

# BENZENE: A CASE STUDY OF THE CONTROL OF A CARCINOGEN IN NSW

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Even when a hazard, such as a carcinogen, is well established, reducing exposure to the hazard through regulation may be a complex process and involve multiple stakeholders working together. It is the health policy maker's job to put the issue, as a potential threat to health, on the agenda. This article describes a case study that illustrates the complexity of attempting to regulate known carcinogens, using benzene control in NSW as an example.

## OCCURRENCE OF BENZENE IN THE ENVIRONMENT

Benzene is a volatile naturally occurring organic compound (C<sub>6</sub>H<sub>6</sub>). It is found in fossil fuels and is produced by the burning of organic material and, as such, occurs in fires, petrol refining, fumes from cooking oils, tobacco smoke, and waste incineration. Benzene is also formed, even during the combustion of lead free petrol, in car engines. Historically, benzene was widely used as a solvent, and is still used in the manufacture of plastics, synthetic fibres, detergents, pharmaceuticals, pesticides, and rubber. Low-level benzene exposure is ubiquitous, and the main route of exposure is through inhalation. Fortunately, benzene in the air is broken down naturally by chemical reactions over a period of hours to days.

## THE CARCINOGENICITY OF BENZENE

Benzene is classified as a definite (that is, a Group 1) human carcinogen by the International Agency for Research on Cancer,<sup>1,2</sup> and is a genotoxic substance that causes mutations in DNA. The National Occupational Health and Safety Commission has also classified benzene as a Category 1 carcinogen (that is, an established human carcinogen). Information about the carcinogenicity of benzene comes from animal studies, and from occupational cohort studies of workers who have been occupationally-exposed to high cumulative doses of benzene in previous decades (for example, shoe making, leather, rubber, and chemical industry workers.) In humans, there is clear evidence of a relationship between exposure to benzene and the development of acute myelocytic leukaemia (AML), which is a cancer of the white blood cells. The risk of leukaemia increases with exposure, with no known threshold but with a significantly elevated risk above 50 parts per million-years—for example, 1.25 parts per million (ppm) (time weighted average eight-hour exposure [TWA<sub>8</sub>]) over 40 years).<sup>3</sup> Benzene exposure is also associated with multiple myeloma and non-Hodgkins lymphoma. Locally, the Health Watch study, a long-term

cohort study of Australian petroleum industry workers, has reported an excess of lympho-haematopoietic cancers (that is, cancers of the blood and bone marrow cells), with a case-control analysis demonstrating that high cumulative exposures to benzene are associated with these cancers in this cohort.<sup>4</sup>

## BENZENE EXPOSURE IN AUSTRALIA

Most exposure to benzene in the Australian population occurs through the air—indoors, inside vehicles, and outdoors—when the atmosphere is locally-contaminated with benzene from vehicle exhaust, petrol evaporation, and tobacco smoke.<sup>3</sup> The estimated excess lifetime risk of leukaemia for the average urban Australian, due to the estimated 24-hour average lifetime exposure of 5.2 parts per billion, is one per 10,000 population, or 1.2 per cent of the lifetime risk of contracting leukaemia of any cause.<sup>3</sup> In NSW, the lifetime risk of leukaemia by age 75 is one in 92 for men (1.1 per cent) and one in 162 for women (0.6 per cent).<sup>5</sup>

There are several industries in Australia where higher than ambient levels of benzene exposure could occur—such as the petroleum, steel and chemical industries—and in laboratories. Additionally workplaces where conspicuous exposures to vehicle exhaust or tobacco smoke occur—such as those of professional drivers, mechanics, or hospitality industry workers—need to be considered.

The control of benzene exposure in NSW is approached through three main avenues: as a poison, as an occupational hazard, and as an environmental pollutant (in air, water, tobacco smoke, and contaminated sites.)

## CONTROL AS A POISON

The *Commonwealth Therapeutic Goods Act 1989* provides a framework for the states and territories to adopt a uniform approach to control the availability and accessibility, and ensure the safe handling, of poisons in Australia. Benzene is listed as a Schedule 7 poison under the 'Standard for the Uniform Scheduling of Drugs and Poisons' (the Standard). Schedule 7 substances are those with a high potential for harm at low exposure requiring special precautions during manufacturing, handling, and use. Products with benzene in concentrations below 1.5 per cent or in petrol up to 5.0 per cent are exempted from the poisons schedule. The legislation and schedule classification restrict access to benzene to authorised users.

In NSW, direct reference to the Standard is made in the *NSW Poisons and Therapeutic Goods Act 1966*, which means that poisons in NSW legislation are updated by

Commonwealth standards. The Pharmaceutical Services Branch of the NSW Department of Health administers the NSW Act. Unless one is an authorised person (doctor, dentist, vet, pharmacist, or holder of a manufacturer–wholesaler–general supplier’s licence), authority must be obtained from the Branch in order to obtain benzene.

### CONTROL AS AN OCCUPATIONAL HAZARD

The National Occupational Health and Safety Commission is a tripartite statutory body with representation from government, employers, and employees. The Commission has the power to declare national occupational health and safety standards and codes of practice, but these need to be adopted into law at a state and territory level. National codes of practice relevant to benzene include the Control of Scheduled Carcinogenic Substances,<sup>6</sup> with benzene under Schedule 2 (Notifiable), and Workplace Hazardous Substances.<sup>7</sup> Benzene is included in the List of Designated Hazardous Substances [NOHSC:10005(1999)] as a Category 1 carcinogen.<sup>8</sup> The Commission has also produced *Guidelines for health surveillance for benzene (1997)*.<sup>9</sup>

Since 1990, the occupational exposure standard for benzene has been 5 ppm. This standard is considered inadequate, given current knowledge about the hazard of benzene and is currently being reviewed with a view to lowering the standard to 1 ppm.<sup>10</sup> Current Australian workplace exposures are estimated to be considerably lower than 5 ppm (mean long term exposures of <0.7 ppm across relevant industries).<sup>3</sup> Substitution of benzene, engineering controls, ensuring adequate ventilation, and safe work practices such as personal protective equipment, are the main methods of workplace control of benzene exposure.

The review of the exposure standard is occurring, in the wake of a recent assessment of benzene as a priority existing chemical by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS).<sup>3</sup> Although NICNAS is not a statutory authority—that is, it cannot regulate—it can make recommendations as a statutory scheme and has a memorandum of understanding with states and territories.

NICNAS conducts its reviews in conjunction with Environment Australia and the Therapeutic Goods Administration—under whose auspices the scheme has recently come—and brings recommendations to the relevant parties for action.

In NSW, the Workcover Authority of NSW is responsible for ensuring compliance with occupational health and safety legislation. The *NSW Occupational Health and Safety Act 2000* places the onus on employers to conduct risk assessments of hazardous substances in the workplace, and thus they are responsible for identifying hazards,

disclosing them to workers, providing safety instructions, and labelling. In relation to benzene, its use as the main raw material in the manufacture of a product (>50 per cent volume) is notifiable and benzene cannot be supplied unless Workcover is notified or unless the benzene is used for research or analysis. Workcover requires employers to provide health surveillance for employees where indicated by risk assessment, to keep appropriate records, and to notify employees of any exposure or potential exposure at the end of employment. The use of greater than one per cent benzene for spray painting is specifically prohibited.

### CONTROL AS AN ENVIRONMENTAL EXPOSURE

Lead agencies involved in measuring, monitoring and reducing benzene in the environment are Environment Australia and the NSW Environment Protection Authority (EPA). ‘Upstream’ control measures include new national fuel standards to reduce benzene emissions by over 50 per cent nationally by 2010, by reducing benzene in petrol to a maximum of one per cent by volume from January 2006.<sup>11</sup> The delay in introducing these standards reflects concerns regarding infrastructure costs to refineries. Industrial benzene emissions are reportable to the National Pollutant Inventory, with a summary of pollutants available publicly.<sup>12</sup> As part of the proposed National Environment Protection Measure for Air Toxics, an air standard for benzene in Australia is being considered. The NSW EPA has reported that air benzene levels in NSW comply with international air quality targets.<sup>13</sup> The NSW Government’s 25 year Action for Air plan aims to provide an integrated strategy for improving air quality, with the NSW EPA working locally with initiatives such as regulations to reduce wood heater emissions, control of open burning and incineration, and working with the oil industry to supply low volatility petrol during summer. However, improving air quality clearly requires cross-sectoral action and involves agencies such as Planning NSW (transport and road infrastructure), the Roads and Traffic Authority, and the Environmental Health Branch of the NSW Department of Health.

Public health campaigns to reduce smoking have not focused on benzene, which is just one of many carcinogens in tobacco smoke. The success of tobacco control interventions in NSW has undoubtedly reduced population benzene exposure, both in smokers and non-smokers. In particular the *NSW Smoke Free Environment Act 2000*, which bans smoking in most enclosed public places, will reduce exposure to benzene from environmental tobacco smoke.

### CONCLUSIONS

Population and subpopulation exposure to benzene is difficult to control comprehensively. This is because

exposure is ubiquitous and occurs in multiple settings, and because responsibilities for control vary according to these settings. Particular problems with the control of benzene in Australia relate to a lack of timeliness in occupational standard setting, to the multiplicity of small workplaces where significant (and unmeasured) exposures may be occurring (such as in petrol stations and car repair shops) and to insufficient data about low dose population exposures and the degree of such exposure in Australia. Concern over benzene in air pollution and in cigarette smoke has not been the driving force behind the control of these issues, and it is fortunate that these problems continue to be addressed for other reasons. The current initiatives, as part of Environment Australia's *Living Cities—Air Toxics Program*, to measure benzene exposures more accurately at the population and subpopulation level may facilitate focused control measures where they are most needed.

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#### Further Reading

The interested reader is referred to the recommendations of the recent report by the National Industrial Chemical Notification and Assessment Scheme,<sup>3</sup> and to a recent report by the European Environment Agency,<sup>14</sup> which uses benzene as a case study of failure to regulate appropriately in the face of significant evidence of harm.

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