



AIOH Submission

Senate Finance and Public Administration References
Committee

Lessons to be learned in relation to the Australian bushfire
season 2019-20

Association number: A0017462L

ABN: 50 423 289 752

Authorisation

This paper expresses the views of the Australian Institute of Occupational Hygienists (the AIOH) in relation to the recent Australian bushfire experience. The AIOH (www.aioh.org.au) is a national, not-for-profit organisation that is the principal go-to organisation for occupational hygiene matters in Australia. Its members are focused on recognition, evaluation and control of health hazards at work. Occupational Hygienists are to be found in private industry, government agencies, universities, equipment and service providers, and in specialist consultancies.

This submission has been prepared by the Institute's External Affairs Committee, in consultation with members selected for their known interest and/or expertise in this area.

Summary

Firefighting is an extremely dangerous occupation. It is also an occupation in which firefighters are exposed to a wide range of hazardous air pollutants, which can result in both short and long-term adverse health effects. There is a significant body of research that has examined both pollutants and health consequences, yet despite this, there is still no adequate protective health framework for bushfire firefighters. The AIOH has sought to identify some gaps in the protection of firefighters' health and has accordingly made four recommendations.

Consolidated recommendations

The AIOH recommends:

1. That individual firefighter's exposure to air toxics is characterised through air monitoring and health surveillance and that appropriate records are kept.
2. That firefighters be issued with Respiratory Protective Equipment (RPE) best suited to the nature of their work. It is further recommended that use of any RPE be supported by a comprehensive training and fit-test program.
3. That a Work Health and Safety Code of Practice for Firefighters be drafted by Safe Work Australia in conjunction with relevant stakeholders.
4. That consideration be given to the establishment of a multi-disciplinary National Institute of Occupational Health.

Introduction

Firefighting under any circumstances is an extremely hazardous occupation. Bushfire firefighting is even more hazardous, as shown by the tragic loss of 9 firefighters' lives in the 2019-20 bushfires¹. The AIOH acknowledges the sacrifice made by each of these individuals.

In making this submission, the AIOH will focus on those aspects within the expertise of its members, i.e. the protection of worker's health. In addressing the terms of reference, we will particularly address the following:

- (c) the Federal Government's response to recommendations from previous bushfire Royal Commissions and inquiries;
- (d) the adequacy of the Federal Government's existing measures and policies to reduce future bushfire risk, including in relation to ... support for firefighters and other disaster mitigation measures;
- (g) the role and process of advising Government and the Federal Parliament of scientific advice;
- (h) an examination of the physical and mental health impacts of bushfires on the population, and the Federal Government's response to those impacts; and
- (i) any related matters.

In January 2020, the AIOH wrote to the Commonwealth Minister for Health and to the Ministers for health in all the States and Territories, ahead of February's COAG Health Council meeting in Perth. The purpose of this communication was to alert the governments to AIOH concerns about the long-term threats to the health of firefighters and other first responders. This issue was widely reported in the media at the time². In their letter, the AIOH drew parallels with the long-term health consequences now being observed in firefighters who attended the 9/11 disaster in New York and pointed out that more firefighters had now died of related diseases than were actually killed on the day of the disaster.

Lessons to be learned in relation to the Australian bushfire season 2019-20 has the potential to make a significant improvement to the health of firefighters. The AIOH welcomes the opportunity to contribute to that process.

Exposure to hazardous chemicals from vegetation fires

Bushfire smoke is a mixture of air pollutants, of which particulate matter is generally held to be the principal threat to public health³.

Particulate matter is a generic term for particles suspended in the air, typically as a mixture of both solid particles and liquid droplets. The size of the particles affects their potential to cause health effects. The smallest particles, those less than 2.5 micrometres in diameter (PM_{2.5}), are the greatest risk to public health because they can reach deep into the lungs and may even gain access to the bloodstream.

Particulates generated from burning wood and other organic matter are composed of chemically inert carbon particles that become coated with other chemical substances – a process called adsorption⁴.

Two other pollutants that may be of concern during bushfire smoke events are carbon monoxide (CO) and ozone (O₃). Carbon monoxide is a colourless, odourless gas produced by incomplete combustion of wood or other organic materials. Carbon monoxide dilutes rapidly in air, so is rarely a concern for the general public. An exception would be with people with heart disease who may be at greater risk if they are in very close proximity to the fire. Carbon monoxide can be a concern

¹ Parliament of Australia, 2019–20 Australian bushfires—frequently asked questions: a quick guide, How many firefighters died

? https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp1920/Quick_Guides/AustralianBushfires

² ABC News, Bushfires prompt call for long-term health study of firefighters to avoid repeat of 9/11 fallout, Kelly Fuller, ABC Illawarra, 26 February 2020, <https://www.abc.net.au/news/2020-02-26/call-for-health-study-into-bushfire-smoke-effect-on-firefighters/11999694>

³ US EPA (2019). Wildfire smoke: A guide for public health officials. Reviewed 2019. Environmental Protection Agency.

⁴ Guidotti, T.L. and Clough, V.M. (1992). Occupational health concerns of firefighting. *Annu. Rev. Public Health*, 12:151-71.

to firefighters close to the fire line. Smoke episodes can also be associated with elevated levels of ozone. This is not emitted directly from a bushfire but forms in the plume as smoke moves downwind⁵.

Carbon monoxide is an asphyxiant, which combines with haemoglobin in the blood to form carboxyhaemoglobin. This reduces the capacity of haemoglobin to transport oxygen. Exposure to elevated levels of CO can result in cognitive impairment, reduced work capacity, dizziness and nausea⁶. This has obvious safety implications for a firefighter, who may be driving or operating machinery that requires concentration.

Many other chemicals are present in bushfire smoke but at much lower concentrations than particulate matter, ozone and carbon monoxide. These include an extensive array of hazardous air pollutants (HAPs) that can be potent respiratory irritants and carcinogens, such as polycyclic aromatic hydrocarbons (PAHs). Given that the specific effects of these pollutants are hard to quantify and measure during an active smoke incident, PM_{2.5} is typically the pollutant that is tracked and monitored, and the pollutant that is used to estimate public health effects from bushfire smoke⁷.

Some researchers have sought to characterise emissions by setting up smoke chambers or taking air measurements during prescribed burns^{8,9}. Others have focused their attention on Volatile Organic Compounds (VOCs), particularly, the BTEX group (benzene, toluene, ethyl benzene and the xylenes) produced during the combustion of forest fuel¹⁰.

Some groups have looked at the variables that influence the makeup of atmospheric contaminants arising from the fire. For example, Barbioni and Chiaramoni (2010) noted higher concentrations closer to the flame front and during the smouldering phase¹¹. Other researchers have examined variables such as the type of vegetation, age of vegetation and intensity of the fire to characterise emissions¹².

Structural fires and aftermath issues

Buildings and structures, including vehicles, burnt in bushfires can leave potential health and safety hazards in the remaining rubble and ash. SafeWork NSW (2020)¹³ summarised these as follows:

Post-fire clean-up may involve contact with:

- Asbestos
- Lead and heavy metals
- Ash from burnt CCA-treated timbers (chrome, copper, arsenate)
- Garden and farm chemicals
- Biological agents
- Damaged gas bottles, including aerosol cans
- Household chemicals

This point was well described by Aiezza and Ahmet (2009)¹⁴ in the aftermath of the February 2009 Black Saturday bushfire in Victoria. At this stage, emergency services personnel, workers involved in the restoration of essential services and people involved in clean-up and recovery activities were faced with a wide range of health hazards. WorkSafe Victoria conducted a risk assessment of all anticipated bush fire hazards and recommended appropriate mitigation measures.

⁵ US EPA, Op. cit

⁶ Reisen, F., Hansen, D. and Meyer, C.P., (2007), Smoke Exposure during Bushfire Firefighting Operations, Conference Proceedings, 25th AIOH Annual Conference, Melbourne, 1-5 December 2007.

⁷ US EPA, Op. cit

⁸ De Vos, A., Cook, A., Devine, B., Thompson, P., and Weinstein, P. (2006). Effect of protective filters on fire fighter respiratory health during simulated bushfire smoke exposure. *American Journal of Industrial Medicine*, 49, pp. 740-750.

⁹ De Vos, A., Reisen, F., Cook, A., Devine, B. and Weinstein, P. (2008). Respiratory irritants in Australian bushfire smoke: Air toxics sampling in a smoke chamber and during prescribed burns. *Archives of Environmental Contamination and Toxicology*, 56(3), pp.380-388.

¹⁰ Barbioni, T. and Chiaramonti, N. (2010). BTEX emissions during prescribed burning in function of combustion stage and distance from flame front. *Combustion Science and Technology*, 182(9), pp.1193-1200.

¹¹ Barbioni, T. and Chiaramonti, N. (2010), *Ibid*.

¹² Bentley, Z. (2019). Recalibrating health risk assessment in bush fire-fighting. In papers from the 2019 AIOH Annual Conference, Australian Institute of Occupational Hygienists, Perth.

¹³ SafeWork NSW (2020). Property hazards following a bushfire: fact sheet. (https://www.safework.nsw.gov.au/_data/assets/pdf_file/0018/101439/SW08411-1117-395339.pdf)

¹⁴ Aiezza, A. and Ahmet, H., (2009), Management of Occupational Hygiene Hazards Arising from the February 2009 Victorian Bushfires, Proceedings of the 27th Annual AIOH Conference, Canberra, 5-9 December 2009.

Potential health impacts

The US EPA (2019) has noted that most healthy adults and children will recover quickly from bushfire (wildfire) smoke exposure. However, certain life stages and populations may be at greater risk of experiencing health effects. These include people with respiratory or cardiovascular diseases, older adults, pregnant women and outdoor workers¹⁵.

The fierce bushfires experienced in Australia during the summer of 2019/20 had an urban interface, and many homes and structures were destroyed. The fires consumed man-made materials as well as natural fuels, thereby creating a complex mix of emissions from natural and man-made material sources.

There is now an extensive body of evidence to show that health effects arising from regular (unprotected) particulate matter exposure will range from eye and respiratory tract irritation to more serious effects. The latter include reduced lung function, pulmonary inflammation, bronchitis, exacerbation of asthma and other lung diseases, exacerbation of cardiovascular diseases, such as heart failure, and even premature death¹⁶.

In 2014, Monash University carried out a national, retrospective study of firefighters' mortality and cancer incidence¹⁷. This was prompted, in part, by the results from several overseas studies that identified excesses of several types of cancers in firefighters^{18,19,20,21}.

The Monash study noted that there is good evidence that firefighting is associated with an increased risk of the following cancers: testicular cancer, prostate cancer, non-Hodgkin lymphoma and multiple myeloma. There is also some evidence that firefighting is associated with the following cancers: leukaemia, malignant melanoma, mesothelioma and cancers of the buccal cavity/pharynx, stomach, colon, rectum, skin, brain and bladder.

However, the Monash study also noted that little evidence was found in the scientific literature about the risk of mortality or cancer incidence for volunteer firefighters.

For other people, those not classified as professional or volunteer firefighters, the position is even less clear. Proximity to the fire, length and frequency of exposure, together with the level of awareness/training, use of protective equipment and the presence of any underlying health issues will be important factors in estimating risk.

For those involved in post-fire repair and reconstruction efforts, namely owners, tradesmen, demolition workers and similar, there will be challenges of the kind identified by SafeWork NSW²². Therefore, awareness building and active involvement by the State authorities becomes crucial. Experienced and qualified Occupational Hygienists can play a vital role in ensuring that these activities are conducted with minimum risk to the individuals involved.

Recommendation: That individual firefighter's exposure to air toxics is characterized through air monitoring and health surveillance and that appropriate records are kept.

¹⁵ EPA, Op cit.

¹⁶ EPA, Op cit.

¹⁷ Monash University (2014). Final Report: Australian Firefighters' Health Study. School of Public Health and Preventive Medicine. December, 2014.

¹⁸ Ma F, Fleming LE, Lee DJ, Trapido E, Gerace TA. (2006). Cancer Incidence in Florida Professional Firefighters, 1981 to 1999. *Journal of Occupational and Environmental Medicine*, 48(9):883-8 10.1097/01.jom.0000235862.12518.04.

¹⁹ Pukkala, E., Martinsen, JI., Weiderpass, E., Kjaerheim, K., Lynge, E., Tryggvadottir, L., Sparén, P., Demers, P.A. (2014). Cancer incidence among firefighters: 45years of follow-up in five Nordic countries. *Occupational and Environmental Medicine*. February 6, 2014.

²⁰ Daniels, R.D., Kubale, T.L., Yiin, J.H., Dahm, M.M., Hales, T.R., Baris, D., Zahm, S.H., Beaumont, J.J., Waters, K.M., Pinkerton L.E. (2014). Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occupational and Environmental Medicine*, 71(6):388-97.

²¹ LeMasters, G.K., Genaigy, A.M., Succop, P., Deddens, J., Sobeih, T., Barriera-Viruet, H., Dunning, K., Lockey, J. (2006). Cancer risk among firefighters: a review and meta-analysis of 32 studies. *Journal of Occupational and Environmental Medicine*, 48(11), pp. 1189-202.

²² SafeWork NSW (2020), Op cit.

Protective measures, including use of PPE

During the recent bushfires, there was some media coverage of inadequate respiratory protective equipment (RPE) supplied to Rural Fire Service crews²³. This report quoted the Volunteer Fire Fighters Association president as saying, "It's probably high time the government started to look at how we can provide some better respiratory protection "and" It shouldn't come out of a volunteer's pocket."

The RFS said it would take a long time to change safety equipment protocols.

"For the service to consider changing any of its provided firefighting equipment and apparel would require a full and comprehensive scientific research and evaluation process," it said.

The AIOH is aware of the shortcomings of available RPE. Disposable P2 respirators do not provide adequate protection against gases or vapours such as CO, cyanide (CN), CO₂, formaldehyde, benzene, PAHs or acrolein. Hence it is unsurprising to read in one report that a firefighter, who had been battling blazes near Canberra, claimed the P2 masks she had been provided often left her with breathing difficulties, coughing up ash, and susceptible to sickness²⁴.

The AIOH has contacted two reputable suppliers of RPE, viz. 3M Australia Pty Ltd²⁵ and the S.E.A. Group²⁶, and sought their recommendations on optimal equipment for firefighters. Both suppliers recommended reusable silicone rubber half face-masks, fitted with a combination of an organic vapour (+ inorganic vapour + acid gas) filter and a P2/P3 particulate filter. Neither supplier recommended P2 respirators.

However, there is no readily available filtration RPE for carbon monoxide.

The AIOH notes the comments of the Volunteer Firefighter's Association²⁷: "Most firefighters know and accept that it is impossible to eliminate exposure to CO unless you choose to use self-contained breathing apparatus (SCBA). Wearing SCBA in a bushfire application is not considered to be 'reasonably practicable' so the next best thing is to reduce your exposure and make use of filtration products that will remove harmful particles and improve your comfort levels. Fatigue management is an important part of the reduced exposure process by allowing time for your body to recover from lower levels of CO exposure. In addition to correct selection of RPE, it is important that RPE is used correctly".

This last statement is supported by Figure 4.2, from AS/NZS 1715:2009²⁸, which is reproduced below. Removing the face mask for just a few minutes over a whole shift significantly compromises the effectiveness of the RPE. Nevertheless, it must be recognized that even at the scene of a fire, firefighters will remove their RPE to communicate, drink or eat, or even just for comfort.

²³ NSW firefighters crowd funding upgraded face masks amid claims RFS gear insufficient, Lucy Thackray, Luisa Rubbo, Bridget Murphy and Peta Doherty, ABC News, 11 December 2019, <https://www.abc.net.au/news/2019-12-11/nsw-bushfires-firefighters-raise-money-to-buy-face-masks/11790096>

²⁴ Firefighter Claims Poor Quality Masks Left Her 'Coughing Ash For A Week', Josh Butler, 10 Daily, 13 December 2019, <https://10daily.com.au/news/australia/a191213uqfmr/firefighter-claims-poor-quality-masks-left-her-coughing-ash-for-a-week-20191214>

²⁵ Personal communication, T. Gorman FAIOH, COH, 3M Australia Pty Ltd, 13/5/2020

²⁶ Personal communication, G. Powe, S.E.A. Group, 13/5/2020.

²⁷ Improved Respiratory Protection for Firefighters – Part 3: What can we do about Carbon Monoxide? <https://volunteerfirefighters.org.au/improved-respiratory-protection-for-firefighters-part-3-what-can-we-do-about-carbon-monoxide>

²⁸ AS/NZS1715:2009, Selection, Maintenance and Use of Respiratory Protective Equipment, SAI Global.

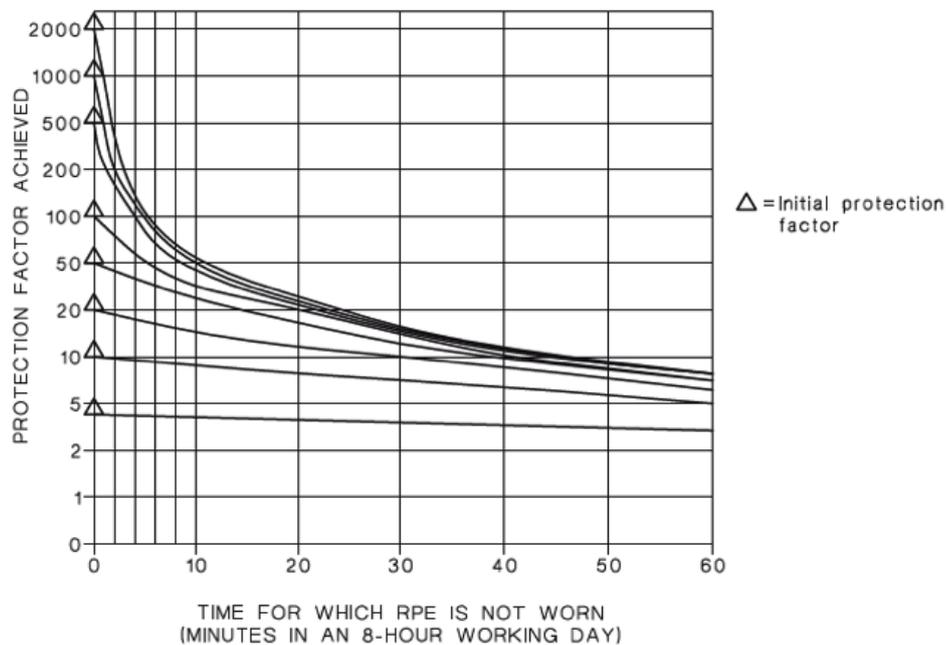


FIGURE 4.2 COMPARISON OF PROTECTION FACTOR ACHIEVED FOR VARIOUS WEAR TIMES

The facial fit will also impact on the effectiveness of the RPE and it was noticeable on several televised news reports that some firefighters had beards. Any facial hair, or other factors affecting the face-seal, will allow inward leakage of contaminants.

To a limited extent, some of the issues can be addressed by improved training of RPE users, including training in fit testing. The AIOH is currently in the process of launching such a fit testing program, called Resp-Fit²⁹; this training can be made available to any Fire Service.

RPE is the last line of protection and it is therefore essential that it should provide the maximum level of protection possible. However, the fact remains that for the reasons outlined above, the protection afforded by RPE in current use falls well below the standard required. Users have a misplaced level of confidence in their RPE and are being unnecessarily exposed to contaminants. For this reason, it is important that their exposures to gases and particulates are monitored.

Recommendation: The AIOH recommends that firefighters be issued with RPE best suited to the nature of their work. It is further recommended that use of any RPE be supported by a comprehensive training and fit-test program.

²⁹ AIOH, <https://www.aioh.org.au/resp-fit/resp-fit-testing-training>

Discussion

In addition to the obvious safety hazards of firefighters' work, there is ample evidence of the hazardous nature of firefighter's exposure to toxic airborne contaminants in the course of their work. These exposures have serious implications for the long-term health of firefighters.

Firefighting is an occupational activity and therefore is covered by Work Health and Safety (WHS) legislation, as applicable to any other workplace. However, there are specific features of firefighting that differentiate it from other work activities and so Australian WHS legislative requirements need to be reviewed in light of these features.

As an example of an aspect that should be reviewed, consideration should be given to existing workplace exposure standards (WESs) for chemicals³⁰. These need to be adjusted to consider the different work environment of bushfire firefighters, including factors as longer and irregular work shifts, heavier workload and exposure to a complex mixture of air toxics that may have interactive health effects³¹.

There is no provision under extant WHS legislation that recognises the highly specialised work of bushfire firefighters. AIOH notes that the ALP³² considers a firefighters' workplace is an unpredictable, volatile and dangerous workplace and is to be recognised as a high-risk occupation in health and safety legislation. The AIOH also notes the ALP believes in achieving the highest level of workplace safety and that a worker's right to a safe workplace should be enshrined in legislation. AIOH concurs with this view.

Recommendation: The AIOH recommends that a Work Health and Safety Code of Practice for firefighters be drafted by Safe Work Australia in conjunction with relevant stakeholders.

The AIOH notes that the Senate inquiry of 2011 into Fair Protection for Firefighters³⁴ considered the issue of exposure to carcinogens, and the subsequent cancers and difficulties experienced by firefighters in receiving adequate compensation. The AIOH notes the following statements from the final report:

3.27 The onus, therefore, would still be on the sick firefighter to prove occupational exposure to carcinogens. In fact, given that cancer results from cumulative exposure, firefighters seeking compensation could be required to provide a trail of evidence on exposure going back a decade or more.

3.28 This, the committee understands, would be achievable only if, after every fire event, authorities conducted a thorough scientific analysis of chemicals present in the fire, and then provide each firefighter involved in the response with a detailed list of chemicals they were exposed to. The administrative burden and cost of such an endeavour would be prohibitive. Easing the extremely difficult task of proving the link between their work and their cancer goes, as outlined earlier in this report, to the very heart of the proposed legislation.

Under Work Health and Safety (WHS) legislation, there is a duty of care upon the PCBU to monitor the exposure of workers, conduct health surveillance, (which is mandatory for asbestos, benzene, lead and PAHs), and to maintain records for at least 30 years. If this duty were adequately discharged, it would greatly assist firefighters in pursuing compensation or in getting optimal medical treatment.

It is noted that as regards record keeping, the Senate inquiry (2011) asked whether the Australian Incident Reporting System (AIRS) was suitable to collect information that could reliably be used in compensation claims. The committee was informed that AIRS had shortcomings in this regard,

³⁰ Safe Work Australia, Workplace exposure standards (WESs) for chemicals, <https://www.safeworkaustralia.gov.au/exposure-standards>

³¹ Reisen, F., (2007), Op. cit.

³² ALP, (2018), A Fair go for Australia, para. 85, https://www.alp.org.au/media/1539/2018_alp_national_platform_constitution.pdf

including that the system does not record firefighters' exposure to toxins as a result of combustion at the fire scene^{33,34}.

With regard to the Federal Government's response to physical and mental health impacts, the AIOH sees great value in the creation of a national database to record exposures to firefighters. Not only would this assist in compliance with WHS legislation, in assisting with compensation claims and obtaining appropriate medical advice, it would also provide a valuable resource for epidemiology and research.

The AIOH sees this as a great opportunity, given that the National Dust Diseases Taskforce has made an interim recommendation to the Commonwealth Minister for Health to develop a strategic national approach to improve Australia's ability to detect and rapidly respond to any future emerging occupational diseases of significance³⁵. The Taskforce has also made an interim recommendation to establish a National dust disease registry, which should be designed with the capability for potential future expansion to cover other occupational lung diseases.

The Taskforce also considers that a registry would facilitate exploring opportunities for data linkage and information sharing across systems to facilitate monitoring of the work-related hazards, and a better understanding of emerging workplace risks, to enable more sophisticated reporting on the incidence and trends in occupational diseases. This could assist with more timely and appropriate interventions and prevention actions.

The AIOH has suggested to the National Dust Diseases Taskforce that the proposed Dust Diseases Registry should be housed within a multi-disciplinary National Institute of Occupational Health, similar to the UK Institute of Occupational Medicine.

We suggest that such an Institute could undertake the role and process of advising Government and the Federal Parliament of scientific advice relating to occupational and environmental health of firefighters.

Recommendation: The AIOH recommends that consideration be given to the establishment of a multi-disciplinary National Institute of Occupational Health.

END OF SUBMISSION

³³ The Senate Education, Employment and Workplace Relations Legislation Committee, Safety, Rehabilitation and Compensation Amendment (Fair Protection for Firefighters), Bill 2011 [Provisions], September 2011

³⁴ Senate (2011), *ibid.* (para. 3.19).

³⁵ Australian Government Department of Health, National Dust Disease Taskforce, Interim Advice to Minister for Health, December 2019, [https://www1.health.gov.au/internet/main/publishing.nsf/Content/562CF83B7AECFC8FCA2584420002B113/\\$File/nat-dusk-interim-advice-dec2019.pdf](https://www1.health.gov.au/internet/main/publishing.nsf/Content/562CF83B7AECFC8FCA2584420002B113/$File/nat-dusk-interim-advice-dec2019.pdf)