

enHealth Guidance for public health agencies
Managing prolonged smoke events from landscape fires

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1. Purpose

This enHealth Guidance (Guidance) aims to support a nationally consistent approach to the health protection measures advised by public health agencies when landscape fires cause community smoke impacts lasting for a prolonged period (typically more than two to three days). Public health agencies will need information about the expected duration of the landscape fire to apply this Guidance.

Scope

In 2020, following the 2019-20 'black summer' bushfires, the Australian Health Protection Principal Committee (AHPPC) approved nationally consistent 1-hour and 24-hour air quality categories for fine particles (PM_{2.5}) with associated public health messages (Appendices 1 and 2 respectively).

This Guidance primarily addresses public health considerations relevant for smoke exposure durations for longer time periods (more than a few days). Historically in Australia it has been uncommon for landscape fire smoke events to persist in an individual location for more than one week.¹ However, in the last decade, episodes of severe landscape fire smoke pollution affecting populations for periods longer than one month have become more frequent. These include smoke from coal mine fires, peat fires, and severe forest fires such as the Australian 2019-2020 Black Summer bushfires.^{2,3} Acceleration of global climate change is increasing the frequency of fire weather conditions conducive to such extreme and prolonged events.²

Decision-makers need clear and consistent evidence-based advice they can provide for the community and various organisations during prolonged smoke events. The overall aim is to reduce smoke exposure and to continue reducing exposure the longer the smoke event continues.

More prolonged or severe episodes cause more community concern, have greater public health impacts, and require more complex public health action and advice. Public health action in this context requires the consideration of many factors to characterise the public health risks. These include:

- Considerations of concurrent public health hazards such as the immediate threat from bushfires (to life and property) or heatwaves.
- Public understanding of the health risks associated with smoke from landscape fires and managing anxiety, especially in prolonged events.
- The cumulative short-term health risks associated with ongoing exposure to smoke from landscape fires, and increased risks of longer-term adverse health impacts associated with longer duration of exposures.
- The changing balance of risks and benefits of advisories and interventions through time.

¹ Hanigan IC, Henderson SB, Morgan GG, et al. The Validated Bushfire Smoke Events Database. Australian National University Data Commons. Canberra: ANU, 2016

² Bowman DM, Kolden CA, Abatzoglou JT, et al. Vegetation fires in the Anthropocene. *Nature Reviews Earth & Environment* 2020:1-16

³ Johnston FH, Borchers Arriagada N, Morgan GG, et al. Unprecedented health costs of smoke-related PM_{2.5} from the 2019-20 Australian megafires. *Nature Sustainability* (accepted 7 August) 2020

- The needs of those more sensitive to smoke exposure, for example, due to age, pre-existing conditions or illness.
- The needs of settings such as educational or aged care facilities, workplaces, or outdoor events.

The Guidance excludes consideration of brief smoke episodes for less than two or three days. Minimising smoke exposure during brief and minor landscape fire smoke pollution episodes can usually be adequately managed by individuals through:

- the provision of advance notification of expected air quality (e.g. with planned burns and smoke forecasts),
- access to real-time or near real-time air quality data,
- hourly and 24-hour PM_{2.5} frameworks (Appendices 1 and 2), which includes public health advice, with additional personal health considerations as may be provided by a medical practitioner.

The Guidance is provided for protecting the health of the community and is not applicable to workers such as firefighters and other emergency service workers involved in an emergency response. Health protection advice for occupational exposure to smoke is the remit of agencies responsible for occupational health and safety.

2. Background

Landscape fires (including planned burns, bushfires and peat fires) are integral to the Australian environment and the associated episodic pollution is often an unavoidable environmental health hazard.

There is a growing body of evidence of health impacts from exposure to landscape fire smoke. The range of outcomes is generally the same as those for PM_{2.5} as from other sources, with the exception of respiratory outcomes. There is increasing evidence that short term respiratory outcomes are greater from landscape fire smoke PM_{2.5} compared to PM_{2.5} from other background sources.^{4,5}

Depending on the underlying health of the individual, physiological responses can lead to the exacerbation of chronic medical conditions especially lung and heart conditions. These in turn can lead to population health outcomes such as increases in medication use, missed work, use of acute medical services (e.g. ambulance and hospital) and increased mortality.^{4,6,7}

Landscape fire smoke episodes can cause extremely high concentrations of PM_{2.5} and associated co-pollutants. However, adverse health outcomes can increase as soon as smoke concentrations increase, with ambulance callouts for breathing difficulties and heart attacks associated with hourly

⁴ Borchers-Arriagada N, Horsley JA, Palmer AJ, et al. Association between fire smoke fine particulate matter and asthma-related outcomes: Systematic review and meta-analysis. *Environmental research* 2019;108777

⁵ Aguilera R, Corringham T, Gershunov A, Benmarhnia T. Wildfire smoke impacts respiratory health more than fine particles from other sources: observational evidence from Southern California. *Nature communications*. 2021 Mar 5;12(1):1-8.

⁶ Liu JC, Pereira G, Uhl SA, et al. A systematic review of the physical health impacts from non-occupational exposure to wildfire smoke. *Environmental research* 2015;136:120-32

⁷ Reid C, Brauer M, Johnston FH, et al. Critical Review of Health Impacts of Wildfire Smoke Exposure. *EHP* 2016;142(9):1334-43

changes in smoke pollution.⁸ While there is less certainty about associations at higher concentrations, some health impacts, such as cardiovascular mortality, likely plateau after an initial steep increase at lower concentrations.⁹

Landscape fire smoke contributes to annual air pollution exposure, which is associated with the development and progression of chronic medical conditions including cardiovascular and respiratory diseases and Type 2 diabetes.^{10,11} In addition, exposure to air pollution during pregnancy or early childhood can influence the trajectory of developing physiological systems.¹²

Landscape fires are mostly short-term events lasting between hours to a few days. However, in Australia, they are also the main reason for elevated PM_{2.5} levels for extended periods, lasting from days to weeks. Short-term health impacts accumulate day to day. Exposure to lower levels of PM_{2.5} over a longer period can have similar and possibly greater impacts than exposure to higher levels over a shorter period, as illustrated in Table 1. At a population level, relative health impacts increase each day the longer the population is exposed.^{13,14}

Table 1: Estimated increases in respiratory hospital admissions based on average PM_{2.5} concentration over 1-6 days¹⁵

Increase in daily respiratory hospitalisations compared with PM _{2.5} of 8 µg/m ³	Days over which PM _{2.5} is averaged		
	1	2	3 to 6
<i>Percent increase and number of hospitalisations per 100,000 people</i>	<i>Average PM_{2.5} concentration (µg/m³)</i>		
3.3%, 1/100,000	25	17	12
9.9%, 2/100,000	58	33	20
29.7%, 6/100,000	145	81	44

Compared with short-term (e.g., daily) PM_{2.5} fluctuations, long term exposure to PM_{2.5} has greater overall health impacts in a population. For example, population mortality increases over a year are much greater than the sum of daily impacts for a year because air pollution acts to increase the

⁸ Yao J, Brauer M, Wei J, McGrail KM, Johnston FH, Henderson SB. Sub-daily exposure to fine particulate matter and ambulance dispatches during wildfire seasons: a case-crossover study in British Columbia, Canada. *Environmental health perspectives*. 2020 Jun 24;128(6):067006.

⁹ Chen G, Guo Y, Yue X, Tong S, Gasparrini A, Bell ML, Armstrong B, Schwartz J, Jaakkola JJ, Zanobetti A, Lavigne E. Mortality risk attributable to wildfire-related PM_{2.5} pollution: a global time series study in 749 locations. *The Lancet Planetary Health*. 2021 Sep 1;5(9):e579-87.

¹⁰ Kelly FJ, Fussell JC. Air pollution and public health: emerging hazards and improved understanding of risk. *Environmental Geochemistry and Health* 2015;37(4):631-49

¹¹ Yang B-Y, Fan S, Thiering E, et al. Ambient air pollution and diabetes: a systematic review and meta-analysis. *Environmental research* 2020;180:108817

¹² Aris IM, Fleisch AF, Oken E. Developmental origins of disease: emerging prenatal risk factors and future disease risk. *Current epidemiology reports* 2018;5(3):293-302

¹³ Kim S, Bell M, Hashizume M, Honda Y, Kan H, Kim H. Associations between mortality and prolonged exposure to elevated particulate matter concentrations in East Asia. *Environ Int*. 2018; 110: 88-94.

¹⁴ Huang J, Pan X, Guo X and Li G. Impacts of air pollution wave on years of life lost: A crucial way to communicate the health risks of air pollution to the public. *Environ Int*. 2018; 113: 42-49

¹⁵ enHealth Working Group 2021 Background literature and technical information – Public health and community smoke exposure during landscape vegetation fires: Health risk-based approach to prolonged smoke events.

development and progression of chronic diseases, in addition to precipitating exacerbations in those already at risk.¹⁶

There is emerging evidence of long-term health impacts following landscape fire smoke episodes lasting four weeks or more. These include long-term increases in respiratory symptoms and reduced lung function in adults and children.^{17,18} This data highlights the importance of reducing individual exposure during prolonged smoke episodes.

This Guidance presents considerations for advice during prolonged smoke events and includes advice for specific population groups and settings. The suggestions should be considered in the light of local circumstances, practical considerations and the rapidly emerging evidence base in this area.

3. Context for messaging for severe or prolonged smoke events

Increased indicators of anxiety are frequently reported with severe or prolonged smoke events. Public understanding of the nature of the risk associated with landscape fire smoke is variable and clear educational messages in addition to generic standing advice are likely to be helpful. In this Guidance, sensitive groups include people with heart and lung conditions including asthma, people over 65 years, infants and young children, pregnant women, and people with diabetes.

Despite the known health effects from exposure to PM_{2.5} during smoke events, the risk of severe acute or chronic health effects for most people is low. People in higher risk groups, especially those with lung conditions such as asthma, bronchitis or emphysema are more sensitive to smoke and may experience symptoms at relatively small increases in levels of smoke. However, just because an individual has one of these conditions does not mean they will experience adverse clinical outcomes, but they are more likely to than those without these conditions.

Health protection measures on a day-to-day basis are important to reduce overall exposure during an event as health risks can add up over time. It is worth reducing exposure whenever possible. People who are not in higher risk groups generally tolerate intermittent high levels of smoke.

4. General public health advice for the community

The following general public health advice could be considered during prolonged smoke events:

- If you or anyone in your care has trouble breathing, chest pain or discomfort call 000 for an ambulance.
- Check and follow any emergency warnings associated with threats from bushfires.

¹⁶ Kelly FJ, Fussell JC. Air pollution and public health: emerging hazards and improved understanding of risk. *Environmental Geochemistry and Health* 2015;37(4):631-49

¹⁷ Orr A, A. L. Migliaccio C, Buford M, Ballou S, Migliaccio CT. Sustained Effects on Lung Function in Community Members Following Exposure to Hazardous PM_{2.5} Levels from Wildfire Smoke. *Toxics*. 2020; 8(3):53. <https://doi.org/10.3390/toxics8030053>

¹⁸ Willis GA, Chappell K, Williams S, Melody SM, Wheeler A, Dalton M, Dharmage SC, Zosky GR, Johnston FH. Respiratory and atopic conditions in children two to four years after the 2014 Hazelwood coalmine fire. *Medical Journal of Australia*. 2020 Sep;213(6):269-75

- Keep the air inside your home as clean as possible. You can do this by:
 - closing windows and doors and opening them when air quality improves,
 - using your split system air conditioner OR switching other types of air conditioners to recirculate if they have this function,
 - not using evaporative coolers because they bring outdoor air inside.
- Spend time in places with cleaner air such as air-conditioned public buildings like libraries and shopping centres, or if possible, spend time in geographical areas not affected by the smoke.
- Using an indoor air cleaner, if you have one, that has a high efficiency particle air (HEPA) filter that is the right size for the room.
- People who are sensitive to smoke should actively monitor symptoms and follow their health management plan recommended by their doctor.

5. Concurrent public health hazards such as bushfires or heatwaves

Issues

Many agencies can be involved with natural disasters or other public health emergencies that can coincide with severe or prolonged landscape fire smoke exposure. Health agencies are unlikely to be the lead agency during a natural disaster. This can lead to competing public messages. It is therefore important to maintain close communication with other agencies and harmonise advice as much as possible.¹⁹

Messages for consideration

- At all times check you are safe from the immediate threat from bushfires and follow the advice of fire services (*public health agencies should provide relevant jurisdictional links to fire advice*)
- Extreme heat and bushfire smoke are both harmful to health and the effects of heat exposure can have serious consequences for sensitive individuals (*public health agencies should provide relevant jurisdictional links to heat and health advice*).

6. Public health considerations for coal and peat fires

Issues

Long-duration impacts are expected for coal or peat fires as these are stationary in the landscape, produce large volumes of smoke and are difficult to extinguish. In these circumstances consider proactive public messaging and early engagement with specific settings like residential aged care, education, and childcare facilities. Specific messaging for settings is provided in Section 9. Additional messaging for these types of prolonged smoke events is suggested below.

¹⁹ Marfori MT, Campbell SL, Garvey K, et al. Public health messaging during extreme smoke events: are we hitting the mark? *Frontiers in Public Health* 2020;8:465

Messages for consideration

- It is likely to be a long time before the smoke impacts are resolved.
- Day to day exposure adds up – try to minimise exposure whenever practical to do this, by planning outdoor activities in times and places less affected by smoke, and by doing indoor activities in air-conditioned buildings.²⁰
- Living in smoky conditions can be stressful so look after your overall health, including your mental health.
- Exercise in air-conditioned spaces instead of outdoors when conditions are poor.
- Monitor hourly PM_{2.5} levels for opportunities for outdoor exercise.
- Monitor hourly PM_{2.5} levels for opportunities to air out the home.
- If you are in a sensitive group and have the opportunity to temporarily move to a less affected area, you should consider doing this when smoke impacts might last for a prolonged period.

7. Interventions: masks, air cleaners, public buildings and adapting physical activity

Issues

Many interventions appropriate for short-term episodes, such as staying indoors with doors and windows closed, are not practical or effective when smoke lasts for several days or more.²¹ Protection against health impacts from prolonged smoke events has not been demonstrated for this intervention (i.e., closing windows and doors) unless additional fit for purpose air filtration systems are in place. Air filtration systems have been shown to reduce exposure to smoke and protect health.^{22,23}

Reduction of physical activity outdoors will reduce personal exposure to smoke but will also reduce the health benefits of exercise, which can offset some of the harmful impacts of air pollution in otherwise healthy people.^{24,25}

Respirators, which includes P1, P2 or N95 masks are not generally recommended for use during smoke events. However, for longer smoke events they could help in reducing overall exposure. P2 and N95 respirators are around 94 percent and 95 percent effective in filtering PM_{2.5} respectively, and P1 respirators are about 80 percent effective. Masks must be fitted properly to be effective and

²⁰ This does not apply to evaporative coolers, only split system or box-style air conditioners with recirculation mode available

²¹ Department of Health and Human Services Victoria 2020 [Supporting people when air quality is heavily impacted by bushfire smoke. Guidance for local government.](#)

²² Fisk W, Chan W. Health benefits and costs of filtration interventions that reduce indoor exposure to PM_{2.5} during wildfires. *Indoor air* 2017;27(1):191-204

²³ Laumbach RJ. Clearing the Air on Personal Interventions to Reduce Exposure to Wildfire Smoke. *Annals of the American Thoracic Society* 2019;16(7):815-8

²⁴ Laeremans M, Dons E, Avila-Palencia I, et al. Short-term effects of physical activity, air pollution and their interaction on the cardiovascular and respiratory system. *Environment international* 2018;117:82-90

²⁵ DeFlorio-Barker S, Lobdelle DT, Stone SL, et al. Acute effects of short-term exposure to air pollution while being physically active, the potential for modification: a review of the literature. *Preventive Medicine* 2020:106195

can make breathing more difficult, especially for people with heart and lung conditions. Public health agencies should provide links to guidance on respirator use.

Additional messages for consideration

- Many office buildings and public buildings like libraries or shopping centres have air conditioning systems that filter air pollution particles. Spending time in air-conditioned places will help reduce the amount of smoky air you breathe.
- Try to reduce your exposure to smoke, even if it's for short periods.
- It gets harder to keep smoke outside of a house the longer the outdoor smoke continues. If you have a portable air cleaner with a HEPA filter you should use it to keep your indoor air cleaner than the air outside.
- During periods when air quality is good, take the opportunity to air out your home.
- P2 (or N95) respirator masks can reduce exposure to fine particles in smoke but it's important to ensure they are fitted correctly to cover the mouth and nose. Follow advice about how to use them properly and who should be especially careful about their use. Respirators are not designed for children and you should consider seeking medical advice before using one if you have a pre-existing heart or lung condition.^{26,27}
- Keep up your usual level of physical activity if conditions allow. Keep track of smoky conditions and schedule outdoor activities for periods when air quality is good or exercise in indoor air-conditioned environments.

8. Sensitive groups

People in lower socioeconomic groups may have more risk factors, such as pre-existing disease, that increase their sensitivity to smoke. Some members of these communities may experience increased exposure to smoke during landscape fires (e.g. homeless people who cannot access cleaner indoor spaces). Other groups, such as people from a non-English speaking background and from culturally and linguistically diverse (CALD) communities, may also experience increased exposure if public health advice is not easily accessible.

Public health agencies should be mindful of these communities and ensure that information is relevant, available in different languages and can reach as much of the population as possible.

Those recognised as being more sensitive to adverse health effects associated with smoke exposure include people with existing chronic diseases including heart and lung conditions and diabetes, people over 65, pregnant women, infants and young children. Some potential messaging more relevant to prolonged smoke episodes is provided below.

²⁶ Department of Health Victoria. 2021. Face masks for environmental hazards <https://www2.health.vic.gov.au/public-health/environmental-health/face-masks-for-environmental-hazards>

²⁷ Australian Government. Statement from the Acting Chief medical Officer and State and Territory Chief Health Officers: Advice on the Use of Masks for Those exposed to Bushfire Smoke https://www.health.gov.au/sites/default/files/documents/2020/01/statement-from-the-acting-chief-medical-officer-and-state-and-territory-chief-health-officers-advice-on-the-use-of-masks-for-those-exposed-to-bushfire-smoke_1.pdf

8.1 Cardiovascular (heart) conditions

Issues

Associations between short-term exposure to landscape fire smoke and cardiac events have been well documented.²⁸ However, there is not good evidence for long-term increases in cardiovascular risk following episodic smoke events, other than through contributions to the average annual exposure. Some studies have found evidence of increased cardiovascular events during and in the months following natural disasters, however it is not known whether this is due to psychological stress, exposure to smoke, or both.

Additional messages for consideration

- Exposure to landscape fire smoke can worsen your heart condition and may lead to symptoms such as palpitations, chest pain or shortness of breath. Pay attention to your symptoms and take early action to manage them.
- If you are having trouble breathing, chest pain or discomfort, call 000 for an ambulance.

8.2 Asthma and other lung conditions

Issues

For people with lung conditions including asthma, the risks of adverse health effects from exposure to smoke increase with increasing exposure. Long term reductions in lung function have been documented one to two years following prolonged and severe smoke episodes.²⁹

Additional messages for consideration

- The longer the smoke persists in your area the more important it is to take precautions to reduce your exposure whenever it is practical.
- Exposure to increased smoke can worsen your symptoms. If you have asthma, follow your asthma action plan and if you have a puffer make sure it's handy at all times.

8.3 Diabetes

Issues

There is emerging evidence of an association between short-term exposure to PM_{2.5} and blood glucose levels including an increased risk of hypoglycaemia,^{30,31,32} and an increased risk of

²⁸ Haikerwal A, Akram M, Del Monaco A, Smith K, Sim MR, Meyer M, Tonkin AM, Abramson MJ, Dennekamp M. Impact of fine particulate matter (PM 2.5) exposure during wildfires on cardiovascular health outcomes. *Journal of the American Heart Association*. 2015 Jul 15;4(7):e001653.

²⁹ Orr A, AL Migliaccio C, Buford M, Ballou S, Migliaccio CT. Sustained effects on lung function in community members following exposure to hazardous pm2. 5 levels from wildfire smoke. *Toxics*. 2020 Sep;8(3):53.

³⁰ Johnston FH, Salimi F, Williamson GJ, et al. Ambient particulate matter and paramedic assessments of acute diabetic, cardiovascular, and respiratory conditions. *Epidemiology (Cambridge, Mass)* 2019;30(1):11

³¹ Yao J, Brauer M, Wei J, et al. Sub-daily exposure to fine particulate matter and ambulance dispatches during wildfire seasons: a case-crossover study in British Columbia, Canada. *Environmental health perspectives* 2020;128(6):067006

³² Shouxin P, Sun J, Liu F, et al. The effect of short-term fine particulate matter exposure on glucose homeostasis: A panel study in health adults. *Atmospheric Environment*, 2021, 11876

gestational diabetes in women exposed during their pregnancy.^{33,34} Awareness that exposure to smoke might make blood glucose harder to manage may be helpful for people with diabetes, with closer monitoring of blood glucose levels a simple and practical action.

Additional messages for consideration

- Smoke may affect blood glucose levels and make them harder to manage. If you have diabetes, try to reduce your time in smoke when practical and pay closer attention to your blood glucose levels.
- The [National Diabetes Services Scheme](#)³⁵ provides comprehensive information about managing diabetes in an emergency and preparing a diabetes management plan.

8.4 People over 65, infants and young children

Issues

Young children are more susceptible to air pollution because they breathe faster than adults and have actively developing lungs, blood vessels and immune systems. While the likely impacts are very small it is sensible to take steps to reduce the overall amount of smoke that infants and young children breathe. Air pollution is one of many risk factors that can affect the development of children.

Older people are included as a sensitive groups because they are more likely to have underlying health conditions.

Additional messages for consideration

- Smoky air can make lung conditions in children worse. Reduce their time in smoky air conditions and keep a close eye on their symptoms.
- Make sure your child's asthma action plan is up to date.
- If you are 65 years or older, actively look after any medical conditions you have and try to reduce your time in smoke.

8.5 Pregnant women

Issues

Advice needs to be contextualised to enable action to be taken where practical but not to cause concern that is out of proportion to the risk in individuals. Minimising repeated or prolonged exposure to all sources of air pollution, including smoke, during pregnancy should be a part of general advice for all pregnant women.

There is emerging evidence of adverse effects but effect sizes are generally very small. For example, outdoor air pollution including from wildfires has been associated with reduced birthweight and

³³ Melody SM, Ford JB, Wills K, et al. Maternal exposure to fine particulate matter from a large coal mine fire is associated with gestational diabetes mellitus: A prospective cohort study. *Environmental Research* 2019;108956.

³⁴ Hu C-Y, Gao X, Fang Y, et al. Human epidemiological evidence about the association between air pollution exposure and gestational diabetes mellitus: Systematic review and meta-analysis. *Environmental Research* 2020; 108843

³⁵ www.ndss.com.au/living-with-diabetes/health-management/emergencies-and-diabetes/

preterm birth,³⁶ and gestational diabetes.³⁷ Other developmental outcomes associated with outdoor air pollution include influences on immunological,^{38,39} respiratory,⁴⁰ and neurological development.⁴¹

Exposure to air pollution in-utero (during pregnancy) is one of many genetic and environmental factors that might influence the development of the foetus and subsequent child health. Not all research studies have found a link between exposure to air pollution and later developmental changes. Those that have were mostly conducted in situations where air pollution was very severe or persisting, and the outcomes identified were usually small and not likely to be of importance to the ongoing health of the child.⁴² An example of a study of wildfire smoke in the US found an average lower birthweight of 7.0g in children of mothers who were in their third trimester at the time of the fires.⁴³

Additional messages for consideration

- Air pollution and outdoor smoke, together with other risk factors, like a family history of diabetes, can increase the risk of diabetes in pregnancy and make blood glucose a bit harder to control.
- It is sensible to reduce your overall exposure to all sources of smoke, including tobacco, while you are pregnant.
- The risks for the mother and child associated with smoking tobacco, or living with a person who smokes, are much greater than risks associated with episodes of outdoor smoke.
- Further information about air pollution and pregnancy is available from the [Royal Australian and New Zealand College of Obstetricians and Gynaecologists](#).⁴⁴

³⁶ Abdo M, Ward I, O'Dell K, et al. Impact of wildfire smoke on adverse pregnancy outcomes in Colorado, 2007–2015. *International journal of environmental research and public health* 2019;16(19):3720

³⁷ Melody SM, Ford JB, Wills K, et al. Maternal exposure to fine particulate matter from a large coal mine fire is associated with gestational diabetes mellitus: A prospective cohort study. *Environmental Research* 2019:108956

³⁸ Huang Q, Ren Y, Liu Y, et al. Associations of gestational and early life exposure to air pollution with childhood allergic rhinitis. *Atmospheric Environment* 2019;200:190-96

³⁹ Lu C, Norbäck D, Li Y, et al. Early-life exposure to air pollution and childhood allergic diseases: An update on the link and its implications. *Expert review of clinical immunology* 2020;16(8):813-27

⁴⁰ Korten I, Ramsey K, Latzin P. Air pollution during pregnancy and lung development in the child. *Paediatric respiratory reviews* 2017;21:38-46

⁴¹ Guxens M, Lubczyńska MJ, Muetzel RL, et al. Air pollution exposure during fetal life, brain morphology, and cognitive function in school-age children. *Biological psychiatry* 2018;84(4):295-303

⁴² Steinle S, Johnston HJ, Loh M, et al. In Utero Exposure to Particulate Air Pollution during Pregnancy: Impact on Birth Weight and Health through the Life Course. *Int J Environ Res Public Health*. 2020;17(23):8948. Published 2020 Dec 1. doi:10.3390/ijerph17238948

⁴³ Holstius DM, Reid CE, Jesdale BM, Morello-Frosch R. Birth weight following pregnancy during the 2003 Southern California wildfires. *Environmental health perspectives*. 2012 Sep;120(9):1340-5

⁴⁴ <https://rancog.edu.au/womens-health/patient-information-guides/patient-information-pamphlets/air-pollution-and-pregnancy>

9. Settings

People responsible for specific settings often contact Public Health agencies for advice. The same general advice and recommendations about higher risk groups applies to all people regardless of settings. Some specific considerations with some of these settings are summarised below.

9.1 Outdoor workers

Issues

In general, workplace health is the responsibility of the employer. The same general public health advice is usually also appropriate for workplace settings. Employers could consider actions such as reducing the length of time outdoors for outdoor workers in higher risk groups, reallocating tasks to cleaner air spaces, or providing PPE if practical and appropriate to the workplace. Safe Work Australia provides advice about smoke and workplaces and refers to jurisdictional workplace regulators for more detailed advice.⁴⁵

Outdoor workers including the self-employed e.g. farmers, may be less able to reduce their time outdoors to protect themselves from exposure. However, the advice provided for the public, i.e., decreasing your exposure to smoke, should apply to the workplace.

9.2 Local governments

Issues

Local governments have roles in supporting their local community and managing public facilities. Local governments should be encouraged to identify and maintain a list of suitable facilities that could provide cleaner air spaces if needed and develop plans for communicating and activating their use in periods of poor air quality. Victoria's guide for local councils to create cleaner air spaces could be considered and modified for individual jurisdictions.⁴⁶

9.3 Settings with people in sensitive groups

Issues

Settings with sensitive groups (e.g. aged care, schools, hospitals) should especially be encouraged to develop a smoke plan similar to a heat health plan. This should include consideration of cleaner air spaces within their facilities, and how and when these would be used when outdoor air quality is affected by landscape fire smoke. Schools should ensure that areas where sick or unwell children and staff are managed, such as a sick-bay, have cleaner air.

There is very little evidence in favour of closing aged care facilities and relocating residents if there is no direct threat from fire. Indeed, there can be increased stress from relocating residents. Providing cleaner air spaces within the facility is the preferred option.

Public health agencies may be asked for advice about whether schools should remain open during prolonged smoke events. The relevant education authority should consider the risks and benefits of

⁴⁵ <https://www.safeworkaustralia.gov.au/media-centre/news/bushfires-and-air-pollution>

⁴⁶ <https://www2.health.vic.gov.au/about/publications/policiesandguidelines/supporting-people-air-quality-impacted-bushfire-smoke>

closing the school during prolonged smoke events. In many situations it may be appropriate to remain open because:

- Schools might offer better protection than what's available at home because schools might have cleaner air spaces.
- Alternative venues with cleaner air quality might not be available.
- Negative impacts on families and children from an abrupt closure could outweigh any potential health benefits.

General measures that should be considered for schools, early childhood services and aged care settings are summarised below.

Key messages for all settings

- For any decision-making, check relevant state or territory authority's website for changes in air quality and follow the advice provided.
- Any reduction in exposure to smoke, however small, will reduce the risk of harmful health effects.
- Refer to Appendix 1 for hourly air quality categories and public health advice, and to appendix 2 for 24-hour air quality categories and forecast messages.

Public health advice for schools and early childhood settings

- Monitor real-time air quality hourly to make decisions about activities throughout the day.
- If anyone has trouble breathing, chest pain or discomfort, call 000 for an ambulance.
- Anyone with asthma should follow their asthma action plan and keep their quick-relief medicine handy. Anyone with other conditions should follow the treatment plan recommended by their doctor.
- Reduce exposure to smoke by considering and taking the actions listed below. This is especially important when air quality is noticeably deteriorating (e.g. can smell smoke, or real-time air monitoring is indicating this) for periods longer than a day.
 - Recommend indoor activities if children develop symptoms like cough or shortness of breath.
 - Longer activities such as physical education or sports training should be avoided outdoors.
 - Shorter and less strenuous activities, such as recess, may be okay to hold outside if air quality impacts are minor and not worsening. Alternative activities should be provided indoors for staff and children at higher risk, or who are experiencing symptoms.
 - Schedule all activities indoors or reschedule them to another day or relocate outdoor events to a location with better air quality.
 - Manage indoor air quality according to conditions.
 - When air quality has worsened outdoors, close windows and doors.
 - Ventilate rooms when air quality improves, i.e. open windows and doors once air quality is better.
 - Where possible, create cleaner air spaces in the school in a room where it is possible to manage entry and exit (keeping windows and doors closed) or by using portable indoor air cleaners if available.

- Use air-conditioned spaces and rooms with additional air cleaners that have a HEPA filter if available. Switch air conditioners to recycle if it has this function. Switch off evaporative coolers. Split system air conditioners do not need to be switched off as they do not take in air from outside.

Public health advice for aged care settings

- If anyone has trouble breathing, chest pain or discomfort, call 000 for an ambulance.
- Make sure people with asthma follow their asthma action plan and keep their quick-relief medicine handy. Make sure people with other conditions, such as Chronic Obstructive Pulmonary Disease (COPD) follow the treatment plan recommended by their doctor. Please note there may be an additional need for oxygen during a smoke event.
- Anyone with concerns about their health should seek medical advice or call their health service specific to the state.
- Manage health by:
 - Closely monitoring medical conditions.
 - Watch for symptoms such as coughing, wheezing, difficulty breathing, and chest pain or discomfort and take action as needed.
 - Monitor real time air quality to enable timing or make decisions about outdoor activities.
- Reduce exposure to smoke by considering and taking the actions listed below. This is especially important when air quality is noticeably deteriorating (e.g., can smell smoke, or real-time air monitoring is indicating air quality is poor or worse).
 - Close windows and doors.
 - Opening windows and doors once air quality is better.
 - Scheduling all activities indoors or reschedule them to another day.
 - Relocating all activities indoors.

9.4 Public health advice for outdoor event organisers

Issues

There are likely to be people in sensitive groups participating in or attending outdoor events. Public health agencies may be contacted for advice. Due to the varied nature of outdoor events and their participants and attendees, a range of factors need to be considered by event organisers. There is therefore no prescribed level of PM_{2.5} that is applicable to every situation.

Issues for consideration

- For any decision-making, event organisers should check the relevant state or territory environment protection authority's website for changes in air quality and follow the advice provided.
- Refer to Appendix 1 for hourly air quality categories and public health advice, and to appendix 2 for 24-hour air quality categories and forecast messages.
- The forecast duration of smoke impact should be considered and balanced against the importance of the event and who the attendees are, especially for sensitive groups. Events could for example be shortened or postponed.
- Event organisers should provide advice about the possible risks of participating so that people can make informed decisions about attending or participating. This can be done by accessing

the relevant agencies' webpages. It is important where relevant, that event organisers not put undue pressure on individuals to participate if the event proceeds.

APPENDIX 1: 1-hour PM_{2.5} Framework

Standard Message: Follow directions from emergency services and advice from your doctor at all times.

Category	PM2.5 1-hour average (µg/m3)	Sensitive groups People with a heart or lung condition, including asthma; people over the age of 65; infants and children; pregnant women	Everyone else
Good	0-25	No change needed to your normal outdoor activities.	No change needed to your normal outdoor activities.
Fair	25-50	Reduce outdoor physical activity if you develop symptoms like cough or shortness of breath. Consider closing windows and doors until outdoor air quality is better. Follow the treatment plan recommended by your doctor. If you are concerned about symptoms call [<i>health service specific to state</i>] or see your doctor. If you or anyone in your care has trouble breathing or tightness in the chest, call 000 for an ambulance.	No change needed to your normal outdoor activities.
Poor	50-100 The air is likely to be dusty or smoky	Avoid outdoor physical activity if you develop symptoms like cough or shortness of breath. When indoors, close windows and doors until outdoor air quality is better. Follow the treatment plan recommended by your doctor. If you are concerned about symptoms call [<i>health service specific to state</i>] or see your doctor. If you or anyone in your care has trouble breathing or tightness in the chest, call 000 for an ambulance.	Reduce outdoor physical activity if you develop symptoms like cough or shortness of breath.
Very poor	100-300 The air is very dusty or smoky	Stay indoors as much as possible with windows and doors closed until outdoor air quality is better. If you feel that the air in your home is uncomfortable, consider going to a place with cleaner air (such as an air-conditioned building like a library or shopping centre) if it is safe to do so. Actively monitor symptoms and follow any treatment plan recommended by your doctor. If you are concerned about symptoms call [<i>health service specific to state</i>] or see your doctor.	Avoid outdoor physical activity if you develop symptoms like cough or shortness of breath. When indoors, close windows and doors until outdoor air quality is better. If you are concerned about symptoms call [<i>health service specific to state</i>] or see your doctor. If you or anyone in your care has trouble breathing or tightness in the chest, call 000 for an ambulance.

		<p>If you or anyone in your care has trouble breathing or tightness in the chest, call 000 for an ambulance.</p>	
<p>Extremely poor</p>	<p>> 300 The air is very dusty or smoky</p>	<p>Stay indoors with windows and doors closed until outdoor air quality is better and reduce indoor activity.</p> <p>If you feel that the air in your home is uncomfortable, consider going to a place with cleaner air (such as an air-conditioned building like a library or shopping centre) if it is safe to do so.</p> <p>Actively monitor symptoms and follow the treatment plan recommended by your doctor.</p> <p>If you are concerned about symptoms call [health service specific to state] or see your doctor.</p> <p>If you or anyone in your care has trouble breathing or tightness in the chest, call 000 for an ambulance.</p>	<p>Stay indoors as much as possible with windows and doors closed until outdoor air quality is better.</p> <p>If you feel that the air in your home is uncomfortable, consider going to a place with cleaner air (such as an air-conditioned building like a library or shopping centre) if it is safe to do so.</p> <p>If you are concerned about symptoms call [health service specific to state] or see your doctor.</p> <p>If you or anyone in your care has trouble breathing or tightness in the chest, call 000 for an ambulance.</p>

* The messaging in red font may contradict COVID-19 related advice and should be deleted if that is the case.

APPENDIX 2: 24-hour PM_{2.5} Framework

Standard Message: Follow directions from emergency services and advice from your doctor at all times.

Optional messaging: (to be displayed on a day that is forecast to be poor or worse):

If you are concerned about symptoms call [health service specific to state] or see your doctor.

If you or anyone in your care has trouble breathing or tightness in the chest, call 000 for an ambulance.

Category	PM2.5 24-hour average (µg/m3)	Sensitive groups People with a heart or lung condition, including asthma; people over the age of 65; infants and children; pregnant women	Everyone else
Good	0-12.5	No need to change your plans.	No need to change your plans.
Fair	12.5-25	There may be periods when air quality is worse in your area. Check [relevant website] for changes to air quality throughout the day and follow the advice provided.	No need to change your plans.
Poor	25-50	<p>Air quality is forecast to be poor.</p> <p>Check [relevant website] for changes to air quality throughout the day and follow the advice provided.</p> <p>Consider actions to reduce your exposure:</p> <ul style="list-style-type: none"> - reconsider planned outdoor activity. - close windows and doors before air quality gets worse and open them when it improves. <p>Follow your health management plan recommended by your doctor.</p>	<p>Air quality is forecast to be poor.</p> <p>Check [relevant website] for changes to air quality throughout the day and follow the advice provided.</p>
Very poor	50-150	<p>Air quality is forecast to be very poor.</p> <p>Check [relevant website] for changes to air quality throughout the day and follow the advice provided.</p> <p>Plan to take actions to reduce your exposure:</p> <ul style="list-style-type: none"> - Avoid outdoor activity. - Close windows and doors and open them when air quality improves. - Consider spending time in spaces where there is cleaner air (such as an air-conditioned building like a library or shopping centre). <p>Actively monitor symptoms and follow your health management plan recommended by your doctor.</p>	<p>Air quality is forecast to be very poor.</p> <p>Check [relevant website] for changes to air quality throughout the day and follow the advice provided.</p> <p>Consider actions to reduce your exposure:</p> <ul style="list-style-type: none"> - Reconsider planned outdoor activity - Close windows and doors and open them when air quality improves.
Extremely poor	> 150	<p>Air quality is forecast to be extremely poor.</p> <p>Check [relevant website] for changes to air quality throughout the day and follow the advice provided.</p> <p>Plan to take actions to reduce your exposure:</p> <ul style="list-style-type: none"> - Stay indoors. - Close windows and doors and open them when air quality improves. 	<p>Air quality is forecast to be extremely poor.</p> <p>Check [relevant website] for changes to air quality throughout the day and follow the advice provided.</p> <p>Plan to take actions to reduce your exposure:</p>

		<ul style="list-style-type: none"> - Consider spending time in spaces where there is cleaner air (such as an air-conditioned building like a library or shopping centre). - If practical, consider temporarily going to areas where the air quality is forecast to be better. <p>Actively monitor symptoms and follow your health management plan recommended by your doctor.</p>	<ul style="list-style-type: none"> - Stay indoors as much as practicable. - Close windows and doors and open them when air quality improves. - Consider spending time in spaces where there is cleaner air (such as an air-conditioned building like a library or shopping centre).
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* The messaging in red font may contradict COVID-19 related advice and should be deleted or amended as required