NOHSAC
National Occupational Health and Safety Advisory Committee
Komiti Tohutohu Mahi A-Motu Hauora me te Haumaru

REVIEW OF AUSTRALIAN AND NEW ZEALAND

WORKPLACE EXPOSURE SURVEILLANCE SYSTEMS

NOHSAC TECHNICAL REPORT 6

TIM DRISCOLL

AUTHOR

Tim Driscoll
Elmatom Pty Ltd

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NOHSAC

Telephone: (04) 915 4463   Fax: (04) 915 4329
Email: info@nohsac.govt.nz
Website: www.nohsac.govt.nz
Postal address: PO Box 3705, Wellington

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Abbreviations

ARPANSA	The Australian Radiation Protection and Nuclear Safety Authority
ASCC	Australian Safety and Compensation Council
CO	Carbon monoxide
HIV	Human Immunodeficiency Virus
NOHSAC	National Occupational Health and Safety Advisory Committee
NIOSH	National Institute of Occupational Safety and Health
PPE	Personal protective equipment
PRMS	Personal Radiation Monitoring Service

Executive Summary

BACKGROUND

The Office of the Australian Safety and Compensation Council (OASCC) of the Australian Government Department of Employment and Workplace Relations (DEWR) and the New Zealand-based National Occupational Health and Safety Advisory Committee (NOHSAC) have identified the prevention of occupational diseases as a priority target area. Existing national data sources have been reviewed and found to be inadequate for this task, since they are often based on workers' compensation data and reports. Programmes of exposure surveillance can compliment disease and injury surveillance (that is, outcome surveillance) and can be used to strengthen and inform occupational disease and injury policy and prevention programmes. To these ends, information is required on the nature, extent, quality and potential replication of existing occupational exposure surveillance projects in Australia and New Zealand, and internationally.

This project was commissioned by the OASCC to address issues raised by the *International review of surveillance and control of workplace exposures*, which was conducted for the OASCC and NOHSAC by the Victorian Institute of Occupational Safety and Health (VIOSH). Specifically, the VIOSH report found that there were no national exposure surveillance systems in Australia and New Zealand that met their criteria. As a result, they only reported on exposure surveillance systems overseas. The Office saw the need to validate VIOSH's findings for Australia and New Zealand, since local datasets of some relevance were known to exist. However, it needed to be established if such datasets were nationally representative or significant. In developing a workplace exposure surveillance strategy of national significance, it was important to:

- be aware of any national or nationally representative systems already in place that could be utilised as a framework for developing an Australian system
- seek to engage stakeholders (including the occupational health and safety and workers' compensation jurisdictions) in the development process to identify potential data owners or data sources that may be of strategic use for the project, and to commence the process of identifying which of these data owners may be willing to contribute their data to a national exposure surveillance repository
- avoid any waste of resources if a specific entity was already found to be working towards the development of a national or nationally representative system
- have a realistic assessment of the risks and possible points of resistance that the development of a strategy may face.

The project aimed to examine occupational health and safety exposure surveillance and control systems that are currently in use in Australia and/or New Zealand, and to produce a critical review of Australian and New Zealand approaches to exposure surveillance relevant to occupational health and safety. It focuses on surveillance systems that provide information on physical, chemical, biological, psychosocial or other hazards that can be present in an occupational context and that increase the risk of developing a work-related disorder. The ultimate aim was to lead to improvement in information sources that will underpin approaches to the prevention of work-related injury and disease in Australia and New Zealand.

For this project, exposure surveillance was defined as "the on-going and systematic collection, analysis and interpretation of data related to occupational exposures, and the use of this information for prevention and control purposes". Exposure control system surveillance was defined as "the on-going and systematic collection, analysis and interpretation of data related to occupational exposure control systems, and the use of this information for prevention and control purposes".

LITERATURE REVIEW

A review was conducted of published Australian and New Zealand literature relevant to occupational exposure or control system surveillance. This review revealed that neither appears to have a prominent role in occupational health and safety at a national or regional level. Exposures were the main focus of a number of studies, covering a range of physical, chemical, biological and psychosocial exposures, and a variety of occupations, industries and exposure circumstances. A few studies reported on detailed exposure systems based on a particular company or, for petroleum production and aluminium production, on a particular industry sector. In some cases, the exposure measurements prompted, or were likely to prompt, a specific response to control the exposures in some way, but this did not appear to be part of a formal exposure surveillance system.

Quantitative information on exposures is also available from many studies that focused on examining the relationship between exposure and a particular outcome and that collected exposure information as part of the investigation, but these studies were also not conducted as part of exposure surveillance, nor arose as a result of exposure surveillance.

OVERVIEW OF APPROACHES TO EXPOSURE SURVEILLANCE

Exposure surveillance can contribute to improvements in occupational health and safety in a number of ways. Most importantly, monitoring of exposures allows prevention action to be instituted earlier than is usually possible when monitoring outcomes, particularly when there is a long latency between exposure and the occurrence of the resulting disorder, as is the case with many work-related diseases. This allows greater potential to prevent more cases developing. Options for feasible exposure surveillance systems depend primarily on the exposure of interest. The outcomes of interest are still relevant, but primarily in terms of influencing the need for an exposure surveillance system. The over-riding aim of any comprehensive occupational health and safety system is the prevention of the work-related injury and illness. There are many inputs into such a system leading to this ultimate goal (with exposure surveillance potentially being one of them), a number of different designs that can be used for exposure surveillance systems, and a variety of appropriate approaches to the collection of data to support them.

SURVEY OF CURRENT EXPOSURE SURVEILLANCE SYSTEMS IN AUSTRALIA AND NEW ZEALAND

The main part of the project was designed to provide an understanding of the way occupational exposure surveillance was used in Australia and New Zealand. The focus was on national systems, or nationally-relevant systems. The required information was collected through a survey. Information was collected via an electronic questionnaire. This questionnaire was distributed in early February 2006, with information collected up until mid April 2006. In New Zealand, organisations were surveyed through direct interview by Mr Mark Wagstaffe.

The survey was sent via email to 240 separate organisations and interested individuals. Responses were received from 63 organisations. The main finding of the survey was that exposure surveillance is not widely used in Australia. The only functioning national exposure surveillance system is the ionising radiation monitoring system run by ARPANSA. This has been in existence for many years and appears to be functioning effectively. The mining industry, through the Minerals Council of Australia, is in the early stages of the development of a national exposure surveillance system that currently focuses on noise but that is expected to soon be expanded to cover some dusts and radiation. The survey (and direct consultation with organisations in New Zealand) suggests that exposure surveillance does not have a high profile in occupational health and safety in Australia and New Zealand. Several multinational companies have comprehensive exposure surveillance systems incorporated into their risk management systems, but these systems are specific to the individual companies.

ISSUES AND ACTIONS RELEVANT TO EFFECTIVE EXPOSURE SURVEILLANCE

There are many issues that present potential barriers and challenges to the establishment of exposure surveillance systems, and no specific guidelines for the development of occupational exposure surveillance, although several references provide insight into the key features such systems should have. The most important potential barriers and challenges relate to data (definition, collection and measurement, coding, recording), training, sampling, resources, prioritisation, commitment and legislation. Detailed recommendations regarding exactly which exposures should be the subject of exposure surveillance in Australia and New Zealand, and how those exposure surveillance systems should function, are beyond the scope of the current report. The development of such recommendations should be made through consultation with key stakeholders. However, some general guidance is provided.

Different exposures will have different requirements regarding the design and function of an exposure surveillance system. Some exposures within a single general class of hazard (physical, chemical, biological and psychosocial) will tend to have similar exposure characteristics and so have similar requirements of an exposure surveillance system, but many will not.

For most exposures that are likely candidates for exposure surveillance, collection of exposure information through recurrent survey seems likely to be the most cost-effective approach. These surveys can take various forms, depending on the exposure of interest. Exposure data already being collected may be able to be utilised for a limited number of exposures. This is a potentially cheaper approach than collecting new data specifically for surveillance purposes, but such information is likely to only be available from jurisdictions or for medium to large organisations, and significant work would probably be required to standardise the data collection and reporting approaches. Other routinely collected information, such as that collected by occupational safety and health authorities for regulation or registration purposes, may be of use, but it is likely that the variations in the approaches currently used between and within jurisdictions will limit the extent to which the information could be viewed as representative. For a small number of exposures, other data collection approaches will be warranted.

The main candidates in terms of the types of exposure surveillance systems for use at a national or jurisdictional level and on an on-going basis seem to be specific exposure databases utilising data collected by area monitoring, personal monitoring, or surveys; and job-exposure matrices. Given the large cost in terms of resources and time required to establish and run an exposure surveillance system, it is likely that in the medium term only a limited number of exposures could be the subject of detailed exposure surveillance. For most of these, recurrent workplace surveys are likely to be the most cost-effective method of obtaining the necessary information. On-going, comprehensive surveillance incorporating a wide range of exposures (i.e. the direct monitoring of potentially thousands of hazardous substances), based on recurrent workplace surveys, is not likely to be viable in the medium term in either Australia or New Zealand. A potentially viable alternative is the construction and maintenance of a national job-exposure matrix (or the related task-exposure matrix). This could provide detailed exposure information on a large number of exposures and exposure tasks. Alternatively, specific exposure databases using information from surveys (of the workplace and of individuals), and specific area or individual measurements for a very limited number of exposures, are viable. Biological monitoring might also be appropriate in certain circumstances. Job-exposure matrices are appropriate for many physical and chemical exposures, as well as some biological exposures.

There are no obvious pending technological changes in exposure monitoring that are likely to affect the development and use of occupational exposure surveillance. However, there are a number of potential developments in exposure surveillance in the medium term. There are also a number of strategic developments that should increase the likelihood that occupational exposure surveillance can be significantly improved in Australia and New Zealand

SUMMARY AND CONCLUSIONS

This primary aim of this project was to examine occupational health and safety exposure surveillance and control system surveillance currently in use in Australia and/or New Zealand, and to produce a critical review of Australian and New Zealand approaches to exposure and control system surveillance relevant to occupational health and safety. The survey revealed that exposure and control system surveillance does not appear to play a major role in occupational health and safety in either Australia or New Zealand, particularly at the jurisdictional or national level. This was confirmed by the literature review, which identified a considerable amount of information about work-related exposures, but very little related to proper exposure or control system surveillance at a national, jurisdictional or regional level. There are a small number of exposure databases that might be appropriate for inclusion in exposure surveillance systems at this level. There is also a fully functioning exposure surveillance system for ionising radiation in Australia and New Zealand.

There are many important issues that need to be considered in developing exposure and control system surveillance in Australia and New Zealand. Significant resources will be required to adequately explore these issues and ultimately resolve them, but there are major advantages to investing such resources. There are many potential hazards that are candidates for exposure surveillance, a small number of appropriate surveillance system designs, and a range of potential approaches to data collection available to support whatever systems are developed.

SECTION ONE

INTRODUCTION

1.1 BACKGROUND

The Office of the Australian Safety and Compensation Council (OASCC) of the Australian Government Department of Employment and Workplace Relations (DEWR) and the New Zealand-based National Occupational Health and Safety Advisory Committee (NOHSAC) have identified the prevention of occupational diseases as a priority target area. Existing national data sources have been reviewed and found to be inadequate for this task, since they are often based on workers' compensation data and reports. Programmes of exposure surveillance can compliment disease and injury surveillance (that is, outcome surveillance) and can be used to strengthen and inform occupational disease and injury policy and prevention programmes. To these ends, information is required on the nature, extent, quality and potential replication of existing occupational exposure surveillance projects in Australia and New Zealand, and internationally.

This project was commissioned by the OASCC to address issues raised by the *International review of surveillance and control of workplace exposures*, which was conducted for the OASCC and NOHSAC by the Victorian Institute of Occupational Safety and Health (VIOSH). Specifically, the VIOSH report found that there were no national exposure surveillance systems in Australia and New Zealand that met their criteria. As a result, they only reported on exposure surveillance systems overseas. The resultant report identified 24 working exposure surveillance systems in various countries, primarily the Scandinavian countries, the United States and the United Kingdom. However, the report identified many problems with the systems currently in place and found that none of the systems was directly applicable to Australia and New Zealand. It was concluded that workplace surveys were likely to be the most effective data collection approach for exposure surveillance in Australia and New Zealand[1].

The Office saw the need to validate VIOSH's findings for Australia and New Zealand, since local datasets of some relevance were known to exist. However, it needed to be established if such datasets were nationally representative or significant. In developing a workplace exposure surveillance strategy of national significance, it was important to:

- be aware of any national or nationally representative systems already in place that could be utilised as a framework for developing an Australian system
- seek to engage stakeholders (including the occupational health and safety and workers' compensation jurisdictions) in the development process to identify potential data owners or data sources that may be of strategic use for the project, and to commence the process of identifying which of these data owners may be willing to contribute their data to a national exposure surveillance repository
- avoid any waste of resources if a specific entity was already found to be working towards the development of a national or nationally representative system
- have a realistic assessment of the risks and possible points of resistance that the development of a strategy may face.

The project aimed to examine occupational health and safety exposure surveillance and control systems that are currently in use in Australia and/or New Zealand, and to produce a critical review of Australian and New Zealand approaches to exposure surveillance relevant to occupational health and safety. It focuses on surveillance systems that provide information on physical, chemical, biological, psychosocial or other hazards that can be present in an occupational context and that increase the risk of developing a work-related disorder. The ultimate aim was to lead to improvement in information sources that will underpin approaches to the prevention of work-related injury and disease in Australia and New Zealand.

The formal aim of the project, as presented in the relevant Request for Quote (RFQ) released on 14th October, 2005, was to "provide DEWR [which contains the OASCC] and NOHSAC with a critical review of Australian and New Zealand workplace exposure surveillance systems which will be used with other information to inform the development of a proposed Australian national hazard exposure surveillance system".

The project was to produce a matrix of exposure surveillance systems which take into account:

- the differing categories of exposures
- the possible types of surveillance methods available
- the disease and injury groups of interest.

All relevant exposures, surveillance methods and disorders were to be considered. No specific exposures were nominated in the RFQ, but physical, chemical, biological and psychological hazards were identified as relevant. All relevant surveillance methods were to be included, but specific surveillance methods to be considered, as documented in the RFQ, included:

- routine surveillance systems
- comprehensive surveillance systems
- workforce systems (labour force surveys)
- exposure databases
- registers of substances
- industry surveillance systems
- relevant population surveillance systems
- other relevant systems.

Similarly, all relevant disorders were to be included, with, as stipulated by the RFQ, priority attention to be given to:

- respiratory diseases
- occupational cancers
- contact dermatitis
- infectious and parasitic diseases
- cardiovascular diseases
- musculoskeletal disorders
- mental or neuropsychiatric disorders
- noise-induced hearing loss.

In addition, injuries and any relevant disorder not included in the above list were included. The project also considered surveillance systems that provide information on exposure control measures or on measures designed to prevent or minimise the effects of exposure (such as the prevalence of smoke detectors, use of appropriate guards or wearing of seat belts).

1.2 DEFINITIONS

This project is focused on exposure surveillance, but also takes into account surveillance of exposure control systems. Although exposure surveillance is sometimes seen as a subset of hazard surveillance[2], in this project the terms “exposure surveillance” and “hazard surveillance” are considered synonymous. For ease of reading, “exposure surveillance” is used throughout this report. Exposure surveillance is taken to cover all forms of occupational hazard, including physical, chemical, biological and psychosocial hazards.

EXPOSURE SURVEILLANCE

In general terms, public health surveillance has been defined by the United States Centres of Disease Control and Prevention (CDC) as "...the on-going systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practices, closely integrated with the timely dissemination of these data to those who need to know. The final link in the surveillance chain is the application of these data to prevention and control. A surveillance system includes a functional capacity for data collection, analysis, and dissemination linked to public health programs."[3]. The International Labour Organisation uses different wording, but has a similar intent, defining exposure surveillance as "the process of assessing the distribution of, and the secular trends in, use and exposure levels of hazards responsible for disease and injury"[4].

For this project, the CDC definition was adapted to an occupational context, and specifically for exposure surveillance. The definition used for exposure surveillance was "the on-going and systematic collection, analysis and interpretation of data related to occupational exposures, and the use of this information for prevention and control purposes".

EXPOSURE CONTROL SYSTEM SURVEILLANCE

Examples of exposure control systems (or hazard control systems) as defined for this project are the presence of potentially protective agents such as seat belts, smoke alarms, roll-over protection on tractors and forklifts, bicycle helmets and residual current devices. Other control systems of interest to the project relate to behavioural attributes such as basic resuscitation skills and defensive driving courses. Exposure control system surveillance is therefore the application of the above approach to exposure surveillance to the collection of data on exposure control systems. The definition used for the project was "the on-going and systematic collection, analysis and interpretation of data related to occupational exposure control systems, and the use of this information for prevention and control purposes".

1.3 REPORT AIMS

The project aimed to examine occupational health and safety exposure surveillance and control systems that are currently in use in Australia and/or New Zealand, and to produce a critical review of Australian and New Zealand approaches to exposure surveillance relevant to occupational health and safety.

1.4 OUTLINE OF THE STRUCTURE OF THIS REPORT

This report has nine main chapters. Chapter 1 provides background regarding the project. The approach taken in conducting the project is described in Chapter 2. Chapter 3 provides a literature review of occupational exposure and control surveillance in Australia and New Zealand, and Chapter 4 is an overview of potential approaches to exposure surveillance. The survey of current exposure surveillance systems in Australia and New Zealand is described in Chapter 5, followed by a consideration of issues relevant to effective exposure surveillance in Chapter 6. Chapter 7 presents brief summary conclusions, and the references are provided in Chapter 8. Chapter 9 contains the appendices.

SECTION TWO

METHODS

2

2.1 LITERATURE REVIEW

A review was conducted of published Australian and New Zealand literature relevant to occupational exposure or control system surveillance. This is described in detail in Chapter 3.

2.2 SURVEY OF CURRENT OR RECENT APPROACHES

It was expected that many of the exposure surveillance systems currently or recently in existence would have been run by public occupational health and safety authorities (or their equivalent) or other public institutions. The initial intention was therefore to search the web sites of each of these authorities for relevant information on the authority's approach to exposure surveillance, including past, present and planned systems. Authorities were then to be contacted directly to obtain further information. However, once the project commenced, it was decided to formally survey a wide range of public, and some private, organisations regarding their use of exposure surveillance systems and exposure control systems, as it was thought this would provide more comprehensive and useful information. The methodology used for this survey is described in detail in Chapter 5.

SECTION THREE

LITERATURE REVIEW

3.1 APPROACH USED TO IDENTIFY RELEVANT LITERATURE

The published literature was searched for original and review articles related to exposure surveillance in Australia or New Zealand. English language literature published from 1986 up to early 2006 inclusive was used. Key words used initially were:

- "work", "work-related", "occupation", or "occupational"

AND "surveillance", "hazard"

AND Australia OR New Zealand

AND one or more of:

- "falls", "motor vehicle", "tractor", "electricity", "accident"
- "exposure", "arsenic", "asbestos", "beryllium", "cadmium", "chromium", "diesel" "exhaust", "nickel", "silica", "tobacco", "smoke", "environmental tobacco smoke", "benzene", "ethylene oxide", "ionising radiation", "noise", "job strain", "job control", "shift work"
- "personal protective equipment", "PPE", "respirator", "harness".

This list was then refined as a result of the initial results of the search. Some secondary follow-up of sources cited in reference lists was also undertaken, but this was not conducted on a comprehensive basis.

Initial searches were conducted through Medline, OSH-ROM and NIOSHTIC.

Abstracts were read and assessed for relevance against the objectives of the project, taking into account the appropriateness of the study methodology.

3.2 OUTCOME OF THE SEARCH AND ABSTRACT REVIEW

The initial search identified 533 references published between 1986 and early 2006 inclusive. Most of these were excluded because they were:

- entirely or primarily focused on countries other than Australia or New Zealand (64)
- not focused on occupational health and safety (124), or
- focused on occupational health and safety, but not relevant to exposure or control surveillance (251).

This left 94 references. Of these, occupational exposures or control measures were the primary objective of 48, and the remaining 46 provided some information on exposures or control measures as part of papers with a different main objective.

There would be other published articles that provide information on exposure in Australian and New Zealand workplaces but that will not have been identified in the literature search because of the focus of the original search on exposure surveillance rather than exposure itself. However, the focus just on exposures was not part of the project as originally envisaged, and identification and description of all relevant published papers is a major task. Therefore, the analysis presented is intended to provide reasonable understanding of the type and extent of information that is available in Australia on occupational exposures, without attempting to be all-encompassing.

3.3 PAPERS WITH OCCUPATIONAL EXPOSURES OR CONTROL MEASURES AS THE PRIMARY OBJECTIVE

There were no papers that described existing or planned exposure surveillance in either Australia or New Zealand. However, 48 papers were primarily focused on measuring occupational exposures. These covered a range of exposures in a variety of occupational settings.

AUSTRALIAN STUDIES

Noise levels were studied on farms (by visiting a sample of farms and taking measurements at the ears of machinery operators and bystanders while they were engaged in their usual farm tasks[5]) and in the headphones of radio announcers[6].

Radiation exposures of technologists operating positron emission technology was reported in one study. This concluded that exposures were within occupational health and safety limits, but could be lowered by using better shielding[7].

Exposure of Queensland farmers to UV-B on the face in the summer was estimated using the probability of outdoor activity, the distribution of solar radiation on the face and the ambient UV-B for the geographic area[8].

The incidence and characteristics of hypoxic episodes in military aircraft was studied through a review of reported incidents[9].

Exposure to potential violence was studied in various settings in the health sector. The methodology included a prospective study of security calls for unarmed violent threats in an emergency department[10], a survey of nursing staff in emergency departments[11], surveys of general practitioners[12, 13], a survey of healthcare workers[14], and a review of violent incidents reported to the Australian Incident Monitoring System[15]. (The Australian Incident Monitoring System[i] was established by the Australian Patient Safety Foundation, and collects information on things that go wrong in healthcare. The focus is on patient safety, but the collected information covers aspects of exposures to healthcare workers, such as violence and fatigue[16]).

Benzene exposures in the petroleum industry were studied in several papers as part of the Health Watch project. (The Health Watch project is a health surveillance programme rather than an exposure surveillance system, but has collected or estimated hydrocarbon exposure, particularly to benzene, in Australian petroleum industry workers[17].) These addressed various aspects of the absolute exposures and the methodology used to best estimate these exposures. Exposures were estimated using a combination of worker interview, inspection of company records, site visits, telephone interviews and exposure monitoring data[18–21]. In another study, artificial neural networks were used to study benzene exposures in tanker operators, and proved useful in decreasing the required input of expert occupational hygienists without losing much in terms of accuracy of exposure predictions[22].

The validity and usefulness of using urine levels as a measure of occupational exposure to 4, 4'-methylene-bis-(2-chloroaniline) (MBOCA) was examined in a study of workers in seven factories with exposed workers[23].

Absolute dust exposures were studied in coal miners using thousands of routine personal respirable dust measurements[24].

Information on environmental tobacco smoke exposure in the workplace was collected via telephone survey of members of a relevant union[25]. Another study examined the prevalence of workplace bans on smoking, using workers' reports about restriction of smoking at their workplaces[26].

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i For more information on AIMS, see http://www.patientsafetyint.com/aims.aspx

The validity of using expert panels to estimate chemical exposures on the basis of job classification was investigated in a study of brain tumours, with the expert panels' assessment compared with quantitative exposure estimates available for the included jobs. The study showed that there was considerable potential for exposure misclassification[27].

Exposure to sharps injuries in the health sector was the subject of several studies. Four analysed sharps injuries reported by staff at large hospitals[28–31]. Two examined the incidence of needlestick injuries and the prevalence of hepatitis B vaccination through surveys – one using ten years of recurrent surveys of nurses[32], and another an anonymous survey of final year medical students, dentistry students and staff at a large teaching hospital[33]. The use of universal precautions was studied in anaesthetists, including the prevalence of always wearing gloves, the re-sheathing of needles and needlestick injuries[34]. A questionnaire survey of Australian teaching hospitals in 1992 showed that all had "...an established procedure for documenting occupational exposure to blood and body fluids". Most of the hospitals reported being willing to contribute information to a national surveillance project, but the study found considerable variation between hospitals in terms of the way they monitored and recorded relevant exposures. The authors recommended that a national surveillance system be established[35].

Potential exposures to blood-borne infection were studied in the beauty therapy industry by sending a self-administered questionnaire to therapists identified through the *Yellow Pages*[36].

Exposures to wood dust and endotoxins were studied at a variety of woodworking sites by taking personal inhalable exposure measurements and environmental samples at the work sites[37, 38].

Exposures to aspergillus during construction work at a hospital was studied using recurrent air sampling[39].

The prevalence of occupational exposure to bat lyssavirus was studied using reports of exposure to a public health unit over three years[40].

The prevalence and nature of exposure to traumatic events has been studied in a survey of "peri-operative" nurses[41].

Fatigue in the transport industry was the focus of two studies. Long-distance truck drivers were studied by interviewing drivers about exposures such as the number of hours of driving, and the number of hours of sleep, in a 24-hour period[42], and taxi drivers were studied over a two-year period, with data on the number and length of shifts, number and length of breaks, and fatigue-related symptoms and incidents collected from company records and through driver interviews[43].

Exposures in the aluminium industry were studied as part of a cohort study of industry workers. Both a task-exposure matrix and a job-exposure matrix were developed using thousands of personal samples collected over many years and covering a range of airborne contaminants, including fluorides, coal tar pitch volatiles, sulphur dioxide, inspirable dust, alumina dust, bauxite dust and oil mist[44, 45].

Exposures in the seafood industry were studied using a cross-sectional survey of employers. This study examined both exposures and the use of control measures[46].

Exposures in veterinary nurses were studied through a self-administered questionnaire. This identified high prevalences of exposure to x-ray radiation, anaesthetics, formaldehyde, pesticides and vaccines[47]. A similar study of veterinarians, also via self-administered questionnaire, identified the main reported exposures as being to chemicals (such as "flea rinses, formalin, glutaraldehyde, x-ray developers and gaseous anaesthetics") and potentially to x-rays. The study also provided information on control measures (extractor fans for scavenging waste anaesthetic gases)[48].

The exposures and settings of the Australian studies are summarised in Table 1.

TABLE 1	Exposures and settings covered in Australian-based studies	
EXPOSURE	SETTING	REFERENCE
Physical		
Noise	Farming, radio announcing	Williams, 2003[6] Depczynski, 2005[5]
Radiation	Positron emission technology operation	Roberts, 2005[7]
UV-B radiation	Farming	Airey, 1997[8]
Hypoxic atmosphere	Airforce	Cable, 2003[9]
Threats of violence	Health sector	Benveniste, 2005[15] Knott, 2005[10] Lyneham, 2000[11] Magin, 2005[12] Mayhew, 2003[14] Tolhurst, 2003[13]
Chemical		
Benzene	Petroleum industry	Black, 2004[22] Glass, 2000, 2001, 2001, 2005[18–21]
MOCA	Manufacturing industry	Wan, 1989[23]
Dust	Coal mining	Kizil, 2002[24]
Environmental tobacco smoke	Various	Borland, 1997[26] Cameron, 2003[25]
Other	Use of expert panels	Benke, 1997[27]
Biological		
Sharps exposures	Health sector	Bowden, 1993[29] Charles, 2003[31] deVries, 1994[33] MacDonald, 1995[35] Mallon, 1992[30] Richards, 1997[34] Smith, 2005[28] Whitby, 2002[32]
Blood-borne infection	Beauty therapists	Murtagh, 2004[36]
Wood dust and endotoxins	Woodworking	Alwis, 1999[38] Mandryl, 2000[37]
Aspergillus	Construction work	Cooper, 2003[39]
Bat lyssavirus	Various occupations	McCall, 2000[40]
Pyschosocial		
Traumatic events	Peri-operative nurses	Michael, 2001[41]
Fatigue	Transport industry	Arnold, 1996[42] Dalziel, 1997[43]
Other		
Various	Aluminium industry	Benke, 2000, 2001[44, 45]
Various	Seafood industry	Lopata, 2004[46]
Various	Veterinary nurses	Van Soest, 2004[47]
Various	Veterinarians	Jeyaretnam, 2000[48]

NEW ZEALAND STUDIES

A task and safety analysis was conducted of physical hazards in chainsaw felling[49].

Noise levels were also studied on farms in New Zealand by taking measurements on a random sample of farms, with noise levels found to average around 85dB(A)[50].

Cosmic ray exposure in flight crew was the subject of one study[51].

Environmental tobacco smoke exposure in the workplace was studied using face-to-face interviews of workers[52].

Blood lead levels and exposure to lead were studied in lead-exposed workers by taking regular blood samples and checking on the responses made for workers with elevated readings[53].

A study of New Zealand welders assessed the response to a respiratory health survey by inspecting the workplaces at a later time and identifying whether local exhaust ventilation and respiratory protection were being used[54].

Exposure to sharps injuries in the health sector was studied in a postal survey of general practitioners and practice nurses, with an 82% response rate[55].

Forestry workers were also the basis of a study of the prevalence of fatigue and associated exposures such as long working hours, reduced recover time, fast-paced work and reduced sleep[56].

A detailed study of plywood mill workers examined exposures to personal inhalable dust, bacterial endotoxin, terpene, abietic acid and formaldehyde[57].

Exposures in the boat-building industry were studied using a questionnaire administered by an occupational health nurse and occupational health and safety inspector. Subjects were workers in randomly selected workplaces. This provided qualitative information on the main exposures[58].

A general approach to exposure surveillance and control surveillance was investigated using a self-administered questionnaire that was regularly completed by managers and supervisors and then used as a basis for advice on how to improve. The approach was trialled in two workplaces and, based on this very limited trial, appeared to be a useful means of both monitoring exposures and improving occupational health and safety[59].

The exposures and settings of the New Zealand studies are summarised in Table 2.

TABLE 2 Exposures and settings covered in New Zealand-based studies

EXPOSURE	SETTING	REFERENCE
Physical		
Physical hazards	Chainsaw felling	Bentley, 2005[49]
Noise	Farming	McBride, 2003[50]
Cosmic rays	Flight crew	Taylor, 2004[51]
Chemical		
Environmental tobacco smoke	Various workplaces	Jones, 2001[52]
Blood lead	Lead workers	Grant, 1992[53]
Biological		
Sharps exposures	Health sector	Lum, 1997[55]
Pyschosocial		
Fatigue	Forestry workers	Lilley, 2002[56]
Other		
Various	Plywood mill workers	Fransman, 2003[57]
Various	Boat building	Ruttenburg, 2001[58]
Respiratory controls	Welders	Slater, 2000[54]
General	Various	Haque, 2000[59]

3.4 PAPERS PROVIDING INFORMATION ON OCCUPATIONAL EXPOSURE OR CONTROL MEASURES AS PART OF A STUDY WITH A DIFFERENT MAIN OBJECTIVE

Forty-six studies provided some quantitative information on exposures or control measures as part of papers with a different main objective. These papers cover a range of topics, which are listed separately for Australia and New Zealand.

AUSTRALIAN STUDIES

Physical:

- noise in various workers[60]
- sun exposure in outdoor workers[61] and general workers[62, 63]
- radiation exposure in reactor workers[64]
- radon gas exposure in uranium miners[65]
- artificial ultraviolet radiation in various workers[66]
- occupational light vehicle use in various workers[67]
- physical hazards to the foot in various workers[68]
- physical factors in surf lifesavers[69]

Chemical:

- asbestos exposure in miners[70, 71]
- silica exposure in various workers[72]

- benzene and other chemical exposure in petroleum workers[73, 74]
- passive smoking in various workers[75–77]
- pesticides in various workers[78]
- solvents, metals, organic dusts and PCBs in various workers[79]
- chemical exposures in farmers[80]

Biological:

- Q-fever exposure in abattoir workers[81]
- wood dust exposures in furniture manufacturing workers[82]

Psychosocial:

- stress in rural nurses[83]
- work stress in public servants[84]
- job strain in professional workers[85]
- work organisation in various workers[86]
- psychological trauma in nurses[87]

Other:

- various exposures in physiotherapists[88, 89]
- chemical and biological exposures in meat workers[90]
- dusts, chemicals and radiation in textile workers[91, 92]
- various exposures in aluminium smelter workers[93]

NEW ZEALAND STUDIES

Physical:

- falls hazards in dairy farming[94]

Chemical:

- dust exposure in saw-millers[95]
- various exposures in foundry workers[96]
- chemical exposures in welders[97, 98]

Biological:

- hepatitis B exposure in police and customs personnel[99]
- condom use in sex workers[100]

Psychosocial:

- fatigue in pilots[101]

Other:

- physical and biological exposures in poultry workers[102]
- chemical and biological exposures in meat workers[103]
- respiratory exposures in farmers[104]

3.5 DISCUSSION

The review of published literature on Australian and New Zealand exposure surveillance and control system surveillance revealed that neither appears to have a prominent role in occupational health and safety at a national or regional level. Exposures were the main focus of a number of studies, covering a range of physical, chemical, biological and psychosocial exposures, and a variety of occupations, industries and exposure circumstances. A few studies reported on detailed exposure systems based on a particular company or, for petroleum production and aluminium production, on a particular industry sector. In some cases, the exposure measurements prompted, or were likely to prompt, a specific response to control the exposures in some way, but this did not appear to be part of a formal exposure surveillance system.

Quantitative information on exposures is also available from many studies that focused on examining the relationship between exposure and a particular outcome and that collected exposure information as part of the investigation, but these studies were also not conducted as part of exposure surveillance, nor arose as a result of exposure surveillance.

In summary, apart from two systems based on an industry sector, there is no published information on detailed exposure surveillance, either of a single exposure or a range of exposures, at a national or regional level in either Australia or New Zealand. What information is available appears to be fragmented, under-resourced and lacks strategic co-ordination and direction.

SECTION FOUR

OVERVIEW OF APPROACHES TO

EXPOSURE SURVEILLANCE

4.1 THE CONTRIBUTION OF EXPOSURE SURVEILLANCE TO OCCUPATIONAL HEALTH AND SAFETY

Exposure surveillance can contribute to improvements in occupational health and safety in a number of ways. Most importantly, monitoring of exposures allows prevention action to be instituted earlier than is usually possible when monitoring outcomes, particularly when there is a long latency between exposure and the occurrence of the resulting disorder, as is the case with many work-related diseases. This allows greater potential to prevent more cases developing. Other potential advantages include:

- there are usually many more potential "occurrences" of exposure than there are occurrences of outcomes[2, 4]
- the approach highlights the causative exposure and the need to properly control it[2, 4]
- monitoring exposures provides the most appropriate and direct measure of the success or otherwise of programmes designed to decrease exposure[2, 4]
- to monitor progress and identify areas needing additional focus
- to evaluate measures already in place
- to demonstrate compliance with legislative/regulatory requirements
- to demonstrate compliance with internal reporting requirements
- to assess or improve cost effectiveness and productivity
- to provide evidence of managerial concern for the health of workers.

Options for feasible exposure surveillance systems depend primarily on the exposure of interest. The outcomes of interest are still relevant, but primarily in terms of influencing the need for an exposure surveillance system. Disorders which have a long latency between exposure and the occurrence of the disorder are appropriate candidates for an exposure surveillance system because monitoring of the outcome reflects exposures many years beforehand rather than recent exposures. Using outcome information to plan prevention measures in long-latency conditions means that the prevention initiatives are based on historical exposures that may not reflect current occupational exposures. In such situations, monitoring of current exposures seems more logical, more likely to lead to faster improvements in occupational health and safety, arguably more ethical and potentially more cost effective. That is not to say that monitoring of the outcome is unimportant. It will always be important to monitor outcomes, because injury and illness are the absolute and unarguable measures of occupational health and safety. Monitoring outcomes therefore provides the best measure of the success or otherwise of prevention initiatives, and provides evidence to support or refute understanding of the relationship between a particular exposure and the outcome to which it has been linked. However, in long latency diseases, only monitoring the outcome means many workers may be exposed in circumstances that could be avoided.

The over-riding aim of any comprehensive occupational health and safety system is the prevention of the work-related injury and illness. There are many inputs into such a system leading to this ultimate goal, with exposure surveillance potentially being one of them. Figure 1 presents one way of representing such a comprehensive system, showing the place of exposure surveillance. (Other representations could also be used.)

The two key inputs into the overall system are information on the level of outcome and information on the level of exposure. Where there is good knowledge about the relationship between exposure and outcome, and good knowledge about effective prevention approaches, information on exposure can lead directly to effective prevention activity. Similarly, information on outcomes can prompt an increase in prevention activity. For conditions of short latency (e.g. injury from exposure to electricity), and where there is a clear connection between occupational exposure and the outcome in all or most individual work-related cases, monitoring outcomes can be an effective way of monitoring the relevant area of occupational health and safety. Exposure surveillance may still be useful, but in many instances it will prove more difficult or costly, at least in the short term, than using outcome information, although ethically it may be better to monitor exposure. For conditions of long latency (such as occupational lung cancer), or where the connection between work and the outcome is difficult to identify in individual cases, the exposure arm of the model becomes more important. This is an important potential use of exposure surveillance.

Where there is not a good understanding of the relationship between exposure and outcome, exposure information can be linked with outcome information to provide a better understanding of the exposure-outcome relationship (e.g. use of pesticides and haematological malignancies such as lymphoma). This is the second potential use of exposure surveillance information. The linkage of exposure information with outcome data (which is commonly collected through specific epidemiological studies) has important implications for the way exposure data might be collected and coded. Once there is good knowledge of the relationship between exposure and outcome, this information can be used to help design potentially effective prevention initiatives for trial.

The middle section of Figure 1 represents the situation where prevention initiatives have been designed, but their effectiveness is not yet known. These initiatives must be trialled in order to identify the initiatives that are most effective. Exposure information may prove useful to such trials, but it is likely that such exposure information would be collected in specifically designed studies rather than it coming from more general surveillance systems.

FIGURE 1 Relationship of exposure and outcome information to occupational health and safety prevention activities

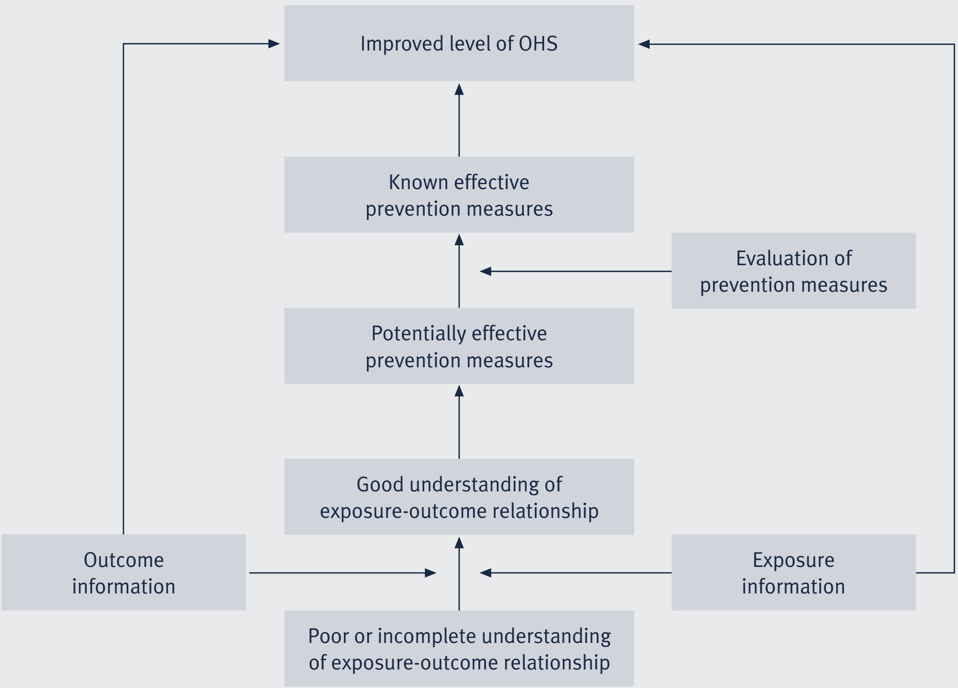
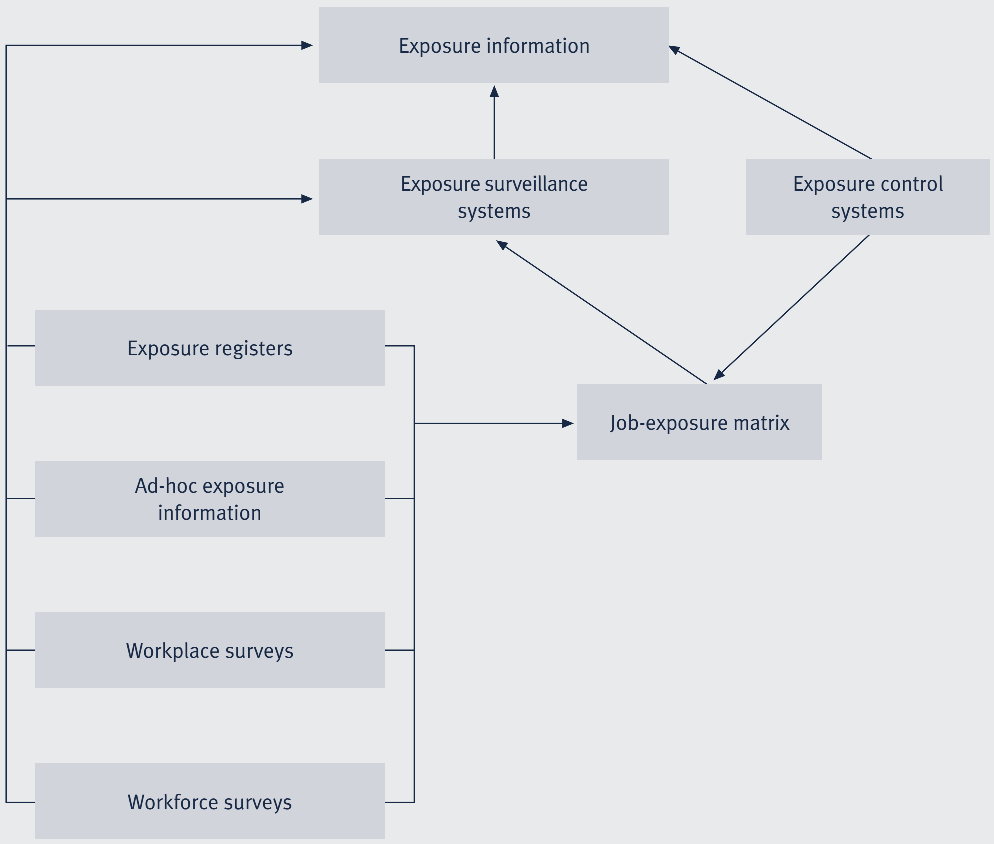


Figure 2 illustrates how the potential sources of exposure information might interact or combine to provide information on exposure that can then be used for prevention purposes (these sources are considered later in this chapter). As with Figure 1, this interaction could be drawn in several different ways. There are currently three existing sources of information that could potentially be used to provide exposure information. These are ad-hoc sources (the most common), exposure surveillance systems (rare) and exposure control systems (rare). Information for exposure surveillance systems can potentially come from several sources, either singly or in combination. The most important of these is probably the job-exposure matrix, or workplace-exposure matrix.

FIGURE 2 Relationship between potential sources of information on occupational exposure



4.2 TYPES OF EXPOSURE SURVEILLANCE SCHEMES OR INFORMATION SOURCES

This section provides a brief overview of the main approaches to exposure surveillance. It is not intended to provide a comprehensive description of the topic. A more detailed literature-based consideration of the area is provided in the recently completed *International review of exposure surveillance and control systems*[1].

ROUTINELY COLLECTED OCCUPATIONAL EXPOSURE DATA

Exposure data is sometimes collected as part of routine work by an occupational health and safety authority or private organisation. The data usually cover a single exposure, or a very limited number of exposures. Such data collections are not usually considered by exposure surveillance systems, as there is no clear connection to prevention or related activity, but in some circumstances the exposure data may be suitable for use in a proper surveillance system.

COMPREHENSIVE SURVEILLANCE SYSTEMS

Comprehensive exposure surveillance systems are systems designed to cover a wide variety of hazards. Several large companies in Australia and New Zealand appear to have such systems in place (although there is no published literature describing them), but there are no such systems run or used by public agencies.

JOB-EXPOSURE MATRIX

A job-exposure matrix is a database that cross-classifies exposures with job tasks or job titles. The major advantage of a job-exposure matrix is that it allows exposures to be predicted for a person with a particular job task (or occupation) in a particular industry without having to separately measure the exposures for every individual. The main disadvantages are that a huge amount of data and associated resources are required to obtain the necessary information to construct the matrix and that, unless the matrix is updated on a regular basis, it soon becomes out of date. The best examples of job-exposure matrices at a national or international level are the National Occupational Hazard Survey and National Occupational Exposure Survey conducted by the National Institute of Occupational Safety and Health in the United States, and the Carcinogenic Exposure (CAREX) database developed by the Finnish Institute of Occupational Health. Job-exposure matrices are based on measured or estimated exposures in a wide range of job tasks. Since the exposures will vary as the tasks vary, job-exposure matrices should ideally be developed de novo in each country. In practice, since the data collection required is so massive, and the same task performed in different settings can often be expected to have similar types and intensities of exposures, job-exposure matrices often combine data collected specifically for the matrix with data collected elsewhere for a different matrix or for different purposes.

SPECIFIC-EXPOSURE DATABASES

Specific-exposure databases are information systems that collect data on specific exposures. A variety of information may be collected. It might be based on personal exposure or on environmental levels of exposure. A typical example of an exposure database based on personal exposure is one used to monitor exposure to ionising radiation. Typical examples of exposures based on environmental levels of exposure are those commonly used to monitor ambient noise levels in industrial worksites. Exposure databases can be expected to form the fundamental part of any exposure surveillance system.

WORKFORCE SYSTEMS

Labour force surveys are population surveys that provide information on the number of people employed in various sections of the labour force. Information is stratified by occupation and industry, either separately or cross-classified. In addition, a labour force survey commonly provides demographic information on the workforce, such as age and gender. Information on aspects of work, such as hours of work, shiftwork, full-time/part-time/casual, is also sometimes available.

Labour force survey data are potentially useful to exposure surveillance in two related ways. Firstly, they provide information on the number of people at risk in a population. Combined with exposure information, this allows the rate (in this case, the prevalence) of exposure to be calculated. These rates can be compared over time to provide a measure of the trend in terms of exposure in the population. The second, related use of such information in exposure surveillance is to provide a measure of how many people are in each occupation-industry group. Used in conjunction with a job-exposure matrix, or related exposure information system, this information can be used when estimating the number of people likely to be exposed to a particular hazard, either overall or stratified by differing exposure levels.

Labour force survey information in Australia and New Zealand is provided by the Australian Bureau of Statistics (ABS) and Statistics New Zealand respectively. Detailed descriptions of the information available from labour force surveys can be found at the web sites of both organisations[ii].

REGISTERS OF SUBSTANCES

Registers of substances are databases that provide information on which workplaces are involved in the storage and/or use of particular hazardous substances. They therefore provide information on potential exposure. In the absence of information of environmental or personal exposure to specific hazardous substances, registers provide guidance as to the likely prevalence of exposure. However, they do not provide information on the intensity or frequency of exposure.

INDUSTRY SURVEILLANCE SYSTEMS

Industry surveillance systems typically involve more than one specific type of surveillance system. Industry-based systems can, in theory, incorporate one or more components of the workforce, exposure or register systems already described. There are no established industry-based systems in Australia or New Zealand. The Health Watch system run by the petroleum industry collects some information on exposures, but only as part of a health surveillance project[18–21]. Similarly, the Healthwise project collects some information on exposure of aluminium workers as part of a detailed health surveillance project[44, 45]. The mining industry in Australia, through the Minerals Council of Australia, is in the process of trialling an industry-based surveillance system focused on noise (see detailed information about this in Section 5.3). The Q-fever Register provides a record of the immune status of workers potentially exposed to Q-fever, but not on the prevalence of exposure to Q-fever[iii].

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ii See http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4A5D8F4E8F9C9DBBCA256F7200832FEC for Australia, and http://www.stats.govt.nz/datasets/work-income/household-labour-force-survey.htm for New Zealand.

iii See http://www.qfever.org/

POPULATION-BASED EXPOSURE DATA

There is likely to be limited collection of exposure data at a population level, and what is collected is likely to have limited direct usefulness in occupational exposure surveillance systems. Population exposure data collection is not undertaken in any systematic fashion and so doesn't really constitute a formal surveillance system. Probably the most potentially useful information is that collected on control systems (e.g. prevalence of residual current devices or smoke detectors in houses), which could be used to compare to similar information collected in an occupational context. Both the National Health Survey[iv] and the Household, Income and Labour Dynamics in Australia (HILDA) survey[v] may provide relevant information if purpose-specific modules are added to them, but such modules are unlikely to be used on an on-going basis. Similarly, the poisons information centres that exist in most jurisdictions provide a little information on poisoning related to workplace exposures, but such exposures only make up a small proportion of the total reports to the centres, e.g. 1% (106 cases) in Victoria in 2005[105] and 2% (645 cases) in Western Australia in 2002[106], the available information (at least the publicly available information) is not detailed, and the data provide only a very broad, general indication of possible occupational exposures.

4.3 APPROACHES TO DATA COLLECTION

This section provides a brief overview of the main approaches to data collection that can be used in exposure surveillance.

WORKPLACE AND WORKFORCE SURVEYS

Workplaces can be surveyed to provide information on exposures of interest. These surveys can involve observations of the workplace and the workforce, take measurements of personal or area exposures, or take the form of questionnaires directly given to workers or managers, or posted to them. The surveys can also involve an audit of the presence of particular exposures or control measures. The resulting information may be qualitative or quantitative. An example of these approaches is a survey of solvent use conducted in a light industrial area in Sydney in the 1990s, which initially sent a questionnaire to businesses and then validated the responses by visiting a sample of the businesses included in the survey[107].

A similar survey approach can be used where the focus is the worker or the manager rather than the workplace. Usually the information is collected via a questionnaire that can be mailed to workers or given to them, either directly or over the phone. Alternatively, the subjects can be interviewed. For example, information on the prevalence of exposure to environmental tobacco smoke, and on the presence of workplace smoking bans (a control measure) has been collected in this manner[25, 26, 52].

The most extensive approaches using surveys for exposure surveillance were conducted in the United States by the National Institute of Occupational Safety and Health (NIOSH) in the 1970s and the 1980s, and a third major survey has been proposed[108]. The goals of the survey provide an indication of the type and extent of information that can be collected. The survey sets out to:

- estimate the total number of workers exposed to a wide range of specific hazards and the number exposed at varying qualitative levels of exposure
- describe the distribution of hazards with regard to occupation, industry, geography and worker demographics

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iv See http://www.abs.gov.au/Ausstats/abs@.nsf/0/cac1a34167e36be3ca2568a900139364?OpenDocument

v See http://melbourneinstitute.com/hilda/

- describe the nature and extent of hazard controls for reducing worker exposures
- describe the nature and extent of specific occupational safety and health programme components
- identify previously unrecognised groups at risk from known hazards
- identify new and emerging hazards (by comparing data from previous surveys and future surveys)[108].

ROUTINE OR AD-HOC MONITORING

Routine and ad-hoc monitoring of exposures at an area level is one of the most common approaches taken to exposure monitoring for virtually all hazards. The exposure measurements are usually organised by the managers of the workplace, or by consultants engaged by the workplace to make such measurements. The measurements may be taken for many reasons, including to compare to worksite requirements (e.g. internal auditing), for external compliance purposes, to check plant functioning, or to monitor the effect of new procedures or equipment. Such monitoring may be done through direct measurement of the intensity of the exposure (e.g. to physical exposures such as noise, heat, light; and to a vast array of hazardous substances), or through surveys providing a qualitative assessment of exposures.

CONTINUOUS AREA MONITORING

Continuous monitoring of many physical and chemical hazards at an area level is technically possible and often not prohibitively expensive. Such monitoring is common in many large workplaces and provides very useful information for exposure surveillance, allowing immediate identification of an increase in exposure and therefore the potential for prompt preventative action in response.

ROUTINE OR AD-HOC PERSONAL MONITORING

Routine and ad-hoc monitoring of exposures is not undertaken as commonly as area monitoring, but nevertheless is a reasonably common approach to obtaining information about personal exposure to physical, and particularly chemical, hazards. Depending on the frequency of sampling and the standardisation of the approach used, exposure data obtained through routine and ad-hoc personal monitoring can be used as part of an exposure surveillance system.

CONTINUOUS PERSONAL MONITORING

For many exposures, the risk of occurrence of the outcome, or the severity of the outcome, is directly related to the total exposure dose, either over a lifetime or over a defined period of time. For such exposures, an on-going assessment of the total exposure dose can make a useful contribution to exposure surveillance. Unfortunately, for most exposures, particularly physical and chemical exposures, continuous monitoring of individual exposure is practically difficult and resource intensive, and so is not feasible. A prominent exception to this is ionising radiation, for which a continuous monitoring system has been in place in Australia for a number of decades. Monitoring of long-distance truck drivers' time whilst driving, or time without a proper rest break, using log books or more sophisticated electronic methods, is an example of such monitoring applied to ergonomic exposures.

BIOLOGICAL MONITORING

The place of biological monitoring in exposure surveillance is uncertain. Strictly speaking, it meets the definition of exposure surveillance, since it relates directly to occupational exposures. Biological monitoring (e.g. of blood lead) can provide very useful information in terms of the qualitative aspects of exposure, but it usually does not provide quantitative information on the exposures in the workplace or of the worker. However, these external exposure measurements that typically form the basis of exposure surveillance are really only used in an attempt to understand the likely internal dose the worker gets of whatever exposure is being considered. In essence, external exposure measures, whether environmental or personal, are really used as surrogate measures of the internal exposure of the worker. So, it can be argued that biological monitoring provides a better exposure estimate, as it is based on the presence of the substance in body fluid or tissue.

Biological effect monitoring (e.g. monitoring red cell cholinesterase in pesticide-exposed workers) is somewhat different, in that it measures not the amount absorbed but the biological consequences of that absorption. If the measured consequences are not themselves important, and precede the development of more serious consequences, then it might be reasonable to use biological effect monitoring in an exposure surveillance programme. However, the philosophy of exposure surveillance is to identify problem exposures before they occur, so biological effect monitoring sits uneasily with it.

For the vast majority of exposures, there are no recognised biological monitoring approaches. For these exposures, external exposure measurement remains the only practical method of data collection on which to base exposure monitoring. For those exposures for which valid and interpretable biological measures are available, they should be considered as part of exposure surveillance. Biological monitoring is virtually always routine or ad-hoc, rather than continuous.

SECTION FIVE

SURVEY OF CURRENT

EXPOSURE SURVEILLANCE SYSTEMS

IN AUSTRALIA AND NEW ZEALAND

5

5.1 INTRODUCTION

The main part of the project was designed to provide an understanding of the way occupational exposure surveillance was used in Australia and New Zealand. The focus was on national systems, or nationally relevant systems. The required information was collected through a survey. This chapter describes the methods and results of the survey, and implications this has for future work in occupational exposure surveillance in Australia and New Zealand. The information provided about the relevant exposure surveillance schemes differs from the structure listed in the project contract, but all areas listed in the contract are included in the report. The original planned structure was modified to more efficiently present the information obtained during the project.

5.2 SURVEY METHODOLOGY

SELECTION OF ORGANISATIONS/COMPANIES TO INCLUDE IN THE SURVEY

The focus of the project was national exposure surveillance systems, or nationally applicable systems. Therefore, in Australia, the original intention of the survey was to target the main occupational health and safety agencies in each of the Australian States and Territories and in New Zealand. In addition, relevant union and industry surveillance schemes were to be targeted for inclusion. Following discussion with the steering committee, it was decided to expand the survey to include most universities and to also include a convenience sample of large Australian-based companies. An opportunistic, key informant methodology was used for recruitment, with an attempt to use key networks that were believed might have experience with exposure surveillance or be aware of organisations that did. This meant that organisations or persons not initially targeted, but who found out about the study and contacted one of the project members, were included. In addition, professional OHS groups such as the Australasian Faculty of Occupational Medicine and the Australian Institute of Occupational Hygienists were contacted in the hope that their members might have relevant information themselves or would nominate relevant organisations. The justification for including universities was that universities may be conducting research relevant to exposure surveillance, or might have exposure surveillance systems in place. The justification for the inclusion of a selected group of large companies was that any exposure surveillance systems being used in the private sector were likely to be used by large companies, and that only systems used by national or multi-national companies would be likely to be applicable at a national level. The project was not designed to provide a comprehensive survey of all large companies and did not attempt to produce such a comprehensive survey.

A similar approach was used in New Zealand, except that only public organisations, as well as union and industry bodies, were included.

In addition, a general call for responses was sent to occupational medicine specialists in Australia and New Zealand via the Australasian Faculty of Occupational Medicine (AFOM). The AFOM sent information about the project to occupational medicine specialists via the general Faculty email list.

DATA COLLECTION APPROACH

The survey was designed to allow the collection of information on surveillance systems and activities relevant to the project. Information was collected via an electronic questionnaire developed by the project leader, in consultation with the steering committee. Participants were asked to provide what information they could for each of the areas listed in the questionnaire. They were encouraged to provide answers electronically and to return the completed questionnaire as an electronic file, although responses on paper, or via telephone, were also accepted. Answers to most questions required text information. Participants were encouraged to provide further information on a separate sheet of paper if this was necessary.

THE SURVEY QUESTIONNAIRE

The survey questionnaire was based on a previous similar questionnaire used by the project leader, but adapted to cover all relevant areas for the current project. The questionnaire began with a brief description of the project and the working definition of exposure surveillance systems and exposure control systems, which was followed by questions covering all relevant aspects of these systems. The main areas covered in the questionnaire were:

- Section 1. Basic information and contents of the system:
  - Name, owner and basic documents of the surveillance system
  - Focus
  - Type of information
  - Data collection
  - Data recording and storage
  - Reliability and validity
  - Linkages
- Section 2. The internal and external uses and aims of the system
  - Data use
  - Frequency and content of reports issued from the surveillance system
  - Ethical and privacy issues
  - Conditions for access and use by external users
- Section 3. Background and future

The full questionnaire is shown in Appendix 1, and the covering letter that accompanied the questionnaire is shown in Appendix 2.

DISTRIBUTION OF THE QUESTIONNAIRE

In Australia, the questionnaire was distributed in early February 2006, with an initial due date of 6th March 2006. Some surveys did not reach the intended persons initially because of incorrect contact details, and additional organisations were identified after the questionnaires were distributed. Therefore, some participants did not receive the questionnaire until late February. These participants were then given several more weeks to complete the questionnaire. For various reasons, certain organisations were unable to complete the questionnaire by the initial due date. These organisations were encouraged to submit the questionnaire as soon as they were able, even if this meant they would be submitting it several weeks “late”. Organisations that did not have a surveillance system were encouraged to send a brief email to the project leader to that effect.

In New Zealand, organisations were surveyed through direct interview by Mr Mark Wagstaffe.

5.3 RESULTS

The Australian and New Zealand aspects of the survey were conducted separately. The Australian component of the survey was more extensive than the New Zealand component, and is described in detail first. The New Zealand component is then summarised.

OVERVIEW OF RESPONSES

The survey was sent via email to 240 separate organisations and interested individuals (eight of these surveys were unable to be properly delivered due to wrong email addresses). Most of these were sent directly, but some were sent following enquiry from an individual or referral from another individual or organisation. The surveyed organisations included industry peak bodies, industry skills councils, employee organisations, government departments, research bodies and selected major companies. The list of included organisations is shown in Appendix 3.

Responses were received from 63 organisations. An organisation was deemed to have responded if they sent a completed questionnaire or contacted the project leader (by email or phone) to say that they either did not have any relevant systems, or that the questionnaire was not relevant to them. Some of the industry peak bodies referred the questionnaire to specific companies whom they represented, and some of these companies then responded directly. Other peak bodies responded, but only to indicate that the questionnaire was not relevant to their work. The level and type of responses received are summarised in Tables 3, 4 and 5.

TABLE 3 General summary of survey – questionnaires sent and responses received – by responder type

RESPONDER TYPE	NUMBER SENT	RESPONSES RECEIVED	%
OHS dept	8	4	50.0
Industry peaks	106	18	17.0
Industry skills councils	6	2	33.3
Major companies	15	10	66.7
Employee bodies	11	1	9.1
Research	50	11	22.0
Departments	28	12	42.9
Other	8	5	62.5
Total	232	63	27.2

TABLE 4 Summary of responses received – responder type for each type of response – percentage of each type of response[vi]

RESPONDER TYPE	COMPLETED SURVEY (%) N = 25	NO SYSTEM (%) N = 13	NOT RELEVANT (%) N = 21
OHS departments	8.0	15.4	0.0
Industry peak bodies	4.0	30.8	50.0
Industry skills councils	0.0	15.4	0.0
Major companies	24.0	15.4	9.1
Employee bodies	0.0	0.0	4.5
Research bodies	28.0	7.7	13.6
Departments	24.0	7.7	18.2
Other	12.0	7.7	4.5
Total	100.0	100.0	100.0

TABLE 5 Summary of responses received – type of response for responder type – percentage of each responder type[vi]

RESPONDER TYPE	NUMBER OF RESPONSES	COMPLETED SURVEY (%)	NO SYSTEM (%)	NOT RELEVANT (%)	TOTAL (%)
OHS departments	4	50.0	50.0	0.0	100.0
Industry peak bodies	18	5.6	22.2	61.1	100.0
Industry skills councils	2	0.0	100.0	0.0	100.0
Major companies	10	60.0	20.0	20.0	100.0
Employee bodies	1	0.0	0.0	100.0	100.0
Research bodies	11	63.6	9.1	27.3	100.0
Departments	12	50.0	8.3	33.3	100.0
Other	5	60.0	20.0	20.0	100.0
Total	62	40.3	21.0	33.9	100.0

OHS DEPARTMENTS

The main OHS agency in each jurisdiction (except Tasmania), plus Comcare, were included in the survey. Four responded – two with completed surveys and two to say they did not have any exposure surveillance systems. The two agencies that did respond did not really have an exposure surveillance system as it is usually understood, but did report activities that had aspects relevant to exposure surveillance. One reported activities primarily covering licensing, which provides similar information to a register of substances. The other reported activities related to biological monitoring of various exposures (including arsenic, asbestos, cadmium, chromium, fluoride, isocyanate, lead, mercury, MOCA, nickel, organophosphate pesticide and vanadium). Although biological monitoring is distinct from exposure monitoring, it provides an integrated measure of individual exposure to certain substances, and so provides information similar to the information obtained by a register of individual radiation exposure.

vi Three responses involved referral to another group (two peak bodies) or indication that a completed response would be sent at a later date (one department). These are not included in this table.

Although useable information was only obtained from two agencies, it is likely that the key OHS agencies in each jurisdiction undertake activities related to licensing and biological monitoring.

INDUSTRY PEAK BODIES

Surveys were sent to 106 industry peak bodies or employer representatives. Formal responses were received from 18. Fifteen indicated that exposure surveillance was not done or was not relevant to their work. Another two referred the questionnaire to one of their constituent companies or organisations, who later submitted completed questionnaires on behalf of themselves. Another responded on behalf of the peak body (mining) and the research organisation allied to it. This was in connection to the Minerals Industry Job-Exposure Matrix (MineJEM). This is described below, based on the information supplied in the completed questionnaire and in a report provided to the ASCC for reference in the current project.

The Minerals Council of Australia (MineJEM)

The MineJEM is owned by the Minerals Council of Australia as part of the Minerals Industry Co-operation Initiative (MICI) project. The MICI project is being completed by the Minerals Industry Safety and Health Centre, part of the Sustainable Minerals Institute at the University of Queensland. The system was originally developed to assist the minerals industry in identifying areas of high exposure to potential health hazards. It is currently focused only on noise exposure. The aim of the current system is to produce a pilot job-exposure matrix based on noise exposures (and later other exposures) to assess the usefulness and appropriateness of such a system for the Australian minerals industry. The information is reported to the Minerals Council of Australia for use by the Australian minerals industry and other interested parties. It is to be used for:

- monitoring purposes
- evaluation of engineering control measures
- benchmarking based on occupation within and between industry sectors.

The noise-exposure matrix is still in its early stages, but has data from coal workers in New South Wales and the metalliferous industries in Western Australia. Individual data are included, but not personal details of the workers. The four variables are industry sector, whether surface or underground, occupation (as free text or code) and noise exposure (dB(A)Leq,8hr). Coal worker data cover 1986 to 2005, and metalliferous worker data cover 1996 to 2005, with 5,300 useable records. The data arose from recurrent routine surveys conducted to collect information for reporting to government agencies. Data quality cannot be directly checked by the current system, as this remains the responsibility of the collecting company, but the data are presumed to be reliable as they are collected using the appropriate Australian Standard.

Preliminary analyses have been done, but no formal reporting of information has yet occurred, but it is intended that relevant information will be included in the Minerals Council of Australia annual report.

The main challenges appear to be the standardisation of data coding and collection techniques (for example, the two data sources currently included use different, non-standard occupation codes). Planned improvements are for:

- other jurisdictions to be included over the next 12 months
- the inclusion of data on dust and radiation exposure, which is currently being actively pursued
- expansion of the data sources to include site monitoring data from individual mine sites.

INDUSTRY SKILLS COUNCILS

Surveys were sent to six industry skills councils. Formal responses were received from two, both of which reported that the council did not have any relevant systems.

MAJOR COMPANIES

Fifteen major companies were included, either being directly targeted in the initial survey, or being included following referral from an industry peak body. Completed questionnaires were received from six companies. Another four indicated that exposure surveillance was not done or was not relevant to their work.

Of the six companies who sent completed responses, the information provided indicated that three of the companies had risk management systems that focused on surveillance of outcomes and regular auditing, rather than using exposure surveillance. One of these companies included some noise measurements, but probably not in a manner that would constitute true exposure surveillance.

The remaining three companies who sent completed responses clearly had very sophisticated risk management systems that included exposure information that was integrated with other occupational health and safety information. All three appeared to have comprehensive coverage of a wide range of hazards, and at least two included surveillance of control measures also. One reported the use of multiple systems, including "hygiene exposures (noise, atmospheric contaminants)… [and] safety systems (guarding etc)". A second reported coverage of air contaminants and noise. The third system identified coverage of virtually all types of occupational hazards:

- Physical – heat, cold, noise, radiation, vibration, high pressure fluid injection
- Chemical – e.g. hydrocarbons, solvents, acids, alkalis, gases, heavy metals
- Biological – infectious diseases; animals, reptiles and insects; blood-borne pathogens; water-borne pathogens (e.g. legionella); poisonous plants; food and drink contaminated with organisms
- Psychosocial – long hours; shiftwork; stress; being away from family; working alone; working in foreign environments; restriction of exercise, social contact and diet (travellers especially)
- Design – workstation/workplace design (HFE); job-person mismatch; thermal comfort; medical support for travellers.

All three companies with functioning exposure surveillance systems reported similar factors that motivated the establishment of the system and similar uses for the systems:

- To monitor progress and identify areas needing additional focus
- To evaluate measures already in place
- To demonstrate compliance with legislative/regulatory requirements
- To demonstrate compliance with internal reporting requirements.

Information was collected through a variety of means, including quantitative hygiene measurements and more qualitative methods, such as site inspections and formal workplace surveys.

Planned or suggested improvements or modifications for the systems were improved interface between the different elements of the systems, better interconnection with operations management, and development of tools to manage the process in a more timely manner.

EMPLOYEE BODIES

Surveys were sent to eleven employee bodies. A formal response was received from only one, and this reported that the survey was not relevant to their work.

RESEARCH BODIES

Surveys were sent to 50 research-based agencies, organisations and universities that were thought might have information on occupational exposure surveillance in Australia or might be conducting such surveillance themselves. Formal responses were received from eleven, four of which indicated that exposure surveillance was not done or was not relevant to their work. The other seven returned completed questionnaires (one of these was a phone conversation about the system).

Several laboratories reported on systems that primarily involved incident monitoring, but some had aspects of exposure surveillance. Two reported radiation monitoring of individual staff members using ARPANSA's system (this is described in the next section). Another monitored the number and types of pathology slides reviewed by staff each day. This was done partly to manage work flow and minimise reporting errors, but also in an attempt to minimise the occurrence of stress and resultant stress-related adverse health outcomes (occupational overuse syndrome and the potential for incidents were both mentioned in this regard).

One university reported a very extensive exposure monitoring system that covered a variety of exposures on a number of campuses. This covered various types of ionising radiation, chemical exposures, biological exposures, electrical exposures, sharps-related hazards, a wide range of physical work environment conditions, plant-related hazards and building-related hazards (e.g. cooling tower testing for legionella, trips/falls hazards, assault). Radiation exposure was monitored using ARPANSA's system. The remaining exposures were monitored using a variety of purpose-designed systems. These cover the type of substance (and related controls), the type of sample and the level of exposure (for some hazards only). Most of the exposure measurements arise from area monitoring, with some individual monitoring used as required. Legislative requirements and promotion of more effective management of occupational health and safety were the main reasons the system was established. It is used for monitoring or control purposes and to support the development of policies and procedures. The system is designed to cover exposures of employees, other regular users of the site (e.g. students, contractors), and the general public. Psychosocial hazards are not covered, nor cumulative exposures at an individual level, unless this is mandated (e.g. for ionising radiation). These are viewed as possible areas for improvement in the system.

Another university reported a similarly comprehensive system, with information collected via laboratory inspection (twice yearly), chemical inventories (ad-hoc), solvent user registers (ad-hoc), radioactivity monitoring (continuous) and gas cylinder inspections (monthly). The system was established for legal reporting requirements and to assess the effectiveness of safety systems. Too much paperwork and unnecessary reporting were seen as the main obstacles to the collection of data. Reducing the time required to comply with reporting by reducing paperwork, and providing a consolidated list of requirements for laboratory managers, were seen as the main areas for potential improvement. A failure to clearly establish an organisation-wide system before attempting implementation at more localised levels in the university was seen as the main problem with the way the current system was established.

Another university reported what sounded like a comprehensive system of exposure monitoring, but there was little detail available. There appeared to be a mixture of systematic and ad-hoc information on actual and potential exposures, and some overlap with health surveillance and incident reporting.

Surveys were sent to 32 government departments or public authorities likely to have some connection to occupational health (such as health departments and transport authorities). Formal responses were received from twelve, five of which indicated that exposure surveillance was not relevant to their work or that they had no systems, six of which were in the form of completed questionnaires, and one indicated information might be able to be provided at a later date.

One department provided comprehensive summary information on its risk management approach, which covered both exposure surveillance and health surveillance. A wide range of exposures are covered, including noise, ionising radiation, whole body vibration and a wide range of chemical substances. Both personal and area monitoring is used, as well as biological monitoring in some instances. The exposure information is kept separately to the outcome information, but there are plans to integrate the information systems. The system was established to meet duty of care requirements, to monitor exposures for prevention and have information relevant to possible future compensation claims, and to provide information to and reassure relevant workers.

Four of the departments that returned completed questionnaires reported systems that were related to health surveillance rather than exposure surveillance. Two of these departments did collect some information on exposure, but only in relation to specific incidents that were deemed outside the normal working exposures. Another collected information on vaccination status as part of health screening of workers. This could perhaps be considered a form of surveillance of control systems, since the presence of a vaccine is designed to prevent ill health arising from worker exposure, rather than to prevent the exposure, in the same way as a seat belt or residual current device are designed to prevent the unwanted consequences of exposure to a vehicle incident or electric current, respectively (although note that vaccine registers, such as the Q-fever register, were not targeted for inclusion in this study). The information was collected through worker self-report and was used to plan vaccination protocols for individual workers.

The remaining authority collects information on exposure in an ad-hoc manner as part of its role in regulation of chemicals in Australia. The data may be quantitative or qualitative exposure; be based on personal or area measurements; and are collected from importers, manufacturers and users of the chemicals in question. Some of the information may relate to exposures outside Australia. The exposure information usually covers aspects such as the identity of the chemical, how the chemical is handled, the numbers of workers exposed in an occupational setting, public exposure and release of the chemical to the environment. The exposure information does not form part of a formal exposure surveillance system, but elements of it may be relevant to aspects of such a system, such as a job-exposure matrix.

The Australian Radiation Protection and Nuclear Safety Authority

The Australian Radiation Protection and Nuclear Safety Authority (ARPANSA) did not respond formally to the survey, but it runs the Personal Radiation Monitoring Service (PRMS). This service "monitors the exposures of workers in the medical, dental, chiropractic, industrial and mining fields to ionising radiation"[vii]. It has been running since 1932 and currently monitors about 35,000 workers at any one time, which is thought to be about 70% of workers occupationally-exposed to ionising radiation in Australia. ARPANSA reports that about 60% of people monitored are measurably exposed to ionising radiation. The system has a register of individual exposure records for all workers exposed to ionising radiation in Australia (as well as covering some workers in other countries). The information is collected for the individual's entire working period, because adverse health effects arising from radiation exposure are related to the cumulative radiation dose. There are about 125,000 records currently in the register.

vii See http://www.arpansa.gov.au/prms.htm (accessed April 2006).

Radiation dose is collected using badges or other monitors that are worn by the individuals being monitored. Control badges are used by each monitoring centre to assess the level of background exposure in the workplace and to help detect badges that may have been faulty or exposed to radiation before or after use in the workplace. The results of the monitoring are reported to the relevant workplace as soon as they become available. The results include the exposure in the monitoring period, exposure in the previous twelve months, and total cumulative exposure. Copies of the reports are also sent to the relevant State or Territory health authority. It is the responsibility of the workplace to respond as appropriate to the results received. As described on the ARPANSA web site:

"Monitors are issued regularly for either 4, 8 or 12 weekly periods. At the end of each period, the monitors are returned to the Personal Radiation Monitoring Service for processing and assessment of the doses recorded by them. The Dose Report which is issued lists the doses received by each monitor and the accumulated doses received in the last twelve month period for each wearer. This can be used to ensure that the doses are below the NHMRC recommended limits.

Each reported dose is traceable back to the Australian Standard of Exposure.

All dose records are kept indefinitely by the Australian Radiation Protection and Nuclear Safety Agency.

Since 1986, each person registered with the Service has had their doses recorded on the PRMS Data Base of Occupationally Exposed Persons which is maintained by the Australian Radiation Protection and Nuclear Safety Agency. This enables a complete dose history of each wearer to be maintained, no matter where they work."[109]

OTHER

Surveys were sent to eight other organisations or individuals. Formal responses were received from five, with two indicating that exposure surveillance was not relevant to their work and three sending completed responses. A sixth organisation referred the initial letter and survey to its members, one of whom subsequently sent a completed response and another of whom provided information by phone (all are included in the above three who sent completed responses).

The two completed responses from individuals described health surveillance (primarily audiometry and respiratory symptoms and signs) and incident reporting systems (incidents of exposure to biological hazards in emergency services) rather than exposure surveillance. One included biological monitoring (surveillance of blood lead levels). The third response was from a large hospital with an extensive sharps-injury notification programme. This programme provides information on incidents of exposure, or potential exposure, to biological hazards in the hospital. Information is collected through staff reporting incidents, with more detailed information collected through subsequent investigations. There appears to be considerable under-reporting of incidents by affected staff, due to a perceived lack of risk and desire to avoid having to complete the forms required for any incident.

(Note that some form of surveillance of biological exposures to blood-borne infections in health service workers is undertaken by many jurisdictions, but as yet there is not a fully co-ordinated approach between, and apparently not within, any jurisdiction. An attempt to provide a co-ordinated approach has begun using a United States-based database called EPINet, and some data for 2005 have been collected but are not yet available[viii]. In Queensland, the Centre for Healthcare Related Infection Surveillance and Prevention has as an objective "to establish and refine a standardised, validated surveillance system in twenty six (26) Queensland public hospitals and provide aggregation and analysis of de-identified data to Queensland Health". In specific relation to occupational health, the Centre aims to "monitor the trends in Queensland Health employee exposure to blood and body fluids so as to: measure the extent of occupational exposure to blood and other potentially infectious substances among

viii See http://www.healthsystem.virginia.edu/internet/epinet/

healthcare workers; measure occupational exposure to HIV, HBV and HCV; establish risk factors for exposure to blood and body fluids among healthcare workers; and provide data for a national database."[ix]. In New South Wales, a standardised approach is encouraged, and it is a mandatory requirement for the Public Health Organisations to collect data on percutaneous and non-percutaneous exposures. However, as the above example of a hospital-based system indicates, there are many problems with current systems, and there is not a co-ordinated system[x]. In Victoria, the Victorian Nosocomial Infection Surveillance System (VICNISS) focuses on nosocomial infection, but the work has clear implications for occupational exposures[xi].

NEW ZEALAND SURVEY

The New Zealand component of the survey was conducted by making direct contact, by phone or in person, with relevant agencies and organisations including the Department of Labour, Environmental Risk Management Authority, unions, employers' and manufacturers' associations and researchers. This component of the project was conducted by Mr Mark Wagstaffe. One industry-based exposure surveillance system was identified that had been in operation for 20 years but was not considered to be a nationally relevant system. ARPANSA also has a very minor presence in New Zealand, the major New Zealand provider of the personal dosimetry being the New Zealand government through the National Radiation Laboratory[xii]. The lack of national New Zealand-based exposure surveillance systems was consistent with the international report conducted in 2005[1].

5.4 DISCUSSION

SUMMARY OF FINDINGS FROM THE SURVEY

The main finding of the survey was that exposure surveillance is not widely carried out in Australia. The major exceptions to this appear to be large, multinational companies and perhaps some universities.

The three multinational companies that returned completed questionnaires appeared to have sophisticated exposure surveillance built into their risk management schemes. However, the systems were purpose-built and, although they were usually common across the organisation, differed between organisations.

Several universities reported monitoring of exposures in laboratories, and it is likely that all universities with laboratory-based research would have some form of exposure surveillance in place. However, these systems were specific to each university, and may well have differed between different parts of the same university.

Occupational health and safety authorities appear to collect some information that is of relevance to exposure surveillance, such as licensing and possibly registers of substances, but do not undertake any comprehensive exposure surveillance. These authorities are also responsible for biological monitoring, which can be considered a form of integrated exposure monitoring, and probably has the potential to be developed into a national or nationally representative system.

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ix For example, see http://www.chrispqld.com/surv_goals.shtm

x See http://www.health.nsw.gov.au/policies/PD/2005/pdf/PD2005_414.pdf and http://www.sphcm.med.unsw.edu.au/SPHCMWeb.nsf/page/HIESU

xi See http://www.vicniss.org.au/index.htm

xii See http://www.nrl.moh.govt.nz/ieindex.html

The only functioning national exposure surveillance system is the ionising radiation monitoring system run by ARPANSA. This has been in existence for many years and appears to be functioning effectively. The mining industry, through the Minerals Council of Australia, is in the early stages of the development of a national exposure surveillance system that currently focuses on noise, but that is expected to soon be expanded to cover some dusts and radiation.

ORGANISATIONS INCLUDED IN THE SURVEY

The identification of appropriate organisations to include in the survey was difficult, as little was formally known about how common or uncommon such exposure surveillance systems were in Australia and New Zealand. In addition, this project had a national or at least a jurisdictional focus and was not intended to target individual companies in a comprehensive fashion. Therefore, it was decided to focus on public organisations thought most likely to undertake exposure surveillance, or to be aware of such surveillance if it was being conducted elsewhere. The approach adopted was to primarily target organisations that represent a number of individual companies or smaller organisations. This was the rationale for including industry peak bodies, employer organisations and employee organisations. However, this approach resulted in a number of practical difficulties. Most important of these was that only one of the peak bodies conducted any surveillance schemes themselves. This meant that the only useful information about current schemes was likely to come from constituent organisations of the peak bodies. It also meant that the peak bodies were unsure of how to respond. While it was useful to know that there were no industry-wide schemes, it meant that little useful information was obtained from the vast majority of the peak bodies. Also, the contact with the constituent organisations was inconsistent between the peak bodies, resulting in some peak bodies forwarding information about the survey to some or all of the constituent members, some of whom then responded directly to the project co-ordinator, and others not forwarding the information to any of the constituent members.

REPRESENTATIVENESS OF THE FINDINGS

The public organisations included in the survey (and in the direct consultation in New Zealand) covered the main public agencies involved in occupational health and safety in Australia and New Zealand, and so they should provide a reasonably accurate picture of the extent to which exposure surveillance is undertaken in those two countries. However, a considerable number of the organisations included in the survey did not formally respond, and for some of those that did, there was some confusion in the distinction between exposure surveillance and outcome surveillance, despite extensive attempts to clarify this in the introduction to the questionnaire and in later telephone or email contact where clarification was sought. Since all the jurisdictions can be expected to have many common statutory responsibilities and requirements for data, the relevant systems mentioned in the responses that were sent are likely to exist in some form in all the jurisdictions. Therefore, the lack of response is not a fatal flaw, and probably provides an additional indication of the relatively low level of involvement of most public agencies in exposure surveillance.

Only a small number of individual companies were included. These were selected on the basis of public profile, business size and perceived likelihood of involvement with exposure surveillance. Therefore, the included organisations cannot be expected to represent all private companies, overall or in any one sector. However, those companies that did respond provided good evidence that exposure surveillance was seen as being relevant to occupational health and safety in some large companies, and that exposure surveillance is both practical and useful to those companies.

PROBLEMS WITH THE SURVEY

The main problems with the survey have already been mentioned – difficulty explaining the concept of exposure surveillance, lack of representativeness of the included agencies and companies, rarity of involvement with exposure surveillance, and low response rate. All these issues were anticipated at the beginning of the survey and the approach taken was designed to minimise the occurrence or significance of these as much as possible, within the general aim of the survey.

An unanticipated issue was that many of the peak bodies appeared reluctant to subject their constituent organisations to what was seen as yet another request for information and/or appeared not to view their role as either providing information about exposure surveillance or passing on the request to their constituent organisations. These concerns are understandable and unlikely to be specific to this project. They reinforce the importance of careful targeting of surveys and attempting to limit the requests for information from private organisations. It also suggests that the peak bodies may not necessarily have been the best targets for the survey. However, the alternative approach of targeting constituent members directly would have been a much bigger task than was desired for the project, and would have been unlikely to provide information on national or nationally representative exposure surveillance systems. In addition, the fact that many of the peak bodies were not aware of exposure surveillance and did not give it a high profile was useful information for the project.

Given that the major aim was to obtain an understanding of the extent to which exposure surveillance is used in Australian and New Zealand workplaces, rather than to conduct a complete audit of the use of such systems, the results were still very useful. A more comprehensive survey of companies and a better response rate from involved organisations and companies would have been preferred, but the responses that were received still contributed importantly to meeting the major aim.

5.5 CONCLUSIONS

The survey (and direct consultation with organisations in New Zealand) suggests that exposure surveillance does not have a high profile in occupational health and safety in Australia and New Zealand. The personal radiation monitoring service run by ARPANSA is the only national exposure surveillance system currently operating in Australia (and it also operates in New Zealand). The Minerals Council of Australia is developing a national system to cover a small number of exposures. Several multinational companies have comprehensive exposure surveillance systems incorporated into their risk management systems, but these systems are specific to the individual companies.

SECTION SIX

ISSUES AND ACTIONS RELEVANT TO

EFFECTIVE EXPOSURE SURVEILLANCE

6

6.1 INTRODUCTION

There are many issues that present potential barriers and challenges to the establishment of exposure surveillance systems, and there are no specific guidelines for the development of occupational exposure surveillance, although several references provide insight into the key features such systems should have[2, 108, 111]. The recent international review of exposure surveillance systems also provides a review of the more important relevant international literature[1], and a previous publication by the National Occupational Health and Safety Commission (NOHSC) also provides some relevant comment[112].

The United States CDC (of which NIOSH is a part) has published evaluation guidelines for surveillance systems[113, 114]. These provide detailed information on the important aspects of surveillance systems in general. Although these guidelines cover all forms of public health surveillance, and have an emphasis on outcome surveillance (that is, health surveillance) rather than exposure surveillance, much of the guidelines are certainly applicable to exposure surveillance programmes. The guidelines identify, by implication, some of the key features needed in any surveillance system, including an exposure surveillance system. These features include "simplicity, flexibility, data quality, acceptability, sensitivity, predictive value positive, representativeness, timeliness, and stability". A more detailed literature-based consideration of the required components of an effective surveillance system is provided in the recently completed *International review of exposure surveillance and control systems*[1].

The main barriers and challenges to the establishment of a successful occupational exposure surveillance system in Australia are considered here, along with approaches to overcome these, with the radiation monitoring scheme run by ARPANSA used to illustrate how a functioning exposure surveillance scheme has successfully met these challenges. Detailed recommendations regarding exactly which exposures should be the subject of exposure surveillance in Australia and New Zealand, and how those exposure surveillance systems should function, are beyond the scope of the current report. The development of such recommendations should be made through consultation with key stakeholders. However, some general guidance is provided here. This guidance is focused on exposure surveillance systems, but it applies equally to surveillance of exposure control systems.

6.2 DATA ISSUES

DEFINITION ISSUES

Variability in the definitions used in any surveillance system is an important source of potential error, as what appear to be simple concepts can be difficult to define or classify. This makes it very important that surveillance systems have clear, unambiguous, well-documented case definitions. This is particularly the case because the definitions are likely to be applied by many different people and over a prolonged period of time.

COLLECTION AND MEASUREMENT ISSUES

Most surveillance systems will involve the collection and measurement of data by different people in different places and at different times. The approach taken to data collection and measurement, such as when, how, and how often the measurements are made, is likely to vary considerably from person to person, from place to place and between different time periods. This makes the development and use of standard approaches to data collection and measurement essential. Standard approaches to data collection and measurement are available for some hazards in the form of Australian Standards[xiii] or New Zealand Standards[xiv], or standards available in the peer-reviewed literature. For other hazards, no such standards exist, and these will need to be developed for any planned exposure surveillance system. Even where recognised standards do exist, it is likely that many will not cover a number of relevant aspects, and standard approaches for these will still need to be developed. The development of standardised approaches might appear straightforward, but in reality it can be expected to require considerable time and resources. Nevertheless, there are examples where such standardisation has been achieved on a national level (e.g. the Australian National Dataset for Compensation-based Statistics[xv] and the National Coroners Information System[xvi]).

CODING ISSUES

Most surveillance systems will also involve the coding of data by different people in different places. Even if the collected data involve measurements of exposure, the measurements may be made using different units, or recorded in ranges rather than in absolute terms. Similarly, other variables related to the exposure measurement (such as those relating to the place, date or nature of the collection) need to be recorded, and such recording can be expected to vary considerably unless a standard approach is available for use. Since the surveillance systems usually compare trends over time, data will also be coded at different times. This raises the potential for variability between the approaches taken by the coders at the time they are doing the coding. It is therefore essential that some form of standard approach to coding be used. The usefulness of any surveillance system can be significantly influenced by the type of coding frames that are used. Standard coding frames dramatically improve the comparability of data from different places, but for many exposures there is no easily identified standard coding frame. These will need to be developed. As mentioned above, such a task might appear straightforward, but it often requires considerable time and resources. In addition, standard systems that are available but not developed with exposure surveillance in mind may not provide the level of detail required and may limit the ability of the data to be used for the surveillance purposes intended. The type and detail of the coding system used should be determined by the needs of the users of the data. Key issues likely to be needed to be considered are the level of detail required and the intended use of the specific data system.

RECORDING ISSUES

As with data collection and coding, variation in the recording of data can be expected to vary between person, place and time. This means standard protocols will be required for all of these, with the associated significant time and resource requirements mentioned earlier for the development of standard approaches to collection and coding.

OVERALL APPROACH TO DATA ISSUES

Where possible, standards, coding frames and protocols already in use and proven to be reliable and valid should be used. Where such standards and protocols are not available, or are not appropriate to the needs of the system, as is particularly likely to be the case for new coding frames, they will need to be developed. Appropriate time and resources will need to be allocated to all these areas. It may be helpful to discuss these aspects with persons who

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xiii See http://www.standards.org.au/

xiv See http://www.standards.co.nz/default.htm

xv See http://www.nohsc.gov.au/statistics/statistics.htm

xvi See http://www.ncis.org.au/

have been involved in establishing or managing other data systems focused at the national or jurisdictional level. A good model may be the National Coroners Information System, which is a relatively new database that incorporates, at a national level, data from a variety of sources[xvii].

6.3 TRAINING ISSUES

National or jurisdictional-based systems such as those being considered for exposure surveillance in Australia and New Zealand will involve many people in many different parts of their respective countries. The systems will be new and will require new skills and new approaches, or the mastery of approaches already being used, to undertake the data collection, measurement, coding and recording. In addition, it is likely that the individuals involved in these tasks will change over time, as the staff doing the coding are commonly reasonably junior, so the turnover of staff can be expected to be substantial.

For these reasons, significant resources will need to be allocated to training staff involved in all aspects of the surveillance systems being developed. Since these staff are likely to change over time, this training will need to be on-going. Adequate resources to plan and undertake this training will be essential.

6.4 SAMPLING ISSUES

Exposure surveillance systems do not have to monitor exposures in all workplaces or work situations in which the relevant exposure occurs. In fact, such complete coverage is likely to be the exception rather than the norm. For many exposures, a representative sample of the relevant workplaces would be both appropriate and preferable, since sampling requires fewer resources. This sampling approach is likely to be appropriate when the number of workplaces with relevant exposures is large, which should be the case for nearly all included exposures, since exposures that occur at only a small number of worksites are unlikely to be good candidates for national or jurisdictional-based exposures. Limitations of sampling include biased sampling and problems with the on-going recording of information because not all relevant workplaces would be included, and the included workplaces might change over time.

6.5 RESOURCE ISSUES

Exposure surveillance systems require very significant resources to be able to function. By their nature, they are on-going systems, so resources are required not just to establish a system but also to maintain it. Careful costing of proposed systems is therefore required before any system is put in place. Smaller systems (such as one focused on a single worksite) would be expected to be individually cheaper to run and establish than larger systems, but economies of scale might make a system based at the company, industry, jurisdiction or national level more appropriate and cost-effective in the long term. The main approach to minimising the required resources is to incorporate the use of routinely collected data, since there are usually few extra costs associated with using the data.

An under-resourced surveillance system is unlikely to be viable in the medium term, and the quality of the data is likely to suffer even if the system is functioning. Quality problems are likely to include incomplete records and decreased reliability of the information that is collected and the way it is coded and recorded[110].

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xvii See http://www.ncis.org.au/

The approach taken to sampling will depend on the exposures included and the available responses to the results. Exposures that are likely to be fairly uniform across the country could involve sampling in only a few (or even one) jurisdiction, on the assumption that change in one jurisdiction will reflect changes in all. Monitoring of exposures that are likely to vary between jurisdictions would be more appropriately undertaken using a sample of workplaces from all relevant jurisdictions. Time periods for collection could also be sampled. The same arguments can be used to determine where within worksites the relevant samples are taken, and to what extent workers are sampled if individual exposure measurements are involved. Exposures that can be monitored in individual workers, which vary significantly between individual workers, and that have important implications for the workers' health, may need to be monitored in all exposed workers, rather than just in a sample of them. Ionising radiation is one of the few examples of this approach in Australia and New Zealand.

There might be merit in targeting work situations that are thought likely to have high exposures relative to other workplaces, on the basis that it is easier to measure and detect change in higher exposures, and because if exposures in these workplaces are found to be dropping, it would be reasonable to expect that exposures in the "better controlled" workplaces would also be dropping (or not getting worse, at least).

6.6 PRIORITISATION ISSUES

Given the large number of exposures that could potentially be the subject of surveillance and the limited resources available to support the surveillance, some form of prioritisation will always be required. If the system is to be a national system, in Australia it necessarily involves the co-operation of the eight Australian jurisdictions, and it can be expected that these jurisdictions will, at least initially, have differing priorities in terms of the focus of any exposure surveillance. This means there will need to be considerable negotiation between the jurisdictions and the Federal government if a consensus is to be reached. This jurisdictional consideration would not be an issue in New Zealand.

Leaving the question of jurisdictional preferences aside, guidelines are needed to help decide which exposures should be given the highest priority. Again, the development and acceptance of such guidelines can be expected to require considerable time and resources. An example of the issues to be considered when deciding on the priority exposures is shown in Table 6. These were developed as part of the current project and other work conducted by the ASCC. They are not proposed as the final criteria that should be used, but form a solid basis on which such criteria could be developed. An example of how these criteria may be used to prioritise which carcinogens should be the focus of exposure surveillance is shown in Appendix 4.

Another factor to consider is the potential cost-effectiveness of utilising systems that are already in development, or vestigial systems that exist in many different places, that might be adapted to form a single, national system. Two potential candidates for this are the MINEJEM of the Minerals Council of Australia (which will cover noise and dust exposure), and the various sharps-incident notification systems present in many large hospitals in Australia and New Zealand (which cover exposure to body fluids, with particular relevance to Hepatitis B, Hepatitis C and HIV).

For the same reason, consideration should be made of making use of data already being collected and potentially amenable to combination with similar data collected across jurisdictions. Using data already being collected for other reasons should lead to major savings in the on-going data collection aspect of any surveillance system. Surveillance of blood lead by using the results of mandatory biological monitoring in each jurisdiction is a clear candidate under this approach.

TABLE 6	Criteria to use when prioritising which exposures should be the focus of exposure surveillance

CRITERION
Long latency disease
There is a disconnection between hazard exposure and disease onset such that the dangers of the hazard can readily be misperceived in the workplace or be attributed to other factors
The disconnection acts as a barrier to effective preventive action
Magnitude of the problem (number of people affected)
Severity (extent of impact on individuals/society)
Absence of adequate data
National standards work (development or revision) currently being undertaken
Support exists within the jurisdiction(s) and/or workplaces to act on this issue
Surveillance activity is linked to practicable risk reduction
Risk reduction strategy has a conceptual framework for action that addresses the specific dynamics of the disease of interest as it manifests itself in workplaces
Builds the national capacity to understand and act to eliminate occupational diseases and the processes that generate them

6.7 COMMITMENT ISSUES

The establishment and maintenance of effective exposure surveillance systems require the co-operation and support of all relevant stakeholders, including State, Territory and Federal governments; employers; industry representatives; workers; and worker representatives. Achieving that commitment is not likely to be easy, given the practical and resource requirements of any such system, but systems such as the Australian National Dataset for Compensation-based Statistics and the National Coroners Information System mentioned above show that it is possible to achieve the required level of commitment from all relevant parties. The exact approaches used to gain the commitment are the purview of the OASCC and NOHSAC, but consultation and education are likely to be two key components of this process. This project, and the other exposure surveillance activities associated with it, are important initial steps in this consultation and education process.

6.8 LEGISLATIVE ISSUES

The role of regulation in encouraging or compelling exposure surveillance is not clear. There is little doubt that exposure surveillance can be encouraged through the judicious use of regulations that require the monitoring of worker exposure to various hazards. Such regulations already exist, for example, in relation to exposure to lead and to asbestos. However, the extent to which compulsion can underly a successful exposure surveillance system is not clear. The role of legislation should be examined in conjunction with the consultation and planning phase of any exposure surveillance system. Exposures for which compulsory monitoring or reporting already exist would be good candidates to include when considering which exposures are appropriate for the development of exposure surveillance systems.

6.9 REQUIRED RESOURCES

Specific recommendations on required resources cannot be made, as the required resources depend crucially on the exposure of interest and the surveillance system put in place. However, it is clear that exposure surveillance is unlikely to be a cheap exercise, with costs for even one functioning system likely to be of the order of several hundred thousand dollars unless currently collected data is able to be utilised.

6.10 CASE STUDY – ARPANSA

As described in Section 5.3, The Australian Radiation Protection and Nuclear Safety Authority (ARPANSA) runs the Personal Radiation Monitoring Service (PRMS). This service "monitors the exposures of workers in the medical, dental, chiropractic, industrial and mining fields to ionising radiation"[xviii]. It has been running since 1932 and currently monitors 35,000 workers at any one time, which is thought to be about 70% of workers occupationally exposed to ionising radiation in Australia. A register is maintained of the doses received by approximately 125,000 people. Given that the system has been running effectively for over half a century, it is clearly a very successful example of an exposure surveillance system. It is therefore instructive to look at the features of the system, and the hazard it covers, and the way these features have addressed each of the issues identified earlier in this chapter.

A SINGLE AGENCY

The PRMS is run by a single agency, making it relatively simple to have a standard approach to all aspects of the system. This includes the development of standardised definitions, the use of standardised data collection and coding approaches, and the development of effective and standard training. The agency is responsible for recording and storing all data collected under the service, minimising the opportunity for variation in recording approaches and for data to be misplaced or lost.

A HIGH PROFILE EXPOSURE

The vast majority of the population is aware of many of the circumstances under which ionising radiation may occur, and has some understanding of the importance of minimising such exposure to ionising radiation. This means that potentially exposed workers are willing to undergo monitoring because they see a direct benefit to themselves. The monitoring becomes a normal part of their working life. Workers are therefore familiar with the process, likely to appropriately use it, and less likely to avoid being involved in the monitoring.

A PROVEN FORM OF MONITORING

The use of thermoluminescent dosemeters has been proven to be a valid approach to the measuring of personal exposure to ionising radiation. Other monitor types are available for some specific monitoring situations. The PRMS uses a standard set of such monitors for all exposure measurements. There are a limited range of monitors of different kinds designed to cover all likely work exposure circumstances. The monitors are designed to be unobtrusive, which encourages workers to use them and to use them as instructed. After the monitors have been read, they can be treated and re-used, thereby lowering costs to the systems of obtaining exposure readings.

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xviii See http://www.arpansa.gov.au/prms.htm (accessed June 2006).

The approach to measurement is also well developed, and each reported dose is collected under the guidelines of the Australian Standard of Exposure.

PERSONAL EXPOSURE PROFILE

Each person for whom exposure data are collected is allocated a unique wearer identification number. This is used to allow all recorded exposure doses for the person to be allocated to that person, providing an on-going record of exposure regardless of where the person works. Since the identification is tied to the person rather than the workplace, and the approach to exposure monitoring is standard in all similar exposure situations, exposure information from many different workplaces can be combined to provide an accurate on-going record of exposure even if the worker moves to a different employer. This is another incentive for the worker to be actively involved in the system.

REGULATORY REQUIREMENTS

Many occupations that potentially involve exposure to ionising radiation are required by law to involve monitoring of workers. This serves as a great encouragement to employers and workers to actively co-operate with the system.

COMMITMENT

Probably due to a combination of all the above factors, there is widespread public and private commitment to radiation monitoring in general, and the PRMS in particular.

NATIONAL COVERAGE

The PRMS provides national coverage in Australia. New Zealand has a similar approach through the National Radiation Laboratory[xix]. Coverage of persons in Australia exposed occupationally to ionising radiation is estimated to be about 70%. This expansive coverage, also probably a result of many of the factors mentioned above, avoids the need to identify a representative sample of workers or workplaces. On the other hand, the nature of the exposure and the risk compels the surveillance to focus on exposure of all relevant individuals, rather than being able to take advantage of potential costs savings in monitoring only a representative sample.

SUMMARY

The PRMS run by ARPANSA demonstrates clearly that the establishment and running of an effective national exposure surveillance system is possible despite the many challenges faced by such a system.

xix See http://www.nrl.moh.govt.nz/ieindex.html

6.11 APPROACH TO DATA COLLECTION

Different exposures will have different requirements regarding the design and function of an exposure surveillance system. Some exposures within a single general class of hazard (physical, chemical, biological and psychosocial) will tend to have similar exposure characteristics and so have similar requirements of an exposure surveillance system, but many will not. For example, noise, ultra-violet light and ionising radiation are all considered physical hazards, but the approach to exposure surveillance is likely to be very different for each one. Proposal of approaches to exposure surveillance for all important hazards is clearly beyond the scope of the current project, but some general guidance is provided here.

For most exposures that are likely candidates for exposure surveillance, collection of exposure information through recurrent survey seems likely to be the most cost-effective approach. These surveys can take various forms, depending on the exposure of interest. Inspections of workplaces could, for example, involve occupational hygiene surveys, conducted on a representative sample of workplaces, in which measurements are made of physical, chemical or biological hazards in the workplaces; making an inventory of which hazards are present (e.g. a chemical inventory); or observing the presence and use of safety systems or personal protective equipment. To investigate psychosocial hazards, it may be more appropriate to survey individual workers or managers, using a self-administered questionnaire or directly via face-to-face interview or over the telephone. Such surveys could be supplemented by direct observations made in the workplace.

Exposure data already being collected may be able to be utilised for a limited number of exposures. This is likely to be the case for exposures that are commonly the subject of exposure measurement in the workplace and for which standard measurement protocols are likely to already be in use. Apart from exposure information on ionising radiation, which is already used for exposure surveillance, potential exposures for which currently collected data may be appropriate for inclusion in a surveillance system are noise, some dust exposures (e.g. coal, silica and asbestos), exposure to body fluids through sharps injuries, and possibly some exposures subject to biological monitoring (e.g. lead). The information may be based on area measurements or individual measurements. This is a potentially cheaper approach than collecting new data specifically for surveillance purposes, but such information is likely to only be available from jurisdictions or for medium to large organisations, and significant work would probably be required to standardise the data collection and reporting approaches. Typically, such information can be expected to come from physical measurements of external exposures, but alternatives might be used for some exposures. For example, biological monitoring may be appropriate for some chemical hazards (e.g. lead) and some primarily administrative information (such as transport driver logs recording time at work and distance travelled, which can provide information relevant to the monitoring of fatigue).

Other routinely collected information, such as that collected by occupational safety and health authorities for regulation or registration purposes, may be of use, but it is likely that the variations in the approaches currently used between and within jurisdictions will limit the extent to which the information could be viewed as representative. However, the development of standardised protocols that could be adopted by jurisdictions in return for access to the relevant data for use in national surveillance might prove a cost-effective approach to developing an exposure surveillance system.

For a small number of exposures, other data collection approaches will be warranted. For example, there is already a functioning national exposure surveillance system for ionising radiation that collects individual exposure information on a continuous basis. However, such continuous monitoring is likely to be relevant for a very limited number of exposures.

6.12 TYPES OF SURVEILLANCE SYSTEMS

The main candidates in terms of the types of exposure surveillance systems for use at a national or jurisdictional level and on an on-going basis seem to be specific-exposure databases utilising data collected by area monitoring, personal monitoring, or surveys; and job-exposure matrices.

Given the large cost in terms of resources and time required to establish and run an exposure surveillance system, it is likely that, in the medium term, only a limited number of exposures could be the subject of detailed exposure surveillance. For most of these, recurrent workplace surveys are likely to be the most cost-effective method of obtaining the necessary information. The only existing example of a surveillance system focused on a specific exposure in Australia or New Zealand is that run by ARPANSA covering ionising radiation (and the related National Radiation Laboratory in New Zealand). The mining industry has a system in development that covers noise exposures, and that should soon be expanded to cover some dust exposure. Several other exposures are currently being monitored in several different places but in an isolated manner, and these may be candidates for the establishment of a system covering the national or jurisdictional level. Exposure to biological substances through sharps injuries in hospitals, and biological monitoring of lead, are two potential candidate exposures for such systems.

On-going, comprehensive surveillance incorporating a wide range of exposures (i.e. the direct monitoring of potentially thousands of hazardous substances), based on recurrent workplace surveys, is not likely to be viable in the medium term in either Australia or New Zealand. Such comprehensive surveillance appears to be currently successfully conducted by a small number of very large companies with a national or international focus, but these systems are unlikely to be easily adapted to focus on a range of exposures across many different companies at a national or jurisdictional level.

A potentially viable alternative is the construction and maintenance of a national job-exposure matrix (or the related task-exposure matrix). This could provide detailed exposure information on a large number of exposures and exposure tasks. Through cross-classification of occupation and industry data, a job-exposure matrix can provide estimated exposure for occupations and tasks for which such data currently are not available or not known. The matrix should incorporate as much local data as possible, but where local data are lacking, appropriate data collected in countries with similar exposure circumstances can be used as surrogates. Clearly, it is desirable to have local exposure data regarding as many exposures as possible. Therefore, a series of surveys should be conducted when the matrix is being established to provide up-to-date, local data on the key exposures for which available data are considered too old, or too unreliable, to be used. Job-exposure matrices typically focus on physical, chemical and, sometimes, biological exposures, but the inclusion of psychosocial exposures is possible in certain circumstances.

The major disadvantages of job-exposure matrices are that they require a lot of time and resources to establish, and are usually not maintained, thereby providing only a snapshot of information on exposures and then gradually becoming out of date. However, workplace exposures generally do not change quickly. Therefore, once established, job-exposure matrices can remain relevant through judicious revision of exposure data. This information might be collected through specific surveys conducted to maintain the matrix, or by making use of exposure data collected for other reasons (e.g. as part of specific studies, such as those described in Chapter 3; for compliance; during occupational health and safety inspections; or as part of routine workplace monitoring in large companies). The representativeness of the data will always be an issue, but allowance for the effect of non-random sampling and non-standardised collection approaches should be possible in many cases.

One of the aims of this project was to examine the current use of exposure surveillance systems, and to suggest potential approaches for future surveillance systems, for exposures relevant to the main outcomes areas of interest to NOHSAC and the OASCC. These outcome areas are:

- respiratory diseases
- occupational cancers
- contact dermatitis
- infectious and parasitic diseases
- cardiovascular diseases
- musculoskeletal disorders
- mental or neuropsychiatric disorders
- noise-induced hearing loss.

As mentioned earlier, producing comprehensive recommendations about which exposures should be monitored, and which surveillance systems should be used for which specific exposures, is well beyond the scope of this project. However, a more general consideration of the topic is possible and is presented here. This information can be used to provide guidance regarding the approaches to occupational surveillance that are likely to be effective. Such guidance has already been provided in a table presented in the international surveillance review that formed the first part of the current OASCC and NOHSAC project on exposure surveillance[1]. That table (Table 20 in the international report) is reproduced in Appendix 5. The suggestions made in that table are soundly based and sensible. However, the table focuses more on the manner of data collection rather than on the exposure systems themselves. Table 7 presents a slightly different approach, although the overall emphases are similar between the two tables. The table attempts to combine information on both the type of surveillance system and the approach to data collection. It does not attempt to list which specific exposures should be the subject of surveillance, but mentions some examples where appropriate. Note also that the information above and in Table 7 focuses on exposure surveillance at the national or jurisdictional level, although many of the recommendations should be relevant for surveillance systems conducted at the industry or even workplace level.

Table 7 indicates that specific-exposure databases using information from surveys (of the workplace and of individuals), and specific area or individual measurements for a very limited number of exposures, are viable. Biological monitoring might also be appropriate in certain circumstances. Job-exposure matrices are appropriate for many physical and chemical exposures, as well as some biological exposures.

TABLE 7 Recommendations regarding exposure surveillance systems and data collection approaches for various general exposures and their associated outcomes – selected priority outcomes

OUTCOME	PHYSICAL	CHEMICAL	BIOLOGICAL	PSYCHOSOCIAL
Respiratory diseases	Job-exposure matrix Survey – workplace	Area measurements Job-exposure matrix Survey – workplace	Survey – workplace (e.g. legionella) Job-exposure matrix	
Occupational cancers	Job-exposure matrix Survey – workplace Continuous personal measurements (e.g. ionising radiation)	Job-exposure matrix Survey – workplace	Low relevance due to limited exposures	
Contact dermatitis		Job-exposure matrix Survey – workplace		
Infectious and parasitic diseases		Job-exposure matrix Incident notification of sharps exposures in hospitals (e.g. hepatitis B, C and HIV) Survey – questionnaire and workplace observation		
Cardiovascular diseases	Job-exposure matrix Survey – workplace Recurrent area measurements (e.g. CO)	Job-exposure matrix Survey – workplace		Survey – questionnaire
Musculoskeletal disorders	Survey – workplace Personal measurements (e.g. vibration)			Survey – questionnaire and workplace
Mental or neuropsychiatric disorders		Job-exposure matrix Survey – workplace		Survey – questionnaire and workplace
Noise-induced hearing loss	Job-exposure matrix Recurrent area measurements (noise)	Low relevance due to limited exposures		
General	Job-exposure matrix Personal measurements Area measurements	Area measurements Job-exposure matrix Survey – workplace Biological monitoring (e.g. lead)	Survey – questionnaire and workplace observation Incident notification Job-exposure matrix	Survey – questionnaire and workplace

6.13 LIKELY AND/OR FEASIBLE DEVELOPMENTS IN EXPOSURE SURVEILLANCE

There are no obvious pending technological changes in exposure monitoring that are likely to affect the development and application of occupational exposure surveillance. However, potential developments in the medium term (the next 10 to 20 years) in terms of exposure surveillance include:

- improvements in the validity, coverage, usefulness and cost of biological monitoring
- increased recognition of the importance of particle size (e.g. nanoparticles), surface area and physico-chemical make-up when assessing exposure to certain hazardous substances
- improvements in the technology and associated costs of monitoring physical and chemical exposures, allowing more frequent monitoring, and monitoring of exposures, or the use of measurement techniques, that was nor previously possible
- improvements in data linking and matching techniques that might allow better tracking of individuals from one workplace to another, with associated improvements in the ability to estimate cumulative exposure
- increasing movement of the workforce into service and office-based work environments, increasing the potential exposure to and importance of psychosocial hazards, and the need to develop better methods to identify and measure relevant exposures.

There are also a number of strategic developments that should increase the likelihood that occupational exposure surveillance can be significantly improved in Australia and New Zealand. These include:

- the Australian National OHS Strategy[xx]
- the National Occupational Disease Prevention Action Plan[xxi]
- the work of NOHSAC in various aspects of occupational surveillance.

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xx See http://www.nohsc.gov.au/nationalstrategy/

xxi See http://www.nohsc.gov.au/nationalstrategy/ActionPlans/Occupational_Disease_Prevention_Action_Plan_webversion.pdf

SECTION SEVEN

SUMMARY AND CONCLUSIONS

This primary aim of this project was to examine occupational health and safety exposure surveillance and control system surveillance currently in use in Australia and/or New Zealand, and to produce a critical review of Australian and New Zealand approaches to exposure and control system surveillance relevant to occupational health and safety. The survey revealed that exposure and control system surveillance does not appear to play a major role in occupational health and safety in either Australia or New Zealand, particularly at the jurisdictional or national level. This was confirmed by the literature review, which identified a considerable amount of information about work-related exposures, but very little related to proper exposure or control system surveillance at a national, jurisdictional or regional level. There are a small number of exposures databases that might be appropriate for inclusion in exposure surveillance systems at this level. There is also a fully-functioning exposure surveillance system for ionising radiation in Australia and New Zealand.

There are many important issues that need to be considered in developing exposure and control system surveillance in Australia and New Zealand. Significant resources will be required to adequately explore these issues and ultimately resolve them, but there are major advantages to investing such resources. There are many potential hazards that are candidates for exposure surveillance, a small number of appropriate surveillance system designs, and a range of potential approaches to data collection available to support whatever systems are developed.

SECTION EIGHT

REFERENCES

1. Brooke D, Cowley S, Else D, et al. *International review of surveillance and control of workplace exposures*. 2005, VIOSH Australia: Ballarat.
2. LaMontagne A, Herrick R, Van Dyke M, et al. Exposure databases and exposure surveillance: promise and practice. *American Industrial Hygiene Association Journal* 2002, 63(2): 205–212.
3. National Institute of Occupational Safety and Health. *Tracking occupational injuries, illnesses, and hazards: The NIOSH surveillance strategic plan*. 2001, NIOSH: Cincinnati.
4. Wegman D, Stillman S. Occupational hazard surveillance, in *Encyclopedia of occupational health and safety*. 1998, International Labour Organisation: Geneva.
5. Depczynski J, Franklin RC, Challinor K, et al. Farm noise emissions during common agricultural activities. *J Agric Saf Health* 2005, 11(3): 325–34.
6. Williams W, Presbury J. Observations of noise exposure through the use of headphones by radio announcers. *Noise Health* 2003, 5(19): 69–73.
7. Roberts FO, Gunawardana DH, Pathmaraj K, et al. Radiation dose to PET technologists and strategies to lower occupational exposure. *J Nucl Med Technol* 2005, 33(1): 44–7.
8. Airey DK, Wong JC, Fleming RA, et al. An estimate of the total UV-B exposure for outdoor workers during a south-east Queensland summer. *Health Phys* 1997, 72(4): 544–9.
9. Cable GG. In-flight hypoxia incidents in military aircraft: causes and implications for training. *Aviat Space Environ Med* 2003, 74(2): 169–72.
10. Knott JC, Bennett D, Rawet J, et al. Epidemiology of unarmed threats in the emergency department. *Emerg Med Australas* 2005, 17(4): 351–8.
11. Lyneham J. Violence in New South Wales emergency departments. *Australian Journal of Advances in Nursing* 2000, 18(2): 8–17.
12. Magin PJ, Adams J, Sibbritt DW, et al. Experiences of occupational violence in Australian urban general practice: a cross-sectional study of GPs. *Med J Aust* 2005, 183(7): 352–6.
13. Tolhurst H, Baker L, Murray G, et al. Rural general practitioner experience of work-related violence in Australia. *Aust J Rural Health* 2003, 11(5): 231–6.
14. Mayhew C, Chappell D. The occupational violence experiences of some Australian health workers: an exploratory study. *Journal of Occupational Health and Safety – Australia and New Zealand* 2003, 19(6): 3–43.
15. Benveniste KA, Hibbert PD, Runciman WB. Violence in health care: the contribution of the Australian Patient Safety Foundation to incident monitoring and analysis. *Med J Aust* 2005, 183(7): 348–51.
16. Australian Patient Safety Foundation. *Published articles on patient safety*. 2005.
17. Gun R, Ryan P, Roder D, et al. *Health Watch. The Australian Institute of Petroleum health surveillance program. 12th report*. 2005, The University of Adelaide: Adelaide.
18. Glass DC, Gray CN, Jolley DJ, et al. Health Watch exposure estimates: do they underestimate benzene exposure? *Chem Biol Interact* 2005, 153–154: 23–32.
19. Glass DC, Gray CN. Estimating mean exposures from censored data: exposure to benzene in the Australian petroleum industry. *Ann Occup Hyg* 2001, 45(4): 275–82.
20. Glass DC, Gray CN, Adams GG, et al. Validation of exposure estimation for benzene in the Australian petroleum industry. *Toxicol Ind Health* 2001, 17(4): 113–27.
21. Glass DC, Adams GG, Manuell RW, et al. Retrospective exposure assessment for benzene in the Australian petroleum industry. *Ann Occup Hyg* 2000, 44(4): 301–20.
22. Black J, Benke G, Smith K, et al. Artificial neural networks and job-specific modules to assess occupational exposure. *Ann Occup Hyg* 2004, 48(7): 595–600.
23. Wan KC, Dare BR, Street NR. Biomedical surveillance of workers exposed to 4,4'-methylene-bis-(2-chloroaniline) (MBOCA) in Perth, Western Australia. *J R Soc Health* 1989, 109(5): 159–65.
24. Kizil GV, Donoghue AM. Coal dust exposures in the longwall mines of New South Wales, Australia: a respiratory risk assessment. *Occup Med (Lond)* 2002, 52(3): 137–49.

25. Cameron M, Wakefield M, Trotter L, et al. Exposure to secondhand smoke at work: a survey of members of the Australian Liquor, Hospitality and Miscellaneous Workers Union. *Aust NZ J Public Health* 2003, 27(5): 496–501.
26. Borland R, Morand M, Mullins R. Prevalence of workplace smoking bans in Victoria. *Aust NZ J Public Health* 1997, 21(7): 694–8.
27. Benke G, Sim M, Forbes A, et al. Retrospective assessment of occupational exposure to chemicals in community-based studies: validity and repeatability of industrial hygiene panel ratings. *Int J Epidemiol* 1997, 26(3): 635–42.
28. Smith DR, Leggat PA, Takahashi K. Percutaneous exposure incidents among Australian hospital staff. *Int J Occup Saf Ergon* 2005, 11(3): 323–30.
29. Bowden FJ, Pollett B, Birrell F, et al. Occupational exposure to the human immunodeficiency virus and other blood-borne pathogens. A six-year prospective study. *Med J Aust* 1993, 158(12): 810–2.
30. Mallon DF, Shearwood W, Mallal SA, et al. Exposure to blood-borne infections in health care workers. *Med J Aust* 1992, 157(9): 592–5.
31. Charles P, Angus P, Sasadeusz J, et al. Management of healthcare workers after occupational exposure to hepatitis C virus. *Medical Journal of Australia* 2003, 179(3): 153–157.
32. Whitby R, McLaws ML. Hollow-bore needlestick injuries in a tertiary teaching hospital: epidemiology, education and engineering. *Medical Journal of Australia* 2002, 177(8): 418–422.
33. deVries B, Cossart YE. Needlestick injury in medical students. *Med J Aust* 1994, 160(7): 398–400.
34. Richards MJ, Jenkin GA, Johnson PD. Universal precautions: attitudes of Australian and New Zealand anaesthetists. *Med J Aust* 1997, 166(3): 138–40.
35. MacDonald MA, Elford J, Kaldor JM. Reporting of occupational exposures to blood-borne pathogens in Australian teaching hospitals. *Med J Aust* 1995, 163(3): 121–3.
36. Murtagh MJ, Hepworth J. Hepatitis C in the workplace: a survey of occupational health and safety knowledge and practice in the beauty therapy industry. *Aust NZ J Public Health* 2004, 28(3): 207–11.
37. Mandryk J, Alwis KU, Hocking AD. Effects of personal exposures on pulmonary function and work-related symptoms among sawmill workers. *Ann Occup Hyg* 2000, 44(4): 281–9.
38. Alwis KU, Mandryk J, Hocking AD. Exposure to biohazards in wood dust: bacteria, fungi, endotoxins, and (1→3)-beta-D-glucans. *Appl Occup Environ Hyg* 1999, 14(9): 598–608.
39. Cooper EE, O'Reilly MA, Guest DI, et al. Influence of building construction work on Aspergillus infection in a hospital setting. *Infect Control Hosp Epidemiol* 2003, 24(7): 472–6.
40. McCall BJ, Epstein JH, Neill AS, et al. Potential exposure to Australian bat lyssavirus, Queensland, 1996–1999. *Emerg Infect Dis* 2000, 6(3): 259–64.
41. Michael R, Jenkins HJ. Work-related trauma: the experiences of perioperative nurses. *Collegian* 2001, 8(1): 19–25.
42. Arnold PK, Hartley LR, Corry A, et al. Hours of work, and perceptions of fatigue among truck drivers. *Accid Anal Prev* 1997, 29(4): 471–7.
43. Dalziel JR, Job RF. Motor vehicle accidents, fatigue and optimism bias in taxi drivers. *Accid Anal Prev* 1997, 29(4): 489–94.
44. Benke G, Sim M, Fritschi L, et al. A task exposure database for use in the alumina and primary aluminium industry. *Appl Occup Environ Hyg* 2001, 16(2): 149–53.
45. Benke G, Sim M, Fritschi L, et al. Beyond the job exposure matrix (JEM): The task exposure matrix (TEM). *Annals of Occupational Hygiene* 2000, 44(6): 475–482.
46. Lopata AL, Baatjies R, Thrower SJ, et al. Occupational allergies in the seafood industry – a comparative study of Australian and South African workplaces. *Int Marit Health* 2004, 55(1–4): 61–73.
47. van Soest EM, Fritschi L. Occupational health risks in veterinary nursing: an exploratory study. *Aust Vet J* 2004, 82(6): 346–50.

48. Jeyaretnam J, Jones H, Phillips M. Disease and injury among veterinarians. *Aust Vet J* 2000, 78(9): 625–9.
49. Bentley TA, Parker RJ, Ashby L. Understanding felling safety in the New Zealand forest industry. *Appl Ergon* 2005, 36(2): 165–75.
50. McBride DI, Firth HM, Herbison GP. Noise exposure and hearing loss in agriculture: a survey of farmers and farm workers in the Southland region of New Zealand. *J Occup Environ Med* 2003, 45(12): 1281–8.
51. Taylor GC, Bentley RD, Horwood NA, et al. TEPC measurements in commercial aircraft. *Radiat Prot Dosimetry* 2004, 110(1–4): 381–6.
52. Jones S, Love C, Thomson G, et al. Second-hand smoke at work: the exposure, perceptions and attitudes of bar and restaurant workers to environmental tobacco smoke. *Aust NZ J Public Health* 2001, 25(1): 90–3.
53. Grant S, Walmsley TA, George PM. Industrial blood lead levels in the South Island during 1988 and 1989: trends and follow up patterns. *NZ Med J* 1992, 105(940): 323–6.
54. Slater T, Erkinjuntti-Pekkanen R, Fishwick D, et al. Changes in work practice after a respiratory health survey among welders in New Zealand. *NZ Med J* 2000, 113(1114): 305–8.
55. Lum D, Mason Z, Meyer-Rochow G, et al. Needle stick injuries in country general practice. *NZ Med J* 1997, 110(1041): 122–5.
56. Lilley R, Feyer AM, Kirk P, et al. A survey of forest workers in New Zealand. Do hours of work, rest, and recovery play a role in accidents and injury? *J Safety Res* 2002, 33(1): 53–71.
57. Fransman W, McLean D, Douwes J, et al. Respiratory symptoms and occupational exposures in New Zealand plywood mill workers. *Ann Occup Hyg* 2003, 47(4): 287–95.
58. Ruttenberg D, Dryson E, Walls C, et al. Hazards associated with the boat building industry in New Zealand: an OSH audit. *NZ Med J* 2001, 114(1132): 225–6.
59. Haque MN. Surveillance on self-report: a trial of health and safety monitoring in occupational settings. *Occup Med (Lond)* 2000, 50(3): 182–4.
60. Sindhusake D, Golding M, Newall P, et al. Risk factors for tinnitus in a population of older adults: the Blue Mountains hearing study. *Ear Hear* 2003, 24(6): 501–7.
61. Frost CA, Green AC, Williams GM. The prevalence and determinants of solar keratoses at a subtropical latitude (Queensland, Australia). *Br J Dermatol* 1998, 139(6): 1033–9.
62. Kricker A, Vajdic CM, Armstrong BK. Reliability and validity of a telephone questionnaire for estimating lifetime personal sun exposure in epidemiologic studies. *Cancer Epidemiol Biomarkers Prev* 2005, 14(10): 2427–32.
63. Vajdic CM, Kricker A, Giblin M, et al. Sun exposure predicts risk of ocular melanoma in Australia. *Int J Cancer* 2002, 101(2): 175–82.
64. Habib RR, Abdallah SM, Law M, et al. Mortality rates among nuclear industry workers at Lucas Heights Science and Technology Centre. *Aust NZ J Public Health* 2005, 29(3): 229–37.
65. Woodward A, Roder D, McMichael AJ, et al. Radon daughter exposures at the Radium Hill uranium mine and lung cancer rates among former workers, 1952–87. *Cancer Causes Control* 1991, 2(4): 213–20.
66. Vajdic CM, Kricker A, Giblin M, et al. Artificial ultraviolet radiation and ocular melanoma in Australia. *Int J Cancer* 2004, 112(5): 896–900.
67. Stuckey R, Lamontagne AD. Occupational light-vehicle use and OHS legislative frameworks: an Australian example. *Int J Occup Environ Health* 2005, 11(2): 167–79.
68. Marr SJ, Quine S. Shoe concerns and foot problems of wearers of safety footwear. *Occup Med (Lond)* 1993, 43(2): 73–7.
69. Yorkston E, Arthur C, Barker T, et al. Inflatable rescue boat-related injuries in Queensland surf lifesavers: the epidemiology – biomechanics interface. *Int J Inj Contr Saf Promot* 2005, 12(1): 39–44.
70. de Klerk NH, Armstrong BK, Musk AW, et al. Cancer mortality in relation to measures of occupational exposure to crocidolite at Wittenoom Gorge in Western Australia. *Br J Ind Med* 1989, 46(8): 529–36.
71. de Klerk NH, Musk AW. Silica, compensated silicosis, and lung cancer in Western Australian goldminers. *Occup Environ Med* 1998, 55(4): 243–8.

72. Englert H, Small-McMahon J, Davis K, et al. Male systemic sclerosis and occupational silica exposure – a population-based study. *Aust NZ J Med* 2000, 30(2): 215–20.
73. Glass DC, Sim MR, Fritschi L, et al. Leukemia risk and relevant benzene exposure period – Re: follow-up time on risk estimates, Am J Ind Med 42:481–489, 2002. *Am J Ind Med* 2004, 45(2): 222–3; author reply 224–5.
74. Gun RT, Pratt NL, Griffith EC, et al. Update of a prospective study of mortality and cancer incidence in the Australian petroleum industry. *Occup Environ Med* 2004, 61(2): 150–6.
75. Dobson AJ, Alexander HM, Heller RF, et al. Passive smoking and the risk of heart attack or coronary death. *Med J Aust* 1991, 154(12): 793–7.
76. Wakefield M, Cameron M, Inglis G, et al. Secondhand smoke exposure and respiratory symptoms among casino, club, and office workers in Victoria, Australia. *J Occup Environ Med* 2005, 47(7): 698–703.
77. Wakefield M, Trotter L, Cameron M, et al. Association between exposure to workplace secondhand smoke and reported respiratory and sensory symptoms: cross-sectional study. *J Occup Environ Med* 2003, 45(6): 622–7.
78. Fritschi L, Benke G, Hughes AM, et al. Occupational exposure to pesticides and risk of non-Hodgkin's lymphoma. *Am J Epidemiol* 2005, 162(9): 849–57.
79. Fritschi L, Benke G, Hughes AM, et al. Risk of non-Hodgkin lymphoma associated with occupational exposure to solvents, metals, organic dusts and PCBs (Australia). *Cancer Causes Control* 2005, 16(5): 599–607.
80. Valery PC, McWhirter W, Sleigh A, et al. Farm exposures, parental occupation, and risk of Ewing's sarcoma in Australia: a national case-control study. *Cancer Causes Control* 2002, 13(3): 263–70.
81. Gilroy N, Formica N, Beers M, et al. Abattoir-associated Q fever: a Q fever outbreak during a Q fever vaccination program. *Aust NZ J Public Health* 2001, 25(4): 362–7.
82. Pisaniello DL, Tkaczuk MN, Owen N. Occupational wood dust exposures, lifestyle variables, and respiratory symptoms. *J Occup Med* 1992, 34(8): 788–92.
83. Albion MJ, Fogarty GJ, Machin MA. Benchmarking occupational stressors and strain levels for rural nurses and other health sector workers. *J Nurs Manag* 2005, 13(5): 411–8.
84. Parslow RA, Jorm AF, Christensen H, et al. The impact of employee level and work stress on mental health and GP service use: an analysis of a sample of Australian government employees. *BMC Public Health* 2004, 4: 41.
85. D'Souza RM, Strazdins L, Lim LL, et al. Work and health in a contemporary society: demands, control, and insecurity. *J Epidemiol Community Health* 2003, 57(11): 849–54.
86. Mayhew C, Quinlan M. The effects of outsourcing on occupational health and safety: a comparative study of factory-based workers and outworkers in the Australian clothing industry. *Int J Health Serv* 1999, 29(1): 83–107.
87. Michael R, Jenkins HJ. The impact of work-related trauma on the well-being of perioperative nurses. *Collegian* 2001, 8(2): 36–40.
88. Cromie JE, Robertson VJ, Best MO. Work-related musculoskeletal disorders in physical therapists: prevalence, severity, risks, and responses. *Phys Ther* 2000, 80(4): 336–51.
89. Cromie JE, Robertson VJ, Best MO. Occupational health in physiotherapy: general health and reproductive outcomes. *Aust J Physiother* 2002, 48(4): 287–94.
90. Fritschi L, Fenwick S, Bulsara M. Mortality and cancer incidence in a cohort of meatworkers. *Occup Environ Med* 2003, 60(9): E4.
91. Fritschi L, Lakhani R, Nadon L. Cancer incidence in textile manufacturing workers in Australia. *J Occup Health* 2004, 46(6): 493–6.
92. Fritschi L, Lakhani R, Nadon L, et al. Mortality in an Australian cohort of textile workers. *Occup Med (Lond)* 2004, 54(4): 255–7.
93. Fritschi L, Sim M, Forbes A, et al. Respiratory symptoms and lung-function changes with exposure to five substances in aluminium smelters. *International Archives of Occupational and Environmental Health* 2003, 76(2): 103–110.
94. Bentley T, Tappin D, Moore D, et al. Investigating slips, trips and falls in the New Zealand dairy farming sector. *Ergonomics* 2005, 48(8): 1008–19.

95. Douwes J, McLean D, Slater T, et al. Asthma and other respiratory symptoms in New Zealand pine processing sawmill workers. *Am J Ind Med* 2001, 39(6): 608–15.
96. Firth HM, Elwood JM, Cox B, et al. Historical cohort study of a New Zealand foundry and heavy engineering plant. *Occup Environ Med* 1999, 56(2): 134–8.
97. Bradshaw LM, Fishwick D, Slater T, et al. Chronic bronchitis, work related respiratory symptoms, and pulmonary function in welders in New Zealand. *Occup Environ Med* 1998, 55(3): 150–4.
98. Fishwick D, Bradshaw L, Slater T, et al. Respiratory symptoms and lung function change in welders: are they associated with workplace exposures? *NZ Med J* 2004, 117(1193): U872.
99. Bandaranayake DR, Salmond CE, Tobias MI. Occupational risk of hepatitis B for police and customs personnel. *Am J Epidemiol* 1991, 134(12): 1447–53.
100. Plumridge L, Abel G. A 'segmented' sex industry in New Zealand: sexual and personal safety of female sex workers. *Aust NZ J Public Health* 2001, 25(1): 78–83.
101. Petrie KJ, Powell D, Broadbent E. Fatigue self-management strategies and reported fatigue in international pilots. *Ergonomics* 2004, 47(5): 461–8.
102. Stehr-Green PA, Hewer P, Meekin GE, et al. The aetiology and risk factors for warts among poultry processing workers. *Int J Epidemiol* 1993, 22(2): 294–8.
103. McLean D, Cheng S, t Mannetje A, et al. Mortality and cancer incidence in New Zealand meat workers. *Occup Environ Med* 2004, 61(6): 541–7.
104. Kimbell-Dunn MR, Fishwick RD, Bradshaw L, et al. Work-related respiratory symptoms in New Zealand farmers. *Am J Ind Med* 2001, 39(3): 292–300.
105. Victorian Poisons Information Centre. *Annual report 2005*. 2005, VPIC: Melbourne.
106. Western Australia Poisons Information Centre. *Annual report 2002*. 2002: Perth.
107. Worksafe Australia. *Survey of solvent use in the Rockdale area*. 1993.
108. Boiano J, Hull R. Development of a National Occupational Exposure Survey and Database associated with NIOSH hazard surveillance initiatives. *Applied Occupational and Environmental Hygiene* 2001, 16(2): 128–134.
109. Australian Radiation Protection and Nuclear Safety Authority. *Personal radiation monitoring service*. 2005, ARPANSA: Canberra.
110. Driscoll T, Harrison J, Langley J. Injury surveillance, in *The scientific basis of injury prevention and control*. R. McClure, M. Stevenson, S. McEvoy, Editors. 2004, IP Communications Pty Ltd: Melbourne. p. 87–109.
111. Lamontagne A, Ruttenber A, Wegman D. Exposure surveillance for chemical and physical hazards, in *Workplace health surveillance. An action-oriented approach*. N. Maizlish, Editor. 2000, Oxford University Press. p. 219–234.
112. Sabic D, Brazenor R, Li R, et al. *Possible applications of disease minimum data set to future activities relating to occupational disease*. 2002, National Occupational Health and Safety Commission: Canberra.
113. Center for Disease Control and Prevention. Guidelines for evaluating surveillance systems. *Morbidity and Mortality Weekly Report* 1988, 37 (Suppl S-5): 1–18.
114. Center for Disease Control and Prevention. Updated guidelines for evaluating public health surveillance systems: recommendations from the Guidelines Working Group. *Morbidity and Mortality Weekly Report* 2001, 50(RR-13): 1–51.

SECTION NINE

APPENDICES

APPENDIX 1: SURVEY QUESTIONNAIRE

OFFICE OF THE AUSTRALIAN SAFETY AND COMPENSATION COUNCIL
EXPOSURE SURVEILLANCE SURVEY
FEBRUARY 2006

The attached survey has been developed as part of a project being conducted by the Office of the Australian Safety and Compensation Council (OASCC) and the New Zealand National Occupational Health and Safety Advisory Committee (NOHSAC). The project aims to examine occupational health and safety exposure surveillance and control systems that are currently in use in Australia and/or New Zealand, and to produce a critical review of Australian and New Zealand approaches to exposure surveillance relevant to occupational health and safety.

EXPOSURE SURVEILLANCE covers a range of data collection activities that might be undertaken in the workplace. It has been described as the "on-going and systematic collection, analysis and interpretation of data related to occupational exposures". The key aspects of the systems we are interested in are that:

- they involve the collection of data about one or more exposures;
- the data is used for some OHS purpose; and
- the system is on-going.

The exposures may be:

- physical;
- chemical;
- biological;
- psychosocial; or
- other hazards.

We are interested in any surveillance activity that covers aspects of one or more of these hazards.

We are also interested in data collection about hazard control systems in use in the workplace. Examples of hazard control systems are the presence of potentially protective agents such as seat belts, smoke alarms, roll-over protection on tractors and forklifts, bicycle helmets and residual current devices. Other control systems of interest relate to behavioural attributes such as basic resuscitation skills and defensive driving courses.

This survey is designed to allow the collection of information on surveillance systems and activities relevant to the project. Please provide what information you can for each of the areas listed below. Answers to most questions require text information. Please feel free to provide further information on a separate sheet of paper. The response to this survey can be provided in written or electronic form. Alternatively, if you would prefer, the information can be provided over the phone to the project leader (please send an email to the project leader to organise this).

All responses will be confidential, with no identifying data presented in the final report. If you would like to discuss any aspects of confidentiality, please contact the project leader.

If you do not have a surveillance system, it would be very helpful if you could send a brief email to let the project leader know. This will help provide a better picture of how common surveillance systems are, and avoid unnecessary follow-up of people who haven't returned their questionnaire.

If you would like further information about this survey or the project, please contact:

Dr Tim Driscoll, Project Leader,
email: elmatom@optushome.com.au
ph: 02-98030301

Dr Peta Miller, OASCC Project Manager
email: peta.miller@dewr.gov.au
ph: 02-61219253 or

Mr Mark Wagstaffe, NOHSAC Project Manager
email: Mark.Wagstaffe@dol.govt.nz
ph: 4-915 4463

We would appreciate the return of the survey by Monday 6th March 2006.

Thank you for your help with this project. If you would like to receive information on the outcomes of the project, please tick the box at the end of the questionnaire.

SECTION 1 Basic information and contents of the system

NAME, OWNER AND BASIC DOCUMENTS OF THE SURVEILLANCE SYSTEM	TEXT INFORMATION/COMMENTS
1.1 What is the name of the surveillance system?	
1.2 Who owns the system?	
1.3 What type of organisation owns the system? a) government b) non-government c) independent d) industry e) private f) other – please describe	
1.4 Where is the system based (State/country)?	
FOCUS	**TEXT INFORMATION/COMMENTS**
1.5 What type of exposures(s) or control system(s) is the focus of the surveillance system (e.g. x-ray radiation in radiography, chemical type in a factory, needlestick events in a hospital, hours of un-rostered overtime, residual current devices, roll-over protection structure, certified first aid courses)?	
1.6 Is the focus of the system individual monitoring (e.g. radiation dose) or area monitoring (e.g. peak noise levels in a factory)?	
1.7 What is the target population for the surveillance system? (e.g. workers performing a particular task, specific occupation or industry, the general public)	
1.8 What is the geographical area relevant to the information collected?	

TYPE OF INFORMATION	TEXT INFORMATION/COMMENTS
1.9 What information is collected (e.g. type of substance, type of sample, level of exposure, number of persons exposed, cumulative personal exposure, proportion of workers working at heights on a particular job who used a fall arrest device, hours of driving in the previous two weeks etc)?	
1.10 What is the type of information collected?	a) quantitative (numbers) b) semi-quantitative (numbers and text) c) qualitative (text)
DATA COLLECTION	**TEXT INFORMATION/COMMENTS**
1.11 How is the information collected (e.g. is it collected through surveys, through environmental hygiene measurements, through regular reporting of routinely collected data)?	
1.12 How often is the information collected?	
DATA RECORDING AND STORAGE	**TEXT INFORMATION/COMMENTS**
1.13 How is the information recorded (i.e. is it coded, structured, free text)?	
1.14 Is it recorded electronically or on paper?	
1.15 If the data is coded, what coding systems are used?	
RELIABILITY AND VALIDITY	**TEXT INFORMATION/COMMENTS**
1.16 How do you maintain and check the accuracy of the information that is collected (i.e. how do you try to make sure that the information collected is correct, and that the collected information is properly recorded)?	
1.17 How good is the coverage of the system (i.e. does it provide information on the people/areas that you want it to provide information on)?	
LINKAGES	**TEXT INFORMATION/COMMENTS**
1.18 Is the data linked to relevant data from other databases? If so: - which databases; - what is the linkage used for?	

SECTION 2 The internal and external uses and aims of the system

DATA USE	TEXT INFORMATION/COMMENTS
2.1 Why was the information/data collection established?	
2.2 What is the intended use of the information?	
2.3 Who uses the information?	
2.4 What is the information used for?	a) monitoring or control purposes b) evaluation of control measures c) to support the development of policies and procedures d) other – please provide details.

FREQUENCY AND CONTENT OF REPORTS ISSUED FROM THE SURVEILLANCE SYSTEMS	TEXT INFORMATION/COMMENTS
2.5 Are reports produced from the system? If so: - who is meant to read the reports? - how often are they produced? - what do they cover? - what are these used for? - what is their format (e.g. detailed reports, brief fact sheets)? - how are they distributed (e.g. printed reports, reports sent via email, posted on the internet)?	
ETHICAL AND PRIVACY ISSUES	**TEXT INFORMATION/COMMENTS**
2.6 What important ethical or privacy issues are associated with the system?	
CONDITIONS FOR ACCESS AND USE BY EXTERNAL USERS	**TEXT INFORMATION/COMMENTS**
2.7 Is the information in the database available publicly? If so, who can use it? What are the conditions for access? If not, what provisions would need to be put in place to allow it to be available publicly?	

SECTION 3 Background and future

3.1 Why was the system developed? (e.g. perceived need in the organisation, legislative requirements)	
3.2 Is the system likely to be on-going?	
3.3 Are modifications planned?	
3.4 Are there any improvements that are feasible and that you think should or could be introduced?	
3.5 Is there anything you would do differently if you had your time over? If so, please tell us about it.	

SECTION 4 Feedback

3.6 Would you like to receive information on the outcomes of this project?	Yes/No

Thank you again for your help with this project

APPENDIX 2: COVERING LETTER FOR SURVEY QUESTIONNAIRE

Australian Government
Australian Safety and Compensation Council

NOHSAC
National Occupational Health and Safety Advisory Committee
Komiti Tōhutohu Mahi A-Motu Hauora me te Haumaru

RE: HAZARD EXPOSURE SURVEILLANCE SURVEY

We are seeking your cooperation by responding to the attached survey on hazard exposure. This survey is part of a joint project between the Office of the Australian Safety and Compensation Council (OASCC) and the New Zealand National Occupational Health and Safety Advisory Committee (NOHSAC).

The ASCC was established in October 2005 and it succeeded the National Occupational Health and Safety Commission (NOHSC). The key role of the ASCC is to provide leadership and coordination for national efforts to prevent workplace death, injury and disease. The council will also work to improve national workers' compensation arrangements.

NOHSAC is responsible for providing independent advice to the Minister of Labour on major occupational health and safety issues in New Zealand. The Committee plays a key role in providing an independent assessment of the measures that will deliver the greatest benefit for the prevention of occupational injury and disease, and in addition developing an evidence-based approach to occupational health and safety issues.

The ASCC and NOHSAC have recognised that there is a need for the development of comprehensive data on occupational disease to assist in the benchmarking of national OHS performance and guide prevention initiatives. In April 2005, NOHSC agreed to the development of a National Hazard Exposure Surveillance Strategy. NOHSAC has also identified a need for information on occupational exposures. Subsequently, the ASCC and NOHSAC have commissioned Dr Tim Driscoll, a medical doctor who is a specialist in occupational medicine and public health medicine, to conduct a review of Australian and New Zealand workplace exposure data collection systems. The information collected from the survey will be used in preparation of a report for this review.

The Office of the ASCC is also planning a workshop on exposure surveillance in June 2006 and survey respondents with relevant data will be invited to attend this workshop. The discussions during this workshop will form the basis of a paper for consideration for the ASCC and NOHSAC on the development of a national exposure surveillance strategy.

We would like to thank you for participating in this survey and for helping us build our knowledge on occupational disease hazard exposure data to inform better prevention initiatives.

Yours sincerely,

Sandra Parker	Mark Wagstaffe
Group Manger	Project Manager
Office of the ASCC, DEWR	NOHSAC

APPENDIX 3: LIST OF ORGANISATIONS INCLUDED IN THE SURVEY

ACROD – National Industry Association for Disability Services

ACT Health

ACT Workcover

Agrifood Industry Skills Council

Alcoa

Almond Board of Australia

Animal Health Australia

Ansell

Apple and Pear Australia Limited

Association of Mining & Exploration Companies Inc (AMEC)

Asthma and Allergy Research Institute

AusBiotech

AUSTMINE

Austool Ltd

Australasian Faculty of Occupational Medicine

Australasian Faculty of Public Health Medicine

Australasian Institute of Mining and Metallurgy

Australasian Railway Association

Australian Aluminium Council

Australian Avocado Growers Federation

Australian Banana Growers Council Inc.

Australian Bureau of Transport and Safety

Australian Business Limited

Australian Centre for Mining Environmental Research (ACMER)

Australian Chamber of Commerce and Industry

Australian Cherry Growers Association

Australian Citrus Growers Incorporated

Australian Coal Association

Australian Coal Research Laboratories ACIRL Pty Ltd

Australian Coal Research Limited

Australian College of Occupational Nurses

Australian Concrete Repair Association

Australian Council of Trade Unions

Australian Custard Apple Growers Association

Australian Dairy Farmers Limited

Australian Die Casting Association

Australian Electrical and Electronics Manufacturers' Association

Australian Flower Export Council (AFEC)

Australian Food and Grocery Council

Australian Forest Growers

Australian Fruit Juice Association

Australian Furniture Removers Association

Australian Garlic Industry Association (AGIA)

Australian Gas Association

Australian Gold Council

Australian Healthcare Association

Australian Honey Bee Industry Council

Australian Industry Group

Australian Institute of Health and Welfare

Australian Institute of Occupational Hygienists

Australian Institute of Petroleum

Australian Livestock Transporters Association

Australian Logistics Council

Australian Macadamia Society

Australian Manufacturing Workers' Union

Australian Maritime Safety Authority

Australian Meat Industry Council

Australian Mushroom Growers' Association

Australian Nashi Growers Association Ltd.

Australian Nursing Federation

Australian Olive Association

Australian Onion Industry Association

Australian Paint Manufacturers' Federation

Australian Paper Industry Council

Australian Pesticides and Veterinary Authority

Australian Petroleum Production & Exploration Association Ltd

Australian Pipeline Industry Association

Australian Pork Limited

Australian Private Hospitals Association

Australian Processing Tomato Research Council

Australian Radiation Protection and Nuclear Safety Authority

Australian Rail Track Corporation Ltd

Australian Road Train Association

Australian Seafood Industry Council

Australian Services Union

Australian Steel Institute

Australian Trucking Association

Australian Vegetable and Potato Growers Federation (AusVeg)

Australian Wine and Brandy Corporation

Australian Workers Union

Avcare

Baker Heart Research Institute

Bionic Ear Institute

BluesScope Steel

BOC

Boral

Burnet Institute

Caltex

Cancer Services, South Eastern Area Health Service

Canning Fruit Industry Council of Australia

Cattle Council of Australia

Cement Concrete & Aggregates Australia (CCAA)

Cement Industry Federation

Centre for Accident Research and Road Safety-Queensland (CARRS-Q)

Centre for Clinical Epidemiology and Biostatistics

Centre for Ergonomics and Human Factors

Centre for Military and Veterans' Health, University of Queensland

Centre for Occupational and Environmental Health (Healthwise project)

Centre for Occupational Health, Department of Defence,

Centre for Work, Leisure and Community Research, Griffith University

Charles Sturt University

Cherry Growers of Australia

Chestnut Growers Association of Australia

Civil Aviation Safety Authority

College of Health Science

Comcare

Community Services and Health Industry Skills Council

Concrete Institute of Australia

Concrete Masonry Association of Australia Limited

Concrete Pipe Association of Australasia

Construction, Forestry Mining and Energy Union

Cotton Australia

Council of Textile Fashion Industries of Australia

CSL

Dairy Australia

Department of Consumer and Employment Protection

Department of Health and Ageing

Department of Health and Chiropractic, Macquarie University

Department of Health and Human Services, Tasmania

Department of Human Services, Victoria

Department of Industry and Tourism Resources

Department of Natural Resources and Mines

Department of Planning and Infrastructure

Department of Primary Industries, Water and Environment, Tasmania

Department of Veterans Affairs

Division of Research and Development, Murdoch University

Engineers Australia

Environment ACT

Environment and Biotechnology Centre

Environment Protection Agency QLD

Environment Protection Authority South Australia

Environment Protection Authority Victoria

Environment Protection Authority WA

Faculty of Science, University of Technology

Faculty of the Sciences, University of New England

Faculty of the Sciences, University of Southern Queensland

Farmsafe

Federation of Automotive Manufacturers

Food Industry Machinery Manufacturers Association

Forest and Forest Products Employment Skills Company

Garvan Institute of Medical Research

Graduate School of Public Health, University of Wollongong

Grains Council

Griffith Health

Hardy Wine Company

Health Services Union

Hearing Services Australia

Heart Research Institute

Housing Industry Australia

Institute for Sustainable Resources

Institution of Surveyors

Lundbeck Australia

Maritime Union of Australia

Master Builders Australia

Master Plumbers' and Mechanical Services Association of Australia

Meat & Livestock Australia Limited

Medical Industry Association of Australia

Medicines Australia

Menzies Research Institute

Menzies School of Health Research

Merck, Sharp and Dohme

Minerals Council of Australia

Minerals Industry Safety & Health Centre

Mundipharma

National Association of Forest Industries

National Centre for Epidemiology and Public Health

National Centre in HIV Epidemiology and Clinical Research

National Farmers Federation

National Precast Concrete Association Australia

National Union of Workers

NICNAS

Novartis

NSW Department of Environment and Protection

NSW Department of Health

NT Worksafe

Nursery & Garden Industry Australia

Optus

Packaging Council of Australia

Petroleum Exploration Society of Australia

Pistachio Growers Association Incorporated

Plastics and Chemicals Industries Association

Printing Industries Association of Australia

Public Health Information Development Unit, The University of Adelaide

Queensland Health

Rail, Tram and Bus Union Australia

Research Centre for Injury Studies

Rice Growers Association of Australia

Rural Training Council of Australia

SA Department of Health

SA Department of Health

Safework SA

School of Biomedical and Health Sciences, University of Western Sydney

School of Health and Physical Education, University of Notre Dame

School of Health and Social Development, Deakin University

School of Health Sciences, RMIT University

School of Health Sciences, University of Canberra

School of Health Sciences, University of Queensland

School of Health Sciences, University of South Australia

School of Health Sciences, Victoria University

School of Medicine, University of Melbourne

School of Nursing and Healthcare, Southern Cross University

School of Public Health and Community Medicine, University of New South Wales

School of Public Health, Curtin University

School of Public Health, Tropical Medicine and Rehabilitation Services, James Cook University

School of Science and Engineering, University of Ballarat

Sheepmeat Council of Australia

Shell Australia

Skin and Cancer Foundation Australia

Smorgon Steel Group

South Australian Wine Industry Association

Strawberries Australia Inc.

Sustainable Minerals Institute

TDT Australia

Telstra

The National Association of Agricultural Educators

Tooling Industry Forum of Australia

Transport Workers' Union of Australia

Unilever Australia (Holdings) Proprietary Limited

Vario Health Institute, Edith Cowan University

Victorian WorkCover Authority

Wool Producers

Workcover NSW

Workplace Health and Safety Queensland Department of Industrial relations

Worksafe WA, Department of Consumer and employment protection

a) Main disease states of primary concern, and their associated hazards

b) For each of these diseases separately, what are the main hazards for which surveillance is needed?

Any surveillance of carcinogenic exposures should focus on occupational exposures that have been strongly linked to one or more malignancies. Information on this can be obtained from many sources. Two recent relevant sources were used to prepare the list shown in Table 1[xxii].

TABLE 1 Malignancies for which there is strong evidence of occupational causation and the associated occupational exposures

CONDITION	OCCUPATIONAL EXPOSURES FOR WHICH THERE IS STRONG EVIDENCE OF CAUSATION
Leukaemia	ionising radiation, benzene and ethylene oxide
Lung and bronchus	asbestos, arsenic, beryllium, cadmium, chromium VI, diesel fumes, nickel, radon, silica, soots, coke oven emissions, bis (chloro-methyl) ether, and environmental tobacco smoke
Lymphoma – Hodgkin's	wood dust
Lymphoma – Non Hodgkin's	phenoxy herbicides (dioxin), chlorophenols and halogenated hydrocarbon solvents
Sino nasal carcinoma	wood dust, leather and work with welding, flame cutting and soldering
Naso pharyngeal carcinoma	formaldehyde
Larynx	sulphuric acid mists, asbestos and organic solvents
Skin (non melanoma)	arsenic, polycyclic hydrocarbons (coal tar products) and sunlight
Mesothelioma	asbestos
Bladder cancer	aromatic amines and poly-cyclic hydrocarbons (and there is good evidence for paints, dyes, chlorinated hydrocarbons, and other solvents, metals and industrial oils/cutting fluids)
Soft tissue sarcoma	dioxin

Therefore, the potential exposures that are reasonable candidates for consideration for inclusion in exposure surveillance appear to be:

aromatic amines, arsenic, asbestos, benzene, beryllium, bis (chloro-methyl) ether, cadmium, chlorinated hydrocarbons, chlorophenols, chromium VI, coke oven emissions, diesel fumes, dioxin, dyes, environmental tobacco smoke, ethylene oxide, flame cutting, formaldehyde, halogenated hydrocarbon solvents, industrial oils/cutting fluids, ionising radiation, leather, metals, nickel, organic solvents, paints, phenoxy herbicides (dioxin), poly cyclic hydrocarbons, radon, silica, soldering, soots, sulphuric acid mists, sunlight, wood dust and work with welding.

Which of these to choose depends on many factors. Anthony Hogan suggested some criteria in an email he sent on 28/3/2006. These are used here to guide selection of a few key exposure candidates:

1. Long-latency disease

All of the above conditions are long-latency diseases.

2. There is a disconnection between hazard exposure and disease onset such that the dangers of the hazard can readily be misperceived in the workplace or be attributed to other factors

All of the cancers mentioned above also have non-occupational causes.

xxii Driscoll T, Dryson E, Feyer A-M, Gander P, McCracken S, Pearce N, Wagstaffe M. *Review of Schedule 2 of the Injury Prevention Rehabilitation Compensation Act 2001 (IPRC Act)*. NOHSAC: Wellington, 2006;
Driscoll T, Mannetje A, Dryson E, Feyer AM, Gander P, McCracken S, Pearce N, Wagstaffe M. *The burden of occupational disease and injury in New Zealand*. Technical Report. Wellington: NOHSAC, 2004.

3. The disconnection acts as a barrier to effective preventive action

The connection between an occupational exposure and the development of cancer is very difficult to establish in any individual case. This means that the contribution of occupational exposures to the development of cancer in the community is commonly under-estimated.

4. Magnitude of the problem (number of people affected)

There are no good Australian data on either the number of people exposed to carcinogens or the number of people with occupational cancer. However, a soon-to-be-published paper[xxiii] has made estimates of both of these. The paper estimates that about 5,000 invasive cancers and 34,000 non-melanoma skin cancers are caused each year by occupational exposures, and that about 1.5 million workers are currently exposed to known carcinogens. Of the conditions listed in Table 1 (page 77) (conditions for which there is strong evidence of occupational causation), the most common occupationally-caused cancers are lung (1,680 per year), mesothelioma (370), bladder (309), non-Hodgkin's lymphoma (301) and leukaemia (290).

This suggests that the candidate exposures can be usefully narrowed to aromatic amines, arsenic, asbestos, beryllium, bis (chloro-methyl) ether, cadmium, chlorophenols, chromium VI, coke oven emissions, diesel fumes, environmental tobacco smoke, halogenated hydrocarbon solvents nickel, phenoxy herbicides (dioxin), poly cyclic hydrocarbons, radon, silica and soots.

The remainder of Anthony's suggested criteria are relevant to all these exposures to a similar extent.

5. Severity (extent of impact on individuals/society)

Cancer has a profound impact on the affected individual and their family, and work-related cancer appears to be a significant problem in developed countries, including Australia. This criterion wouldn't help choose one exposure type over another, except perhaps to put non-melanoma skin cancer lower on the priority list because the condition is often less severe.

6. Absence of adequate data

There are no good Australian data on the carcinogens used in workplaces, the level of exposure to known carcinogens, or the number of people exposed to carcinogens.

7. National standards work (development or revision) currently being undertaken

8. Support exists within the jurisdiction(s) and/or workplaces to act on this issue

9. Surveillance activity is linked to practicable risk reduction

This would depend on the system that is put in place.

10. Risk reduction strategy has a conceptual framework for action that addresses the specific dynamics of the disease of interest as it manifests itself in workplaces

This would depend on the system that is put in place but it is reasonable to expect that this would be the case.

11. Builds the national capacity to understand and act to eliminate occupational diseases and the processes that generate them

This would depend on the system that is put in place but it is reasonable to expect that this would be the case.

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xxiii Fritschi L, Driscoll T. Cancer due to occupation in Australia. *Australian and New Zealand Journal of Public Health*, 2006. In press.

OVERALL RECOMMENDATION FOR EXPOSURES TO TARGET FOR SURVEILLANCE

On the basis of estimates of how many workers might be exposed, and what the relative levels of the exposures might be, it is suggested that asbestos, diesel fumes, halogenated hydrocarbon solvents, poly-cyclic hydrocarbons and silica be the first candidates for consideration for exposure surveillance. However, this decision should be subject to review following consideration of exposure prevalence and levels by occupational hygienists.

APPENDIX 5: PROPOSED EXPOSURE SURVEILLANCE MATRIX FROM BROOKE ET AL, 2005

Reproduced from Brooke et al, 2005: *International review of surveillance and control of workplace exposures*[1]

TABLE 20 Matrix of surveillance system categories and OASCC and NOHSAC priorities

OUTCOME	HAZARD															
	CHEMICAL				PHYSICAL				BIOLOGICAL				PSYCHOSOCIAL			
SURVEILLANCE SYSTEM TYPE	INTEGRATED SYSTEMS	WORKING CONDITIONS SURVEYS	WORKPLACE OBSERVATIONS; OHS SERVICES DATA	REGISTERS	INTEGRATED SYSTEMS	WORKING CONDITIONS SURVEYS	WORKPLACE OBSERVATIONS; OHS SERVICES DATA	REGISTERS	INTEGRATED SYSTEMS	WORKING CONDITIONS SURVEYS	WORKPLACE OBSERVATIONS; OHS SERVICES DATA	REGISTERS	INTEGRATED SYSTEMS	WORKING CONDITIONS SURVEYS	WORKPLACE OBSERVATIONS; OHS SERVICES DATA	REGISTERS
Respiratory disease	●	✔	●													
Occupational cancer			✔ ●	✔ ●												
Contact dermatitis		✔ ●	●													
Infectious and parasitic disease									●	✔		●				
Cardiovascular disease													●	✔	●	
Musculoskeletal disorders						✔	●									
Mental or neuropsychiatric disorders													●	✔	●	
Noise-induced hearing loss						✔	●									

● *Best approach for the surveillance of exposures in relation to priority outcomes reviewed within literature and through survey work.*
✔ *Potentially most applicable system for the surveillance of exposures in relation to priority outcomes in Australia and New Zealand, based on literature and field work.*

NOHSAC

National Occupational Health and Safety Advisory Committee

Komiti Tohutohu Mahi A-Motu Hauora me te Haumaru