

Manitoba Health's Emerging Work on Wildland Fire Smoke

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Abstract—Smoke caused by wildland fire events is an important public health issue, involving major risks to the health of people and the environment. Smoke from wildland fires can travel hundreds of kilometers, affecting air quality far from the flames. Through a partnership with Health Canada, Manitoba Health's Office of Disaster Management (ODM) has undertaken a number of multi-year projects to improve our understanding of some of the aspects of these scientific and social issues related to wildland fire smoke. Through these projects, ODM will meet the following objectives: 1) develop specific smoke event health messaging for the general public, 2) develop First Nations messaging for smoke events, 3) examine the health outcomes and appropriate messaging for situations when the Air Quality Health Index (AQHI) rises above 10, 4) provide nationally-applicable guidance for decision-makers to protect people from wildland fire smoke, 5) examine the combined risks of smoke and heat and develop appropriate messaging for a combination smoke and heat event, and 6) determine the validity of using the AQHI as a wildland fire smoke response. As climate change models suggest an increasing probability for more wildland fires events in the future, it can be expected that wildland fire smoke events will increase as well. For Canadians to deal with these events effectively, an evidence-based approach to smoke response is needed which will allow health officials and emergency managers to appropriately message and communicate to them the extent of the risk of wildland fire smoke and to provide guidance for decision-makers during these events.

Introduction

Wildland fires are an important part of the Canadian landscape. Canada has about 10% of the world's forests and each year over the last 25 years, about 8,300 wildland fires have occurred (Summers and others 2011). These fires occur in forests, shrub lands and grasslands. Some are uncontrolled wildland fires started by lightning or human carelessness. A small number are prescribed fires set by authorized forest managers to mimic natural fire processes that renew and maintain healthy ecosystems (Natural Resources Canada 2013). On one hand, wildland fires are a natural part of the forest ecosystem and important in many parts of Canada for maintaining the health and diversity of the forest, and on the other, wildland fires can threaten communities and destroy vast amounts of timber resources, resulting in costly losses.

While wildland fires are a hazard in and of themselves, within the burning boreal forests lay another hazard, one which has a much wider impact: dense smoke. Smoke from wildland fires can travel hundreds of kilometers, affecting air quality far from the flames (Lipsett and others 2012). Smoke rises from a fire in a plume consisting of liquids, gases, and particles of different sizes. Pollutants in smoke can include deadly gases like carbon monoxide and many solid and liquid elements known as particulates or particles. Many, like acrolein, formaldehyde and benzene, are toxic or carcinogenic for humans (Lipsett and others 2012). The health impacts from wildland fire smoke can include

increased mortality, increased hospital admissions due to respiratory and cardiovascular diseases and increased emergency room and outpatient visits (Lipsett and others 2012).

The study of wildland fire smoke and its relationship to air quality and human health is a relatively novel and emerging field. Thus, with concern about climate change and climate variability mounting, new demands are being created for scientific, economic and social information to reduce the remaining uncertainties in these fields. Among the demands is the growing need for an evidence-based approach to consistent health messaging and guidance for decision-makers for wildland fire smoke events.

Manitoba Health & Health Canada Partnership In Wildland Fire Smoke

Smoke caused by wildland fire events is an important public health and safety issue, involving major risks to the health of people and the environment. Manitoba Health's Office of Disaster Management (ODM) decided to undertake the critical work of improving our understanding of some of the scientific and social issues surrounding wildland fire smoke.

In 2012, ODM signed a Memorandum of Agreement (MOA) with Health Canada to oversee a number of multi-year projects related to air quality and wildland fire smoke to gain a better understanding of the health impacts of wildland fire smoke to aid in the development of smoke-specific health messaging and guidance tools for decision-makers during a wildland fire smoke event. The scope of work from the MOA includes the following objectives:

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- Develop specific smoke event health messaging for the general public;
- Develop First Nation messaging for smoke events;
- Examine the health outcomes and appropriate messaging for situations when the Air Quality Health Index (AQHI) rises above 10;
- Provide nationally-applicable guidance for decision makes to protect people from wildland fire smoke;
- Examine the combined risk of smoke and heat and develop appropriate messaging for a combination smoke and heat event; and
- Determine the validity of the AQHI as a wildland fire smoke response tool.

The work conducted through this MOA is based on the AQHI which is a public information tool that helps Canadians protect their health on a daily basis from the negative effects of air pollution by helping them understand what the air quality around them means to their health. This tool has been developed by Health Canada and Environment Canada, in collaboration with provinces and key health and environment stakeholders. The AQHI assesses the cumulative health impact of ground level ozone (O₃), particulate matter (PM_{2.5}), and nitrogen dioxide (NO₂) to calculate an index number from 1 to 10⁺. The higher the number, the greater the health risk and the greater need to take additional precautions.

Objective A: Develop Specific Smoke Event Health Messaging

Health communication is important in public health as it is the principal way in which health officials can exchange health information with the general public. Given the challenges posed by wildland fire smoke events, health communication plays a strong role in providing those affected with accurate, useable and timely information. In the past year, ODM worked with a number of stakeholders to develop draft Special Air Quality Statements to be used when a smoke event forecast creates elevated AQHI forecasts. In the next phase of this project, ODM plans to validate the statements by testing the messages with sample communities, areas, or groups to determine their effectiveness and to identify any gaps in the messaging.

Objective B: Develop First Nation Messaging for Smoke Events

In the previous objective, Special Air Quality Statements were developed with all audiences in mind. It is noted from the existing literature that First Nations communities in Canada receive information through different means than non-First Nation communities (Driedger and others 2013). For this objective, ODM will work to develop a tailored approach for First Nations communities to ensure health

communication messaging related to smoke is effective in reaching the First Nation audience.

ODM conducted research on health and risk communication on First Nations peoples and developed a preliminary plan to tailor the Special Air Quality Statements so they can be effectively used to communicate health information to First Nations communities. ODM plans to work with a number of stakeholders involved in wildland fire smoke response in First Nations communities including government agencies from all levels involved with responding to wildland fires, First Nation youth groups, and front-line staff in a number of interview rounds that will see messages being tailored at the end of each round and used in the beginning of the next.

Objective C: Examine the Health Outcomes and Appropriate Messaging for Situations When the Aqhi Rises Above 10

During wildland fire smoke events where PM_{2.5} levels are elevated due to intense smoke, the publicly displayed AQHI reaches 10⁺, the highest risk level. In the past year, ODM has studied a number of wildland fire smoke events and their health impacts and prepared a status report for Health Canada based on our findings. The status report identified a number of issues related to examining health outcomes using the AQHI.

Of the issues identified, two stand out as the most significant limitations of the AQHI when examining health outcomes using the tool. To date, no studies have attempted to quantify the health impacts of wildland fire smoke exposure using the AQHI which makes understanding the health effects of wildland fire smoke through the AQHI challenging. Existing literature on the health impacts of wildland fire smoke have focused on particulate matter emitted from the smoke as it is the primary pollutant from smoke and the most cause for concern. There are also various air quality indices utilized around the world which would make comparisons of health effects of wildland smoke from different countries difficult. Consistency in methods and variables are important to be able to replicate studies and determine whether an association exists or not. Research in this area has focused on particulate matter which suggests that this is considered best practice when researching the health effects of wildland fire smoke.

Another important issue that was identified during the development of the status report deals with the severity of serious air pollution events. When the amount of air pollution is very high, the AQHI reports the number as 10⁺. For all serious air pollution events, the AQHI will describe the event as 10⁺, regardless of the actual level of severity of the event. For wildland fire smoke events, all events are not the same with some being more serious than others. This may result in the AQHI communicating to users to reduce or avoid strenuous activities outdoors when in fact, PM_{2.5} may

be elevated to levels that may require users to take additional precautions such as sheltering in place and voluntary and mandatory evacuations.

The findings suggest that the AQHI, as it is, may not be the best response/health communication tool for wildland fire smoke and that a new approach that can address these issues is needed. ODM will continue to monitor scholarly literature for new studies that may help address the gaps identified in the status report and prepare a final report for Health Canada in 2015.

Objective D: Provide Nationally-Applicable Guidance for Decision-Makers To Protect People From Wildland Fire Smoke

For this objective, ODM will develop operational guidance for provincial entities, using smoke forecasts and associated health impacts, which would be subsequently shared by Health Canada across the country. Guidelines currently being utilized for wildland fire smoke events in Manitoba have been based on visibility guidelines which can be subjective and open to interpretation. In the past year, ODM worked with stakeholders to develop a first draft of a package for decision-makers to provide them guidance during a wildland fire smoke event. In the next phases of the project, ODM will develop a second draft of the decision-makers' package, which will include a smoke enhanced revision to the wildland fire annex of the provincial emergency plan, critical care guidelines, and triage guidelines.

Objective E: Examine the Combined Risks of Smoke and Heat and Develop Appropriate Messaging for a Combination Smoke and Heat Event

Temperature is an important variable in assessing the probability of a wildland fire event. These events tend to occur when the ambient temperature is high, increasing the likelihood of drier conditions and lightning strikes which may increase the frequency of wildland fire events (Naeher and others 2007). As these events tend to occur when ambient temperature is high, there is a potential for interaction between wildland fire smoke and extreme heat to cause a synergistic health effect. This was demonstrated in the heat wave and wildland fire conditions in the summer of 2010 in Russia where there was a large health impact on the population with reported increases in adverse effects on respiratory health and mortality rates doubling from previous years.

In the past year, ODM examined the combined risks of wildland fire smoke and heat and prepared a report based on our findings. For the report, ODM conducted a systematic

review of the existing literature related to the synergistic health effects of heat and wildland fire smoke. The primary objective was to determine whether any synergistic health effects occurred during a simultaneous heat and smoke event. Due to the limited literature on the combined effects of wildland fire smoke and heat, assumptions were made in the research phase, and subsequently, in the report, to include the combined effects of heat and air pollution and combined effects of heat and particulate matter.

While the World Health Organization (WHO) has stated that the combined effect of high temperatures, particulate matter and air pollution is becoming increasingly evident, the synergistic health outcomes for simultaneous wildland fire smoke and extreme heat events remain uncertain. While some of the available literature made reference to the combined health effects of heat and wildland fire smoke, the references were made in passing and did not attempt to make any scientific link. The wildland fire smoke and heat event in Russia in 2010 provides a great case study for possible synergistic health outcomes; however, there has been no study to date that has evaluated the possible combined effects of the two events. Current practice is therefore reliant upon extrapolation of their singular impacts and the impact of combined hazards with inherent similarities (air pollution and heat; particulate matter and heat).

In the next phase of this project, ODM will conduct a cross-jurisdictional scan for existing messaging for simultaneous wildland fire smoke and heat events and work with provincial and federal stakeholders to develop draft messaging for simultaneous heat and wildland fire smoke events.

Objective F: Determine the Validity of Using the Aqhi As a Wildland Fire Smoke Response Tool

The research conducted by ODM in the past year on health outcomes of wildland fire smoke and the AQHI showed that while the AQHI provides a useful mechanism to communicate local air quality conditions to Canadians, there is concern the tool may not provide sufficient information during wildland fire smoke events as the precautions being communicated to Canadians through the AQHI may not reflect the real risk of the situation or the precautions that should be taken. This is especially evident during wildland fire smoke events where the AQHI is above 10 and messaging is fixed to specific messages regardless of how serious the air pollution event is.

Understanding the benefits and limitations of the AQHI, ODM is currently exploring ways to integrate smoke-specific messaging into the AQHI. While some jurisdictions have utilized two separate health communication tools, an air quality index and separate wildland fire air quality scale, using two separate tools may be complicating to the public which counters the AQHI's benefit of being easy to use and understand. Additionally, the concern from the AQHI is not

from the tool itself, but the “10+” health category where it can lump all serious air pollution events into one category.

A tool that can be integrated with the AQHI and utilized only during wildland fire smoke events where the AQHI is above 10 would provide the most benefit to Canadians as the AQHI has been a successful tool thus far for general day-to-day activities. ODM will continue to explore ways to integrate health messaging and guidance for decision-makers with the AQHI to ensure that health messaging during wildland fire smoke events is consistent with actions from decision-makers.

Conclusion

Climate change models suggest that conditions will likely become drier and warmer throughout much of Canada. Wildland fires can therefore be expected to increase in Canadian forests on the whole, with the area burned possibly doubling over the next century. With wildland fires in Canada expected to increase, the potential also increases for a greater number of smoke events with changes in air quality that will result in greater threats to human health and the environment.

For Canadians to deal with these events effectively, health officials and emergency managers must be able to appropriately message and communicate to them the extent of the risk during a wildland fire smoke event. Guidance, based on objective rather than subjective means, is also important as

it provides an evidence-based approach for decision-makers during a wildland fire smoke event.

Manitoba Health’s Office of Disaster Management will continue this work in hopes of developing an evidence-based approach to wildland fire response that can be used throughout Canada. The better prepared Canada is for wildland fire smoke events, the more can be done to mitigate their adverse health effects.

References

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