It’s safe to say there is no safe level of air pollution

Adrian G. Barnett
School of Public Health and Social Work, Queensland University of Technology

Outdoor air pollution is a killer. A recent report from the World Health Organization estimated that 3.7 million deaths per year are due to outdoor air pollution. Most of these deaths are in low and middle income countries, with China often springing to mind. However, Australia still has a relatively big air pollution problem with an estimated 3,000 deaths per year.1 Traffic pollution is the major contributor to urban air pollution in Australia. Extreme events, such dust storms, bushfires and the recent coal fire in Morwell dramatically increase pollution levels (for days or weeks) and are very hazardous to health.2,3

Australian governments in the past 30 years have committed to improving air quality, and policies have been discussed and implemented with the aim of creating cleaner air. One key policy measure is the National Environment Protection Measures for air quality. These set standards for six important outdoor pollutants. Their key goal is to create "ambient air quality that allows for the adequate protection of human health and wellbeing".

One of the six standards is for particulate air pollution with a diameter less than 10 micrometres or less (known as PM$_{10}$), and allows a maximum daily average of 50 μg/m$^3$ (micrograms per cubic metre). For most people, these numbers will not mean much, and certainly the public and the media struggle to understand the standards. The standards are often interpreted to mean that particulate matter levels below 50 μg/m$^3$ are safe and those above 50 μg/m$^3$ are potentially dangerous. This is completely wrong.

To demonstrate how wrong this is we can predict what would happen if the current average pollution levels in Sydney, Melbourne and Brisbane were increased to just below the national standards. I used estimates of health effects from studies of the risks of outdoor pollution exposure in children and the elderly.4,6

Combining the pollutant increases, relative risks and current daily numbers of deaths and emergency hospital admissions gives annual increases of 2,600 deaths and 7,500 admissions in Sydney, 2,600 deaths and 5,800 admissions in Melbourne, and 800 deaths and 7,400 admissions in Brisbane. Further breakdowns of these numbers by age groups, diseases and pollutants are in Tables 1 and 2. The numbers show the massive health problems we could expect across Australia if pollution levels were increased to what some see as a ‘safe’ level.

There may be some double counting in these estimates, as some of the pollutants are positively correlated. However, these numbers do not cover all the health effects of air pollution, as I did not consider pollutants such as ultrafine particles nor include the full range of health effects including reduced lung function and preterm births.2,8

The estimated numbers assume that the association between pollution and health is linear with no threshold, and they extrapolate beyond the typical Australian pollution levels. Some studies have found threshold effects, such as a strong reduction in the association between non-cardiovascular and non-respiratory mortality and particulate matter below 50 μg/m$^3$.9 A recent study of the effect of particulate matter on life expectancy across the US found no threshold for levels between 10 μg/m$^3$ and 18 μg/m$^3$.3,10

The latest WHO air quality guidelines state, "there is little evidence to suggest a threshold below which no adverse health effects would be anticipated"11 and an international workshop of multiple pollution experts in

Table 1: Estimated number of additional annual deaths (all ages) by increasing current pollution levels to just below the national standards. Estimates by cities and pollutants. Estimates rounded to the nearest 100.

<table>
<thead>
<tr>
<th>Cities:</th>
<th>Brisbane</th>
<th>Melbourne</th>
<th>Sydney</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollutants:</td>
<td>NO$_2$</td>
<td>O$_3$</td>
<td>NO$_2$</td>
</tr>
<tr>
<td>800</td>
<td>2,600</td>
<td>2,600</td>
<td></td>
</tr>
<tr>
<td>5,300</td>
<td>700</td>
<td></td>
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</tbody>
</table>

NO$_2$ = nitrogen dioxide
O$_3$ = ozone
2009 concluded, “there are no established thresholds of exposure below which population health impacts are absent”.12

Misuse of the standards

It is understandable that the public and the media misinterpret the standards to mean safe or dangerous. What is hard to understand is when the safe or dangerous interpretation is used by professionals, such as environmental scientists employed to estimate the health impacts of new infrastructure. Such misinterpretation happens often. For example, recent environmental reports on the likely increases in air pollution from the East West road link in Melbourne and trains carrying coal in Queensland made just such a conclusion. Locals who are concerned about the potential health effects have found it difficult to get past the argument that the increases are below the standards and therefore everything is fine. But any new project that increases air pollution will mean an increase in health effects.

Instead of using a simplistic (and wrong) threshold argument, studies should be based on a thorough cost-benefit analysis, where the increase in health effects due to increased exposure is quantified. The increased health effects will depend on how many people are exposed and the estimated increase in pollution. The increased health effects can then be balanced against the economic and societal benefit of the new road, tunnel or industry. Policy makers can use these numbers to make an informed decision based on the merits and costs of the project. Such cost-benefit analyses are not difficult to do.

Changes also need to be made to the National Environment Protection Measures (NEPM) documentation and website to prominently state that the standards should not be used to judge whether individual projects are safe or dangerous. A report on the NEPM standards recognised that compliance with the standards, “may not achieve the desired outcome of adequate protection”.13 This was published back in 2011, but the documentation has still not been changed and the standards are still regularly being misused.

Changes could also be made to better communicate the risks of air pollution to the public. For example, the Victorian Environmental Protection Agency gives hourly updates on air quality for 16 sites across the state (http://www.epa.vic.gov.au/air/bulletins/aqhour.asp). While such speedy and free information is commendable, the pollution numbers are hard for non-specialists to interpret. This was clear during the recent fire at Morwell where the particulate matter numbers peaked at more than 550 µg/m³. To help interpret the numbers, the Victorian EPA has categorised and colour-coded the results into five categories from ‘very good’ to ‘very poor’. However, these categories still do not have enough meaning for lay people, particularly when people want to know if they should change their behaviour in order to reduce their exposure.

To help people interpret these categories the estimated health impacts could be added. For example, the category of ‘fair’ for particulate matter (PM2.5) could be augmented with the information of an expected extra 2–5 hospital admissions per 100,000 people exposed per week, while for ‘very poor’ the numbers would be 10 or more admissions. Again, these numbers are based on published studies of the risks of pollution, the increased in pollutants and current average levels of hospital admissions.

Change is long overdue

Air pollution can be complex. There are multiple gases and metals that are measured on unfamiliar scales. Air pollution is often difficult to measure and many pollutants interact with the weather, meaning measurements just 100 metres apart can be very different. However, the epidemiology of air pollution is simple: when average levels increase, the average health effects increase, and this association has been shown repeatedly around the world. I have lost count of the number of government-commissioned environmental reports that have used the safe or dangerous fallacy. This practice should have ended years ago and proper cost-benefit studies should be undertaken for the current massive projects that could affect many people’s lives, such as the expansion of coal trains in residential areas and the East West road link in Melbourne.

Table 2: Estimated number of additional annual emergency hospital admissions by increasing current pollution levels to just below the national standards. Estimates by cities, diseases, age groups and pollutants. Estimates rounded to the nearest 100

<table>
<thead>
<tr>
<th>Cities:</th>
<th>Diseases:</th>
<th>Age groups (years):</th>
<th>Pollutants:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anthrhapsia</td>
<td>0–4</td>
<td>PM</td>
</tr>
<tr>
<td></td>
<td>Cardiac failure</td>
<td>5–14</td>
<td>PM</td>
</tr>
<tr>
<td></td>
<td>Ischehic heart disease</td>
<td>15–64</td>
<td>PM</td>
</tr>
<tr>
<td></td>
<td>Respiratory</td>
<td>65+</td>
<td>SO2</td>
</tr>
<tr>
<td>Brisbane</td>
<td>7,400</td>
<td>300</td>
<td>CO</td>
</tr>
<tr>
<td>Melbourne</td>
<td>5,800</td>
<td>1,500</td>
<td>NO2</td>
</tr>
<tr>
<td>Sydney</td>
<td>7,500</td>
<td>15,100</td>
<td>PM2.5</td>
</tr>
</tbody>
</table>

CO = carbon monoxide; NO2 = nitrogen dioxide; PM = particulate matter with a diameter less than 10 micrometres; PM2.5 = particulate matter with a diameter less than 2.5 micrometres; SO2 = sulphur dioxide

References

14. Correspondence to: Dr Adrian G. Barnett, School of Public Health and Social Work, Queensland University of Technology, 60 Musk Avenue, Kelvin Grove, QLD 4059; e-mail: a.barnett@qut.edu.au

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