful substances in smoke
- They increase resistance to airflow and may lead to physiological stresses such as increased respiratory rates and heart rates and heat stress
- Because of this, masks used by those with cardiopulmonary and respiratory diseases can be dangerous, and should only be done under a doctor's supervision

- It is extremely important for families to create their own disaster plan before a disaster strikes
- If evacuated from home, bring:
  - Important documents
  - Family disaster supply kit which should contain food, water, and supplies (including medications) to sustain your family for at least 3 days

- Sources of more information
  - Additional information on how to prepare your family for disasters with links to your state's EMA or Department of Health
  - www.airnow.gov or your state EPA or Department of Health for up-to-date air quality information and warnings