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How many times in recent summers have you walked outside in the morning and felt like you were at a campsite, or have seen a haze of smoke midday or a dull red sky at night? Residents in Northwestern Ontario are familiar with visible indicators of smoke from wildfires. But what are the implications of the smoke on their health?

Forest fires are a regular occurrence and do contribute to the renewal of forested areas. However, the number and intensity of the fires has been increasing in recent years, with encroachment on cities, requiring mobilization of firefighting services, evacuations, and significant effects on population health. This summer and the last couple of years saw several large wildfires burning out west and in Northern Ontario. Communities in British Columbia and Alberta experienced the rapid spread of wildfire and in several instances the residents had to evacuate through thick smoke and with the fear that their homes may not be there when they returned. Plumes of smoke from Northern Ontario wildfires were carried down to Toronto, Ottawa, Montreal, and New York such that each of those cities, at some point, had the worst air quality in the world. The smoke itself can have significant consequences on health, and the additional mental health burden due to evacuations and property loss can lead to devastating long-term medical consequences.

The effects of smoke and pollutants from wildfires are felt most profoundly in the respiratory system because this system provides a large surface area which acts as an interface between the environment and the rest of the body. Wildfires produce particulate matter as well as gases which are toxic to animals and humans. Some of these noxious substances include carbon monoxide, nitrogen dioxide, polycyclic aromatic hydrocarbons, and others and which are inhaled during smoke exposure.

Human beings require approximately 10 litres of air per minute via breathing, which translates to approximately 600 litres an hour. This means that the respiratory tract starting with the mouth and nose and ending at the alveolar sacs, the smallest unit involved in gas exchange, is in constant and immediate contact with all the chemicals in the air. The immediate response is that the respiratory system becomes the site of inflammation during irritant exposure and also serves as a portal for the absorption of ultrafine particles into the

systemic circulation. Thus, the medical effects are both local to the respiratory tract as well as systemic in the rest of the body.

The noxious chemicals can be gaseous but also particulate form. Ultrafine particles as small as 1.0 micrometers are found in wildfire emissions. The smallest diameter of the airways is 2.5 micrometers in at the level of the alveoli. The alveoli are the end point of the respiratory system, where oxygen is absorbed into the bloodstream. This is particularly relevant to understanding the effects of the chemicals on humans and other animals because any particle that is 2.5 micrometers or less in diameter can reach the smallest branches of the airways and can cause an inflammatory reaction. This means that not only the gases, but particulate matter can be inhaled and have both local effects in the lung, but also will have systemic effects due to the absorption of ultrafine particles less than 1.0 micrometers in diameter, into the blood stream. For comparison, the human hair is 50 micrometers in diameter. This means that the inhaled particles which are detrimental to biological systems are invisible to the human eye.

Air quality is expressed by The Air Quality Health Index (AQHI) and is readily accessible on the Environment Canada website. It is a sum of particulate matter of 2.5 micrometers or less, ozone concentration and volatile organic compounds (VOC). This is termed PM 2.5 for ease of communication. Prolonged poor AQHI can lead to significant health consequences.

Symptoms of acute inhalation of smoke include cough, the production of phlegm, and wheezing due to the inflammation of membranes of the respiratory tract, and headaches. Most of the symptoms resolve after several hours once the air has cleared, but if there is persistent exposure, the symptoms may last for days or weeks, particularly if there is a prior history of respiratory disease. If severe, these symptoms may require medical evaluation and treatment. Patients with respiratory conditions such as asthma, bronchitis or chronic obstruction pulmonary disease (COPD) may find that their symptoms deteriorate and become severe, they may find that they are relying on more frequent use of inhalers, or that they are unable to function properly. Sometimes, the deterioration in health is such that hospitalization and treatment with significantly stronger medications is required in order to stabilize patients.

Smoke inhalation over the long term causes inflammation of the tissues of the respiratory system, with chronic inflammation resulting in increased mucous production, reduced lung function, increased rhinitis with nasal congestion and dripping, symptoms of sinusitis such as headaches and head pressure and worsening control of asthma and COPD. Persistent exposure to inhaled particulate matter and gases over weeks to months results in systemic illnesses from absorption of particulate matter through the respiratory

tract. Impacts on the cardiovascular system are changes in blood pressure and cardiac rhythm abnormalities and an increased frequency of angina and heart attacks . Mental health effects from poor air quality and forced evacuations which have been documented include anxiety, depression and poor sleep. Chronic exposure to noxious chemicals has also been linked to the development of several types of cancer.

The reason for the increase in the numbers of wildfires being experienced in Canada and the rest of the world can be linked to the increase in the global temperature and climate change. As the temperature of the earth has increased over the past years, so has the number of wildfires. As we continue into the future, if we are not cognizant of the effects of climate change, and we do not implement tactics and behaviours to counter climate change, we will continue to see the progression of the long-term consequences of environmental issues such as wildfires.