

Exposure hazards for wildland firefighters

Wildland fires are common in BC, especially during the dry season. Every year thousands of fires of various sizes are started by natural or human causes. Wildland firefighters work on the front line to control the extent of damage from these fires, exposing themselves to the hazardous emissions and thermal stresses, occasionally with tragic consequences.

Exposure to hazardous fire emissions experienced by wildland firefighters differs both qualitatively and quantitatively from the types of exposure experienced by their urban counterparts. Urban firefighters typically deal with more locally restricted conflagrations that are controlled within a relatively short period of time, whereas wildland firefighters deal with fires that can extend thousands of hectares and last for weeks. The work shift of a wildland firefighter can be long, and is repeated daily for many consecutive days or weeks. Exhaustion, dehydration, poor diet, and lack of sleep are possible consequences of this demanding work schedule.

The exposure to hazards also differs significantly. Wildland firefighters are generally exposed to a complex mixture of organic material pyrolysis and decomposition. Urban firefighters are exposed to an even larger and

more complex mixture of toxins from fires that can include combustion by-products of organic and synthetic material, solvents, heavy metals, pesticides, and industrial chemicals.

Exposure situations differ as well. Urban firefighters often work indoors and in confined spaces, where the concentration of hazardous airborne toxins can be extremely high for prolonged periods of time. Wildland firefighters work outdoors, where exposure levels can be mitigated by winds and convective currents, and workers may have the freedom to position themselves in less polluted areas or work upwind. While urban firefighters typically rely on respirators for protection, wildland firefighters, for a number of pragmatic reasons, cannot use respiratory protection regularly. Some rely on bandanas, which may be psychologically reassuring and act as a minor heat barrier, but in reality a bandana offers no protection against hazardous airborne toxins.

Wildland fire emissions may consist of hundreds of toxic by-products, and their formation depends on a number of unpredictable and uncontrollable factors, including fuel type, moisture content, topography, and meteorological conditions. Flaming fires generate a lot of heat, and the combustion efficiency of the fuel produces mostly simpler molecules such as carbon dioxide. Convective forces are large, carrying the smoke high into the atmosphere and farther away. Smoldering fires aren't as hot, so oxidative combustion isn't complete, producing many more toxic intermediate by-products of pyrolysis. Convective winds are also weaker, and the smoke tends to stay closer to the ground. This increases the exposure risk for firefighters.

Wildland fire emissions include

carbon dioxide, fine particulate matter, carbon monoxide, volatile organic compounds such as formaldehyde and acrolein, nitrogen, and sulfur oxides, as well as lower levels of carcinogens like polycyclic aromatic hydrocarbons. Measuring the exposure of wildland firefighters to these emissions is logistically challenging. Studies have generally found that the average exposures to specific toxins are lower than established occupational exposure limits, but, on occasion, they may be elevated. These sporadic peak exposures can transiently result in moderately elevated carboxyhemoglobin—typically 10% or less.

Elevated exposure to airborne irritants can produce transient respiratory tract symptoms. Cross-shift and cross-seasonal lung function studies of wildland firefighters have observed small reductions in average lung function parameters. These appear to reverse at the end of the season, but the long-term effects are uncertain, due to the lack of data.

What you can do for patients who are wildland firefighters

Get to know your patient's work activities. Evaluate and discuss the risks with your patient. It is useful to get a baseline spirometry that can be used for future reference if the need arises. Most patients have had a chest X-ray at some point, and that may be useful as a baseline reference.

Most firefighters, by requirement, are healthy, fit individuals. But some may have or develop cardiac disease or chronic obstructive pulmonary disease. In these cases, you will need to determine the patient's fitness to work. Individuals with ischemic heart disease may be at high risk when

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Season's Greetings

Have a safe holiday season and a healthy, happy 2014.

—Peter Rothfels, MD
Chief Medical Officer and Director,
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engaging in this type of work, especially if they are front-line firefighters working in fire suppression. This work is extremely physically demanding. Workers with mild and well-controlled respiratory disease may be able to work with few or no restrictions. Those with more advanced COPD with fixed airway obstruction or brittle asthma may be limited in their ability to do this type of work. Such cases may warrant a referral to a cardiologist, respirologist, or occupational medicine specialist.

For more information

If your patient is a seasonal wildland firefighter and you would like further information or assistance with his or her diagnosis or treatment, please call a medical advisor in your nearest WorkSafeBC office.

—Sami Youakim MD, MSc,
FRCP

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A version of this article listing sources is available online at bcmj.org.

Additional reading

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many of the traditions that had left such an impression on me. I even added a new custom—a trip out to the forest in my snowmobile to cut down a Charlie Brown Christmas tree and then haul it back on the trailer. We were guaranteed snow over Christmas in Yukon.

My own children have been brought up with the same blend of traditions. And we added something else to the mix: a musical Christmas in which the family and guests each bring and play a musical instrument—we've had more than a dozen musicians.

However you enjoy this festive season, I wish you happiness and laughter, good food and good cheer, and time spent with friends and loved ones.

—William Cunningham, MD
President

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- Office redesign coaching to examine care services and optimize care delivery to improve access and thus improve attachment.
- Enhanced home and community care to better support chronic disease management in the community and be connected with the primary care home and family physician rather than being geographically based.

In the Cowichan Valley, attachment was explored through a patient-centric lens, and several improvement options were supported by the division and its partners. The prototype work has seen early positive results, connecting about 2000 Cowichan residents with family doctors. However, the issue of patient attachment is complex. The next step is to implement additional changes and to continually evaluate their impact in order to share the outcomes.

For more details on the Cowichan Valley Attachment initiative prototype, visit www.leadlab.ca/wp-content/uploads/2013/09/CowichanAttachment.pdf.

For more information on the GPSC's Attachment initiative, visit www.gpsc.bc.ca/attachment-initiative.

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