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Coal Mine Fire at Morwell, Victoria, Australia. PEER REVIEWS

Review of the EPA Victoria response to the Morwell Coal Fire: Process for Public Health Protection.

Review scope:

1. Does the draft Carbon Monoxide Response Protocol adequately address protection of public health?
2. Are there any other procedures or techniques that might be used in addition to this, or as alternatives?
3. Is the EPA monitoring the right parameters to adequately inform public health assessments?
4. Any other relevant comments?

Reviewer details:

HR Anderson FMed Sci, MD MSC FFPH FRCP. Professor of Epidemiology and Public Health, St Georges, University of London and King's College London.

Brief Bio:

Professor Ross Anderson is an epidemiologist and public health specialist with a medical background. He is now working post-retirement in a part-time capacity at St George's, University of London and King's College London. He is a fellow of the Academy of Medical Sciences. He is currently a member of the Committee on the Medical Effects of Air Pollutants, and a member of the executive of the MRC-HPA Centre for Environment and Health. He is also a member of the World Health Organisation (WHO) Scientific Advisory Committee for the Review of Evidence of Health Aspects of Air Pollution (REVIHAAP) and for Health Risks of Air Pollution in Europe (HRAPIE). He is a co-chair of two expert groups within the Global Burden of Diseases, Injuries and Risk Factors programme: outdoor air pollution and chronic respiratory disease. External activities in the recent past include the Scientific Advisory Committee for the recent WHO updates of outdoor and indoor air quality guidelines, membership of the US Health Effects Institute Review Committee and Steering Committee of the International Study of Asthma and Allergies in Childhood.

Your understanding of the topic and scope:

A verbal brief of the Morwell situation, along with the material supplied was adequate.

Material supplied by EPA:

1. More detailed maps of Morwell town (with monitoring sites)
2. An example of the daily AIR DATA QUALITY report
3. The 21/2/2014 Draft of the LVCF Carbon Monoxide Response Protocol

Additional material requested:

Nil



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Any other relevant comments:

See attachment to the main report, received later.

Response

I am responding to your request for a succinct assessment of the draft CMR protocol. I understand that due to a brown coal mine fire, CO and PM concentrations are considerably elevated above Air Quality Objectives in nearby populated areas and that this situation may continue for weeks or more, depending on efforts to extinguish the fire. I also understand that other pollutants such as SO₂ are being investigated.

I am new to the idea of responding to an air pollution event on the basis of CO concentrations but am familiar with episodes due to other pollutants such as PM and NO₂. I have therefore consulted a number of reports and reviews of CO in an attempt to see how their conclusions and recommendations marry with the draft protocol. These are WHO Guidelines for outdoor (2000) and indoor (2010) CO, the UK DEFRA website. I have also consulted the AEGL technical document that you have used as a basis for your proposal.

On the first pass, a number of issues are apparent to me.

1. Quantification of risk.

Exposure of the population will be over days or weeks rather than hours. As such it falls between an acute and longer term exposure pattern and there is little empirical evidence to inform risk assessment in such situations. For outdoor CO, most population evidence is based on daily time-series studies. This is also the case for PM_{2.5} for which long term exposure (annual) is also an important source of evidence. Less evidence is available for episodes of weeks because these are difficult to study epidemiologically (bushfires, Asian haze, Kuwait oil fires, and volcanic eruptions). Fay Johnstone is of course an expert in this area (biomass burning) and I gather that you are consulting her. While quantification of risk on the basis of empirical evidence may be difficult, it is safe to assume that the concentrations both CO and PM_{2.5} occurring near to the fire are sufficiently high to cause a range of health effects some of which might be irreversible (such as a myocardial infarction or effects on the foetus) or aggravate existing chronic or acute cardiorespiratory disease.

2. Rationale for choice of health protection thresholds

You are using the AEGL-2 values as a basis for your thresholds. This value is based on an extensive review of evidence from all sources and is widely accepted. You are using it to determine trigger thresholds in a situation where you are uncertain about future exposures and in which the exposure may not just be “acute”. I have several comments about this which you may wish to consider.

- 2.1 The AEGL is designed for acute exposures not for continuous or intermittent exposure over days. In this review an 8 hour exposure to 27 ppm is predicted to result, in a non-smoker, in a COHb of 4%.
- 2.2. The AEGL is working on a no effects level of 4% based on angina studies. However, I note that WHO 2010 (on which I was a member of the Scientific Advisory Committee), based its recommendations on a no effects COHb level of 2%. This gave an 8-hour guideline of 10 mg/m³ (~9 ppm).
- 2.3. WHO 2010, while basing its guideline on laboratory dose-effect experiments in human subjects with angina supported its recommendation with evidence from laboratory experiments in normal subjects, numerous epidemiological studies of acute and long term exposure and cardiovascular morbidity. For the first time it recommended a 24 hr



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guideline of 7 mg/m³ (~6 ppb) for both indoor and outdoor exposure. This might be more appropriate for a scenario going on for weeks.

- 2.4 There seems to be quite a gap between the AEGL and WHO recommendations. It is interesting that AEGL did not set an AEGL-1 value “because susceptible persons may experience more serious effects (equivalent to AEGL-2) at concentrations that do not yet cause AEGL-1 effects in the general population”. In their main report they try to explain what this means but I remain confused by their statement.

3. Use of the AEGL-2 for the Protective Action Decision Guide.

Whatever health based guideline is adopted, decisions will need to take into account predicted values. This is accompanied by uncertainties and involves balancing of false positives with false negatives. However, it seems to me that public health protection should be based on a predicted exposure that is nearer to the 24 hour guideline recommended by WHO and associated with 2% COHb than the AEGL-2 value. Use of a trigger threshold based on 1 hour 70 ppm or 8 hour 27 ppb is likely to easily encompass a 24 hr value of 6 ppm in the context of an ongoing fire. Perhaps you have enough data already to look at the relationship between 1 hour and 24 hour levels. The Advice matrix in Figure 2 therefore looks more than adequate but I am making the case for it not being sufficient to give adequate protection to health. Perhaps it would be prudent to lower the threshold for EWsip. This would also be advisable to reduce the adverse effects of PM_{2.5}.

My response has been hurried and I expect that I have not said any more than you know already and that I may have misunderstood some of the documentation. I do hope that it has been helpful and I hope that there is a speedy resolution to this nasty problem.

Reference: *WHO 2010 Guidelines for Indoor Air Quality: Selected Pollutants* (this has a good review of the relevant literature and arguments). In includes an update *for WHO 2000 Air Quality Guidelines for Europe, 2nd edition*

With best wishes

Ross Anderson

Additional material received 4 March 2014

Note from EPA: These references were passed on the Department of Health (Vikki Lynch) and Dr Fay Johnstone, 4 March 2014. (The links look very complicated – but they do work.)

Dear Gavin

I expect that you have a lot on your plate at present but I thought that you might want to tuck this material away just in case. It was obtained for another purpose by our HPA (now Public Health England). Much of it is methodological but the report attached gives some specific information. It concerns an expert elicitation with which I was an "expert" designed to estimate the health impacts of the Kuwait oil fires. Not a straightforward business. We have little or no empirical evidence and need to draw on short and long-term exposure studies and make assumptions concerning equitoxicity of PM. Essentially we do not know the short or long term effects of episodes of medium duration, such as the mine fire, which makes it difficult to base action and health advice on firmly established evidence.



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* Mortality in Kuwait Due to PM From Oil Fires After the Gulf War: Combining Expert Elicitation Assessments<http://cp.mcafee.com/d/1jWVlp4wUpdEiCzBBVNdXV4TsSzt5Z5NeUVcSzt5Z4sOUUOrhKyqejhOevosKrhKyqehP9EVu7cCOeCpgVSI2vN1nHrNCIK8RcZHpLRJUPaT4qCuRISwOeRx5B_HYyCyqejhOCVRXBQQT7-h7nd7bPPfkhvmKCHuWvaxVZichs3jq9IsrLOB2rPUV5xcQsCXCM0ozlKcdfFNVwNO-uJ93Rs5SPPV-7PNeZTYKqerTLwTmcZfBclaOwawkSoSkNkerYIDkl2OEGbNGGaxyhUGbOzZ1kgtDYuhupU7xVKeMg-dawGx5l_JJPkS-euhpo76NsMwAq80md96y02CP6OCq80N8YQg2YE_gSC-rzJgEdk8VJVF> Tuomisto, J T.; Wilson, A; Cooke, R M.; More, Epidemiology. 16(5):S74-S75, September 2005.

* What Risk Assessment Can Tell Us About the Mortality Impacts of the Kuwaiti Oil Fires<http://cp.mcafee.com/d/k-Kr41ApdEiCzBBVNdXV4TsSzt5Z5NeUVcSzt5Z4sOUUOrhKyqejhOevosKrhKyqehP9EVu7cCOeCpgVSI2vN1nHrNCIK8RcZHpLRJUPaT4qCuRISwOeRx5B_HYyCyqejhOCVRXBQQT7-h7nd7bPPfkhvmKCHuWvaxVZichs3jq9IsrLOB2rPUV5xcQsCXCM0ozlKcdfFNVwNO-uJ93Rs5SPPV-7PNeZTYKqerTLw2AZCawKl2EG8kFZaa_2oG9r0l1fDDYejEay12HsNmpf-po7s3MYT7o8v6BglgySvSSVIGrv7f8II3zoKogid40b6Azh01jzpjid40oAug81ukvErjvdVgEt-nlhpMLE> Evans, J S.; Wilson, A; Tuomisto, J T.; More; Epidemiology. 16(5): S137-S138 September 2005

* A probabilistic characterization of the relationship between fine particulate matter and mortality: elicitation of European experts. Cooke RM, Wilson AM, Tuomisto JT, Morales O, Tainio M, Evans JS. Environ Sci Technol. 2007 Sep 15;41(18):6598-605.(available here http://cp.mcafee.com/d/avndxMOCxMOrhpd7bbPyr3O9KVJ6WbWbytnOpJ6WbW8VBNNASzt4QsCzAs-MVszt4QszCjhOYepdAtcOxPIG4_y2LmTzcHshGpXmPvHrNCIK8RcZHpJ1AtH2bb_nV5d4QsCzBdPHTbFFKfYyeKqenDCuEy-JtdmZQ-l3PWApmU6CSjoUTvAm4TDNOB2pEVdTdw0yHpzpjmkzh-Q-00U5wUnMbdA3VmSsGMFwBmFkl0mhZaM5giTlml9R5hEPIa2EQc0AljLstOO3FKeMg-dawGx5l_JJPkS-euhpo76NsMwAq80md96y02CP6OCq80N8YQg2YE_gSC-rk9r2)

Whilst looking for the above and work by the above authors I came across the following which makes some reference to the Kuwait fires:

Highlights of the Expert Judgement Symposium and Technical Workshop (see attached doc and website http://cp.mcafee.com/d/avndxMOCz8srhpd7bbPyr3O9KVJ6WbWbytnOpJ6WbW8VBNNASzt4QsCzAs-MVszt4QszCjhOYepdAtcOxPIG4_y2LmTzcHshGpXmPvHrNCIK8RcZHpJ1AtH2bb_nV5d4QsCzBdPHTbFFKfYyeKqenDCuEy-JtdmZQ-l3PWApmU6CS3oUTvAm4TDNOB2pEVdTdw0EKKY01PMZrUP4mQ2aLMCoH4HgDlOT7o8v6BglgySvSSVIGrv7f8II3zoKogid40b6Azh01jzpjid40oAug81ukvErjvdHznflkaCVtnj) Resources for the Future (RFF) hosted a two-day workshop in March 2006 on the theory and practice of expert judgment in risk and environmental studies. The School of Engineering and Public Policy at Carnegie Mellon University and the Center for Risk Analysis at Harvard University co-sponsored the workshop with RFF. The workshop brought together some of the most experienced researchers in expert judgment, senior policymakers from federal agencies, academics, and private consultants to discuss the role of probabilistic uncertainty analysis in public policy analysis, and the contributions and limitations of expert judgment to this analysis.

From the same symposium as above - Uncertainty in Mortality Response to Airborne Fine Particulate Matter: Combining European Air Pollution Experts http://cp.mcafee.com/d/5fHCN0SyOqemnd4S7AjtPqdQnQn4XzAPqdQnQhPbzz9J6W9EVd78VZxOVJ6W9EV7cczBU5Or8WpB3Dpk9_45uJL6pmUzkPSJC_mTzcHshGpXmPq38Xm4mn-LOaq9EVd7arDnKnijsv44tsQsLfcZh5ZqWqjXfYG7DR8OJmddLCNNK_8I9LfzAm4PhOrKr01NBgGDTC9tdJ3PTpZ0_f3VNRSh_QMq0yRmUQ_1wD_Pfwb6xwobxorivVp1QT7o8v6BglgySvSSVIGrv7f8II3zoKogid40b6Azh01jzpjid40oAug81ukvErjvdys7_ax4q

Protocol for Probabilistic Characterization of Uncertainty in Mortality Response to Airborne Fine Particulate Matter http://cp.mcafee.com/d/avndygO86QmjhOOYUCMYyrKrhKy-yUDssCrhKy-yepsspdeThd79EV7flendEThd78VAQsL3Cjp7jcEsXaxfUwHRJUPaT4qCuRITWSYpBrydjfqSrgp7qMvO_R-hjhd79EVjsWZOWqrz_8zHCzBVVDG8LHnjllTfBgY-F6lK1FJMSedTV5xdVYsyMCqejtPo0ecG5k-YNbFJEUuXfE7VUveeKOf-C3g4mGT6DUc4_-tc6zVmBfpOH0bhHeJGDyEm6Q-vV2JzstwxYqlI12bp_rrCOFJYsYyOMedyVx18Qg0Iqid405dCdBcOg1yhVEw5Vh-xJdYT_YBMwMJL03