



Priorities in Occupational Health and Safety

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Symposium in Health Research and Policy

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Introduction

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This publication is an edited version of the proceedings of a Symposium on Priorities in Occupational Health and Safety which was held in the Museum Building, Massey University Wellington Campus, 4th September 2002. The Symposium was supported by funding from Occupational Safety and Health (OSH) and Massey University. This was the second in a series of Annual Symposia in Health Research and Policy organised by the Centre for Public Health Research (CPHR). Each Symposium involves a review of current knowledge, both internationally and nationally, followed by a discussion of the implications for policy in New Zealand. Wherever possible, each symposium is organised jointly with a specific Ministry or Government Department which is encouraged to present its

policy framework for comment and discussion.

The 2002 Symposium was jointly organised with Occupational Safety and Health (OSH). The topic of “Priorities in Occupational Health and Safety” was timely since the Symposium was held at a time when the Health and Safety in Employment Amendment Bill was being considered by Parliament. The Bill was controversial, particularly the inclusion of specific reference to occupational stress and fatigue, with some Employers considering that the Bill would place an excessive burden upon them in terms of compliance costs. Others considered that the Bill did not go far enough, in that it primarily addressed the problems of occupational injury and did little to address the larger problems of occupational health. In particular it was argued

that OSH had paid disproportionately greater attention to occupational injury, and had neglected problems of occupational health which account for a much greater burden of occupational morbidity and mortality. It was therefore timely to obtain an overview of the current burden of occupational injury and ill-health and to consider the priorities for research and policy.

Professor Jorma Rantanen’s keynote address showed just how far we are behind in addressing these issues in New Zealand. We invited Professor Rantanen not only because of his international standing as Director of the Finnish Institute for Occupational Health (FIOH), but also because Finland is often held up as an example of a small country that is an economic success story which provides a model for New Zealand.

However, in parallel to (and closely integrated with) its economic development, it has taken a very active role in occupational health and safety. Jorma Rantanen's presentation showed that we can learn a great from what Finland has done in the occupational health and safety field, just as we can learn from what they have done in the economic field.

The next session involved a series of presentations on the major occupational health and safety problems including cancer (Dave McLean), injury (John Langley), injury in Māori (Selwyn McCracken), respiratory disease (Malcolm Sim), fatigue (Philippa Gander), and the social and economic consequences of occupational injury and illness (Mary Adams, Rashmi Rajan). These give an overview of the current situation in New Zealand, and provide a striking picture of the burden of occupational injury and illness. Several issues are particularly striking. The first is that even for the field of injury, which has received the most

attention, we really have a long way to go even to be able to identify the size and nature of the problems, let alone to develop effective interventions. Secondly, there is a striking lack of adequate statistics which would enable us to know what the major problems are and to monitor the effectiveness of regulatory changes. Thirdly, there is a particular lack of data on occupational injury and illness in Māori. Fourthly, as had been anticipated, although the burden of occupational injury remains largely unaddressed, there is a much greater burden of occupational illness (including cancer, respiratory disease, and the effects of fatigue) which has received little attention in New Zealand in recent years, and which will only indirectly be addressed by the amendments to the Health and Safety in Employment Act (HSE Act). The striking findings of the Social and Economic Consequences of Workplace Injury and Illness Study (presented by Mary Adams and Rashmi Rajan) show that the consequences of

occupational injury and illness are long-term and represent a significant cost (in both social and economic terms) to workers, employers, the Government, and the economy.

The next two sessions examined the implications for policy including presentations on OSH's priorities for occupational health (Frank Darby), the OSH Occupational Cancer Register (Evan Dryson), intervention research (Anthony LaMontagne), and contributions from CPHR (Dave McLean), the Employers and Manufacturers Association (David Wutzler), the Council of Trade Unions (Bella Pardoe) and OSH (Bob Hill).

The Symposium presentations are presented in edited form in the current publication. This is also available in (free) downloadable pdf format on our website at <http://www.publichealth.ac.nz/>, along with the corresponding powerpoint files for each presentation.



Opening Remarks

Hon Margaret Wilson

Minister of Labour

Thank you for the invitation to open this Symposium on Priorities in Occupational Health and Safety. It is encouraging to see such a large number of you gathered, and I hope the day will be worthwhile and stimulating.

Professor Pearce is to be congratulated for drawing together the group of speakers and developing a programme covering those topics important to individuals,

small businesses, corporations and society. The reputation of the Centre for Public Health Research stands high internationally and I would like to thank him and the Organising Committee for taking this initiative.

May I particularly welcome the overseas speakers, Professor Jorma Rantanen from Finland, and Dr Anthony LaMontagne and Associate Professor

Malcom Sim both from Australia. We welcome you to New Zealand and hope your visit is enjoyable. We look forward to learning from your experiences and from the opportunity to see New Zealand's situation from a different perspective.

The Symposium comes at a time when the Government is amending the Health and Safety in Employment Act.

The Health and Safety in Employment Amendment Bill

The primary objective of this Bill is to improve security and productivity for all New Zealanders, through better health and safety management at work.

It completes the final piece of the government's legislative framework for the improvement of workplace health and

safety management in New Zealand. It follows logically alongside legislation introduced for improved employment relationships based on good faith and trust (the Employment Relations Act) and for improved injury prevention practice by ACC (through the Injury Prevention,

Rehabilitation and Compensation Act).

A key change in this Bill is the introduction of the principle of good faith, and the concept of consultation and co-operation to achieve best possible practice.

Its aim is to develop strong health and safety awareness and co-

operative cultures in all workplaces. It encourages best practice rather than the adoption of “one size fits all” standards, providing opportunities for employers and employees to work together to develop the right approach for the needs of their particular workplace.

Experience shows that high levels of prescription or regulation by government will not achieve cultural or

behavioural change and will not achieve strong cultures of workplace safety, and it is simply not possible for legislation to provide solutions for every workplace hazard. Therefore the Bill continues the thrust of the existing, 10-year-old, legislation.

While the present legislative framework is sound, and its enabling language must be retained, it does not go far enough to encourage

the development of workplace cultures which make health and safety real priorities. Therefore, this Bill provides tools to those who are most likely to have effective solutions for managing health and safety in workplaces, i.e. employers and employees.

We want this new, practical, health and safety culture to cover everyone, everywhere.

Key Changes

To achieve the goals I have outlined, the Bill includes changes in three broad areas – coverage, participation and enforcement.

- *Comprehensive coverage.* The legislation must be clear and easily applied across the full range of New Zealand’s workplaces. For the first time aircrew, maritime and rail workers, and volunteers are covered explicitly.
- *Full participation* requires improved levels of co-operation between employers and employees in the management of

workplace health and safety. This improved opportunity to influence behaviour in the workplace for the first time makes clear not only the right of employees to participate, but the corresponding responsibility placed upon them. Safe workplaces require commitment from both parties.

- *A range of appropriate enforcement tools* are required to provide an effective deterrent to poor injury prevention practice and to demonstrate the seriousness with which human life and well

being should be taken in the workplace. These tools will be matched within the Occupational Safety and Health Service by a commitment to assisting workplaces as they work to establish best practice.

None of this is threatening. All of it is designed to take us forward.

Essentially, that’s what the Health and Safety in Employment Amendment Bill is about:

- safe workplaces through best practice
- based on positive relationships

- with clear guidelines for everyone.

The Bill is not about turning the world on its

head. It is about creating a workplace culture where health and safety is a real priority, and it builds on the existing

legislation through small, but significant steps.

The Occupational Health Dimension

One important dimension, which will be welcomed by a group such as this, is the significance the Bill places on health. It recognises that the health dimension of workplace health and safety – including workplace stress and fatigue – has not been given the attention and emphasis overseas and New Zealand research suggests it deserves.

The Bill proposes increasing the limitation period for bringing an action under the Act to six months from the time when the breach became known or should have become known to an inspector. There is also provision to apply to the District Court to extend this time in certain circumstances. This is particularly important in situations of occupational illness where symptoms may only appear some years after exposure.

While we have made valuable progress, identifying and

effectively tackling the causes of work-related ill health remains intrinsically difficult, and success, in terms of preventive measures, continues to elude us. Time scales - between the time of exposure and the manifestation of health effects and the developing of successful controls - are often long.

Meanwhile, people's health is still affected by work activities and the cost of ill health caused or made worse by work is substantial. But the perception of "it won't happen to me" is reinforced by the time lapse between the event and health symptoms, and between symptoms and the implementation of management control systems.

In some cases, good practice or changes in industrial structure have almost eliminated previously common illnesses, although the legacies of past practice unfortunately remain

with us. Asbestos is a case in point.

To address occupational health issues, we are aiming to improve the Notification of Occupational Disease System (NODS). On a local level, OSH and ACC are exploring how occupational disease data may be used to extend the use of the notification system. However, to my mind, an important barrier in getting occupational health on the health and safety agenda is that we do not know - and have not been able to demonstrate - the full extent of the problem or issue so far. We are taking steps to address this lack of knowledge so proactive prevention can be targeted intelligently.

One positive development is Cabinet's "in principle" agreement to include occupational disease as part of the definition of injury for the injury data framework. As a result, the Department of Labour is developing a

long-term project that aims to improve occupational disease information. Until we have a well developed and robust national view of injury - including occupational illness and disease - then we will be well off the mark in terms of effective prevention strategies.

Simply stated, limited resources require intelligent targeting, and intelligent targeting must be driven by quality information.

A further development is the Government's proposed Ministerial Inquiry into the Effect of Chemicals on Employees. The inquiry is prompted by the adverse health consequences experienced by persons working in the health, printing, and manufacturing industries who have been exposed to chemicals such as glutaraldehyde, other aldehydes, and solvents.

I expect the inquiry will identify any gaps in the management of these particular hazardous substances in those

industries, and identify possible ways of improving the management of hazardous substances in those industries and others.

I will announce further details of the timing and terms of reference of the inquiry once these have been agreed by Cabinet.

Finally I wish you well in your deliberations and look forward to the results of your discussions.



Occupational Health and Safety in the 21st Century

Jorma Rantanen

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Occupational health is needed today, and in the future, more than ever. We once thought that we would be so effective in

prevention of occupational disease that we would eliminate ourselves, as it is the doctrine of preventive medicine in general.

However, a new era has started for occupational health, and we are now needed more than ever.

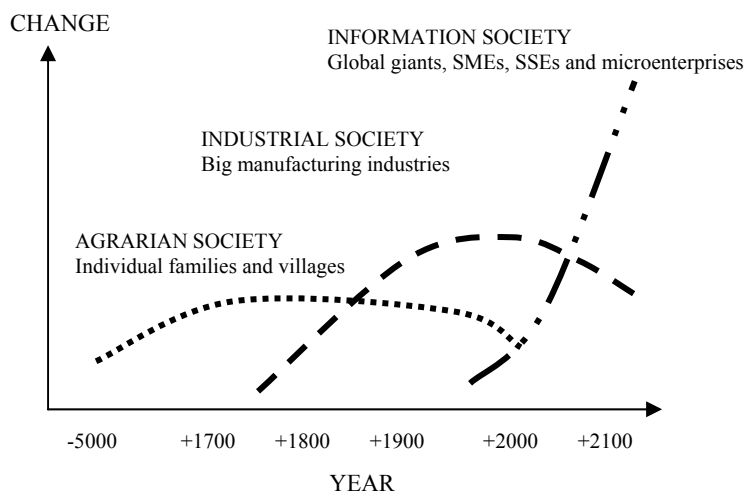
New Trends at the Macro and Micro Level

Figure 1 shows three phases of development of economic structures, each with its own characteristics. Agriculture society has existed for more than

5,000 years. That era is not totally finished, we still continue to work with agriculture products today. About 250 years ago we started industrial production, and now in

less than 20 years we have a new society which is called the “information society”. The infrastructures, rules of the game, problems and balances are very

Figure 1: Three phases of development of economic structures, each with special types of enterprises



different in these different types of setting, and we are now living in all of them at the same time. Agriculture has not gone away, industry has not gone away, and the information

society is now here. We have to deal with the problems and challenges of all of these. This is going to continue for at least ten to fifteen years. So we really are in a very

important period of our development, because we cannot ignore the traditional hazards of the work, but we also have to sort out new challenges and needs simultaneously.

Globalization

Globalization can be defined as an increase in the total world economic activity as a consequence of the liberalization of trade and the elimination of the hindrances to the transfer of capital, goods

and services across borders (Rantanen, 1999). Widespread use of communication and information technologies facilitates such interactions. In practice, globalization is seen as

growing economic investments, as an increase in direct foreign investments, and as an increase in world trade faster than the world total production.

Table 1: States and corporations in the global system

Country/company	Total GDP or sales (billions)
Indonesia	174.6
General Motors	168.8
Denmark	146.1
Ford	137.1
South Africa	123.3
Toyota	111.1
Shell	109.8
Norway	109.6
Poland	92.8
Portugal	91.6
IBM	72.0
Malaysia	68.5
Venezuela	59.0
Unilever	49.7
Egypt	43.9
Nigeria	30.4

We have a number of changes in working life due to globalization and changes in information

technologies. The most important changes are in the organizational enterprise. Table 1 shows

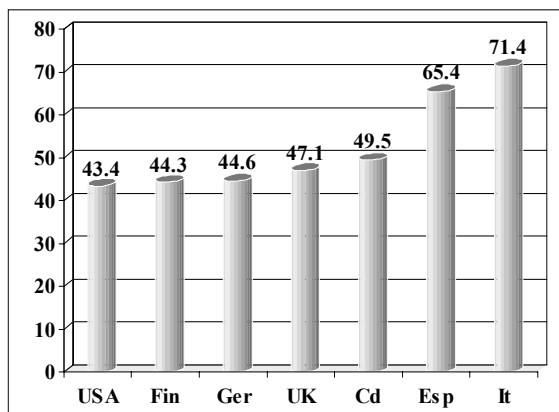
that some corporations are bigger economies than individual countries. For example, General

Motors has a larger economic volume than the national economy of Denmark, while Ford, Toyota and Exxon each constitute a larger economy than Norway, Poland, or Portugal. The top five multinational corporations exceed the total economic volume of the thirty least-developed countries by more than ten-fold, and they have a larger economy than South Asia and Sub-

Saharan Africa together. This situation implies that the policies in work life and the resources allocated for developing work life by multinational companies are of utmost importance. There may also be differences between the policy of a global multinational corporation and the national policies on occupational health and safety. Fortunately, many of the leading

companies have adopted a responsible policy, and even transfer good examples and practices to the areas where they operate, but less positive examples also exist. There is a universal need to study the effects of globalisation on health and safety at work and to provide scientific bases for universal minimum standards for work conditions.

Figure 2: Proportion of employees of small enterprises (<100) out of total workforce (%)



Fragmentation

Simultaneously, as the bigger companies get bigger, the smaller companies get smaller. About 85% of European Union's 158 million workers are working in small facilities, with 15% in bigger companies.

Figure 2 shows how Finland and the USA still are pretty much dominated by big companies, but the trend is very rapid towards fragmentation. This involves smaller independent

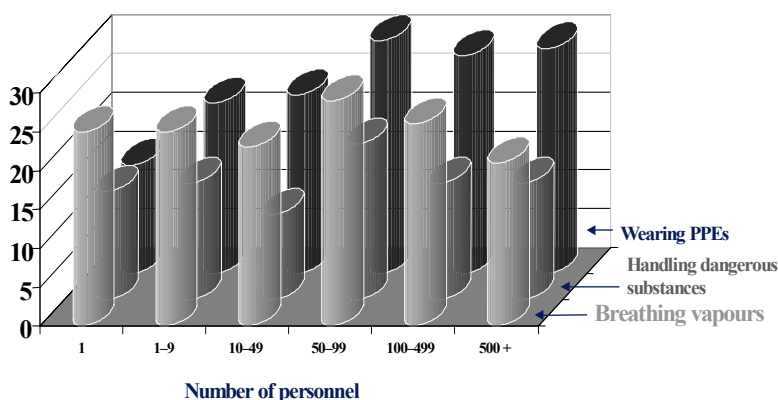
decentralised units that often work as networks, outsourcing activities to smaller units, subcontracting, and developing flexible work organisations. We will soon have the diametric situation where we have

50,000 giant companies, but 97%-99% of companies are very small

at national level, operating locally and also

serving the bigger multinationals.

Figure 3: Company size and working conditions



This has certain consequences for occupational health. The risks in smaller companies are usually higher than in the big companies. The reason is that the bigger companies have more specialized resources, including occupational health physicians, safety officers, safety chiefs, and industrial hygienists (figure 3). The middle sized and smaller companies, who have all of the chemicals and all

of the technology, but less resources to take care of occupational health, probably involve the highest risks. However, the general work climate and the relationships between managers and workers and the degree of self-steering seem to be more favourable in small and medium-sized enterprises (Bergström et al, 1997). The fragmentation of work life is likely to grow in the future, and therefore the problems of

small enterprises deserve more attention. Important research questions are how to get sufficient information on conditions of work, health and safety in small and medium-sized enterprises, how to make such small enterprises and self-employed persons effective users of occupational health research, and how to provide them with the services needed for improving their work conditions.

Demographic Trends

The demography of the world's six billion population as a whole is

aging due to two macro-scale trends. Firstly, population growth has

declined to an average level of 1.5% a year, and, secondly the improved

health situation has substantially increased life expectancy in almost all countries of the world (WHO, 1999). Particularly, the industrialized countries and, first of all, Western Europe and Japan, face the challenge of their 600 million work force aging in the next 2-3 decades (WHO, 1998). There is growing concern about the development of old-age dependency ratios and the sustainability of social security schemes (OECD, 1998). The question of postponing retirement ages and preventing the exclusion of workers from work because of age are topical issues on the political agenda. A likely development, which is already visible in some countries, is the elevation of the stipulated retirement age

by two to three years to correspond to increased life expectancies. A prerequisite for the success of such new policies is good health and work ability, sufficient competence and skill, and the ability to change to acceptable new jobs.

Simultaneously with the aging work force, a shortage of young labour is foreseen, and therefore higher productivity pressures are expected for those in the middle of their work life. In view of such future trends, which are likely to continue up to 2030, one of the key research challenges is to ensure the work ability of aging persons and to ensure their participation in active work life up to the stipulated retirement age. This effort requires the

adaptation of work to the worker and the promotion of his or her health, work ability, competence, and skill to correspond with the new job demands. In many countries the workforce reserves will be recruited to the workforce in the next decade, and the most important source will be the women of working age. We also need research on the effect of aging on both physical and mental work capacity. Particularly, the question of the ageing individual as the user of modern information technology, and the development of age-related criteria for information technology and information-intensive work, needs to be answered in the next decade (Rantanen and Lehtinen, 1998).

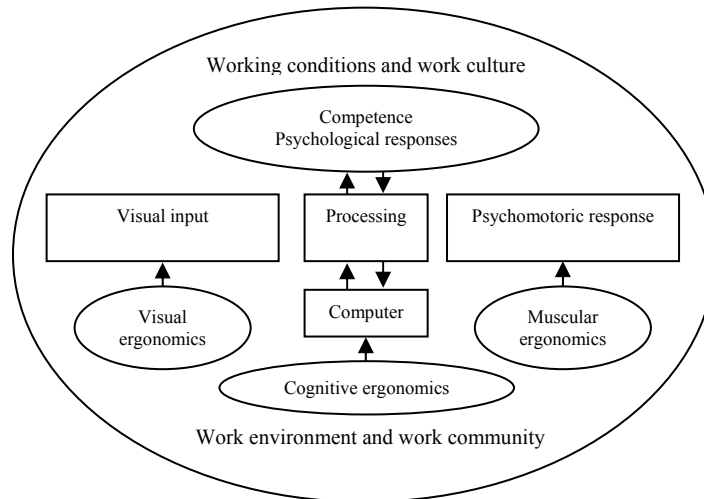
New Technology

The introduction of information and communication technologies (ICT) has grown with accelerating rates in all parts of the world, and it does not show any sign of levelling off (World Bank, 1999). In the industrialised countries, such as Finland, 50-100% of employees use

computers at work. The use of the new information and communication technologies will make several "old skills" outdated, and simultaneously new competence profiles will be generated. New ICT occupations are the most rapidly growing groups of employees in general,

and even in the countries with relatively high unemployment rates, such as Finland, there is a severe shortage of ICT experts. New technologies also change the job contents, organisation of work, and competence demands for workers (figure 4).

Figure 4: Human-technology interface in modern information work



There is a major research question about how best to adjust the new technology and the new complex work environment to the competence, work ability, and aspirations of people at work, and how to ensure the long-term sustainability and productivity of the new human-technology relationships. Research is needed in three main areas: (i) the demands on the visual and auditory sensory system in the design of information and communication technologies; (ii) cognitive ergonomics in the computerized information-intensive work; and (iii) the manual ergonomics of ICT worksites and the

organisation of information work.

The foreseeable IT developments indicate increasing mobility of well-equipped communication tools and mobile worksites. This situation implies the possibility to work increasingly at any time and place without the limitations of a fixed worksite. How such “nomadic” work will be organised in the long term, and how to ensure health and safety, remains to be researched.

The new information and communication technologies have made many old jobs outdated, and the new jobs that have been generated have totally new competence

demands. At least in the transition phase, the risk of unemployment is expected to increase as a consequence of the use of the new information and communication technologies (Freeman and Soete, 1994), and the most pessimistic estimates predict high chronic unemployment in the future (Rifkin, 1996). The adverse effects of unemployment on health and work ability have been found to increase as the duration of the unemployment increases. Research is needed to design strategies for preventing a negative health impact and for promoting employability and the maintenance of work ability during unemployment (Ilmarinen et al, 1997).

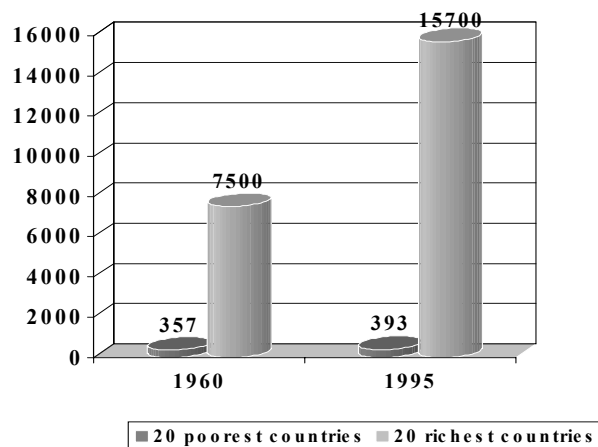
Development

Paradoxically, during the times of globalisation, as the gross national product of the world has grown at the rate of 3-5% a year and trade has grown even more (7% per year on average) the developing countries have suffered economically. Part of this is because agriculture workers

have lost their earnings, on the global scale, because of globalisation. In fact, the share of agricultural products in world trade has been halved during the past twenty years, in the period when the high-tech products have doubled in importance in world trade. If the prices of the products are lower, than the

salaries of the workers also are lower. That means that relatively, the workers in primary products in developing countries have lowered incomes and lowered standards of living in general. This is probably true for the forty or fifty so called "least developed countries" (LDC).

Figure 5: Widening gap in per capita income (in US\$) between rich and poor countries



This has also widened the gap between poor and rich countries. Figure 5 shows how we in the industrialised countries have increased our wealth in the past thirty years very effectively, whereas these LDCs

have not increased their wealth at all. To get sustainable development we cannot think only one dimensionally, we have to address the employment issues (800 million unemployed in the world), the social

dimension (including health and safety), and the environmental dimension, as well as the economy, productivity and competitiveness.

It is often assumed that occupational health (and

the social dimension in general) and competitiveness are in contradiction. We have been able to show that this doctrine is not true. There is even good data to show that the more

funding and effort you put into health and safety, the more competitive you are. Finland is now the number one country in the world in competitiveness and

productivity, but it still has a very strong social dimension. In fact, we think that our competitive advantage is because of our very strong social dimension, not in spite of it.

The Burden of Occupational Disease

Every year, there are about 270 million occupational accidents and 160 million occupational diseases globally. Of these, about 360,000 accidents and 1,600,000 diseases are fatal. Thus, about two million citizens of the world will die because of occupational safety and health reasons; 90 % of this happens in developing countries.

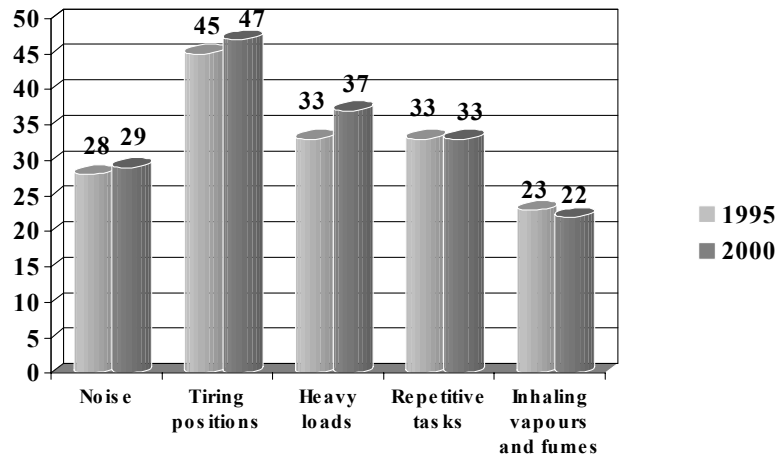
There are some fifty major occupational diseases listed in official lists and textbooks of occupational medicine (WHO, 1995). Many of the industrialized countries see declining morbidity in such traditional diseases as chemical poisonings, pneumoconiosis, vibration-induced vasospastic syndrome, or noise-induced hearing loss, while “work related” diseases increase in occurrence (WHO, 1989). Some of the “old” diseases, such as

asbestos-related cancers, however, will continue to increase still for 2-3 decades (Peto et al, 1995).

In addition to traditional occupational health problems, a number of new problems will also be met with a totally new character and often with a multi-factorial and multi-causal origin. Instead of a search for specific diseases, concern will be focused increasingly on functional capacity and behavioural, environmental and social determinants of work ability, work motivation, and the quality of working life in general. In addition to specific health problems, new aspects, such as productivity, quality of products, innovation, capacity to handle clients, and life-long work ability, are being given growing attention. These outcomes are often ill-defined and cannot

necessarily be measured with existing methods. The inter-individual variation in outcomes may be wide and confounded by several new factors either at work or outside of work. The outcomes, such as the reduction of functional capacity or work ability, can also be very context-dependent. A typical example is the work ability index (WAI), which is dependent on both the capacity of the worker and the demands of the job (Ilmarinen et al, 1997). Another example is the risk of burnout, which is highly dependent on the person’s resources, but also on the context of work and on several factors occurring at the workplace (Maslach, 1994). Such a new development calls for a qualitative research approach to complement the quantitative one.

Figure 6: Percentage of workers in the European Union exposed to various factors

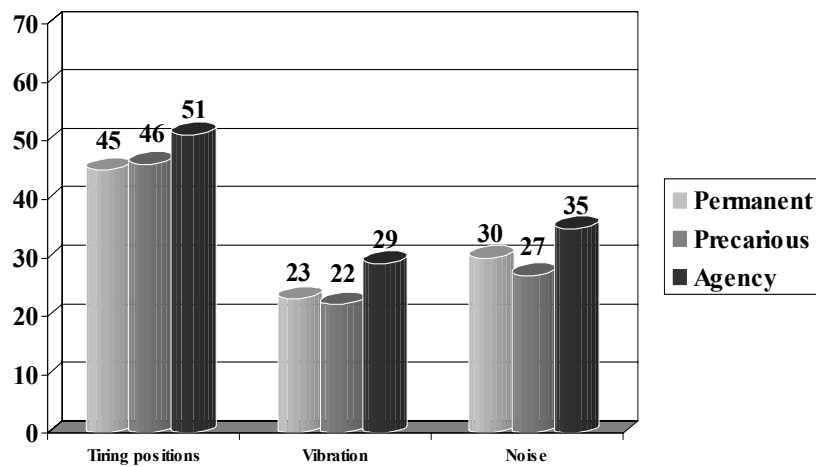


The European Union has strong directives for occupational health and safety. In spite of that, traditional work environment factors are risks for European

workers (figure 6): 30-50% of the 158 million workers in Europe are exposed to occupational and health and safety problems that are very traditional. Furthermore,

these traditional problems have not declined during the past ten years, in fact a slight increase has occurred, so we have not been very effective.

Figure 7: Work status and percentage exposed to physical hazards at work

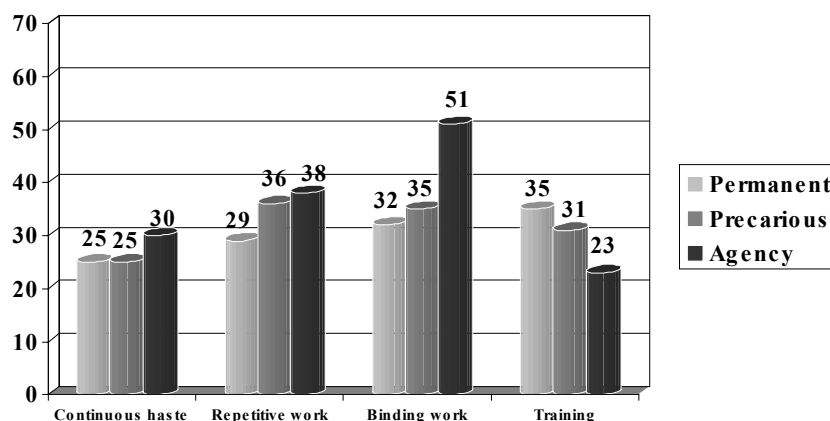


If we consider the conditions of short term employees, whose numbers are growing rapidly as a consequence of flexibility related to globalization, figure 7 shows that the more

short-term and precarious your job is, the more adverse are your working conditions. This is a rule which seems to be valid for every European country including Finland. Positive factors,

such as the opportunities for having training are declining (figure 8). Nobody wants to train the short term worker who may not be at work any more for you in the near future.

Figure 8: Work status and working conditions



Time Pressure

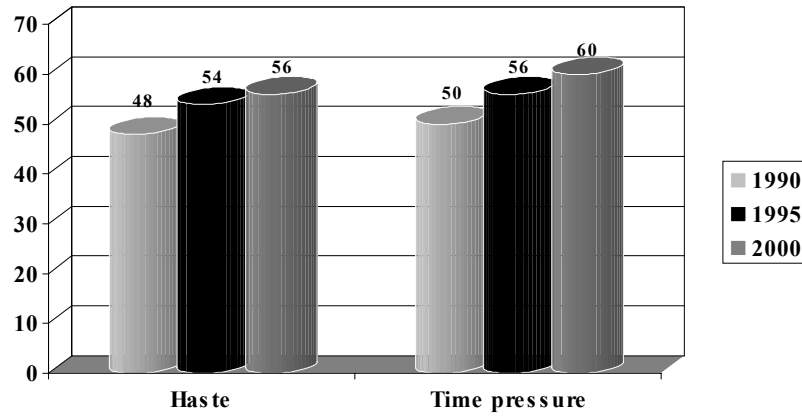
One of the most frightening trends is the growing time pressure in modern working life. This is in some ways paradoxical with all of the new technologies which are supposed to help us. In fact, we are busier than ever in working life, and we are more bound to our work than before (figure 9). About 50% of European workers report such high time pressure at work

that they don't have the opportunity to do work well.

We in Europe have been able to reduce the accident risk at work by 75-80% in the past twenty-five to thirty years period (figure 10). However, the government of Finland is not happy with these figures, and they have declared a new general accident programme to

substantially reduce workplace accidents by the year 2010. In the smaller companies in Finland, the high time pressure and the high stress at work is the number one risk for accidents (figure 11). Thus, we are still at risk for these traditional hazards in the new working environment.

Figure 9: Haste and time pressure at work in the European Union



Musculoskeletal Disorders

In most of the western industrialised countries, musculoskeletal disorders constitute a major cause of work disability and premature retirement. The exposures associated with musculoskeletal

morbidity vary widely, and for only a minor portion of diseases is the etiology known. The musculoskeletal disorders associated with the ageing of working population, with previous traumas and overloads,

heavy work load, and unergonomic work conditions need to be further studied to find the risk exposures, mechanisms of action, and targets for prevention (NIOSH, 1997).

Figure 10: Accidents and fatal accidents at work 1945-99

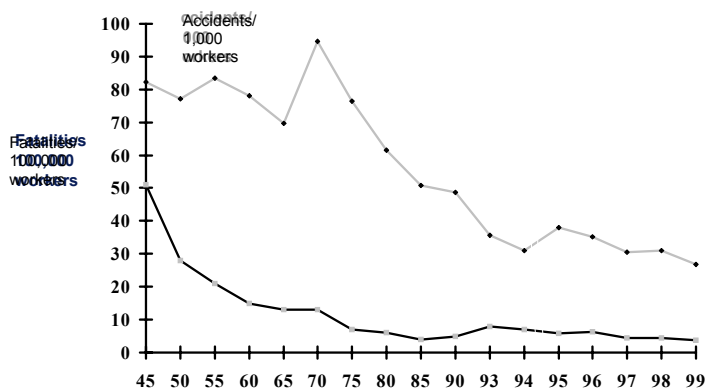
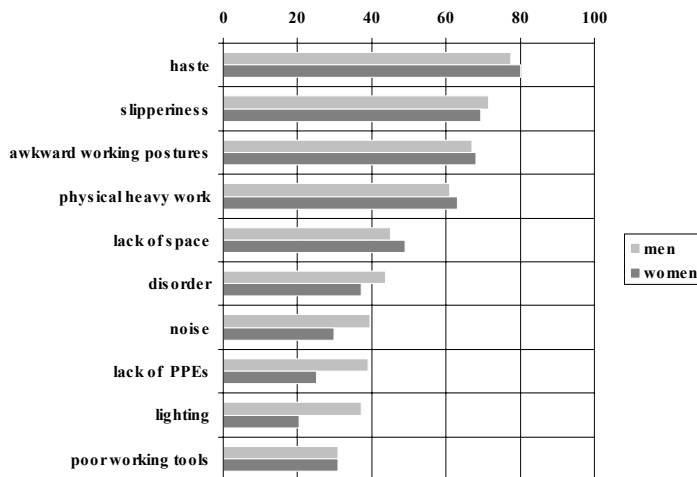


Figure 11: Risk of occupational accidents: % of respondents who reported the factor causing risk “to some extent” or “much”



There is also a need to develop validated methods for the measurement of exposures, and to sharpen the criteria for outcomes, in order to identify in more detail the possible associations between working conditions and health. The development of research on physical work load and the risk of injury of the

musculoskeletal system, particularly in light physical work, such as that done at worksites with visual display units, is also necessary. Simultaneously the combined effects of psychological stress, and un-ergonomic work with hand-arm systems, on musculoskeletal morbidity need to be studied. The challenge for basic research is the

elucidation of the biomedical mechanisms of various musculoskeletal disorders, starting from mechanisms of arthrosis, injury of muscular and connective tissue structures by static and repetitive work load, and ending up with studies on the etiology of chronic muscular and connective tissue pain.

Air Quality

Next of the new diseases are those arising from indoor air problems. This is a typical multi-factorial, multi-mechanisms, multi-outcome problem which is really challenging for

us to study and control. Allergies and other hypersensitivity diseases are gaining more importance in the whole population, and allergies are one of the most rapidly growing groups

of occupational diseases. The increasing hypersensitivity of the young population increases the number of susceptible people entering work. There are several research needs in

relation to occupational allergies, for example the identification and risk assessment of allergens at work, the determination of indicators for immunologic properties of allergenic exposures,

and the development of early and more specific indicators for immunologic hypersensitivity responses. Some new exposures, such as mould contamination in wet buildings and its impact

on health, still require study, and the characterization of exposures, the outcomes, and studies of the casual associations and risk assessment are needed (Andersson, 1994).

Stress-Related Disorders

An increasing prevalence of mental work, the introduction of new technologies with demands for the quick learning of their use, high time pressure, long work hours, unconventional work shifts, information overload, poor work climate at the workplace, high pressure for increased productivity, continuous change, adaptation to new work organizations, uncertainty about continuation of employment, threats of violence at work, and high emotional load in certain care-giving occupations all increase the psychological load of working people and may lead to stress reactions. One of the key issues from the health point of view is the organization of flexible work hours. Several different models have been utilized in Europe, the United Kingdom, and the United States, and these models differ substantially in

their consequences to health (Härma et al, 1998). While the total annual work time has decreased in the past 120 years by 30-50% in the industrialised countries, productivity has grown by 1,000-4,000%, and the gross domestic products of various countries by 500 to 2,600% (Maddison, 1995). Although most of the productivity has been obtained through technology, also better organisation, intensive use, and increased competence of human resources have played a role. Stress is the consequence of the overuse of human capacities at work.

According to recent studies, over 50% of Finnish workers, 54% of workers in the European Union, and equal numbers of workers in the United States perceive high time pressures, growing demands at work, and

long working hours as factors increasing stress at work (Sauter and Rosenstock, 1998). The combination of high demands at work and a low degree of control of work conditions by the employees themselves seems to particularly increase stress reactions. Time pressure at work is one of the factors signalling both a high demand and a low degree of freedom. Continuous unreasonable stress has been found to be associated with elevated risk of somatic diseases, such as coronary heart disease and hypertension (Karasek and Theorell, 1990), and evidence of an increased risk of musculoskeletal disorders under stress is increasing (Westgaard, 1998). A look at the development of the conditions of work in modern work life, and predictions of trends for the next 5 to 10 years, supports the expectation that occupational stress

in its different forms, and derived from different sources, will be one of the major occupational health epidemics of the next decade.

The research challenges are many, including the identification of the factors at work and outside work that contribute to stress, an explanation of wide inter-individual variation in stress reactions, the

development of “objective” indicators for stress reactions and particularly for the risk of ill health, and the development of preventive measures at the individual, workplace, and company level. There is a special need to develop early indicators of psychological overload, and the risk of exhaustion in order to

enable preventive actions in time. Occupational stress is not only an issue of individual stress management capacity, but also a question of work organisation. The optimal way to organise work in view of stress prevention needs to be studied further. A multidisciplinary approach in such research is likely to be the most fruitful.

Making an Impact

We have to find ways to control this situation. Earlier it was much easier when we had one single risk factor, one single mechanism and one single outcome. Now we are in the situation where we have a many factors simultaneously and many mechanisms and an even greater number of outcomes. That means that we have to generate new methods. The individually-oriented approach of course continues to be very important, but we have to develop and use methods and strategies that treat the whole company, the whole work community and the whole work life at large.

A new approach to making an impact in practice for the

development of workers' work conditions, health and safety, and also to supporting the overall development of the enterprise, has been generated in Finland. The approach to the maintenance and promotion of work ability comprises a comprehensive multidisciplinary program for the improvement of health, work ability, safety, work organisation, and management, plus the development of professional competence of both employees and managers. This approach requires the workers' own activity, but it is supported by external occupational health services or by organisational development experts. On

the basis of massive research over the past 20 years, the Finnish Institute of Occupational Health has collected packages of validated methods for good practice in the maintenance and promotion of work ability, particularly for expert use (Rantanen, 1999). The experiences are so far positive. More than 80% of Finnish employees work at workplaces where a work ability program has been implemented, and over 85% of both workers and managers are convinced of the positive impact on health, work ability and the economy of the company. Activity to maintain and promote the work ability of employees is well on its way to becoming an

important instrument for strengthening both the overall development and sustainability of companies and the health and well-being of employees.

It has been argued as to whether we can afford to cultivate the social dimension, but we in Europe think that that's the way we cultivate success, that's the sustainable way to manage the globalising world in the new century. Real sustainable development is dependent on economic growth and competitiveness, it is dependent on the social dimension including health and safety, and it

is dependant on the environment.

Figure 12 summarizes information on the work environment, and figure 13 summarizes information on the prevalence of working time arrangements, in Finland compared to the best and worst European Union countries for each dimension. It is important that we continue to develop indicators that can we use to assess progress in this manner. Many companies are now taking these issues into consideration. Figure 14 shows an example of sustainability scores for a huge Finnish multinational which has

some 50,000 workers in a hundred countries. Dow Jones has produced a so-called Sustainable Index (DJSI) for companies, and you can see the economic dimensions, environmental dimensions, social dimensions and total score. Investors start to look at these graphs, including the social and environmental dimensions. I think this is very promising that in the globalising economy we are getting these kind of comprehensive indicators, and it is quite consistent with the Finnish model of occupational health and safety (figure 14).

Figure 12: Work environment in Finland

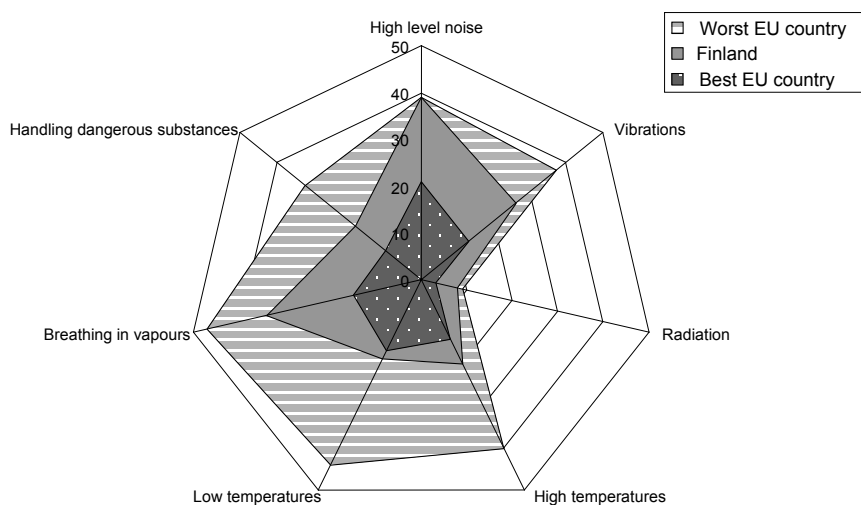
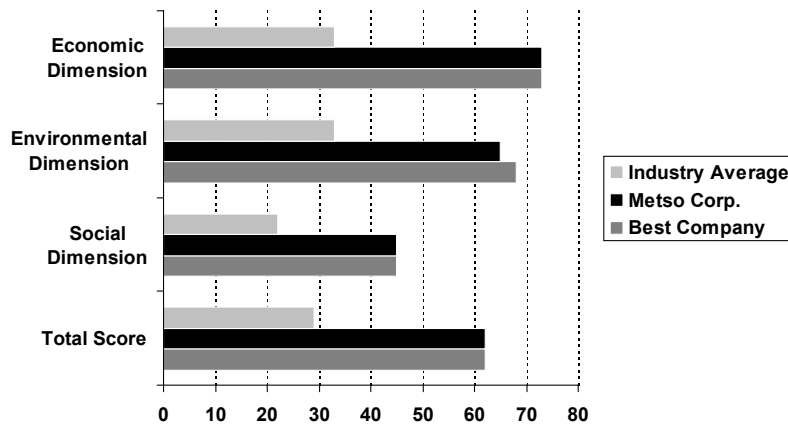


Figure 13: Prevalence of working arrangements in Finland



Figure 14: Dow Jones Sustainability Index (DJSI) Sustainability scores



The final issue is the economic dimension. In Finland, we were challenged to show whether occupational health is profitable or

not, and we were very surprised of the results. We evaluated 200 companies who had implemented the pyramid strategy (figure 15) and

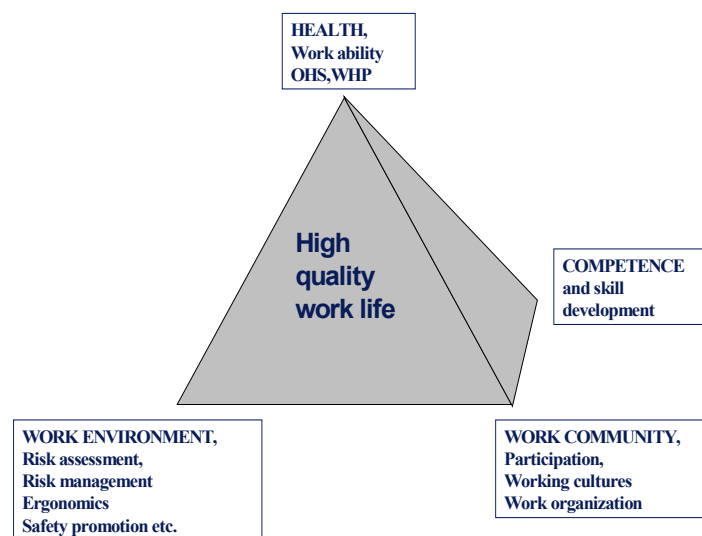
the first calculation came from steel industry. It turns out that the savings from following this strategy were tenfold (i.e. it saved ten times as

much as it cost). Since then we have been studying 200 companies,

large and small, in different sectors of the economy and estimates

of the benefit-cost ratio vary between three-fold and twenty-fold.

Figure 15: Finnish model for occupational health and safety

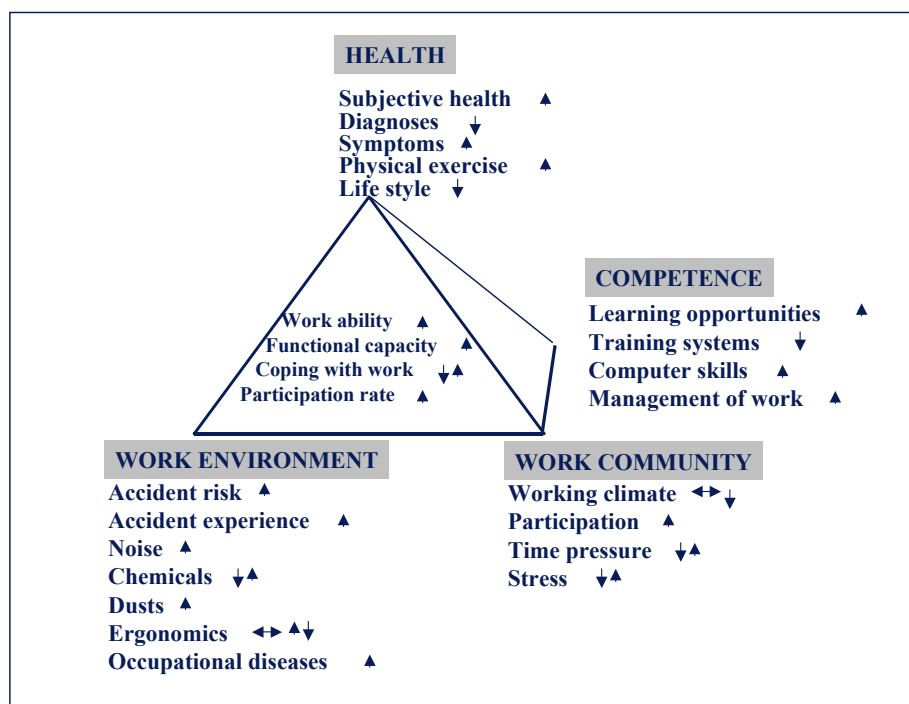


We have also worked nationwide with this new strategy, and it gave also some promising results. Figure 16 shows that the strategy has not only improved health, but has improved work ability also. Regarding the work environment, in some areas we have improved, in some areas because of the new problems discussed above we have worsened the situation. Overall, this strategy seems to respond

relatively well to traditional problems, but also to new problems of modern work life. We are moving away from the specific prevention of occupational disease, to development-oriented occupational health and safety which is not a burden for the company, but an established force which is supporting the objectives of social, economic and environmental development.

In summary, in the 21st century, work life will need occupational health and safety more than ever. New service provision models are needed using a multidisciplinary, comprehensive approach. This approach has been found to not only protect and improve occupational health and safety, but also to improve work ability, competitiveness and development.

Figure 16: Changes in working conditions and work ability 1997-2000



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Occupational Cancer

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Many occupations are associated with increased risk of cancer, with occupation being the main source of exposure for almost half the chemicals, mixtures or exposure circumstances

that are recognised causes of cancer. In spite of the significant advances made in the identification of the causes of occupational cancer over recent decades, numerous

associations that have been observed between specific occupations and high cancer risks still need to be evaluated. Furthermore, exposure to carcinogens remains relatively widespread.

Evaluation of Carcinogenicity

The prevention of occupational cancer depends on a systematic process in which the carcinogenicity of specific agents or exposures is assessed, so that regulatory controls can be implemented to

eliminate worker exposure. The pre-eminent agency in this field is the International Agency for Research on Cancer (IARC), a division of the World Health Organisation that was established in 1965

and is based in Lyon, France. IARC coordinates and conducts both epidemiological and laboratory based research into the causes, mechanisms and control of cancer.

The IARC Monographs Programme

IARC makes an important contribution to the control of occupational carcinogens through the systematic review and evaluation of the scientific evidence concerning carcinogenic risks to humans from specific agents

(chemical, physical and biological), mixtures and exposure circumstances under the IARC Monographs programme (Vainio et al, 1994). In making evaluations, both epidemiological and experimental studies are considered. The main

determinant is the evidence from human (i.e. epidemiological) studies, but evidence of carcinogenicity in animals and of the possible mechanisms of action of the agent are also considered.

Table 1: IARC evaluation of carcinogenic risk to humans (this is the default classification but can be changed on the basis of mechanistic data)

Human			
Animal	<i>Sufficient</i>	<i>Limited</i>	<i>Inadequate</i>
<i>Sufficient</i>	1	2A	2B
<i>Limited</i>	1	2B	3
<i>Inadequate</i>	1	2B	3

1: carcinogenic to humans
 2A: probably carcinogenic to humans
 2B: possibly carcinogenic to humans
 3: not classifiable as for carcinogenicity to humans

Table 1 shows how the human and animal evidence is combined to produce the IARC default evaluation of carcinogenicity to humans, in which the agent, mixture or exposure circumstance is placed into one of five categories:

- (i) Group 1: the agent is carcinogenic to humans. (This category is normally used when there is sufficient evidence of carcinogenicity in humans.)
- (ii) Group 2A: the agent is probably carcinogenic to humans. (A positive association has been observed between the exposure and human cancer for which a causal interpretation is credible, but

chance, bias or confounding could not be ruled out with reasonable confidence, and there is also sufficient evidence of carcinogenicity in experimental animals.)

- (iii) Group 2B: the agent is possibly carcinogenic to humans. (There is sufficient evidence of carcinogenicity in experimental animals, but inadequate data on cancer in exposed humans.)
- (iv) Group 3: the agent, mixture or exposure circumstance is not classifiable as to its carcinogenicity to humans. (This grouping applies

when no other category is used.)

- (v) Group 4: the agent, mixture or exposure circumstance is probably not carcinogenic to humans. (There is evidence suggesting lack of carcinogenicity in both humans and experimental animals.)

Thus, if there is sufficient evidence from epidemiological research in human populations that an agent, exposure circumstance or mixture is carcinogenic, then those agents will be ranked in group 1 - carcinogenic to humans. If there is only limited evidence for human carcinogenicity then the

factor may be ranked group 2A – probably carcinogenic to humans, or 2B – possibly carcinogenic to humans – depending on the strength of the evidence from animal studies. Occasionally, where there are similar mechanisms operating in both humans and animals, the mechanistic evidence may be used to

influence a determination of carcinogenicity in humans – even in the absence of sufficient human evidence. This situation is seen in the example of TCDD dioxin, illustrated in table 2. TCDD would normally have been classified in category 2A (because the epidemiological evidence was limited rather than

sufficient), but was moved to category 1 on the basis of mechanistic evidence - there is very strong evidence of cancer causation in animal studies and sufficient evidence that such a mechanism is also operational in humans (in this case, the central role of the Ah receptor in the cellular response to dioxin).

Table 2: Use of mechanistic data to classify the carcinogenicity of TCDD into category 1

Animal	Human		
	<i>Sufficient</i>	<i>Limited</i>	<i>Inadequate</i>
<i>Sufficient</i>	1	2A →1	2B
<i>Limited</i>	1	2B	3
<i>Inadequate</i>	1	2B	3

Evidence of mechanism operating in animals and exposed humans.
Example: TCDD (AH receptor)

Table 3: Agents evaluated within the IARC Monographs programme

Group	Agents	Mixtures	Exposure circumstances	Total
1 (carcinogenic)	64	12	12	88
2A (probably carcinogenic)	55	5	4	64
2B (possibly carcinogenic)	220	12	4	236
3 (not classifiable)	478	12	6	496
4 (probably not carcinogenic)	1	0	0	1

To date, in volumes 1-82, the IARC Monographs programme has evaluated 885 agents (chemicals, groups of chemicals, complex mixtures,

occupational exposures, cultural habits, biological or physical agents), of which 88 have been ranked as group 1 carcinogens, 64 as group

2A, 236 as group 2B, 496 as group 3, and only one agent is rated as 'probably not carcinogenic'.

Occupational Carcinogens Identified by the IARC Programme

Occupational and environmental factors are

the main source of exposure for nearly half

of the IARC group 1 carcinogens (table 4).

Table 4: Main source of exposure of agents classified into IARC Group 1

Group	Agents	Mixtures	Exposure circumstances	Total
Occupational	20	6	12	38
Other	44	6	0	50

Table 5: Occupational agents classified as having sufficient evidence of carcinogenicity in humans (Group 1)

Type of exposure	
<i>Agents</i>	4-Aminobiphenyl Arsenic and arsenic compounds Asbestos Benzene Benzidine Beryllium and beryllium compounds Bis(chloromethyl)ether Cadmium and cadmium compounds Chloromethyl ether Chromium[VI] compounds Ethylene oxide Mineral oils, untreated and mildly treated Mustard gas (Sulphur mustard) 2-Naphthylamine Nickel compounds Silica, crystalline Strong organic mists containing sulphuric acid Talc containing asbestiform fibres 2,3,7,8-Tetrachlorodibenzo- <i>para</i> -dioxin (TCDD) Vinyl chloride
<i>Mixtures</i>	Coal-tar pitches Coal-tars Mineral oils, untreated and mildly treated Shale-oils Soots Wood dust

Table 5 lists occupational and environmental agents and mixtures that are classified as having sufficient evidence of carcinogenicity in humans. Exposures to a number of these, such as arsenic, chromium-VI, wood dust, and asbestos are still quite widespread in New Zealand. As well as specific agents, there

are a number of occupations and industries or exposure circumstances which have also been classified as entailing exposures with sufficient evidence of carcinogenicity in humans (table 6). In some circumstances the specific causative agent may be known (e.g. wood dust in furniture

making), but in other cases it may not be known or it may have disappeared or been removed from the workplace. Environmental exposures such as radon, environmental tobacco smoke and solar radiation can also be occupational exposures in some circumstances.

Table 6: Occupational exposure circumstances classified as having sufficient evidence of carcinogenicity in humans

<p>Aluminium production Auramine, manufacture of Boot and shoe manufacture and repair Coal gasification Coke production Furniture and cabinet making Haematite mining (underground) with exposure to radon Iron and steel founding Isopropanol manufacture (strong-acid process) Magenta, manufacture of Painter (occupational exposure as a) Rubber industry</p>
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There is also a range of occupational agents that have been rated as having limited evidence

of carcinogenicity in humans (table 7); these are comparable to the IARC classification

groups 2A or 2B. Again, a number are currently or were previously widely used in New Zealand.

Table 7: Occupational agents classified as having limited evidence of carcinogenicity in humans

Acrylamide	Polychlorophenols	Benzo(a)pyrene
Acrylonitrile	Rock/slag wool	Benz(a)anthracene
1,3- Butadiene	TCDD	Vinyl bromide
Chlorophenoxy herbicides	Tetrachloroethyl	Creosotes
p-Chloro-o-toluidine	Trichloroethylene	Diesel engine exhaust
Ethylene oxide	1,3,3-Trichloropropane	Non-arsenical. insecticides
Formaldehyde	Nitrogen mustard	PCBs
		Welding fumes

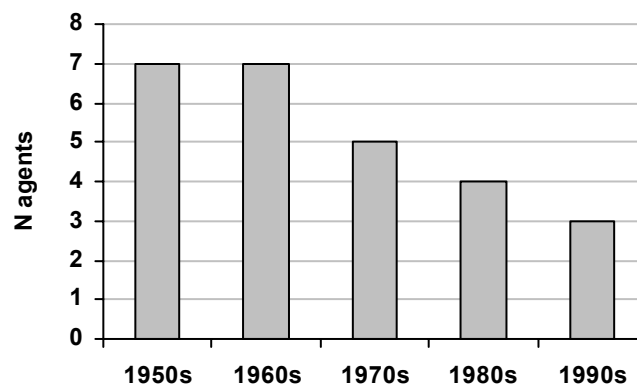
Table 8: Occupations and industries classified as entailing exposures with limited evidence of carcinogenicity in humans

Art glass (manufacturing)	Hairdresser, barber	Printing process
Carpentry and joinery	Petroleum refining	Textile industry
Dry cleaning		

Similarly there is limited evidence of carcinogenicity

for a number of industries (table 8).

Figure 1: Decade of publication of key results on occupational and environmental carcinogens



Is Occupational Cancer a Problem of the Past?

The majority of the epidemiological studies investigating and first reporting the occurrence of increased risk of cancer due to occupational factors were published in the period between the 1950s and 1970s (figure 1). Of the IARC group 1 carcinogens, only cadmium, beryllium, ethylene oxide, strong inorganic acid mists

containing sulphuric acid and crystalline silica have been included on the basis of more recent evidence (Vainio et al, 1994). There have been numerous studies since, many of which have suggested associations between industrial processes or substances and cancer, but for only a few of these has the evidence been considered to be sufficient. This

could be taken to indicate that occupational cancer is a problem of the past. However, an alternative view is that we have found the “easy to identify” occupational carcinogens that have high potency, high exposure levels, few co-exposures and rare target tumours (table 9), but that many other occupational carcinogens remain to be identified.

Table 9: *Historical and new occupational and environmental carcinogen.*

	Historical carcinogens	New carcinogens
Potency	High	Low
Exposure levels	High	Low
Co-exposures	Few	Many
Target tumour	Rare	Common

As illustrated in table 9, for these “hard to identify” carcinogens, often the potency is low - the relative risks are about 1.5 rather than 5 or 10. Exposure may be more widespread but is

often at a lower level and complicated by exposures to other substances. The target tumour is often common and has multiple causes. A relevant example is that of diesel engine

emissions as a risk factor for lung cancer – a very complex but widespread exposure of relatively low potency for a common tumour.

Pooling and meta-analysis

One way of reducing these problems of evaluating carcinogenicity is the pooling of data from different studies. This may involve a combined

reanalysis of several independent studies, or preferably may be coordinated as a multi-centre study in which a consistent approach to the assessment of

exposures is applied in a number of studies conducted in different centres in different countries.

Figure 2: Risk of lung cancer and occupational exposure to diesel emissions

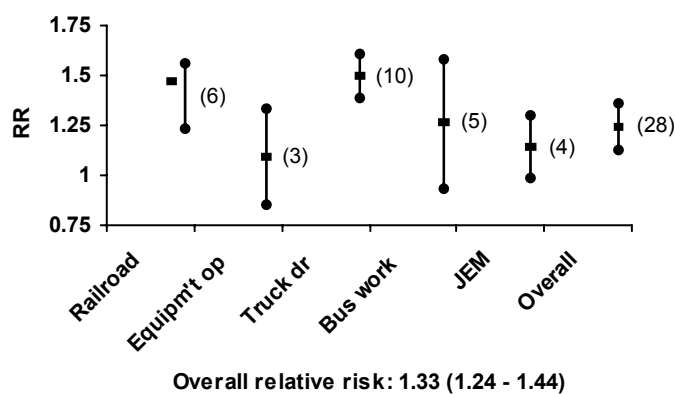


Figure 2 summarizes studies of diesel emissions and lung cancer risk (Bhatia et al, 1998). It shows that, while on their own many of these studies would not necessarily have

provided conclusive evidence that diesel emissions were carcinogenic, the overall evidence gives a clear indication that diesel emissions are associated with an increased risk of

lung cancer with a summary relative risk of about 1.33 (95% CI 1.24-1.44). Given that exposure to diesel fumes is very widespread, the public health significance of these findings is clear.

Unrecognised exposures

It is also noteworthy that unrecognised exposures to known carcinogens may be relatively common. A good example of this is asbestos as it has a unique causal association with

mesothelioma. In case studies it is common that for 40-60% of cases the contributing exposure cannot be confidently identified. Figure 3 shows the proportion of cases of

mesothelioma for which the source of occupational exposure to asbestos is unrecognised.

Figure 4 shows European Union (EU) estimates of the total number of

people who are still exposed to asbestos at work within the EU. These figures suggest

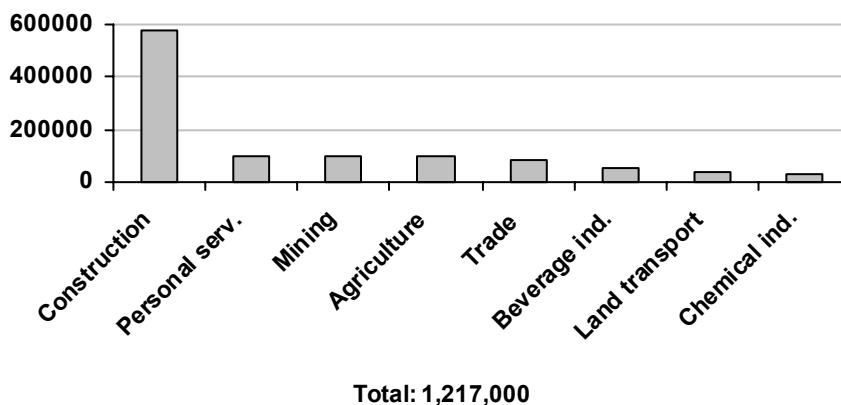
that 1.2 million people are still exposed, with such exposures occurring mainly outside the

“traditional” industries, and therefore being likely to be undetected.

Figure 3: Mesotheliomas attributable to occupational exposures, by gender



Figure 4: Numbers of workers exposed to asbestos in the European Union, by industry



Future research

There are several key issues for future research into occupational causes of cancer.

Firstly, there is likely to be an increased need for biomarker-based and mechanistic studies. There has been an increase in the use of biomarkers of biologically active doses and early carcinogenic effects in industry-based studies in recent years. The re-evaluation by IARC of ethylene oxide and TCDD into group 1 was based on evidence either from internal dose-response analyses or from mechanistic studies. These examples suggest that the two main pathways for future work in the identification of occupational carcinogens could be improvement of exposure assessment and the use of biomarkers (Boffetta, 1995). It is expected that this will lead to an improvement in the assessment of exposures and in the clarification of the mechanisms of carcinogenesis in both humans and experimental animals. This is not always the case, and there are considerable limitations of currently available biomarkers (Pearce et al, 1995). Nevertheless, appropriate

use of valid biomarkers would help both etiologic research and its applications in the domains of prevention and compensation.

Secondly, there is the need to better address complex exposure circumstances, and to recognize that cancer risk arises from the sum total of exposures that occur in combination and it may not always be possible, or desirable, to isolate the effects of individual exposures.

Thirdly, it is important to consider occupational cancer on a global basis, including exposures in developing countries (Pearce et al, 1994). An extensive transfer of discarded or superseded technologies from the industrialised world to the developing world has been taking place, and the processes that caused occupational cancers in our workforce are now operating in the developing world. For example the total production of asbestos has not decreased worldwide, indicating that the problem has merely been moved rather than removed (Pearce et al, 1994). A particular problem in developing countries is

that much of the industrial activity takes place in small industries, often characterized by old machinery and buildings, limited staff training, and lack of safety and protective equipment.

Finally, there is the problem of unrecognized exposure to known carcinogens, such as the case of asbestos discussed previously.

Our current knowledge of environmental carcinogens has been very much biased towards the “easy to study” exposure circumstances. If we are going to progress any further there are some strong challenges for cancer researchers to improve exposure assessment and to better integrate the data we get from animal studies and laboratory based studies. We need to develop techniques such as meta-analyses and multi-centre studies to better study low-level exposure circumstances, and to recognise that the major burden of occupational cancer is now occurring in developing countries.

The Burden of Occupational Cancer

There has been considerable debate about the proportion of cancer cases that are attributable to occupational exposures. La Vecchia et al (2000) recently made this point stating that:

“Estimates of the proportion of cancer deaths attributable to occupational and environmental carcinogens are complex and difficult, apart from the effect of past occupational exposure to asbestos which may account by itself for a quarter of a million deaths in Western Europe over the next three decades”.

Doll and Peto (1981) estimated that four percent of cancer deaths in the American population may be caused by work related exposures (with plausible limits of 2-8 percent). This has remained the most influential estimate, but has come under criticism for a number of reasons. In particular, it was based on adding up the contributions from established occupational carcinogens (e.g. asbestos), almost all of which were discovered

by studying exposures in the 1950s and 1960s in male workers in large industries. In particular, the different estimates for males and females (7 % and 2%) were probably largely due to the lack of research into industries with predominantly female employees. Since that estimate was made, further occupational causes of cancer have been discovered or have become more “established”, while a large number of both old and new occupational exposures remain relatively unexplored with respect to their potential carcinogenicity. Moreover, population averages can conceal what is happening to specific groups within the general population. In the segment of the adult population in which exposure to known occupational carcinogens almost exclusively occurs, i.e. blue collar workers in forestry, agriculture, mining and manufacture, the proportion of cancers that are attributable to occupational exposures is believed to be closer to 25%. For certain specific populations located in industrial areas up to 40% of lung and bladder cancer cases may be

attributable to occupational exposures.

Kauppinen et al (2000) evaluated the available national data (or Finnish and US data where national data was not available) for countries in the European Union on exposure levels by expert panels, and estimated the existence and level of exposure to known or suspected carcinogens for different standard industrial classifications. They estimated that 23% of the European workforce is currently exposed to one or more agents listed by IARC as group 1, group 2A, or selected group 2B carcinogens. If the data is restricted to group 1 carcinogens alone, then more than 15% of the workforce (22-24 million workers) are still experiencing exposure - the most ubiquitous being solar radiation and environmental tobacco smoke (both at least 75% of the time), crystalline silica, diesel engine exhaust, radon and wood dust

A similar estimate was obtained for the United States by Infante (1995) who evaluated exposure to lung carcinogens and estimated that almost 13

million U.S workers were routinely exposed to IARC group 1 occupational lung carcinogens, and 8 million exposed to Group 2A occupational lung carcinogens. Taken together these figures mean that the number of US workers routinely exposed to known occupational causes of lung cancer is equal to almost 50 percent of the number of current smokers in the US.

In spite of these estimates, the perception that occupational cancer is insignificant and a thing of the past is unfortunately very widespread. The New Zealand Cancer Society's 'Daffodil Day' publicity of 2000 listed a number of different risk factors for cancer, but suggested that cancer hazards in the workplace had disappeared (The Evening Post, 24 August 2000). In fact, based on these overseas estimates,

New Zealand workers probably currently experience about 500 cancer deaths due to occupational exposures each year. This is only a very rough estimate, and it is important that we obtain much better estimates based on New Zealand data, but it does indicate that the number of deaths due to occupational cancer annually in New Zealand far exceeds the 50-100 deaths from workplace accidents.

Prevention of Occupational Cancer

Swerdlow (1990) outlined a series of options for the prevention of exposure to

occupational causes of cancer (Pearce et al, 1994).

Non-introduction of carcinogens into the workplace

The most successful form of prevention is to avoid use of recognized human carcinogens in the workplace. This has rarely, if ever, been an option in industrialized countries: virtually all occupational carcinogens have been identified as such by epidemiological

studies of populations that were already occupationally exposed. Nevertheless, there are some examples of carcinogens that were used in certain industrialized countries but not in others. For example, 4-aminobiphenyl

(xenylamine), a potent bladder carcinogen, was used in the USA but was never manufactured commercially or widely used in the United Kingdom because of concern that it would prove to be carcinogenic (Melick et al, 1971).

Removal of carcinogens

The next best option after non-introduction of established carcinogens is the removal of such

agents once their carcinogenicity has been established or suspected. Once again, relatively

few examples exist. They include the closure of plants making the bladder carcinogens

α -naphthylamine and benzidine in the United Kingdom (Anon, 1965), termination of British gas manufacture involving

coal carbonization; closure of Japanese and British mustard gas factories after the end of the Second World War

(Swerdlow, 1990), and gradual elimination of the use of benzene in the shoe industry in Istanbul (Aksoy, 1985)

Reduction in Exposure Levels

In many other instances, however, complete removal of a carcinogen (without closing down the industry) is either not possible (because alternative, non-carcinogenic agents are not available) or is judged politically or economically unacceptable (because the alternative agents are more expensive). Exposure levels must

therefore be reduced by changing production processes and industrial hygiene practices, as has occurred in many industrialized countries in recent decades. Exposures to recognized carcinogens, such as asbestos, nickel, arsenic, benzene, pesticides and ionizing radiation, have progressively been reduced. There is some evidence of declining

exposure levels coinciding with declining cancer incidence but these examples are rare. One such example is that of nickel refinery workers shown in figure 5. It shows the drop in lung cancer incidence that occurred in nickel refinery workers first employed between 1916 and 1965 (Magnus et al, 1982).

Figure 5: Decrease in exposure levels at the work place producing a decrease in risk by period of first employment: lung cancer incidence of nickel refinery workers by year of hire (Source: Magnus et al (1982))

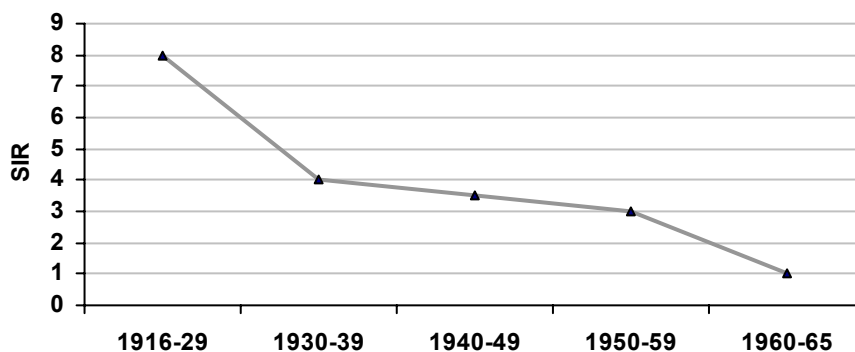
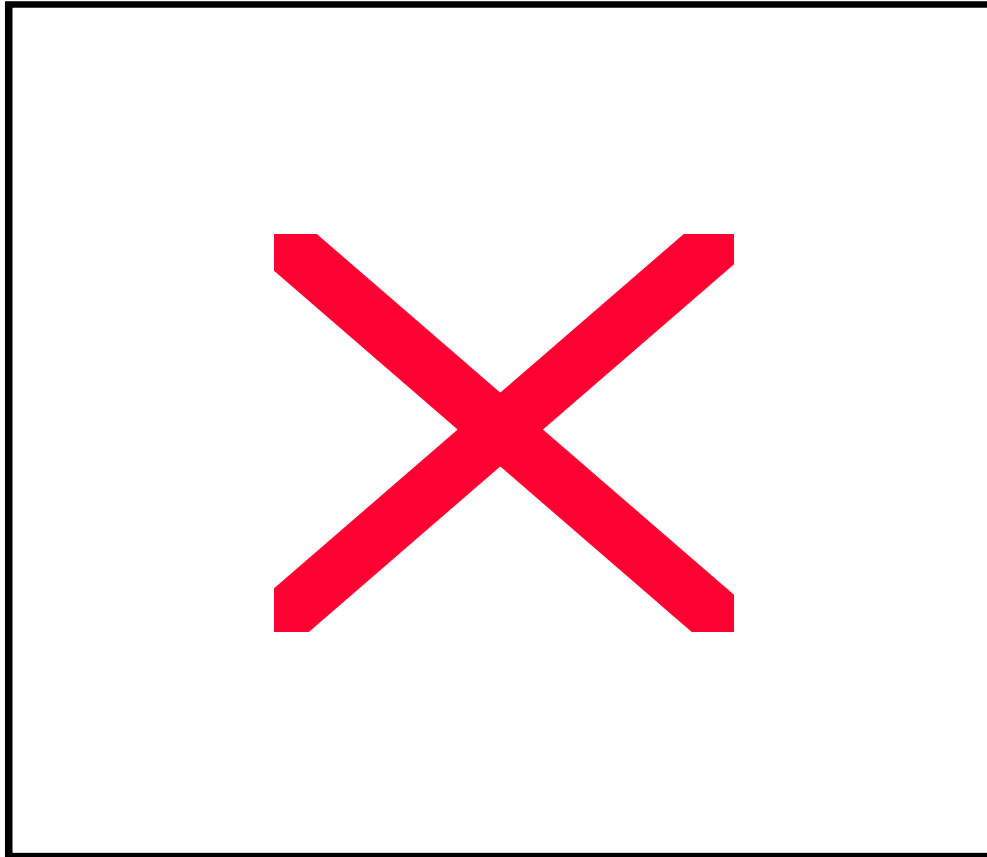


Figure 6: Imports of raw asbestos to Sweden and annual incidence of pleural mesothelioma



Due to the latency in cancer between exposure and manifestation of disease, where exposure has been reduced or eliminated the benefits will take many years to take effect. The Swedish data in figure 6 shows

that even in Sweden, where the importation and use of asbestos was stopped in the mid 1970s, and the exposure of Swedish workers was thereby dramatically reduced, the Swedish rates of mesothelioma

have only recently started to decline. There have been similar studies done in New Zealand, where asbestos imports did not stop until 1990 (Glass et al, 1991; Kjellstrom and Smartt, 2000).

Reduction in hazardous activities

A related approach is to reduce or eliminate the activities that involve the heaviest exposures. For example, 65 years after Pott

reported the existence of scrotal cancer in chimney weeps, in 1775, an Act was passed in England and Wales to prohibit chimney

sweeps from being sent up chimneys, and the number of cases of scrotal cancer subsequently decreased (Waldron, 1983).

Increased protection

Exposure can also be minimized through the use of protective equipment. For example, scrotal cancer was rare in sweeps in continental Europe and Scotland, where protective clothing was more widely used than in England and Wales (Doll, 1975; Waldron, 1983). A

related approach is to impose protective hygiene measures. Three years after Pott's 1775 report, rules were introduced in Denmark requiring sweeps to take a daily bath, and since the start of the 20th century, Swedish sweeps have had the right to take a bath during working

hours at the end of each day (Swerdlow, 1990). Nevertheless, steelworkers in the USA still experience an excess risk from exposure to coke-oven fumes - essentially the same exposures that Pott discovered were carcinogenic 200 years ago (Wagoner, 1976).

Surveillance and education

An effective overall strategy in the control and prevention of exposure to occupational carcinogens generally involves a combination of approaches, including monitoring of exposures. One interesting example is a Finnish registry which has as its objectives to increase awareness about carcinogens, to evaluate exposure at individual workplaces and to stimulate preventive measures (Alho et al, 1988; Heikkila and Kauppinen, 1992). The register was established after ratification of ILO Convention No. 137 and appears to be the only

such national register currently in existence. It contains information on both workplaces and exposed workers (Kerva and Partanen, 1981), and all employers are required to maintain files on employees exposed to carcinogens and to supply the information to the register. Regional labour inspectorates have legal power to order reports on exposure, and manufacturers and importers of any products containing carcinogens on the registry list must put warning labels on their products. Coverage of the exposed work-force appears to be only about one-third complete,

however, and the number of workers reported accounted for 0.6% of the total work-force (Heikkila and Kauppinen, 1992). Nevertheless, the system appears to have been at least partially successful in decreasing carcinogenic exposures in the workplace. For example, Alho et al (1988) reported that hydrazine was previously widely used as an anticorrosive agent at power plants, but that there had been a decline in its use which coincided with establishment of the registry system.

Comprehensive approaches

The occurrence of occupational cancer depends not only on levels of exposure to

carcinogens, but also on biological absorption and individual susceptibility, which are in turn affected

by more general environmental conditions, including income, nutrition,

housing and sanitation. Thus, although the prevention of occupational cancer is often focused on limiting individual exposures to specific agents (as discussed above), the greatest progress can be made when such

measures are part of a more general strategy to improve living and working conditions. Such a comprehensive strategy is not only the most efficient in terms of the narrow goals of preventing occupational cancer but will also have

other health and social benefits. Such programmes must, however, be complementary to, and never a substitute for, strenuous efforts to reduce or eliminate workplace exposures.

Conclusions

In summary, about 26 agents or mixtures and 12 occupations and industries have been established as causes of occupational cancer; a large number of other agents, occupations and industries are probably causes of occupational cancer. There is considerable debate about the proportion of

cancers that are caused by occupational exposures, particularly because most studies to date have been of male workers in large industries. However, even relatively conservative estimates indicate that about 500 cancer deaths each year in New Zealand are caused by occupational

exposures. A number of approaches are available for the identification and elimination (or reduction) of exposures to occupational carcinogens, and work from Finland indicates that such approaches may have considerable success.

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Occupational Injury

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The primary problem facing us in preventing occupational injuries in New Zealand is the absence of an adequate evidence base to inform

policy and practice. To make progress in reducing occupational injury we need to: (i) identify problem areas; (ii) quantify and

prioritise risk factors; and (iii) identify/develop, implement, and evaluate interventions.

Identifying Problem Areas

Our task is to identify major contributors to the occupational injury burden. To do this we

should examine the incidence of fatal and non-fatal injuries, with due regard to the severity

of the latter in terms of threat to life and threat of subsequent disablement.

Fatal injuries

We have no system in place with which to reliably determine the number of work-related fatalities each year. Consequently we have had to rely on expensive one-off studies to derive estimates (Cryer and Fleming, 1987; Feyer et al, 2001). Even under these circumstances, estimates of work related traffic crashes are particularly elusive, and as a consequence have

not been determined in the two New Zealand studies which have been conducted to date. The proportion of all work-related fatalities (excluding bystanders) which are motor vehicle traffic incidents is approximately 25% for USA (US Department of Labor, 1998) and 37% for Australia (National Occupational Health and Safety Commission, 1998). As such they lead

all other events, in terms of activity, in the number of work-related fatalities. It is only recently that research has commenced in New Zealand which seeks to produce estimates for these events.

Information on the circumstances of death is variable in completeness and quality (Law Commission, 2000). Take for example the

issue of all terrain vehicle (ATV) crashes. It is often unclear from the examination of coronial files whether a ‘motorcycle’:

- had two, three or four wheels

- was towing a trailer
- was on a slope
- had adequate tyre tread
- was four-wheel drive

Yet, such information is critical in determining,

for example, the cost effectiveness of measures aimed at reducing deaths associated with roll-overs of four-wheeler farm bikes.

Non-fatal injuries

Inpatient hospitalisations

For persons admitted to hospital for treatment, the nature and circumstances of their injury are coded according to the International Classification of Diseases (ICD). The circumstances of injury are coded according to the “External Causes of Injury and Poisoning” codes, commonly referred to as E-codes in version 9 of ICD (WHO, 1977). This classification system has some major shortcomings, not the least of which is that the activity of the victim at the time of injury is not coded (Langley, 1982). It is thus not possible to determine how many incidents resulting in hospitalisation were due to work activity. This problem has in theory

been overcome with the introduction by the New Zealand Health Information Service (NZHIS) of ICD-10-AM (National Centre for Classification in Health, 2000), which was fully implemented in 2000. However, it is not known how reliable activity coding is under ICD-10-AM. To date no published estimates of work related injuries resulting in inpatient treatment have been produced using NZHIS hospitalisation data.

Typically in describing the epidemiology of occupational injury we seek to determine risks for various occupational groups. Assuming that we are able to produce reliable estimates of work related injuries

using hospital data coded under ICD-10-AM, we will still not be able to produce occupation specific risk estimates, as occupation is no longer included in the National Minimum Data Set (NMDS), the database which contains details on all public hospital discharges in New Zealand (Langley, 1998). Occupation was identified by the recent New Injury Data Review as one of the desirable variables for a national (all cause) injury dataset (Department of Labour and Statistics New Zealand, 2002). It should be noted that occupation is also no longer recorded in the national mortality dataset maintained by NZHIS.

ACC entitlement claims

Accident Compensation Corporation (ACC) entitlement claims

database present a complementary picture of non-fatal injury.

Entitlement claims are those claims that involve more than compensation

for medical expenses. Typically, in the work context, such claims would be for earnings related compensation and rehabilitation costs. For these claims, detail is recorded on the circumstances of injury.

Many of the significant injuries which result in hospitalisation do not result in an ACC entitlement claim and vice versa. This is because the database is a claims database and whether one makes a claim to ACC depends on a range of factors other than the severity of one's injury. For example:

“Under the old Accredited Employer programme, some large employers managed their own claims for the first year in return for reduced premiums. When the programme ended on 30 June 1999, about 10% of the workforce was covered in this way. On 1 July 2000 the new Accredited Employer programme, “The Partnership Plan” was introduced.

Under this plan employers can take responsibility for the cost and management of injured employees for a nominated period from one to five years. As at 31 December 2000, 165 companies had joined the Partnership plan, providing cover for 250,000 employees, or 14% of the workforce. Accredited Employer claims are not reported” (ACC Injury Statistics 2001)

Similarly, for the period July 1999 - June 2000 compensation for injuries to employees was privatised and thus the relevant data for this period are not in ACC claims database.

Complicating matters further is the fact that the primary categorisation of entitlement claims is by the ACC account they are paid from. Work-related entitlement claims can be assigned to at least one of three accounts: employers, self employed, or motor vehicle. While there is provision on the claim form to separately identify whether or not an incident was work-

related, this field is considered to be unreliable. It is thus not possible to accurately identify the total population of work-related entitlement claims.

Despite these limitations the entitlement claims database is the best available source of data for determining priority areas for occupational injury problems. It permits the estimation of risk by occupation and industry and compensation costs can also be considered when prioritising for prevention. It is unlikely that a gross level of examination of hospital inpatient cases would result in a different set of priorities. Recently a narrative free-text has been added to the database. The Injury Prevention Research Unit (IPRU) has recently demonstrated for ‘sheep and beef cattle farming’, and ‘dairy cattle farming’ that this field provides additional information that is useful for targeting prevention activity.

Severity: threat to life, disablement

We have no direct measures of the severity

of occupational injury in terms of threat to life or

threat of disablement. Moreover, indirect

measures such as the nature of injury can be very unreliable indicators of severity. For example the ACC's website has this to say about the injury coding frame the corporation has used:

"The injury coding used by ACC is very

wide in its categories and of limited use in differentiating the severity of the injury. For example, the injury code of "Soft Tissue Injury" covers injuries ranging from strained muscles to dislocated discs to paraplegia and

tetraplegia." (ACC Injury Statistics, 2001)

The best indirect measure of on-going disablement associated with injury is the number of persons who are long-term ACC entitlement claimants.

Priority occupations

Despite the gaps in our knowledge, we have sufficient information from compensation claims data and the most recent study of work related fatalities (Feyer et al, 2001) to identify priority occupations for prevention based on risk or the absolute number of cases. They are:

- Light plane and helicopter pilots
- Farmers
- Fishers
- Forestry workers
- Labourers
- Builders
- Drivers of mobile plant

It should be noted that the nature and extent of work-related motor vehicle traffic crashes has yet to be documented. Once this has occurred there may be some other categories which warrant adding to this list.

Quantifying and Prioritising Risk Factors

"Despite increased attention to the epidemiology of occupational injuries and work-related musculoskeletal disorders, little is known about the relative contribution of risk factors for specific injuries..." (Burdorf et al, 1997, p180)

Work-related farm injury is a typical example of the state of the evidence

base. To date, injury prevention policy and practice has been guided by descriptive studies, often from incomplete databases. Such studies are useful for identifying injury patterns and trends, targeting major concerns for prevention programmes, and generating causal hypotheses. In some descriptive studies, sufficient evidence is available (e.g if the hazard is obvious) to

move directly to a preventive strategy (e.g. tractor roll overs and ROPs). Evidence based instances of preventive action arising directly from descriptive studies are, however, limited. A more sophisticated understanding of risk factors, such as can be provided by analytic epidemiological studies, is required to ensure effective use of limited injury prevention resources.

Canadian and North American population based prospective cohort and case control studies have identified a range of risk factors in univariate analyses, a number of which appear to be proxies for the size of the property and hours worked (Boyle et al, 1997; Brison and Pickett, 1992; Layde et al, 1995; Norstrom et al, 1995; Pickett et al, 1996). Independent risk factors identified in multivariable analyses include hours worked, presence of non-resident workers on property, owner/operator, and use of either stomach remedies or cardiovascular medications, with odds ratios (OR) ranging from 1.02 to 4.2 (95% CI 1.01-14.7). Milking (31-63 hours, OR 20.6, 95% CI 2.9-144.8), and trimming or treating hooves (OR 4.2, 95% CI 1.2-15.4) are activities associated with increased risk of dairy cattle related injury

(Boyle et al, 1997). Limitations of these studies include being under-powered, exclusion of non-resident farm workers, absence of exposure data for the period immediately prior to the injury, absence of on-farm inspections, and the limited range of risk factors studied.

While some farm injury risk factors may operate across cultures and commodity groups, it is highly likely that farm injury risk factors will vary according to agricultural practices, commodities produced, climate and culture. For example, the feeding of cows in barns in summer was found to protect against farm machinery injury in a North American study (Layde et al, 1995). The likely effect of barn feeding on risk is a reduction in the use of machinery associated with supplementary feeding in pastures. The farming

practice of barn feeding is rare in New Zealand farming. Similarly, all-terrain vehicles (ATVs), a common source of serious farm injury in New Zealand, are used extensively in this country and largely for farm work. In the USA their primary use is recreational and usage for farm work is, relative to New Zealand, rare. Overseas research findings, therefore, may not be readily generalised to the New Zealand setting, necessitating the undertaking of analytic epidemiological studies in New Zealand. Such research is non-existent in New Zealand. However, a study of risk factors for farm injury has recently commenced in Victoria Australia. Given the similarity of farming practices and culture between the two countries the findings are likely to be of relevance to New Zealand.

Identifying/Developing, Implementing and Evaluating Interventions

"The safety literature and anecdotal evidence suggest that many interventions in occupational safety are implemented with the sincere hope that they work, but with a

lack of solid evidence of their effectiveness, especially in the area of safety training and education" (Shannon et al, 1999, p161).

Zwerling et al (1997) recently reviewed the literature on the design, conduct, and evaluation of occupational injury interventions. They concluded:

“Our review suggests that randomised controlled trials are rare and also notes that quasi-experimental studies in the literature often use the weakest designs” (Zwerling et al, 1997, p164).

DeRoos and Rautiainen (2000) recently undertook a systematic review of the existing literature on the effectiveness of farm injury prevention interventions. All study designs were accepted, including those without a comparison group. This liberal approach was adopted because most of the studies reviewed did not meet the usual methodological criteria of systematic reviews. The authors felt this liberal approach would best characterise the

current state of farm safety research. Only 25 from a total of 118 studies identified met the inclusion criteria. Eleven involved farm safety education programmes and five consisted of multifaceted interventions that included environmental modifications and/or a farm visit. Finally nine papers described interventions but did not include results or data from the completed evaluation. The farm safety education interventions typically targeted farm families. Most involved the dissemination of information through lectures, written materials, testimonials, or demonstrations. Evaluations generally use a pre- and post-test methodology examining

changes in behaviour, attitudes, knowledge, or a combination of these. Only one study compared injury rates after the intervention with those measured before and this reported a reduction in injury. It should be noted that this outcome was based on self reports.

The multifaceted interventions typically targeted farm operators and were characterised by farm audits undertaken by specialists who provided safety recommendations. Only two of the five studies assessed injury outcomes. Only one used a randomised design, the rest being pre- and post-test methodology. All five evaluations reported some positive changes in outcomes.

Conclusions

There is ample evidence from other areas, especially road safety, to demonstrate that injuries can be significantly reduced through the implementation of preventive measures. However, the road safety example suggests that this requires a

commitment of resources well in excess of those we currently devote to the occupational injury problem. Priorities for the use of these resources should include:

- improving our "administrative "databases to facilitate

better and rapid problem identification

- employing more sophisticated methods for identifying risk and protective factors and their relative contribution
- more rigorous evaluation of interventions.

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Occupational Injury in Māori

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In this paper I shall touch upon three areas in the study of occupational injury in Māori. Firstly, I will discuss the issues surrounding ethnicity classification in regards to occupational injury in

Māori. Then I will consider Māori occupational injury in New Zealand for two particular areas: fatalities that occurred from 1985 through to 1994, and work related injuries that made

contact with the ACC system. As I discuss these two sources of information I shall also discuss possible explanations for the differences encountered in fatality rates.

Classification of Ethnicity

One of the perennial issues of Māori health that is equally relevant to occupational injury is that of ethnicity classification (Graham et al, 1989; Pomare et al, 1995; Sporle and Pearce, 1999; Te Roopu Rangahau Hauora a Eru Pomare, 2000). There are a number of issues with regards to ethnicity classification that make Māori occupational injury difficult to study, particularly across time. Firstly, the ethnicity questions have changed in the past five censuses, making it difficult to

monitor trends over time. Secondly, in the mid to late eighties there has been a general change towards self-identified ethnicity classifications, examples being registrations and hospital admissions. Despite the general trend to standardise ethnicity classifications, there still remain some differences in the definitions used between government agencies - a recent example being the definitions used by ACC as well as those used by the Accident Insurance Regulator.

Another issue specific to occupational injury is that ethnicity is not collected upon the standard OSH Accident and Serious-Harm notification form, thereby removing an otherwise important occupational indicator. Underpinning all of these issues is the fact that the accuracy of ethnicity information or data is, to a certain extent, uncertain or unknown when it is compared amongst death registrations, coronial files and ACC claims.

Figure 1: Percentage of new claims by ethnic group.

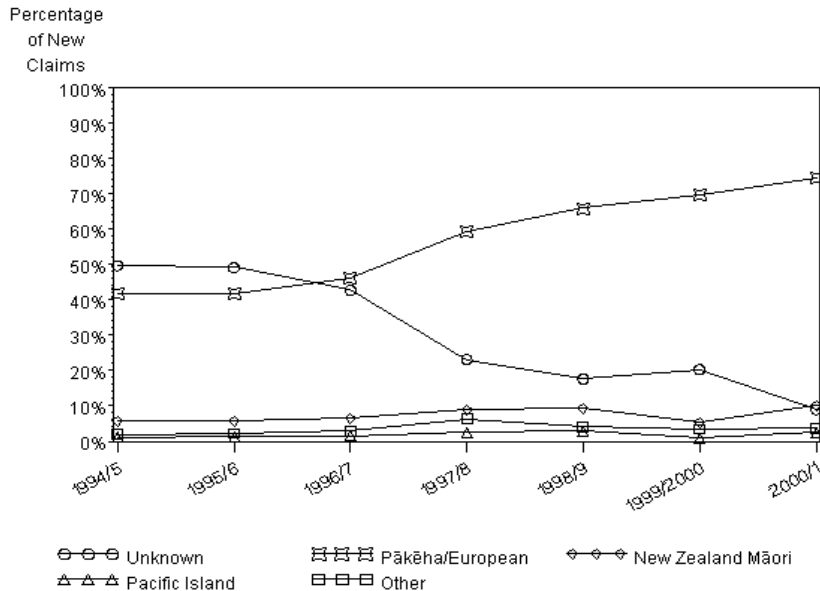


Figure 1 shows an example of the difficulties of examining injury rates by ethnic group within New Zealand. It presents the

percentage of new ACC claims by ethnic group, and shows that between 1994 and 2000, 20%-50% of new claims were for

people of unknown ethnicity, although this figure fell to 8% for 2000-2001.

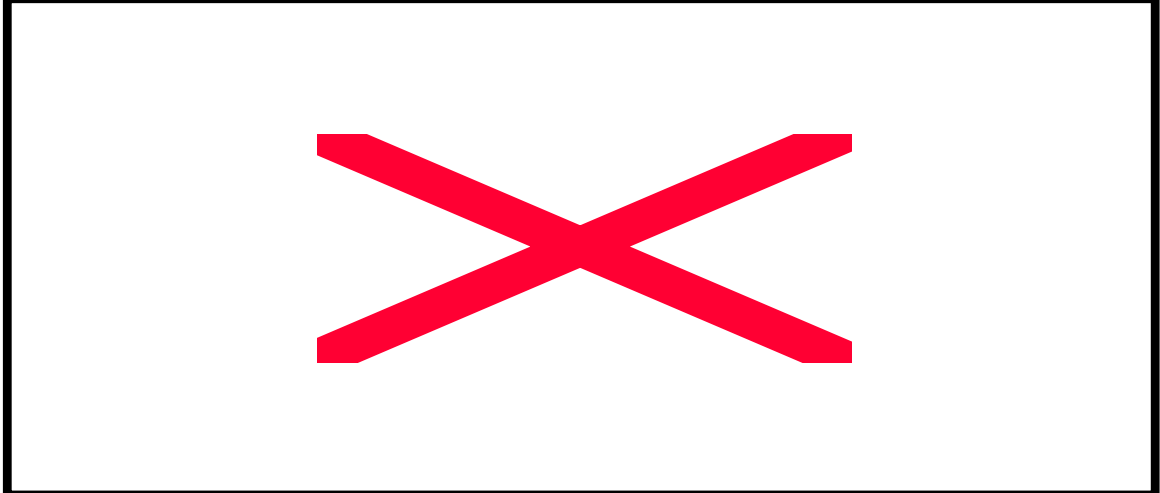
Occupational Injury in Māori

Despite these classification difficulties, we attempted to investigate Māori fatal injury as thoroughly and as accurately as possible as an extension to the Work-Related Fatal Injury study (Feyer et al, 2001). This examined coroner's files for work-related deaths for the period of 1985 through to 1994. Within these files, ethnicity was established

from two sources: (i) death registrations; and (ii) coronial information, which could take the form of either witness statements, police statements or pathologist reports. If the person was identified as Māori in either source they were classified as Māori for the study; otherwise they were considered to be non-Māori.

Figure 2 shows the male rate of fatal injury; there is a significant decrease for the period 1985 – 1994 for non-Māori which wasn't evident in the Māori data across the same period of time. This resulted in a higher overall rate of fatal injury for Māori of 11 per hundred thousand workers per year as compared to 8.3 per hundred thousand workers per year in non-Māori workers.

Figure 2: Male rate of work-related fatal injury by ethnicity and year

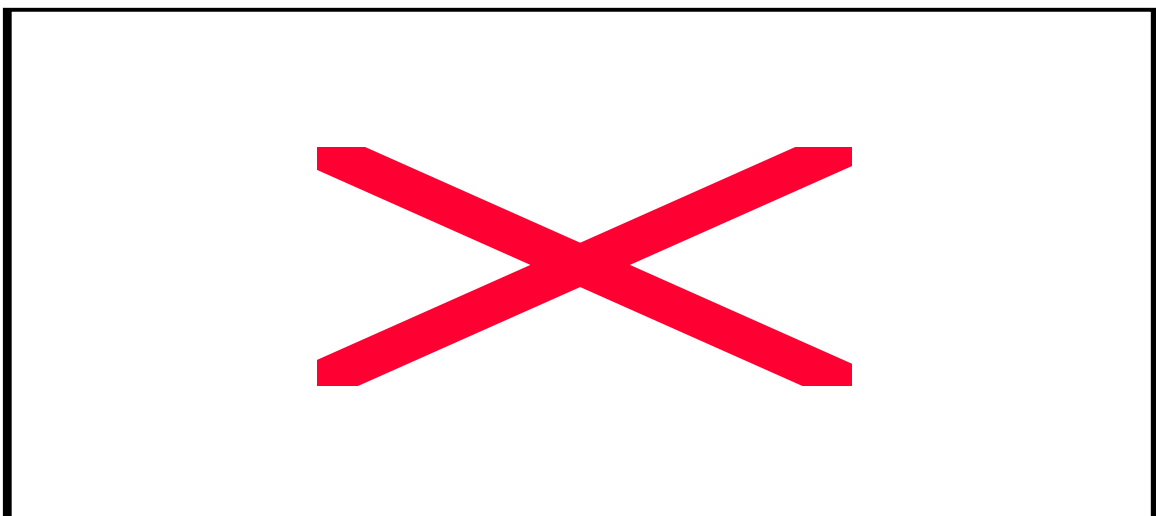


Although the fatality data ends in 1994, the overall trend is presumed to continue to the present on the assumption that the fatality rate mirrors

the non-fatal injury rate as shown in Figure 3. This shows the rate of new work-related ACC entitlement claims by ethnic group for the

period 1994 to 2001 and shows that the Māori rate is substantially and consistently higher than the European/Pakeha rate.

Figure 3: Rate of new work-related ACC entitlement claims, by ethnic group 1994-2001



It is obviously difficult to assess the reasons for ethnic differences just by examining overall rates. Therefore Table 1 presents the crude and standardised Māori

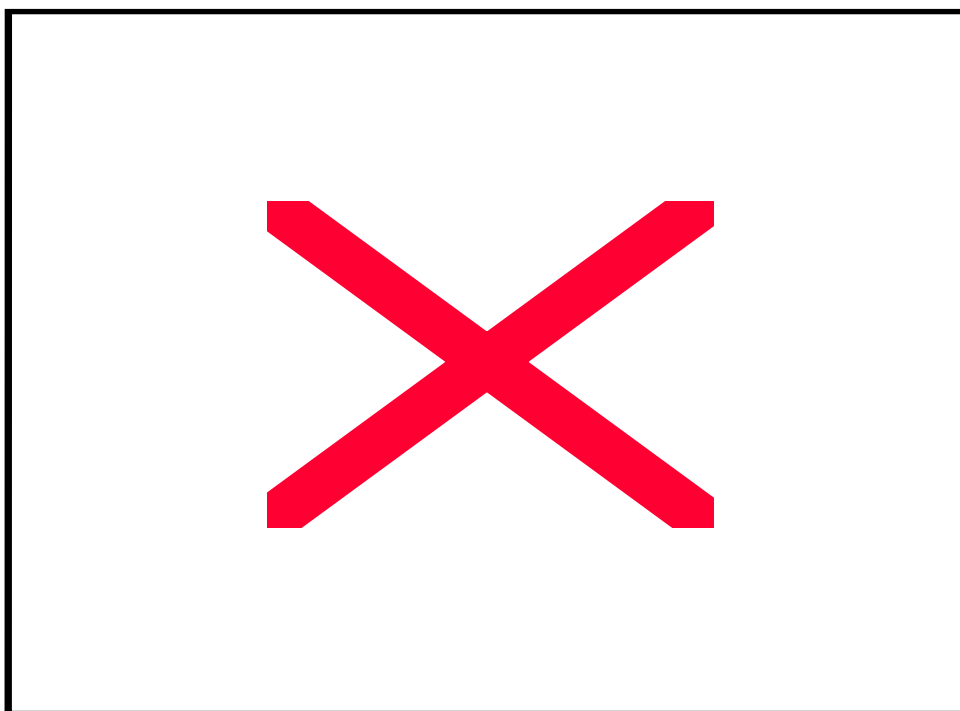
fatality rates. The Māori rates were standardised to the industry and occupational distribution of the non-Māori population. Once the data is standardised for

industry and occupation, the Māori rate decreases to a level more comparable to that of the Non-Māori population.

Table 1: Male Māori and non-Māori fatality rates per 100,000 workers per year

Type of Rate	Maori	Non-Maori	Relative Risk	95%CI
Crude	11.02	8.33	1.32	(1.06-1.65)
Industry Standardised	10.03	Reference	1.19	(0.95-1.50)
Occupation Standardised	9.25	Reference	1.10	(0.86-1.41)

Figure 4: Distribution of new ACC work-related claims 2001-2002 by ethnicity



This effect can perhaps be more easily seen in Figure 4, which shows the distribution of new ACC workload claims for the financial year ending in 2002. The two tallest spikes at the right of the graph represent plant and machine operators and elementary occupations, which also happen to be the two occupational categories that have the highest rate of professional injury (Feyer et al, 2001).

Table 2 presents this information in a more formal manner, showing the crude rate in Māori and Europeans, and the Māori rates standardised for age and occupation, using the European population distribution as the standard. It must be remembered when examining these rates that they do not include the 8% of cases which do not have an occupational classification so therefore the confidence intervals

that are presented here are probably too narrow. Nevertheless, the pattern is similar to what was found amongst the fatalities once the Māori rate was standardised to the European occupational distribution. There is a substantial reduction in the overall Māori rate and little difference between the Māori and European rates once the Māori rates are standardised.

Table 2: Work-related injury rates by ethnic group (ACC new claims 2001/2002)

Type of Rate	N Cases	Rate/100 Workers	95% CI	Relative Risk
Crude NZ				
European/Pakeha	146,662	10.1	(10.0 – 10.2)	1.00*
Crude Māori	23,603	13.8	(13.6 – 14.0)	1.37
Age Standardised Māori		13.5	(13.3- 13.6)	1.34
Occupation Standardised Māori		11.2	(11.0 – 11.3)	1.11
Age & Occupation Standardised Māori		10.9	(10.7 – 11.0)	1.08
*Reference population				

Despite the issues surrounding ethnicity classification it is reasonable to conclude that the higher overall rate of Māori occupational injury is largely due to the Māori workforce being

concentrated in the highest risk occupations and industries. For the fatalities the occupational distribution explains approximately 70 percent of the difference between Māori and non-Māori, and for ACC new claims

the occupational and age distribution explains about 75 percent of the difference between the Māori and New Zealand European/Pakeha populations.

Conclusions

So where does this leave us now?

There are three sets of priorities that should be implemented with regards to ethnicity data. Firstly, ethnicity should be added to the standard OSH Accident and Serious Harm notification form. Secondly, with the creation of the new position of Injury Information Manager at Statistics New

Zealand, there should be serious consideration of the possibility of routine data matching activities between currently held data sets, including the Census, to improve readily available ethnicity data. Thirdly, the current ethnicity questions should be retained for the 2006 Census.

With regards to injury prevention for Māori,

two priorities can be identified. Firstly, in the long-term the socio-economic forces that have created these occupational disparities need to be addressed. Secondly, in the meanwhile, effective targeting of high risk industries and occupations will pay a proportionally higher dividend for Māori.

Acknowledgements

I would like to acknowledge the support of the three research units that I work with:

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Occupational Respiratory Disease

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Deciding upon what are the main occupational respiratory disease problems today depends upon how we choose to define 'problems'. Occupational respiratory diseases, as with other diseases related to the workplace, can be examined in several different ways. These perspectives include the direct impact of the disease on the affected workers themselves, the actual incidence of these diseases, the burden of these diseases in the community, research activity, and the direct and indirect costs of managing, treating and preventing them.

Traditionally the main focus in occupational respiratory disease has been on chronic interstitial diseases of medium to long latency, in particular the pneumoconioses. These comprise such conditions as silicosis, coal workers' pneumoconiosis, and asbestosis. Some of these conditions were first recorded in the medical literature centuries ago. Respiratory and pleural cancers due to workplace exposures became more prominent during the latter half of the 20th century, for example mesothelioma and lung cancer in relation to asbestos exposure. More

recently, occupational respiratory diseases of shorter latency and/or those affecting airways have assumed an increasing degree of prominence. These conditions include occupational asthma, inhalational injury, extrinsic allergic alveolitis and respiratory infections.

The main purpose of this paper is to discuss the changing nature and pattern of occupational respiratory disease and the impact that these changes are having on our approach to measurement, prevention and control of such diseases.

Research Activity

One way to assess the changing nature of occupational respiratory diseases and its relative importance in occupational health and safety is examine changes in the spectrum

of occupational respiratory disease papers published in the literature over time. To do this, we have reviewed the papers published in the journal *Occupational and*

Environmental Medicine (called the *British Journal of Industrial Medicine* in 1981 and 1991) for each of the years 1981, 1991 and 2001. We have categorised the published

papers into occupational respiratory diseases and others. We then further categorised the respiratory papers into four subgroups: pulmonary fibrosis, cancer, obstructive airways disease and other. The findings of

this review are presented in Tables 1 and 2.

Table 1 shows that the percentage of published papers concerned with occupational respiratory disease was highest in 1991, but by 2001 had waned to a level similar to that found in 1981.

This is most likely due to the trend in recent years for the occupational disease research effort to cover a broader cross-section of work-related conditions, such as musculoskeletal disorders, reproductive disorders, psychosocial factors, etc.

Table 1: *Published papers in Occupational and Environmental Medicine 1981, 1991 and 2001*

Year	Total papers each year	Respiratory disease papers each year	% respiratory papers each year
1981	61	15	25%
1991	70	51	73%
2001	123	25	20%

Table 2 shows that the spectrum of the types of respiratory conditions which the published papers have investigated has also changed considerably over this 20 year period. In 1981, fibrotic lung disease accounted for almost half of the published papers

on occupational respiratory disease. By 1991, this percentage had almost halved, and respiratory cancers had increased by almost four fold. By 2001, the cancer papers had dropped by half from the 1991 level and the fibrosis proportion had

slightly increased. For obstructive disease, mainly concerned with occupational asthma, there has been a steady increase in prominence over this 20 year period, to account for almost half of the published papers in 2001.

Table 2: *Published occupational respiratory disease papers in Occupational and Environmental Medicine 1981, 1991 and 2001*

Year	Fibrosis	Cancer	Obstructive Diseases	Other Respiratory Diseases
1981	47%	6%	33%	13%
1991	24%	27%	41%	8%
2001	32%	12%	48%	8%

This brief review of the published research effort in one occupational health journal indicates that obstructive respiratory diseases, such as occupational asthma, are increasing in research prominence, while

attention to other types of occupational respiratory disease has been waning to some degree. Research findings tend to predate practice in occupational health, so this suggests that in the future, practitioners interested in

the prevention of occupational respiratory diseases will be required to pay closest attention to reducing exposure to those workplace causes of obstructive diseases.

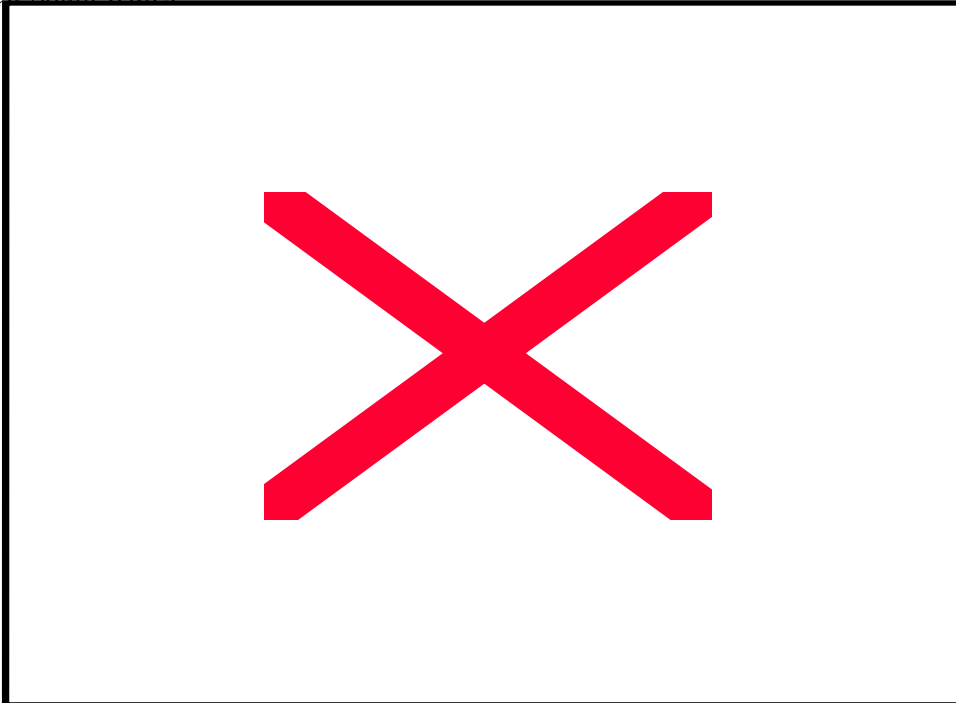
Compensation Payments

Another way to assess where the main problems are in relation to occupational lung disease is to review the level of compensation payouts to affected workers over time. A review of the total amounts paid by the Workers' Compensation Dust Diseases Board to workers affected by dust-related respiratory

disease in New South Wales, Australia over three two-year periods each about five years apart, is shown in Figure 1 (Workers Compensation Dust Diseases Board, 2002). These data demonstrate that payments for mesothelioma cases have increased substantially over this period, by more

than a factor of ten. In contrast, the increase in payments for silicosis have changed little over that period, and in real terms have probably dropped. Payouts for both lung cancer and asbestosis have increased, but at a considerably lower rate than is the case for mesothelioma.

Figure 1: Payouts per year for occupational respiratory diseases, Dust Diseases Board, New South Wales



Such compensation data only show the direct payments to affected workers and don't include the other less direct costs to the community of these types of diseases. To gain a better understanding of the direct and indirect costs, attempts have been made to calculate the population attributable risk (PAR), i.e. the proportion of the disorders attributable to workplace causes, in

order to estimate the full economic burden to the community. Such calculations take into account the costs of medical care, costs of retraining etc. A review found a range of PARs in published papers for occupational asthma between 2% and 33%, with a median of 9% (Blanc and Toren, 1999). A more recent USA estimate, based on data collected for the third National Health and

Nutrition Examination Survey, suggested that 36% of asthma is occupational in origin (Arif et al, 2002). Assuming a PAR of 15% for each of occupational asthma and chronic obstructive pulmonary disease (COPD), Leigh et al (2002) estimated the costs in the USA to be \$US1.6 billion for asthma and \$US5 billion for COPD due to workplace causes.

Surveillance Schemes

Another way to assess the current state of the problem in relation to occupational respiratory

disease is to review statistical data in relation to incidence. This is often done using

workers' compensation data, but these types of data have several limitations in their ability

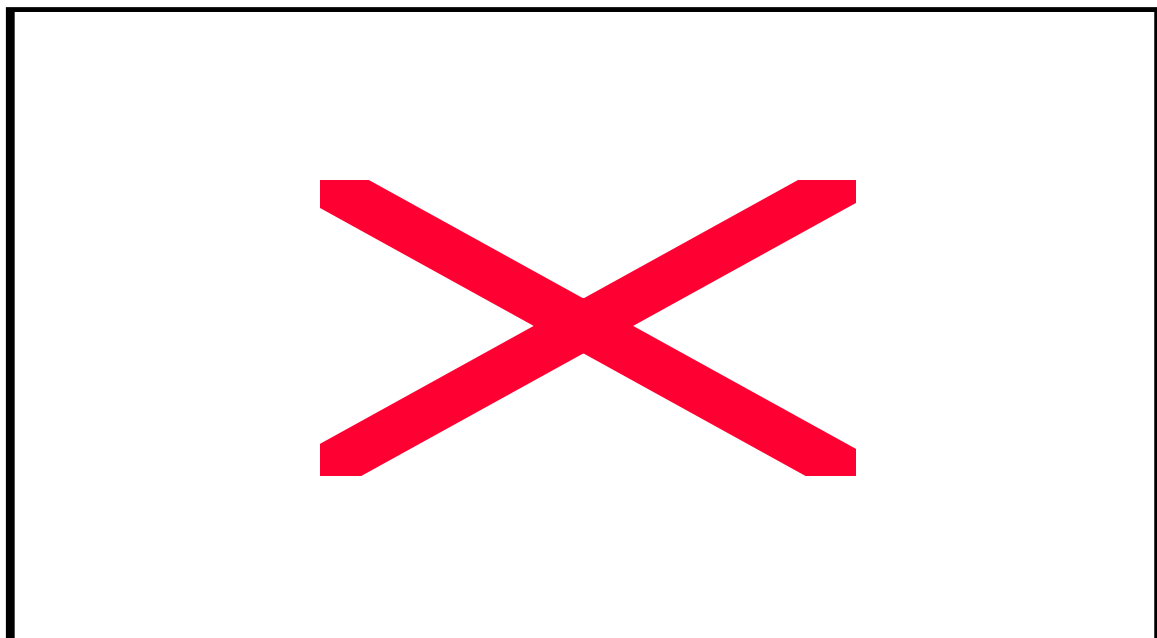
to estimate the true incidence of occupational diseases (Goldsmith, 1998). This is due to several factors, including poor recognition of these conditions on the part of the medical community, the failure to identify the link between the diagnosis of the disease with past workplace exposures, and changes in definitions for insurance purposes.

For this reason, surveillance systems which rely on specialist physician notifications of cases of occupational

respiratory disease have been established in many countries. The best known of these is the Surveillance of Work-related and Occupational Respiratory Disease (SWORD) project in the United Kingdom, which has now accumulated more than twelve years of data (McDonald et al, 2000). Similar notification projects have been established in many other countries of the world, including Finland, the USA, Canada and South Africa. The findings of these

occupational respiratory disease surveillance schemes have consistently shown occupational asthma to be the most commonly reported condition. SWORD has also shown that despite better surveillance data being available through this project, incidence rates for occupational asthma have peaked in the UK but not fallen, suggesting that there is a problem with effective use of the data for prevention purposes.

Figure 2: Incident cases of malignant mesothelioma in Australia, 1945-1999

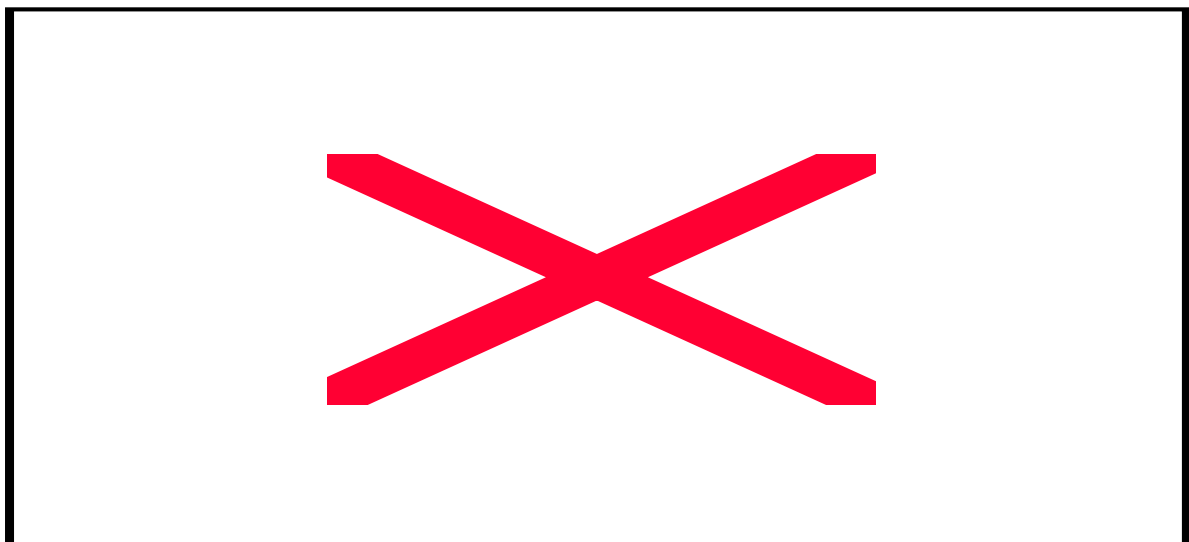


In Australia, the only occupational respiratory disease for which notification data have been collected is mesothelioma (Leigh et al, 2001). Figure 2 shows the dramatic increase in the number of cases of this disease since the 1970s. As overseas surveillance schemes have shown

occupational asthma and other occupational respiratory diseases to occur more commonly than mesothelioma, an occupational respiratory notification scheme was established in the State of Victoria in 1999 (Sim et al, 2002). This is called the Surveillance of Australian workplace-Based Respiratory

Events (SABRE) and collects notified cases of occupational respiratory disease from occupational and respiratory physicians. Figure 3 shows that, as with overseas notification schemes, occupational asthma is the most commonly reported condition.

Figure 3: SABRE notifications 1999-2002



Occupational Asthma

Both the research activity and surveillance schemes suggest that occupational asthma is the occupational respiratory disease of most prominence in recent times. Therefore, it is useful to consider how we define occupational

asthma and the types of workplace exposures which cause this condition. Occupational asthma is defined as asthma appearing *de novo* in someone who works with a known asthmagenic agent, who has no pre-existing

asthma. While aggravation of pre-existing asthma at work, from well-recognised triggers such as cold, nonspecific dusts, irritant gases and exercise, is also an important occupational health problem, this is not

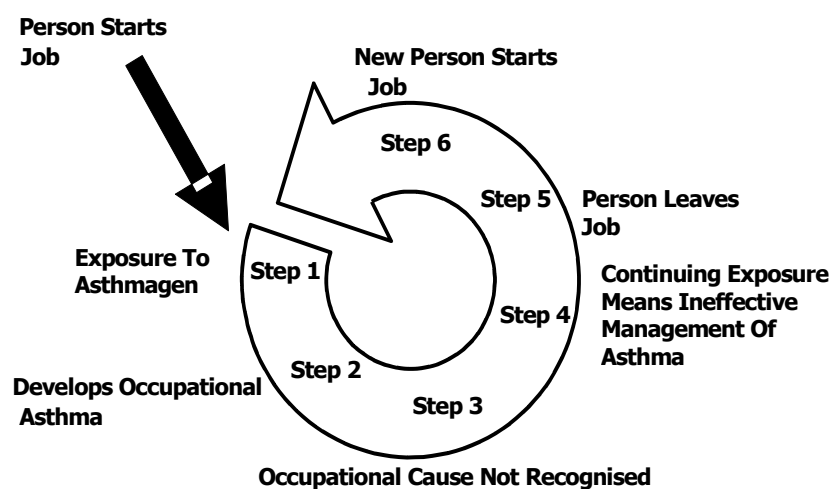
generally included in the definition of occupational asthma. The number of workplace chemical agents known to cause occupational asthma has been steadily increasing in recent years, with over 450 known agents implicated in the causation of this condition (Hendrick and Burge, 2002). These agents are encountered across a very wide range of industries and therefore differ from the agents which cause the pneumoconioses, both in terms of the considerably smaller number of causative agents and the number of industries in which they are found. Some common asthmagenic agents and the industries in which they are used are:

- Isocyanates - polyurethane foam manufacture, two-pack paints
- Pot room asthma - aluminium production
- Colophony resin - electronics industry
- Grain dust - farming
- Animal handlers - animal houses, farming
- Wood dusts - timber industry, construction
- Antibiotics and other drugs – pharmaceutical industry
- Enzymes - washing powder manufacture
- Glutaraldehyde - sterilising agent in hospitals

For the high molecular weight agents, there is thought to be an

immunological basis. For the low molecular weight agents, the mechanism is less clear, but is thought to be a combination of immunological and irritant factors. The latent period between first exposure and onset of the disease can be as short as a few weeks to a few months. This short latency can lead to a continuous cycle of exposure and disease, as workers begin work with these agents, develop occupational asthma, eventually need to leave the job and, if the cause is not identified, are replaced by another worker who is then at risk of developing the disease (Figure 4).

Figure 4: Cycle of exposure and disease in occupational asthma



Conclusions

In conclusion, occupational respiratory disease continues to be an important problem, although the spectrum of these types of diseases is changing. Airways disease, in particular occupational asthma and COPD, is becoming more prominent in terms of incidence, population attributable risk, economic burden to the community and generation of research activity.

However, compensation payouts still tend to be dominated by the longer latency diseases, such as mesothelioma and the pneumoconioses. The reason for this is that these conditions have long latent periods and we are still continuing to pay for the past mistakes of insufficient prevention in relation to exposures relevant to the development of these

longer latency diseases many years or decades in the past. With the shorter latency occupational respiratory conditions, we have the opportunity to put in place more effective prevention measures, without the need to wait for many years or decades to see the results. However, the experience of the SWORD surveillance scheme shows us that just monitoring the incidence of these diseases will not, in itself, bring about a reduction in incidence. We need to more effectively use such data to target prevention measures and close the surveillance/prevention loop to bring about real reductions in the burden of occupational respiratory diseases in the community.

One last point to remember is that the

information presented in this paper generally relates to occupational respiratory disease in the developed world. The situation in the developing world is likely to be quite different. A recent survey of occupational exposure limits (OELs) for asbestos and crystalline silica in countries of the Asia-Pacific region has found that there is considerable variability in these OELs (Sim and Phoon, 2002). What is most worrying is that several of these countries have OELs for these two workplace agents which are considerably higher than those usually in place in countries in the developed world, suggesting that the longer latency respiratory diseases are likely to be a continuing problem in these countries.

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Occupational Fatigue

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Stress and fatigue are coming under consideration in the Health and Safety in Employment Amendment Bill as identifiable hazards in the workplace. Therefore, whether or not we are ready for it, we will soon have to be dealing with the

issue of stress and fatigue in the workplace.

The field of fatigue research got waylaid for a long time in the attempt to define what fatigue was, and to some extent that has affected how much we know about fatigue and

whether or not it is an issue in workplace safety. We have now moved on in our understanding of what causes fatigue and are making some progress in what can be done about it.

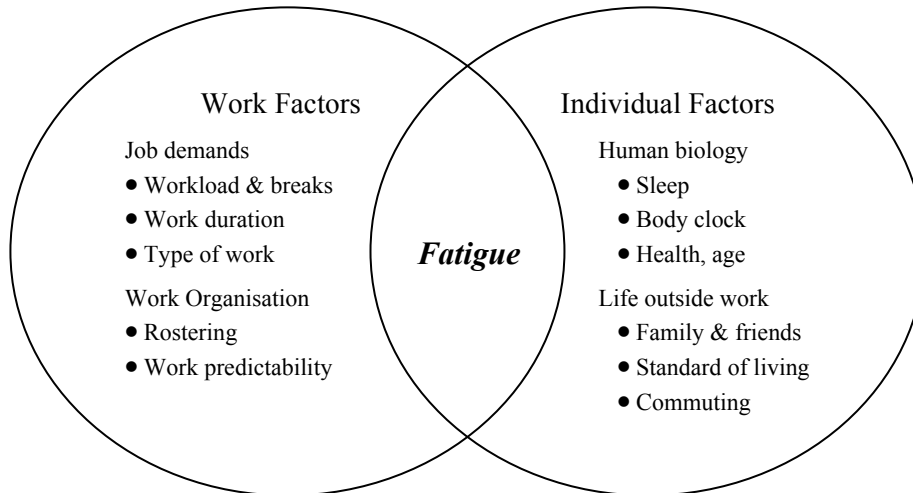
Fatigue as a Workplace Safety Issue

Fatigue as a workplace safety issue has traditionally been identified by the symptoms of people becoming sleepy, apathetic, lethargic, irritable, and uncommunicative. There is reasonable evidence that when this happens people change their work strategies; they tend to be less safety conscious (Harrison and Horne, 2000). Primarily from a range of laboratory research, we began to realize that when these

symptoms are appearing there are actually changes taking place in the way that people are functioning. When a person starts to feel these symptoms they are likely to be also demonstrating a progressive performance impairment in most aspects of their functioning. Alertness, attention span, and reaction time are affected, short-term memory deficit starts to set in, and there are changes in cognitive processing - the speed at

which a person can interpret and integrate information and their flexibility in their approach to decision making. The end point of this is people falling asleep uncontrollably, which in the workplace can have quite catastrophic consequences and is not as uncommon as might be expected (Mitler et al, 1988; Harrison and Horne, 2000; Gander, 2003).

Figure 1: Causes of fatigue



As with most factors that are contributing to occupational injury, and potentially to longer-term health outcomes, the causes of fatigue are complex. Probably the real progress in the last ten or fifteen years has been in the understanding of what has been termed the “human biological causes”. In some sense, this term is useful because these factors are the ones that are reasonably generic, while the other contributing factors are going to be very much specific to the

workplace in question. If we consider individual factors, we know that the symptoms and performance changes mentioned previously can be induced by experimental sleep loss; therefore the focus in managing fatigue is upon managing sleep. As mentioned before, there is not very good data available on the extent of the problem of fatigue in the workplace, but we have recently conducted a survey of New Zealanders aged 30-60 years (Harris, 2003).

A sleep questionnaire was mailed out to 10,000 people and we received over 7,000 replies. Of these respondents, 37% said they rarely or never get enough sleep. People who are not getting enough sleep are not functioning at their maximal level. As individuals, communities, and as a nation, the costs of this widespread sleep debt may be very high (US National Commission on Sleep Disorders Research, 1993).

The Circadian Clock

A vital fact - which has not yet been taken on board in occupational

safety and health at all - is that human beings fluctuate in their

functional capacity (Gander, 2003). We do not function in an

equivalent manner during night and day. In fact, we are genetically programmed to sleep at night, and we do not adapt to altered work schedules. Thus, people who work at night will be functioning when they are least able, and they will also be trying to sleep when they are less able to sleep effectively. There is some interesting anecdotal evidence to suggest that the body's responses to toxins for example, are different at night to what they are during the day. The immune system certainly functions differently at night to what it does during the day, so when considering exposures to

other kinds of work place hazards we would probably be looking at differential rates for night workers versus day workers.

There is a great deal of new research adding to our understanding of this fluctuating human physiology. In the last few years we have understood the molecular genetics of the circadian clock. We know a lot less about how cyclic changes in proteins in the hypothalamus regulate a whole lot of other body functions, but this information is coming very quickly. One clear implication of circadian physiology is that we

need to consider both sleep and waking function to fully understand occupational health and safety risks.

I think one of the reasons that stress and fatigue get lumped together is that, although they may be identified as a workplace hazards, both clearly also involve factors outside of work. Certainly life outside of work needs to be addressed in some way, because fatigue management is the overall balance between all of a person's waking activities and their opportunities for restoration, and most importantly sleep.

Identifying Fatigue as a Workplace Hazard

We do not have good information, as I have already alluded to, about the extent of fatigue as a workplace hazard. If you are trying to identify whether or not fatigue is a factor in an incident or an accident then you can ask the individual involved. However, people whose function is impaired by fatigue are unable to give you a reliable indication under normal circumstances, let alone under the circumstances of dealing with a major event. The

symptoms of fatigue are also not generally obvious to witnesses at the scene. Those directly involved may be injured, in shock, or experiencing an adrenaline rush. It is very hard to tell by looking at a person whether or not they may have been systematically impaired by fatigue.

A further problem is that the question of fatigue simply is not asked in most accident investigations. The best we get is usually a "tick

box" where somebody indicates that they think it may have been fatigue - either the person involved or the accident investigator subsequently. Because we know a lot about the systematic causes of degradation in human functioning we can actually be a lot more specific. We should be asking about sleep history, we need to be considering the time of day that the event occurred, and the type of performance errors that

were involved in the event, in order to be able to make any real judgement as to whether fatigue was a

contributing factor or not. There are several models for doing this (e.g. National Transportation Safety

Board, 1994). The following examples are some recent studies from New Zealand.

Examples of Fatigue as a Workplace Hazard

We did a survey in 1998 of all New Zealand anaesthetists by sending out a large questionnaire with their newsletter for which we had a seventy percent response rate (Gander et al, 2000). Eighty-six percent of the respondents could recall a fatigue related error in clinical practice, and 32% could recall a fatigue related error in clinical practice in the last six months. This is not to pick on anaesthesia; anaesthesia is a specialty where people tend to be particularly self-critical in terms of improving their work practices. We have done a great deal of work on the links between what somebody considers to be fatigue related and what is actually fatigue related in anaesthesia. This suggests to us that the anaesthetists are probably underestimating by about a factor of three the number of times that fatigue is involved in an incident. This was done through adding sleep histories to standard

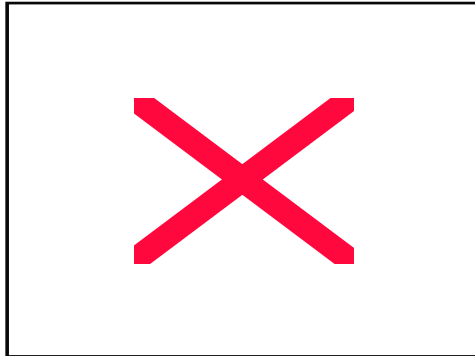
incidence reporting forms used for safety audit (Millar and Gander, 2002).

We have also periodically done a great deal of work in the rail industry on the relative risks of workplace impairment. In our 1998 survey of locomotive engineers (Gander et al, 1998a), one third of those surveyed said they often or always nod off in the cab while moving by the end of a long night shift. There is a great deal of data from around the world suggesting that the problem of locomotive engineers falling asleep is a significant safety issue. We are starting to document our own problems in New Zealand: in 2000 there were two derailments and a head-on collision that were attributed by the Transport Accident Investigation Commission to drivers being asleep.

Realistically, we don't know how large the problem is of fatigue as a workplace safety issue. However, we have

reason to expect that it is a fairly major contributing factor to safety and health, and that it will be stronger amongst shift workers, particularly night workers. The USA has been considering the issue of driver fatigue in a great deal more detail than in New Zealand. The US National Transportation Safety Board is an independent branch of government that answers directly to the President and has a large team of professional accident investigators. It has decided that driver fatigue is the number one truck safety issue in their industry (National Transportation Safety Board, 1990, 1995). Fatigue is estimated to contribute to 30%-40% of all heavy truck crashes and 31% of fatal-to-the-truck-driver crashes. In New Zealand if we consider the information coming out from our Commercial Vehicle Investigation Unit (the police unit responsible

Figure 2 – Fatigue related car accident



for truck crash investigation), the corresponding estimate is up to about 7%. In Australia, a third of all workplace deaths occur on public roads and twenty six percent of them are related to commuting (National Occupational Health and Safety Commission, 1998). I believe the fact that we don't collect such information in New Zealand means that we are missing a very large problem. My particular concern is that if we

focus only on how fatigued a person is by the end of their work-shift and then leave them out on a public road to go home, then we are probably missing a great deal of the really significant impact of fatigue. For example, in the survey conducted amongst locomotive engineers (Gander et al, 1998) there were 4% who said they often or always fell asleep driving home after a long night shift. In fact there have been several deaths of

locomotive engineers driving home after long night shifts, but these will not appear in OSH records because they do not count as occupational. To illustrate this point, the car in figure 2 belongs to a colleague who had just spent two years training truck drivers around the country on fatigue management and then fell asleep at the wheel of his car while driving home from work.

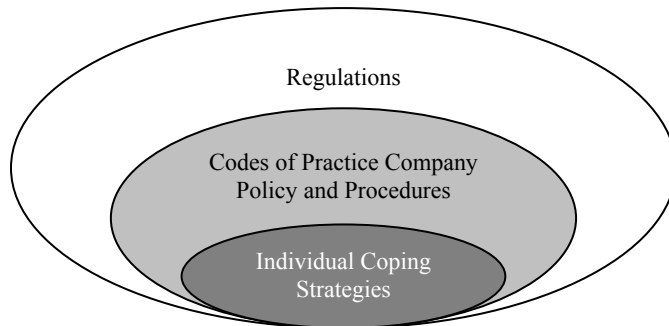
What Can Be Done?

What can be done about fatigue as a workplace health and safety issue? (figure 3) It is a complex problem because, unlike many other occupational

hazards, exposure is not only in the workplace, but is related to the whole of a person's activities across their waking time, and also to

their opportunity for recovery. Recovery is not about rest, recovery is about sleep.

Figure 3: *What can be done about it?*



The Health and Safety in Employment Amendment Bill

I believe that the approach adopted in the recent changes to the Health and Safety in Employment Act, particularly the idea of developing a better collaborative partnership in the workforce between employee and employer, is going to be the only way to manage these issues. The extensions to the coverage of the Health and Safety in Employment Act will include the aviation, rail and maritime industries. In fact, each of these modes of transport has had regulations managing fatigue and a long tradition of doing so. Traditionally, hours of work regulations have limited maximum duty periods and minimum rest breaks. What has been happening in our part of the world in the

last few years is that we have taken some fairly radical steps in deregulating this approach. It has really been led by the Australian trucking industry. Now, rather than a company having to conform to a strict set of hours of work regulations they may instead go back to the regulator and state that they have in place a series of measures in their company to manage fatigue. This may then, under certain circumstances, allow them to operate outside the prescriptive hours.

This is a move to deregulation, to what are becoming known as “fatigue management schemes”. The Australian trucking industry has been

running trials in Queensland for some years now, and the Land Transport Safety Authority (LTSA) is apparently going to run a similar trial with a number of trucking companies in New Zealand. The other area where this has been done in New Zealand is in aviation. We already have for flight crew the provision for companies to put in place a fatigue management scheme and therefore operate outside prescriptive hours of work. There has been legislation put before the minister to make the same changes in air traffic control. Table 1 shows part of the proposed rule, and illustrates the much wider scope of fatigue management schemes compared to traditional

hours of work regulations. This is an area where, in our part of the world, we have taken some fairly bold steps. We think we have understood enough about the causes to be able to

actually start working at the regulatory level and begin changing things. It will be very interesting to see what will happen once the aforesaid modes of transport fall under the Health and Safety in

Employment Act, how or if that will change things, and what sort of information flow there will be among the different regulators.

Table 1: *ATC proposed rules*

<p>A fatigue management scheme shall take account of:</p> <ol style="list-style-type: none"> 1. The rest period available prior to commencing duty 2. Typical traffic for the shifts to be worked 3. The availability of rest, refreshment and meal breaks 4. The availability of relief staff 5. Circadian rhythms 6. Short-term and accumulated sleep deficient 7. The shift rotation system in use

At the level of companies we have these fatigue management schemes, which really are initiated by the company itself. They are likely to be the prerogative of larger companies who have the money to invest in the problem. Such schemes entail a great deal of work and external expertise, and it is unlikely that many small companies would have the resources to spend on this. One possible

response to this situation is to develop industry codes of practice. Once again this is a nice idea, but at the moment one without any resources. Thus, there is some concern even with the fatigue management programmes in trucking (Gander et al, 1998b), that they will be accessible only to the wealthy, and that this will enable such companies to have a competitive advantage

over others who must fit to the prescriptive hours. Furthermore, we are never going to get away from the fact that there is individual responsibility involved in people arriving at the workplace in a fit condition, which includes using their time away from work to get adequate sleep. In my mind, the level of individual coping strategies can really only be addressed through education.

Conclusions

I would like to make a number of points in conclusion. We cannot be definitive at this stage, but there is reasonable evidence to suggest that workplace fatigue is a significant safety issue. We know very little about the evolution of fatigue to chronic health problems, except perhaps in shift work where there is more and more evidence that such work is an independent risk factor for a number of major health problems, particularly gastrointestinal and cardiovascular illness, sleep problems and reproductive health problems. Generally we don't know what the long-term effects are for a person who is coping poorly in the workplace and having an ongoing problem with sleep.

I am possibly being optimistic in saying that the causes of fatigue are

fairly well understood, being a combination of working at the wrong time in the circadian cycle, sleep loss and the effects of long, continuous periods of work. Because of the balance between life outside of work and life at work we do need to have a comprehensive approach to the management of fatigue. It cannot be left as the responsibility of one group. I believe that the intent of the Health and Safety in Employment Amendment Act is very good in this regard, and that improved communication in the workplace is a way of managing these risk factors.

A number people, myself included, have been developing fatigue management tools (Gander et al, 1998b), but the real problem is that none of these has

been evaluated. While they are based on good ideas, we don't know if they are actually going to deliver comparable or improved safety, or whether they are going to give us the flexibility to meet the changes that are ongoing in these industries.

Finally, we need to think about how we are going to provide the necessary information and support to smaller companies, particularly if fatigue is going to be identified as a workplace hazard. The Statistics New Zealand website states that the average New Zealand business enterprise has three full time equivalent employees. Therefore putting into place a comprehensive fatigue management programme is going to be far beyond the capabilities of most New Zealand businesses.

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Social and Economic Consequences

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No one person experiences, sees or accounts for the full consequences of a workplace injury or illness. Consequently, the full depth and breadth of costs and consequences are often not measure or recorded in any official statistic. Often they are not recorded anywhere.

Employees who are harmed will inevitably bear much of the consequences of what happens to them by themselves, as others simply will not experience or fully understand the degree of pain or isolation that they may experience.

Likewise, the costs and consequences to family, friends, or work colleagues often goes unrecorded and unobserved, although they are nonetheless real. Many consequences are

unable to be measured directly as an economic cost or some other cost, such as loss of intimacy between spouses, or the breakdown of a family unit due to an unexpected death. The experience of being harmed at work can be devastating, with profound emotional consequences for all those involved. People may become isolated, estranged from their community and depressed. Isolation and estrangement can become permanent. A widow who took part in the study presented here expressed the profound and lasting impact of her husband's injury on her:

There was never a point to say goodbye to a marriage and that of all things of the whole lot I feel I have lost. I have lost my marriage... I always feel I live in

the shade, I no longer live in the sun. (Ian's wife)

To explore these wider costs for society the Social and Economic Consequences of Workplace Injury and Illness Study (Adams et al, 2002) aimed to gain an understanding of the full range of consequences of workplace illness and injury. It attempted to do this by examining the costs through the experiences of the affected participant in the study, their family, friends, their colleagues, employers and supervisors in the workplace. As much as is possible the study tried to gain a depth of understanding of each case and chart the intangible effects on society.

Background

Prior research in 2000, focussed on the potential costs to the business sector arising from complying with the Health and Safety in Employment Act 1992 (HSE Act). It found that these costs were hard to quantify and specifically identify. In 2001 the Department of Labour and the Accident Compensation Corporation (ACC) undertook research into the effectiveness of health and safety legislation through case studies.

Other research by the Ministry of Economic Development examined the effect of the costs of compliance on employers. Although these costs were seen as part of business, there were concerns about the nature and amount of these costs. Small-to medium-size enterprises were particularly affected. There were concerns over the impact on competitiveness, innovation and investment. As regards to the HSE Act, businesses while supportive, described the Act as resource hungry. Both pieces of research have provided only indirect insight into the social consequences of

injury and illness in the workplace.

The government will shortly be consulting on the New Zealand Injury Prevention Strategy (NZIPS). This is to promote a co-ordinated approach to injury prevention across government. One of the identified strategies of the NZIPS that the government wants to develop is a workplace injury strategy. Another solution is to focus government and business attention on the cost of non-compliance through legislative change. The Injury Prevention, Rehabilitation, and Compensation Act 2001 (IPRC Act) and Health and Safety in Employment Amendment Bill (HSE Amendment) currently before Parliament are integral parts of producing a more co-ordinated strategy for injury prevention and rehabilitation.

This study was initiated by the Occupational Safety and Health Service (OSH) of the Department of Labour (the Department). Because of the wider interest that was shown internal and external to the department, OSH

invited groups with interests in injury prevention, such as the Labour Market Policy Group and ACC to participate. So, in 2001 the Department and ACC undertook case study research to obtain a deeper understanding of the consequences of injury and illness. While employer's understanding of the costs of compliance are well documented, the costs and consequences of avoidable occupational injury and illness are not. Further, how non-compliance affects the community is to a greater degree unknown. How costs are distributed beyond the employer, and the experiences of those who bear them, need investigation. Because of their nature, the full breadth and depth of costs of workplace illness and injury are not recorded in any official statistic.

To explore the social and economic consequences of workplace injury and illness, three objectives were identified:

- To explore the social and economic consequences of workplace injury and illness for injured and

ill employees, their families and the workplace;

- To identify key characteristics that determine social consequences; and

- To inform investment in health and safety in the workplace.

Methodology

To achieve the purpose of the study, four research questions were drawn from the study objectives. These were:

1. What are the main social consequences of workplace injury and illness and how can they be identified and avoided?
2. What are the key characteristics (for example gender, ethnicity, age, family status, injury or illness type, and location) that shape the social consequences and economic costs following occupational illness or injury?
3. What is the nature and extend of the financial costs (for example loss of income, medical costs) of workplace illness and injury and how can these be valued in economic and social terms?
4. What are the links between social consequences and

economic costs of workplace illness and injury?

The unit of analysis for these questions was the ill or injured employee and their relationships in the home, workplace and community. A case study approach, with both quantitative and qualitative methods was utilised. This involved triangulating data from a number of sources, including existing ACC and OSH research, analysis of stakeholder views, and case studies interviews with the affected person, their family, workmates, and appropriate OSH and other health professionals.

An iterative research process was used. The research objectives, the questions the case study framework, and a participant selection process were developed. From this, a literature review was completed, semi-structured interview questions developed, workshops on the

analytical framework for data analysis conducted, and a report writing process established. A framework for data analysis for the interviews within a case was created and this led to cross-case analysis. From each interview the key themes were drawn out using the interview transcripts, OSH and ACC information. When two cases were completed, a formal stocktake was done to determine whether the process was working correctly. Once all the interviews had been conducted, the themes from all cases were analysed and cross-case analysis performed.

Fifteen cases were selected using a number of criteria including age, family status, socio-economic status, occupation, gender, nature of workplace injury or illness or conditions/environment. All but one of the cases had been the subject of an OSH investigation and were, in the opinion of

the inspector involved, characterised by causing serious direct consequences to the participants. As such, they should not be seen as ‘average’, but were selected to represent what happens when things go seriously wrong. Therefore, while the cases were representative of ordinary people in common industries, they also represented the potential for serious consequences when things go wrong.

The research team was made up of seven researchers from the Department of Labour, two independent researchers, and a researcher from ACC.

The team was from a wide range of academic disciplines and backgrounds (nursing, law, community development, and social sciences). An external virtual group was set up to provide extra input by electronic mail. Information and comments were available to the whole group. It helped to keep those outside the project up to date with the research, provided different perspectives, gave additional information and access to international knowledge.

We attempted to measure economic costs. We divided economic costs into two types:

- Unknown economic costs-costs which are known to exist but for which dollar values were not known.
- Known economic costs-specific dollar costs.

Costs were viewed in terms of which person or organisation bore them. These costs were worked out from both documented and secondary sources.

Social consequences were not given a dollar value, but we sought a detailed understanding from participants, families and workplaces and others in the interviews.

Findings

Principal findings

The research produced seven principal findings from analysis of the case studies:

1. **Minor mistakes cause big consequences**

Workplace injury or illness often resulted from minor failures in workplace systems or practices. Gaps in systems or practices that may have seemed

minuscule or insignificant prior to an injury or illness often turned out to have huge consequences for the affected person and others.

2. **The consequences ripple out**

Injury or illness had huge consequences not just for the participant but for their family, their workplace and their community. The effects rippled out from the

participant to touch the whole community.

3. **Costs were enormous, non-recoverable and ongoing**

The social and economic costs of a workplace injury or illness are non-recoverable and ongoing. They include both quantifiable and unquantifiable costs, and they continue to mount long after the injury or illness event.

4. In spite of common characteristics between cases, consequences varied greatly

Although there were commonalities between the cases in the study, for each injury or illness there were also unique individual or situational factors. Other influences to be considered were personal, social, organisational and environmental variables. These all affected the consequences of the injury or illness

5. Relationship between cause and consequence

This research indicated that if a company has

good health and safety systems that were an integral part of the work environment, then their support systems for injured or ill employees were also better. A full commitment to health and safety by an employer was more often than not reflected in rehabilitation and support structures. There was in effect, a health and safety culture.

6. Over arching cost determinants

A number of over-arching cost determinants emerged from analysis of the data. These determinants included isolation, suffering, responsibility, blame,

power and understanding. The cost determinants were most often linked and inter-dependent and influenced the recovery and coping ability of the affected.

7. Support

Support in whatever form, and whether from family, friends, colleagues, workplace and/or community, was again a major factor in the recovery and the ability of the injured or ill person to cope, as well as from others affected. Better support resulted in better rehabilitation outcomes and an easier return to working and community life.

Detailed findings

The research process and analysis produced findings in five areas of society. These areas were the participant, the

participant's family and friends, the participant's workplace, the medical sector and the government. The

principal findings kept reappearing in each of these specific areas in the study.

The individual

Past research indicates that injured employees bear about 30% of the total costs of workplace injury and illness, which include loss of income, pain and suffering, loss of future earnings, medical costs and travel costs. The share of costs borne by injured

employees rises sharply with the severity of the outcome while the share borne by their employer falls. There was a varied range of social and economic consequences for the participants in the study. These were influenced by a number of factors, such as the

participant's personality, the understanding the participant had of their condition and the availability of support.

The importance of understanding of the participants and by their family and friends was highlighted in the study.

Participants were keen to understand what was wrong with them. This related to finding appropriate rehabilitation, how long the recovery took, if they recovered completely, and what they should have done. There were differing levels of understanding of conditions and treatment, which influenced recovery. With gradual process conditions, it was harder to diagnose and for the affected to recognise that there was a problem (Lisa, Julia, Murray, John, Philip). Relationships with family and friends were strained through emotional stress, financial pressure or physical isolation. Family and friends were deeply impacted, leading to either deeper bonding or disintegration of the relationship. In a number of cases the injury or illness resulted in temporary or permanent loss of sexual or other intimacy between partners (Brian, Keith, Peter, Thomas). Thomas' wife commented on the effects of his injury on his relationship with his children:

[The kids] stayed away from him. He couldn't lift his kids up, he couldn't cuddle

his kids... (Thomas' wife)

Support and its presence or absence was of considerable importance in this study.

Participants often felt isolated from support structures. These included sources of information, support groups, and often, infrastructural support.

This affected their ability to cope and their recovery. Related to this was the attitudes they encountered in their workplace. Attitudes and support received from the workplace affected the psychological and physical recovery process of individuals, as well as their ability to understand and handle their condition (Lisa, Grant). In certain cases, it impacted on the participant's family's ability to deal with the aftermath (Ian).

Participants' careers were affected directly as a result of their condition. This included shifting to other jobs, retraining, and being unable to continue what they had been doing and actually doing nothing (Murray, John, Peter, Julia). It also included those who returned to the same job, but felt that career options had been lost (Grant, Thomas):

It's narrowed my options down something shocking really, and it's quite scary sometimes to think about it and think about where you, because everybody likes to think they can do whatever they like. And I have, I have been able to up until now. (Grant)

Participants whose jobs were disrupted by injury or illness suffered financial losses. These costs included ongoing medical costs, direct income loss, transport costs and losses related to lifestyle changes.

Participants' experiences with dealing with government agencies such as OSH and the Accident Compensation Corporation (ACC) differed. In dealing with OSH, in two of the cases mention was made about the negative effects that OSH staff had on the participant (Grant, Murray). This affected the recovery and rehabilitation in one of the cases (Grant). A number of the participants found ACC frustrating to deal with (Murray, John, Julia, Lisa, Barbara). This was particularly apparent with occupational illness where individuals can find it hard to establish

an occupational cause for their condition. A number of participants were involved in legal proceedings, either prosecution of an employer for breaches of the HSE Act or review or appeal of ACC decisions.

Participants' personality had an observed effect on the presence of certain social consequences, and their severity. Some took charge of their situation, made changes and felt more positive as a result (Paul, Lisa, Thomas). Other personality traits impacted negatively on the consequences suffered by participants. They became withdrawn, internalising their problems and worries (Martin, Peter). This led to pressure within their personal relationships. As a result of their condition, some became suicidal, depressed or violent. This affected their relationships (John, Murray):

I just hate living like this, eh. I really do.

The main focus I've got in life is with most of the guys in relationships is to make sure that their partner is well-catered for when they die sort of thing. That's my focus. I want to make sure that [the] mortgage is paid and everything like this, then I don't mind doing something, disappearing or whatever... (Murray)

Some participants' labour market status was such that they did not feel secure in their job (Thomas, Grant). Labour market factors for these participants meant it would have been hard to be re-employed elsewhere. This has meant staying in their former occupation. Others have chosen to retrain (Peter, John) and others have yet to find alternative employment (Julia, Murray).

Who wants to hire a crazy? (Murray)

The total documented costs borne by the 15 participants themselves were \$56,952.00. These do not include the potential estimated income loss as far as Philip is concerned, of \$105,833.00 that would have earned had he completed his training and specialised as he had planned to do. Also not included is the \$225,000.00 spent by Elizabeth on a house that would accommodate Brian's special needs. The potential income loss to the individual and their family is not included, as this is unreliable and difficult to quantify. Other financial costs are also not included, due to the limitations of participant recall. This figure also does not include the undocumented costs to each individual, which would be considerable higher. Note that this also includes costs to the immediate family of the participants.

Friends and Family

In all the cases the family suffered emotionally, mentally and financially. Family relationships were affected, mostly negatively. This impact rippled outside the

immediate circle of the participant touching the workplace and the community.

The initial reaction to an injury or illness was

shock and disbelief. This was affected by the severity of the injury or illness, the degree of information and support available, when it was provided, and the amount

of follow-up care that was offered. Lack of awareness of information about the injury or illness contributed to the initial shock. The degree of shock and trauma varied, but was present to some extent in all of the cases. Because of the sudden nature of injuries, it was generally more pronounced in these cases. Shock was exacerbated by the lack of clear communication between family workplace and medical professionals, and inability to access good information and support (Brian, John, Murray, Ian, Peter, Mark, Sarah):

The doctors... are a bit cavalier with relatives, y'know... [they said] he's stuffed... we've taken out X amount of his brain, the rest of it's like a bowl of jell dropped from a height. It's just shattered. He will be no good. They really push you to [turn off] the ventilator. (Brian's wife)

Communication, information and support continued to influence the families' and friends' experiences long after the initial reaction to the injury or illness.

Within family relationships partners

were in most cases severely affected. The injury or illness strained the relationship through emotional stress, financial pressure or physical isolation in five cases (John, Murray, Peter, Philip, Thomas). An important factor was whether there was understanding of the effects upon the individual, and whether they understood the impact on their partner, particularly so for illnesses where symptoms appeared gradually (John, Murray):

We separated... the reason was that she said I had changed that much and I was, just that I was a harder person to get along with... Which I was. (Murray)

The strain resulted in a separation or redefinition of the relationship in four cases. In two cases, the pre-injury relationship was lost permanently and irrevocably (Ian, Brian). Intimacy was frequently severely affected, often further impacting the relationship. Beyond the affected person and their partner the relationships with their families; children, parents, and siblings were impacted in all cases. For young children, the effects of an illness or injury on an

individual could substantially change the way that person was able to interact with them, sometimes resulting in physical and/or emotional isolation (Brian, Sarah, Thomas, Paul, John). Where the individual had adult children, the injury or illness and its aftermath profoundly affected their relationship with them, though not always negatively. (Mark, Grant):

For a long, long time, every time I thought about the accident, I was, I think I started to realise how close he was to dying, I mean if it had been a foot the other way, he'd be dead, and, just how lucky we were... you just realise how quickly things can change... I sort of, took thing for granted a bit before the accident, things that I don't take for granted now... you might not be around to say things later. I think a lot more like that now. (Mark's Son)

Not unsurprisingly, in some cases, family members expressed some animosity to the individual's workplace (Paul, John, Ian, Brian, Thomas, Peter, Mark). This varied from

concerns about workplace safety, to anger at workplace responses to injury or illness:

*I was angry. I was so angry at the firm. How can they have done that to me.
(Ian's widow)*

Suffering rippled beyond the immediate family to friends, workplaces and communities. A serious injury or illness isolated the participants and their families. Close friends were often unable to relate to the participants' new circumstances (Brian, Murray, Julia, John, Ian). Isolation was on occasion self-imposed. The major reasons for self-isolation appeared to be others' lack of understanding, self-consciousness about injuries or, in the case of solvent induced neurotoxicity, inability to cope with mood swings (Murray, John, Brian, Peter). Brian's wife described their life after the injury:

*I really don't have a social life anymore. We don't go fishing, we don't go for trips away anymore
(Brian's wife)*

The temporary or permanent removal of an injured or ill worker from the workplace impacted

not only on their career, responsibilities and lifestyle but also on those around them. Many families found that their domestic and family responsibilities altered (Julia, Sarah, Mark, Ian, Brian, Peter). The changes were either directly related to caring for affected, or assuming their normal responsibilities when they were unable to perform them. In some cases this was temporary, in others it was a permanent change. Employment and study prospects were also altered. Partners gave up employment or study to become the major caregiver following the injury or onset of illness (Brian, Peter). These revisions in income and career led to, in almost all the cases, changes in the affected persons' lifestyles. This varied from being a comparatively temporary change during recovery, to being massive and permanent. It depended on the nature and severity of the injury or illness, but was also affected by the pre-injury situation, and financial considerations. For some participants, even with ACC entitlements, there was a considerable drop in income:

They had no money, I remember something

that really hit home to me was the fact that they had no money for their twins' first birthday. Thomas was so upset because [he saw] himself as the provider and was very, very adamant that it was his job to provide for Karen and the girls. And he just, he just couldn't cope with the fact that he couldn't give his girls a birthday, he couldn't, they couldn't go and buy a cake. (OSH Inspector – Thomas)

The extent and degree of family support available to the affected person was important in rehabilitation outcomes. In three cases, the family played an active role, becoming involved in the medical treatment (Brian, Peter, John). This involvement varied, depending on the medical knowledge of the family member. In three cases, friends offered considerable help (Brian, Julia, John). Often families found there were barriers to providing the support they wished to offer (Brian, John). This related to the availability of support structures or information, or the difficulties experienced in dealing with government institutions. There was also a lack of

support for partners of injured and ill workers.

Family status and in particular those who had dependants were affected in the way they reacted and the consequences faced after their injury or illness. The age of the individual affected the social and familial responsibilities that the individual had to assume.

The workplace

The social and economic consequences of injury and illness impacted on the workplace, not just primary actors such as the employer and the affected employee, but also employee representatives, workmates and other staff. The effects of an injury or illness rippled through the workplaces in the study. An injury or illness highlighted systems' adequacy or inadequacy within workplaces.

The employment relationship between the employer and employee is important in understanding the consequences for the workplace. The key components of this relationship, for the injury or illness and its outcomes, were influence and responsibility. Who held influence and how it

Younger participants cared for young children while older participants were caring for elderly relatives (Thomas, Paul, Julia).

Rehabilitation and recovery (physical and mental) was aided when there was good support from both family and friends. For family members to offer

was used was important. Its use affected work processes and health and safety in a workplace. Perceptions of who had responsibility and influence, and workplace roles, often determined influence. In five of the cases (Barbara, Peter, Thomas, Julia, Martin) employers did not believe themselves to be influential or able to influence unsafe behaviours. Conversely, five of the workers (Philip, Brian, Peter, John, Thomas) felt unable to refuse work which proved to be dangerous. The approach taken to the injury event by the supervisor or employer impacted on the rehabilitation outcomes for the worker in two cases (Lisa and Grant). The most successful outcomes for both the worker and workplace

appropriate support, they needed to understand the condition and its effects on the individual. This understanding was generally more apparent in injury cases. Where participants lived largely determined the extent of the support structures that were available to the families.

were when the employer took an active role with the worker and appropriate responsibility for what occurred. This is the most evident in the case of Lisa, whose manager supported her and gave evidence at an ACC hearing. Lisa said:

My manager has been really good in supporting me. She was part of my review... gave supporting evidence for me. (Lisa)

In four of the cases unions played an important role in the aftermath of the injury or illness (Barbara, Ian, Lisa, Julia). The union was able to redress imbalances between individuals, workplaces and government organisations. They did this by providing resources, mediation,

knowledge of government systems and support. For Julia the union was of great importance:

...[the union official] gave me hope that something could be done. (Julia)

Workmates were both affected by an injury or illness, and had important effects in their attitude to the participants and their predicament. Reactions of workmates differed, ranging from hostility through indifference to minimisation, inability to support, guilt, and support. Where the injury was visible greater sympathy and understanding was shown to the participant (Saran, Brian, Mark). There were doubts over occupational illnesses diagnoses in all but Lisa's case. When a popular colleague was badly injured in a workplace, the workmates experienced grief, anger, and frustration (Ian, Brian, Julia). The availability of counselling was important in Brian's case. For colleagues no matter whether the relationship with the injured person was positive or negative, illness or injury had an impact. A workmate of Thomas' commented on

the immediate and graphic nature of his injury,

I picked up the first finger by the pile of wood inside the Dry-end shed. Then I saw the second finger by the small shed. Blood was everywhere. (Thomas' workmate)

The health and safety systems in the workplaces were on occasion shown to be deficient following OSH prosecutions in six cases (Mark, Grant, Brian, Ian, Thomas). Even where these deficiencies appeared minor at first glance, they often had larger ripple effects for worker safety and the workplace. These deficiencies included: a lack of knowledge; incomplete procedures and inadequate equipment; impractical health and safety systems; non-existent policies and procedures, and failures of supervision. The deficiencies were linked and cumulative. For health and safety systems to function effectively there had to be both responsibility from the worker and the workplace. Unfavourable outcomes resulted when systems were incomplete and workers within the workplace did not feel

empowered to ask for change, such as in the cases of Peter and John. In Peter's injury a faulty light caused an explosion and burns to forty percent of his body. He commented:

It was, it was supposed to be a sealed halogen light but apparently somebody had put an extension cord on it, a longer extension cord and left out the sealing boot around where the wire goes into the light, omitted to put that back in. And apparently one of the screws inside was loose. According to the OSH inspectors. And that caused a spark and the fumes got into the light and it exploded, yeah. (Peter)

Five workplaces in the study cited communication as a problem in dealing with government agencies (the employers of Julia, Murray, Mark, Barbara and Peter). The employers of Julia and Murray found it hard to access information from ACC on the affected employee and how their situation affected the workplace. Similar comments were made in regard to OSH by the employers of Mark, Barbara and Peter.

Economic costs to the workplace centred on lost production and morale in the workplace, extra health and safety compliance work, damage to plant and equipment, loss of business due to public odium, legal costs resulting from fines and prosecutions (including preparing for cases) and staff costs. Staff costs were made up of hiring and training new staff, paying out redundancy, and over-employment

(creating a new job while the worker recovered).

Companies who had good health and safety systems had good support systems for injured and ill workers. When an employer could and did assist, there were better outcomes for the affected person. More generally in the workplace the importance of relationships was apparent. If the worker was able to return or remain within the

workplace, they experience better rehabilitation outcomes (Grant, Lisa).

The total documented costs to the fifteen workplaces in the study was \$477,830.78 plus six months, two days, and 12 hours of company time (not costed). This did not include undocumented costs such as lost production which would add considerably to the total.

Medical

With all the occupational illness cases there was debate over diagnosis and whether the illness was work-related (Murray, John, Barbara, Lisa, Julia, Paul). Debate was considerable because enforcement or compensation was involved. Non-work related conditions might have had the same symptoms. Results of diagnoses were often inconclusive and healthcare providers were the ones caught in the middle. An injury which resulted in a visible injury was more readily accepted. Injuries were generally obvious, and their work-relationship indisputable.

Many of the occupational disease cases experienced delays in getting a diagnosis. While those with occupational disease cases were diagnosed slowly or inaccurately (Murray, John, Martin, Julia) there was also a case of incorrect diagnoses of physical injuries (Sarah). Late diagnosis impacted on recovery time (Martin, Julia, Murray, John). In some cases there was insufficient communication between treatment providers, which had implications for recovery (Thomas, Brian, Sarah). Health professionals did not always have the training, expertise or resources to deal with occupational

diseases (Murray, John, Martin):

I went to see my GP and my GP goes 'I don't want to know about it'. I went 'you're kidding?' You're joking?' I mean I had sort of gone in there with different sorts of things from time to time and he'd be alright. [GP said] 'I don't want to know about this'. (Murray)

Delays led to increased pain, delayed recovery, adverse psychological and emotional reactions, and medical complications because of delays in treatment for participants.

Several of the cases commented on how over-worked medical professionals (particularly in hospitals) seemed to be (Barbara, Sarah, Brian, Ian, Mark, Grant). This was central to Philip's case, illustrated by his description of being paged to attend to patient needs:

On the pager it fills up after twenty beeps and you have to clear to get rid of them so that the next lot can

come through. So my first Sunday, I cleared it twenty times. That's four hundred times I was paged in the space of some sixteen hours.
(Philip)

In three cases family and friends had medical knowledge and wanted to be involved in the care. Similarly, some of the affected wanted to be involved in their own treatment. Involvement varied, as did the opportunities for

involvement, and the consequences of doing so (Peter, Brian, Martin, John).

Overall the cases revealed there was a lack of knowledge and resources in relation to occupational health medicine. General practitioners had a lack of exposure to occupational illness cases. This delayed diagnoses and treatment. Consequently suffering was increased and recovery delayed.

Government

Government agencies have a range of statutory functions that impact on the social and economic costs of injury. The government sector administers a range of laws to enable and enforce sound health and safety practices in the workplace. In this study, the relevant organisations and their role were: OSH/ the Department administer health and safety legislation; OSH and the Police enforce legislation relating to public safety; the Department/Labour Market Policy Group develop policy advice for health and safety and ACC legislation; and ACC which is responsible for the policies and

administration of ACC. These organisations had both direct and indirect impacts on the investigation and payment of compensation/ rehabilitation while indirect impacts included education and prevention programmes.

Costs for the government could be both direct and indirect. There were costs related to infrastructure and services. For instance provision of the justice system, such as courts and collection of fines. Less obviously, there were costs to the economy through the loss of paid and unpaid work. The government lost taxation revenue. Loss

of income through workplace illness and injury can lead to reduced taxable income for the government.

ACC's and OSH's costs were considerable in the study. ACC economic costs were wide-ranging, including anything from the funding of acute health care to rehabilitation to income replacement, and the costs of administration. Various cases included medical costs that were not documented in the ACC or OSH notes, such as the cost of particular medical procedures. ACC pays for most public health costs of injured employees through bulk payments to the Ministry of Health.

The total cost of entitlement claims for ACC does not represent the total cost of ACC's financial contribution to injury. OSH's quantifiable economic costs arose from investigations. These were calculated on direct costs, and costs were assigned according to the hours worked, based on staff salaries. The full costs on all OSH overheads could not be calculated. There are also social costs in administering legislation. OSH and the ACC are obliged to perform particular functions that are not always well understood or appreciated. ACC staff are required to make difficult cover decisions. OSH investigations where prosecution is a possibility, can be unpleasant. Public responses can be negative:

[The OSH inspector] was a woman and she said she was quite, quite convinced if she had been a man she would have had her lights punched out several times. Y'know the attitude to OSH in some places. (H&S officer, Thomas' case)

There were considerable social consequences for government employees. They centered on the

extreme stresses that resulted from difficult and occasionally hazardous jobs. These social consequences were difficult to quantify. They centred on stress and fatigue occasioned through having to deal with fatalities, serious injuries, catastrophic situations, and distressed an injured people:

I have been to several fatal accidents with various [inspectors] in the past... at least two where the other [inspectors] have gone back to the car. In fact one of them walked...left the site and started walking back to the office. And he walked something like 12 kilometres before I actually caught up with him. (OSH Inspector - Brian's case)

Mention was made by some participants of a lack of information on ACC's entitlements and services, both before and after a claim was accepted, and during the review process (Lisa, Murray, John, Barbara). OSH was seen as supportive by the participants (John, Sarah, Thomas, Julia); but over-reactive by the employer:

[The OSH inspector] wrote a letter back to

me and more or less had to find something wrong which she did by saying I need to show them the exercises instead of just putting a poster up. Something about something in my first aid kit being expired which I found absolutely ridiculous, sticking plasters or something. (Julia's manager)

Most participants were, however satisfied with government services. The professionalism and support of OSH and ACC staff alleviated the participants' suffering. The costs associated with the provision of care and support minimise the injury costs.

Of the eight occupational illness cases one did not make a claim as he had no entitlement (Philip), two were initially unsuccessful and required review (Julia and Lisa), and compensation for four claims was delayed due to difficulties in establishing work-relatedness (John, Murray, Martin, Barbara). Two claims remained unsettled at the time of the interviews (Barbara, Julia). The occupational illness claims were administratively difficult; there was a lack of evidence and therefore

stress came with making a claim.

Documented costs for the government (excluding ACC), including OSH costs and sickness benefits (Barbara) were \$46, 488.89, plus over 390 hours of inspector time. This did not

include undocumented government costs, which would have been considerably greater.

The documented costs for ACC and the private insurer for the 15 cases in the study were \$585,400.17. The cost of medical treatment or

public health acute services received under ACC's bulk funding of the health sector have been estimated. It also does not include any time or administration costs. Projected future costs for these cases are expected to be \$3,985,989.00.

Conclusions

Key messages in identifying the consequences.

Minor mistakes (a series of oversights, failures, assumptions) can cause large consequences. Gaps in systems or practices that seem insignificant on their own can create huge, far-reaching consequences. These consequences ripple out. From the injured or ill employee, these impacts ripple out to the people closest to them, others they are in contact with, rely on, or

whose job it is, to the wider community. The consequences may change, but a common feature is that the effects are overlapping and compounding.

These cumulative costs are incalculable and only incomplete records are kept of some costs. This study sought to uncover as many of the costs as we could identify. Costs are absorbed into the

bottom line, not compensated and many cases are permanent. Unique individual or situational factors influenced the outcomes depending on the presence and influence of cost determinants in personal, social, organisational and environmental (government, medical) variables.

The total documented costs for these 15 cases are \$1,167,471.84.

The total projected future costs of the seven cases that are still receiving ACC and, in Brian's case, payments from a private insurer, is expected to be \$3,985,989.00.

This does not include the time of OSH inspectors, ACC case managers, workplaces, individuals, and their families. Costs of emergency medical treatment are estimated. It also does not include the loss of income borne by individuals and their families as a result of their injury or illness.

The actual costs for these 15 cases would far exceed this figure.

Acknowledgement and support from the workplace was more common in cases where the health and safety was an integral part of the working system, a commitment to health and safety in the workplace alleviated the outcomes for all concerned (Grant, Lisa).

Acknowledgement and support include appropriate treatment and compensation, thus lessening the burden on family and friends. Participants cited involvement in this study as an important validation for them. Participants were able to reflect on their

experiences and understand some of their actions and reactions. Participants also commented they hoped others would benefit from their understanding and experience by avoiding the types of consequences detailed in this report.

Identifying the consequences

We found examples of costs that arose directly from the injuries or illnesses and those that flowed indirectly from their consequences, which affected the worker, employer, and community. These are largely uncalculated in cost studies, and by the participants and in workplaces of this study. Because many costs are largely uncalculated, economic incentives alone provided a very blunt means for workplaces coming to understand the full consequences of poor

health and safety practice.

One set of indirect costs that were considerable arose from family separations, both physical and emotional. In four cases relationships were broken, with a further two cases losing their pre-injury relationships permanently. In addition, there were major lifestyle changes for many of the families, with many participants changing their careers, beginning or stopping study, and giving up

hobbies to care for the family member.

Employer's costs included lost production, negative impacts on staff morale, negative publicity, and the costs of replacing workers or equipment, and in some cases legal costs. For the workplace, costs included the loss of a friend and colleague, the immeasurable impact of feeling responsible for an injury or illness or fatality and possible animosity towards the injured or ill employee.

Factors that impacted across all parties involved

The visibility of invisibility of a participant's injury or illness was highlighted time and again. Injured participants, who could prove a demonstrable link to the workplace, received more prompt

support from their workplaces, health providers and ACC. The more obvious and visible the injury, the greater the sympathy and recognition it received. Diagnosis was much more likely to be

accurate and prompt. Conversely, for the ill participants, it was hard to prove that work caused their illness. There was doubt over the diagnosis of the illness, especially where there was the possibility of

there being more that work factors involved (John, Murray, Barbara, Julia). These problems for participants had serious implications for treatment and recovery. Fast and appropriate treatment, and acknowledgement of the causes, led to a quicker recovery and return to work.

We found socio-economic status had an important impact on social and economic

consequences. Some of the factors that prevented or alleviated adverse social or economic consequences was being in a high socio-economic group, having a higher level of education, and having ample social and/or workplace support. Participants from low-socio-economic groups had fewer choices and support following their injury or illness to prevent economic consequences in

particular reaching into and harming their home and family life. Thomas and Barbara lived in small towns, with limited employment opportunities and unskilled, insecure jobs. Their choices were a lot fewer than Philip's who, although he did not receive much (if any) workplace support, still had the unstinting support of his family and financial reserves to change careers and still earn a high salary.

The links between social consequences and economic costs

The study demonstrated the close relationship between social and economic costs. Many social effects had an economic outcome, and economic costs led to or impacted on the social effect. We found six overarching determinants of the extent or presence of adverse consequences. These determinants were: **isolation; understanding; responsibility; blame; suffering; and power or powerlessness**. These determinants were inter-related and affected both social and economic costs.

Isolation from support structures could severely impede recovery. Participants' rehabilitation and recovery (physical and mental) were aided when

there was good support from both family and friends. In six cases isolation from partners was permanent. For family members to offer appropriate support, they needed to understand the condition and the effect that it had on the individual. This understanding was generally more apparent in injury cases:

It's just the wrong type of injury. I mean if he had ripped a leg [off] it would have, probably would got the whole support and sympathy and everything else, but... (Company OHN-Grant's case)

Understanding could be further constrained by the

presence or otherwise of appropriate support and information for the individual, family, friends, workplace and employer.

When an injury or illness occurred, a common reaction was to apportion **blame**. Employers blamed employees and employees blamed employers. Supervisors, workmates and families blamed themselves or the injured or ill participant. Failure to accept **responsibility** or culpability affected everybody's ability to recover from an injury or illness. Often it was unclear as to who or what was 'to blame'. ACC and OSH's roles sometimes produced conflict with participants

and workplaces over who or what was responsible or to blame for the injury or illness. Ian's widow initially believed he was responsible for his own injury, until the OSH investigation revealed the employer's responsibility. She commented that when she believed Ian was to blame she thought:

You love somebody that much and they did to themselves. And it's horrible and how they dare do it to themselves. (Ian's widow)

Taking responsibility allowed participants to move on with their lives. When workplaces admitted appropriate culpability, they were able to make positive changes in their health and safety culture. For the individuals in the study, some made choices or were forced by circumstance to make a new career, change their lifestyle or go back to study. This could lead to something totally different. One participant said:

I guess it's a new career now, a new start, something different. (John)

In all cases there was a degree of **suffering**, in some suffering was

extreme for both participants and their families. The suffering wrought by an illness or injury caused, on occasion, unexpected results. Some positive lifestyle changes resulted, such as giving up smoking or taking a new approach to life (Mark, Martin, Barbara). One participant, Martin, was more willing and able to express himself. Others felt they had gained considerable understanding of themselves through the progress they made in recovery and comprehending their situation (Murray, Julia, Mark).

The **understanding** of participants and others, or lack of it, of an injury or illness contributed to the social and economic consequences. In general, in the case studies, there was a lack of knowledge and resources in occupational health medicine. This resulted in delays in diagnosis and treatment. These delays in diagnosis and treatment increased suffering and delayed recovery. Further, it caused ongoing debate between treatment providers, claimants and government departments over diagnoses. If a diagnosis was unclear and specific treatment was dependent on

compensation cover, this negatively affected the participants and meant increased investigation costs for government.

Participants' power or powerlessness affected their ability to control the risks in their workplace (and therefore their chances of being harmed) and subsequently their rehabilitation. Being able to access specialists, remain in their workplace, get advice and receive compensation was affected by the amount of power they possessed. Power also involved participants taking charge of their own situation or have changes forced upon them.

The consequences of workplace injury and illness ripple out and affect all of us. International estimates of the costs to GDP of injury and illness at work lie between three and five percent. We all pay, even if not directly, for occupational illness and injury. Consequences may be temporary or permanent; or sometimes fatal. To understand the total social and economic consequences require going beyond statistics and recording economic costs. Gaining a human perspective of costs incurred allow us to understand the non-

economic 'costs' and the complex inter-relationship between economic and non-economic consequences.

Understanding how the social and economic consequences apply increases our understanding of the impacts on people of policy and legislation.

But importantly, it also contributes to our understanding of how to minimise the aftermath of occupational injury and illness, and plan appropriate preventative measures and support systems. The fifteen case studies illustrated common experiences of employers, in a positive or negative way. This

study highlights the debilitating effect of not minimising workplace injury and illness; for the injured or ill worker, their friends and family, workplace and the substantial costs to government and its agencies.

Acknowledgements

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the Massey University Centre for Public Health Research, Wellington, New Zealand, September 2002. It is based on both the presentation itself,

and the Executive Summary of the Report (Adams et al, 2002) on which the presentation was based.

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Implications for Policy: Introductory Remarks

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To acknowledge that exposure and absorption of chemicals at work can

damage the central nervous system is not something new, so let us

briefly remind ourselves of some history.

Chemicals at Work and the Brain

Lead

In 100 AD Dioscorides wrote of paralysis and delirium occurring to those who ingested lead (Hunter, 1957). In 1713, Ramazzini wrote of the paralysis of potters (Ramazzini, 1940). In the 18th and 19th centuries women in the white lead industry were dying of acute apoplexy within weeks of beginning work.

Mercury

With regards to mercury, again Ramazzini wrote of the “mental stupor” of gilders (Ramazzini, 1940). Later in England and Europe the term “erethism” was used to refer to the quarrelsomeness, loss of memory, hallucinations,

delusions and mania that occurred to those who absorbed inorganic mercury at work.

Manganese

In 1821, Couper described the symptoms of what had become known as Parkinson’s disease, in a worker exposed to manganese dioxide (Couper, 1837, 1857). Two years ago I saw my first case of pre-Parkinsonian symptoms in a stainless steel welder.

Carbon Disulphide

In 1856, Delpech wrote of chronic injury to the nervous system resulting from exposure to carbon disulphide in the rubber industry (Delpech, 1856). Since that date many

cases of psychosis have occurred to workers in the cold curing of rubber and in viscose artificial silk manufacture. In 1971, Hanninen discussed the psychological picture of manifest and latent carbon disulphide poisoning (Hanninen, 1971).

Solvents

Among the halogenated hydrocarbons, methyl bromide has both acute central nervous system effects, but also delayed chronic effects. Trichloroethylene use among engineers was shown to be associated with neurological and psychiatric symptoms (Grandjean et al, 1955). Toluene, a solvent with widespread use in

industry, was first reported as causing irreversible brain damage by Grabski in 1961 (Grabski, 1961). In 1976, Hanninen et al reported on behavioural effects on long-term exposure to mixed organic solvents (Hanninen et al, 1976). Subsequent studies have confirmed permanent central nervous system damage from the

inhalation of solvents in the workplace.

Carbon Monoxide

In 1936, Shillito et al, investigating 21,143 cases of carbon monoxide poisoning observed delayed onset of neuropsychiatric complications in 43 with the longest lucid interval of 21 days (Shillito et al,

1936). In 1962 a Lancet annotation referred to cases of anoxic encephalopathy after a period of apparent clinical recovery (Anon, 1962). In 1993, Gorman et al stated carbon monoxide was the most common domestic and industrial poison in Australia (Gorman et al, 1993).

What Is To Be Done?

What then of New Zealand?

There is investigative evidence available among solvent exposed workers as well as case studies which support what the rest of the world has known for decades, that the central nervous system – the brain – is at risk in a range of work situations. Some years ago I suggested that solvent neurotoxicity was the new asbestos - nothing has led me to change this view.

100 years ago a Russian gentleman by the name of Vladimir Illych Ulyanov wrote a pamphlet entitled “What is to be done?”. In Chapter 3 he dealt with the issue of exposing and publicising the conditions under which the workers were

employed and he praised the various newspapers, etc, which did this. However, he then went on to discuss the next step – in other words the steps necessary to change these circumstances.

So, perhaps on this occasion we should reflect on this next step. To move from a “hands off” position, that is publicising and researching the problems and making the policies, to a “hands on” position – that is changing the circumstances or work that are leading to these consequences.

One of my old classmates and a close friend was the Australian eye doctor, Fred Hollows; his great attribute was “to do”, to turn theory into practice,

“to make changes” so as “to leave the world a better place”. Of course, it takes courage and energy and it is uncomfortable for the bosses to have to accept the need for changes in the workplace and then to fund it. It is uncomfortable for the workers to have to change attitudes and to learn new safer work practices. It is uncomfortable for the health and safety practitioners, whether public or private, to have to recognise the problems, provide solutions and insist on the solutions being put into practice. The question, therefore, we need to decide on as individuals, is whether we are prepared to be a little uncomfortable for a time in order to make

changes to what can only be described as carnage in the workplace.

I shall conclude with some recommendations:

- The Occupational Safety and Health (OSH) Chemical Panel will work with The Centre for Public Health Research to investigate chemicals at work and the brain.
- OSH will ensure that HAZARD becomes user friendly and that

the information entered into the system can be extracted and used.

- OSH will contact every GP in the country informing them that work can cause ill health and what questions to ask their patients.
- The Council of Trade Unions (CTU) should ask their members to report on a brief and standard form to OSH every time a worker believes that their

health has been damaged by work.

I trust that these recommendations will make us all feel a little uncomfortable, and, if that is the case, the question “what is to be done?” will be answered.

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OSH's Priorities for Occupational Health

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Principles

People engaged in providing for workplace health and safety face a difficult task. These difficulties are similar to those which have always faced people - and are to do with the complexity of the topic, the frequent obscurity and unpredictability of causation, the infrequency and unpredictability of some types of mishaps and occupational diseases, the legal manner of addressing the issue (which is hard to understand but clearly has its foundation in humanity), the tendency of all parties to shift responsibility to other groups and individuals, the lack of societal acknowledgement as to its role as a causative agent and a low level of

available resources. Against this background there are the very real possibilities for harm and serious harm posed by hazards that do not sleep or otherwise accommodate human frailty.

The Health and Safety in Employment Act and its recent amendments make clear that it is the employer's responsibility to manage health and safety, and increased emphasis has been placed on employee involvement in this regard.

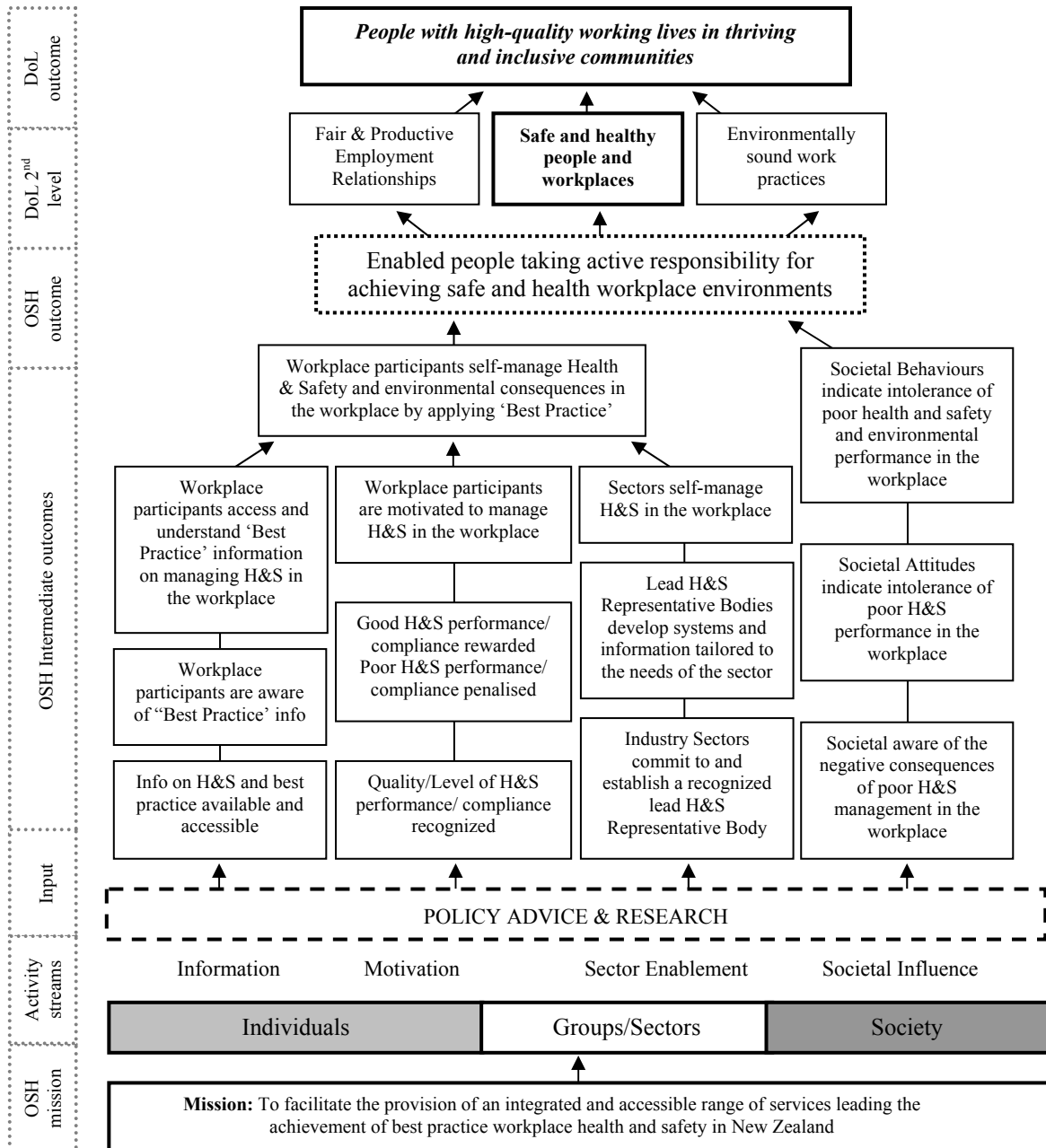
Given these influences and the general 'performance based' approach to health and safety, OSH regards its influence as catalytic.

OSH Strategic

Outcomes Statement:

In recent years there has been a whole of government push toward a change in accountability, and an outcome rather than an output (activity) focus. The Department of Labour has one overarching outcome that all Services contribute to: "People with high-quality working lives in thriving and inclusive communities". OSH contributes to three second-level outcomes that feed into the main outcome. The latest outcome hierarchy, which encompasses our intended outcomes, is shown in figure 1.

Figure 1: OSH Outcomes Hierarchy



In considering its role, OSH has recently reviewed influences such as the New Zealand character and the vernacular commentary

of New Zealand small businesses towards workplace health and safety, and these are summarized in tables 1 and 2. These tables offer

some clear and positive opportunities for promoting workplace health and safety.

Table 1: Key Traits of New Zealanders – their positive origins, their negative developments, what we might become

Trait	<p>The positive origin of the trait. Pioneers respond creatively – perhaps with a touch of desperation.</p>	<p>The negative development? Kiwis take a rest from real engagement with life? Or, is this just our view of ourselves? Either way, it's not pretty.</p>	<p>What we could become. A spirit of youthfulness recaptured – perhaps the re-emergence of what has been there all along. We are enjoying life - again.</p>
<p>“She’ll be right.”</p>	<p>We’ve done all we can, there’s nothing more we can do in the time left and with the resources available – it’s getting dark, we’re getting tired – let’s go home. I’m sure things will still be OK tomorrow - Worrying won’t help - “She’ll be right”.</p>	<p>Carelessness – It was OK yesterday – it will still be OK tomorrow next week next year. Why bother changing it – it has worked fine until now – If anything is going to happen – it won’t be to me.</p>	<p>We’ve done it right, as far we can tell, so let’s trust in ourselves. Worrying is always pointless - we will learn from any errors - we can only get better at this! Informed risk taking coupled with personal responsibility for keeping safe.</p>
<p>“I’m all right Jack”</p>	<p>I’m fine just the way I am. If you want to do things differently, go ahead, but your ideals aren’t important to me.</p>	<p>I got here under my own steam – and you should too! Smug selfishness and blow everyone else.</p>	<p>You’re not coping. Perhaps you did it to yourself, perhaps not; I’ll lend a hand. Return the favour to someone, some day.</p>
<p>“Give it a go”</p>	<p>Willingness to try something new – we’re not bound by tradition. We are resourceful and curious.</p>	<p>Haste without thought. Training is for sissies. Real men can do anything.</p>	<p>We are curious to see what the outcome will be. We are taking a well informed risk. We will know when we are getting to the point where there’s no going back – and we will stop before then. We like variety.</p>

“Number 8 fencing wire”	It’s not perfect, it won’t last forever, but it will do the job.	Getting the job finished is all that matters. Can’t be bothered with quality. Do a rough job with cheap materials and get out of here. Hopefully nobody will notice until we’re gone.	Our assets and resource consumption are minimised. System adaptability is maximised. We have worked out a balance between complexity and comprehensibility. We know our strengths and weaknesses.
“The quick fix”	This is not the main problem, so let’s fix it quickly and get on with things. Our ‘fix’ may have to be revised later.	We never come back to do the job properly; and the next time we face the same problem, we do it the same “quick fix” way, which is nearly always more expensive in the long run.	We invest in our future by planning our work methods. Then we will save time, money and resources every time we do this job again.
“Who can I blame?”	Wake up, you lot! We can’t afford mistakes, the environment is just too dangerous.	The transfer of responsibility. It’s his fault. Or if it’s my fault, you made me do it. Only inadequate people make mistakes and I’m not one of them.	We never blame people for making mistakes. Errors are our most valuable and positive pieces of information – they are vital to improving our systems.
“The fast buck”	Family comes first - I look after my family, I do what it takes. I’m prepared for a fall as well as a win.	Greed and shortcuts. I need it more than they do. If you’re that stupid, you deserve to be fleeced.	I get all my business through recommendation. People pay me well for what I do, because they know I’ll do it properly.
“Don’t ask me”	I really don’t know about that sort of thing! Ask someone who knows.	You can’t be criticised for being wrong if you never offer an opinion.	Nobody knows everything! I’ll take a risk and join in.
Machosim”	Manly virtues – independence, courage, risk taking.	Risk taking to show off – (all brawn, no brains). Arrogant disregard for others. Thrashing the company truck; rude to customers.	Confident, calculated risk taking to achieve visionary, worthwhile goals. Male energy without the side effects.

Table 2: Problems facing small businesses health and safety – the vernacular commentary

	Problem Principle		Common sense solutions
1.	There is little shared agreement about the limits on health and safety. Any injury or occupational disease means that someone did something wrong and is to blame.		Someone authoritative needs to make a sensible statement about limits:
2.	Small business owners see: (a) Inequity - why should I guard my machines to the nth degree (including against deliberate sabotage) when we have roads where cars pass within 2 metres of each other at 200kmh? (b) Iniquity - no matter what I do I can be caught out – any hazard not dealt with, no matter the size of the risk it poses might, after an event, result in blame. (c) Hypocrisy - health and safety, as it is today, discourages the informed risk taking and sense of adventure, the exercise of common sense and the personal responsibility necessary for personal safety that established the New Zealand that we know and which is the basis of the confidence necessary for progress. It is in danger of becoming an ambulance at the bottom of the cliff.		<ul style="list-style-type: none"> • Commending the good things employers do • Emphasising the meaning of ‘practicable steps’ • Stating the need for risk taking and emphasising the validity of risk assessment • Making a clear statement that defines endpoints such as the 80:20 principle and Paragraph 83 of the Gilbert Appeal Judgement
3.	If something goes wrong, OSH (and others) will be looking for <i>someone to blame</i> .	Clarify that when OSH investigates it is looking to ask (a) Would we prosecute if there had been no injury after this sequence of events? and (b) what practicable steps that could have been taken were not taken?	
4.	It’s not worth trying. Nobody commends the positive things I do – in particular that I provide employment for people – which we know is healthful. I spend time on working out how not to get caught rather than on the real risks I face.		Seek the good and praise it. See how others see it before criticising. If necessary, mind your own business.
5.	Human error means - ‘here’s who we blame’. Common experience is that human perceptions of things - after they have happened – is ‘all wise’. The <i>evidence</i> is that people are much more confident about what they think other people ‘ <i>ought to have known</i> ’ than they have any right to be. (See Reason J – Human Error.)		Provide accurate information about human error. Be diligent in prevention. After an incident to approach its consequences with compassion. To err is human – to forgive is divine.
6.	People in small businesses have little or no attention left over to give to health and safety. They are preoccupied with daily business hassles, the struggle to survive and to keep hopes alive. Health and safety is – necessarily – a low priority.		Acknowledge this limitation publicly but say also that hazards never sleep. Provide practical assistance.
7.	These thoughts may result in paralysis or cheating.		Nevertheless, maybe a fatal paralysis/short cut.

8.	There may be little perceived reward for the effort expended – “it’s not worth the effort” in dollars or time. “It will probably never happen to me”.	Promote risk assessment. To avoid wasted effort, recognise when the latter statement <i>is correct</i> .
9.	Most small businesses would like to be competent in health and safety but (i) do not know where to begin or what to do (ii) do not know where to go for advice (iii) do not trust advisors and (iv) can’t see an end to things.	(i) Provide basic model methods/tools free. (ii) Acknowledge competent advisors. (iii) Identify and work through trusted advisors. (iv) see item 1.
10.	The behaviour of ‘society’ as a whole, which does not acknowledge its role in workplace health and safety, helps fuel all these problems. (People want cheap buildings, cheap food and therefore cheap transport, for example.)	Life is a partnership – business and H&S risks are shared and need to be faced equally together by employees, employers and society.
11.	Media coverage is negative, lacking in integrity, unhelpful, irresponsible and often deliberately inflammatory. It not only feeds the fears of small business owners but prevents them from finding out the real facts or how to do health and safety.	Promote good practice.
12.	Small businesses have been stung by buying advice that is (a) unhelpful – not tailored to their specific needs, (b) insincere – it is only concerned with setting up a system of protection if something goes wrong or (c) too complicated.	Publicise and promote the difference between good advice and bad. Match the small business’s complexity with the extent of its H&S system.
13.	There is a dearth of good advisors for small businesses.	Set up a mechanism to certify advisors.
14.	Small business managers/owners do not listen to Government advisors, read their advice – or trust it. They may be hostile towards both. People in small businesses <i>may</i> listen to trusted advisors such as industry associations – (and perhaps, in some instances, accountants, bank managers and insurance agents).	(a) A personal approach and social skills are needed so that hostility is replaced with first, attention and then respect and trust. (b) Use an ergonomics approach to document design. (c) Work through the groups mentioned. See also 1 - 3.
15.	OSH and ACC exert little, direct, positive influence on small businesses. ACC premiums are unresponsive for individual businesses – insurance means there is no need to be careful anyway (affects both employers and employees).	Government effort is directed to catalyse.

OSH, along with other overseas jurisdictions, has recently acknowledged the need to place more emphasis on the 'H' in OSH (Holden, 1996). It is generally thought that, although there are some differences between occupational safety and occupational health (see Table 3), and that these differences stem from

particular features of the differences between injuries and disease, standard health and safety management systems ought to be able to accommodate the control of the factors that lead to disease as well as injury.

The important differences are in terms of the timing and latency

of diseases (with implications for prevention), the relation between exposure and outcome (which may be subtle and hard to define or prove) and the intrinsic differences between a disease and a personal injury and the consequences for medical assessment and treatment.

Table 3: *General differences between health and safety*

Safety	Health
<ol style="list-style-type: none"> 1. Data is better 2. Risks are usually immediate 3. Injuries are visible 4. The focus of a lot of effort 5. Interventions can have a quick, positive result 6. Usually a clear link to one employer 7. Clear compensation cover 8. The medical history of the victim is usually less relevant 9. On investigation of incidents, obscurity may develop because of complex interactions between system components 10. The OSH investigation is usually only into the event itself 	<ol style="list-style-type: none"> 1. Data is poorer 2. Risks are often delayed (due to latency) 3. Ill health or disease may be less visible 4. Often put in the 'too-hard basket' 5. Interventions less likely to have a quick, positive result 6. The impact of the employment history on causation is greater 7. The onus of proof is more of an issue 8. Medical history significant part of assessment 9. On investigation of disease, obscurity may develop because of the complexity of the body and the interaction of mind and body 10. The OSH investigation needs to confirm a diagnosis and establish (or not) a link to workplace exposure

The relative importances of occupational injuries and occupational diseases was explored in a recent paper by the National Environmental and Occupational Health Centre (Feyer et al, 2001; see also Zhang et al, 2001). The researchers concluded that there had been a total of 188 occupation attributable deaths in New Zealand

each year over the last 5 years. These deaths were attributed to:

Deaths due to injuries (including deaths due to workplace injuries, work related road crashes and commuting accidents) **88**

Deaths due to specific diseases **9**

Deaths due to work-related diseases **91**

These data, (which are at odds with other estimates that deaths due to occupational diseases occur at up to four times the rate due to occupational injuries), show that occupational diseases and injuries require at least equal attention.

Frameworks

The fundamental frameworks in which OSH plans operate are those of nature, humanity, human nature and society. The formal expression of how the Government expects New Zealanders to address workplace health and safety in the face of those factors is the Health and Safety in Employment Act (HSE Act). The OSH Strategic Framework (see above) is the formal statement of the social conduct of OSH in implementing the Act.

The principles of the HSE Act are becoming well known:

- The responsibility for workplace health and

safety lies with employers

- Prevent foreseeable harm
- Identify, assess and control hazards (Including monitoring)
- Inform, train and supervise
- Employee responsibility
- Investigate injuries and diseases and report harm

Amendments to the Act address:

- Extension of coverage to include duties of persons supplying plant
- Employee participation and involvement

- The right to refuse dangerous work
- Hazard notices being laid by health and safety representatives
- Infringement notices being laid by the OSH Inspectorate
- An extension of the time for laying informations
- Altered penalties
- Removal of the right to insure against fines

Another framework is data. At present, data about occupational diseases is of poor quality. The appointment of the Information Manager promises to address this situation, but work on occupational disease data has been put in abeyance until a clear picture of the

incidence of occupational injuries is obtained and the sources of data about occupational diseases can be improved.

There are some specific instances of occupational disease data being used for specific projects. For example:

- OSH and ACC are now, for the first time, sharing occupational disease claims data. The first batch of these data showed 38 claims for the first three months of 2003,

and these will feed into the OSH Notifiable Occupational Disease System (NODS).

- OSH is seeking to develop improved links with Environmental Science and Research so that the epidemiology of diseases such as lead poisoning and leptospirosis may be better understood.
- Links with the New Zealand Health Information Service

have led to significant research about occupational cancer in the last two years.

Each of these initiatives depend on the successful operation of the OSH NODS system, and this is the subject of a present review which is intended to lead to its more comprehensive coverage and promotion and its more effective administration.

Strategies

To put the 'H' back in OSH, the following general activities are under way within OSH:

- To describe and promote a 'health focus' within OSH
- To review and expand the Health Module of the OSH Development College
- To integrate health matters into the Inspectorate's repertoire of skills
- To appreciate the many similarities between safety and health – and to draw the distinctions

between the differences

- To take occupational health out of the 'too hard' basket
- To overhaul and promote the NODS system
- To build health matters into OSH Industry Sector Plans
- To continue with information and compliance projects
- To explore possibilities for an increased level of compliance action in health matters

OSH relations externally are informed by the OSH strategic outcomes statement (see above). One aspect of OSH strategy is to encourage, with ACC, the formation of health and safety groups by Industry Groupings.

OSH is also exploring the possibility of forming an overarching group of health and safety practitioners (covering 5 different disciplines) to address the fragmented and widely varying standards of occupational safety and health consultants in New Zealand.

The purposes of these groups are to:

- Promote systematic H&S management

- Develop and promote best practice
- Bridge the plethora of small organisations
- Review standards

- Provide advice to OSH and ACC

Tactics

To implement the strategies described above in a practical manner, OSH has developed tools and assessment sheets for use in its Health Sector Plan. These cover the following topics:

- Manual handling*
- Manual Handling in construction*
- Noise*
- Home based health care[#]

- Patient handling*[#]
- Spraycoating*

These topics have been selected because they are serious, continuing and ongoing problems(*), or topical in the sense that recent material has been made available about them([#]).

An information sheet and health and safety assessment tool was developed about each topic and the OSH

Inspectorate has been visiting employers and assessing their status against the assessment tool.

At the time of writing, interim reports of these results are available. It is intended that the information gained from this project will inform involvement with stakeholders, compliance strategies and future OSH plans.

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The OSH Occupational Cancer Project

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In 1980, Doll and Peto (1981) estimated that occupational exposures were responsible for about 4% (with a plausible range of 2% and 8%) of all deaths from cancer in the United States. The commonest occupational cancer is probably bladder cancer, where about 25% of male cases and about 10% of female cases are due to occupational exposures. These estimates involved relatively conservative assumptions, and were based solely on occupational causes of cancer that were well established at that time. It has also been noted that they were also based almost entirely on research that had focussed on males, on exposures that had occurred in the 1950s and 1960s, and that the different estimates for males and females (7% and 2%) were probably largely due to the lack of research into industries

with predominantly female employees (Zahm et al, 1994). Since that estimate was made, further occupational causes of cancer have been discovered, or have become more “established”, while a large number of both old and new occupational exposures remain relatively unexplored.

Occupational exposure to a range of carcinogens remains widespread. For example it has been estimated that 23% of the European Union workforce (or 32 million workers) is currently exposed to one or more agents in their workplace that are listed by the International Agency for Research on Cancer (IARC) as recognised (Group 1), probable (Group 2A), or selected possible (Group 2B) occupational carcinogens (Kauppinen et al, 2000). Similarly Infante (1995) has compared the

estimated 20 million US workers exposed to occupational lung carcinogens, namely 12,864,000 to IARC Group 1 and a further 7,321,000 to Group 2A lung carcinogens, with an American Lung Association estimate of 46 million tobacco smokers in the US.

While the type and range of industry may differ in New Zealand, it is unlikely that New Zealand workplace conditions differ markedly from those in other developed countries in terms of their occupational cancer risk. Even if the relatively conservative estimate of Doll and Peto is accepted as being applicable today, one would expect up to 600 cases of occupational cancer to occur each year in New Zealand, an estimate consistent with that of Firth et al (1993). However, notifications of

occupational cancer to the Occupational Safety & Health (OSH) Service of the Department of Labour have not been

comprehensive with only 11 cases notified between the years 1992 and 1997, excluding those related to asbestos (OSH, 1996). Of

the latter there were 94 cases of Mesothelioma and 49 cases of lung cancer for the same period (OSH, 1997).

The OSH Cancer Register

In 2001 OSH, in conjunction with the Massey University Centre for Public Health Research, therefore commenced a project

whereby all cases of three types of cancer commonly notified to the New Zealand Cancer Registry were invited to be interviewed by OSH

staff to obtain an accurate occupational history. The three types of cancer were bladder cancer, non-Hodgkin's lymphoma and leukemia.

Methods

The recruitment protocol took the form of sequential letters to the treating clinician (obtained from the pathology form), general practitioner, and finally the subject themselves. Consenting subjects then took part in a face-to-face interview. Between January 2001 and January 2002, 343 cases of bladder cancer were reported to OSH. Between July 2001 and May 2002, 325 cases of non-Hodgkin's lymphoma were reported to OSH. Between October 2001 and May 2002, 135 cases of leukemia were reported. Exclusion criteria were: (i) cases over 70 years were not interviewed on the grounds that cancers developing over that age were unlikely to be

occupational due to the latency period involved; (ii) new residents in New Zealand, who had never worked in New Zealand, were likewise excluded from the study.

Following interviews, the completed questionnaires were presented to the OSH Cancer Panel for assessment. The Panel comprised two occupational physicians, and two occupational epidemiologists. The Panel assessed each case for occupations known from internationally published literature to be associated with the cancer type. An estimate of exposure was made, based on type of exposure, length of exposure and intensity.

A relative risk was obtained from the published research literature for the type and duration of exposure. The probability that that person's exposure had caused their cancer was calculated using the formula $(RR - 1)/RR$, where RR represents the relative risk. For example, if the relative risk for an occupational exposure as a cause of bladder cancer has been estimated as 3.0 (i.e. three times the "usual" risk), then if a worker who has had that exposure develops bladder cancer, then the probability that the occupational exposure caused the bladder cancer can be estimated as $(3-1)/3 = 0.67$ (or 67%). A probability of over 50% was recorded by the

Panel as “probable occupational cancer”, and a probability under 50% (but greater than 0%) was recorded as

“possible occupational cancer”, whereas those subjects who had no occupational exposures associated with their

cancer were registered as “not occupational cancer”.

Table 1: Male bladder cancer (n=114): 35 cases (31%) considered to be probable occupational cancer

Occupation	No.	%
Truck/heavy machinery driver	15	43
Engineering/metal workers	9	26
Farmer/orchardist/horticulture	3	9
Painters/furniture finishers	2	5
Plastics manufacture	2	5
Hairdresser	1	3
Textile worker	1	3
Analytical chemist	1	3
Retail sales	1	3

Results

To date 150 cases of bladder cancer have been assessed. The distribution of occupations in the male cases is shown in Table 1. Those for

female bladder cancer are shown in Table 2. These comprised 36 females and 114 males. Of the female cases, three were considered probable

occupational cancer (8%). Of the male cases, 35 were considered to be probable occupational cancer (31%).

Table 2: Female bladder cancer (n=36): 3 cases (8%) considered to be probable occupational cancer

Occupation	No.	%
Textile workers	2	67
Telephonist	1	33

At the time of presentation, only 58 non-Hodgkin's lymphoma cases had been assessed. Of these, 26 were female and 32 were male. One female was considered to be probable occupational cancer, and two males.

One male was a meat worker and one male and one female were a farm worker/orchardist.

Only 13 leukaemia cases have been assessed, seven female and six male. Three male cases were considered to

probable occupational cancer. Two of these were farmers exposed to herbicides, and one was an electric furnace operator exposed to an electromagnetic field.

Discussion

The proportion of bladder cancer cases considered by the Panel to be occupational, based on occupational history, is consistent with the estimates already published in the international literature. Male rates are considerably higher than female rates, because of the types of occupations involved. The largest occupational group for males was those of truck and heavy machinery drivers, which made up 43% of the case that were considered to be of occupational origin. The presumed carcinogens are polycyclic aromatic hydrocarbons contained in exhaust fumes. Research indicates that diesel fumes are probably the main suspect, but drivers of petrol vehicles also have an increased risk, although lower than those of diesel vehicles. It has been suggested that prolonged periods of urinary retention while on the road may also be a

causative mechanism in truck drivers, but no firm data is available on this. Research suggests that the type of load carried is not associated with onset of bladder cancer. Two of the group were railway locomotive drivers. Emissions from coal have also been implicated in bladder cancer.

The second largest group, at 26%, was engineering and metal workers. The most likely causative agents are cutting and lubricating oils, which contain aromatic amines and N-nitrosamines.

The third largest group, at 9%, were farmers/orchardists/horticultural workers. Although this group has been identified as having an increased risk for bladder cancer the causative agent or agents is not known, but is hypothesised to be herbicide use.

Painters/furniture finishers, and plastics manufacture workers comprised 5% of the sample each. There are a variety of chemicals in paints and surface coatings which have been identified as carcinogens. These include benzidine, polychlorinated biphenyls, formaldehyde, benzene, dioxane and methylene chloride. The causative agent in plastic manufacturer is likely to be dyes. One hairdresser formed part of the probable occupational cancer group. There is research evidence implicating occupational exposure to hair dyes as a cause of bladder cancer. One textile worker was identified. The international literature indicates an increased risk in textile workers generally, but also in tailors and dressmakers, handling textiles. The causative agent is likely to be dyes. One sales worker formed part of the group. There have

been several studies implicating an increased risk of bladder cancer in retail sales workers, both in men and women. No causative agent has been identified, but urinary retention due to inability to take breaks may be a factor. Other possibilities include environmental pollution such as tobacco smoke and other pollutants.

Of the females identified as having problems with bladder cancer, there was

one telephonist and two textile workers. Textile workers have already been discussed. There is research evidence implicating an increased risk of bladder cancer in telephonists, particularly over 10 years of employment. The causative agent is not known but may include similar factors to retail workers i.e. urinary retention, environmental tobacco smoke and air pollutants generally.

These are interim results, based on interviews to date of only 45% of bladder cancer cases notified in the period, and considerably less for non-Hodgkin's lymphoma and leukaemia. Nevertheless, the results do indicate that rates of occupational bladder cancer appear to be similar to those estimated in other parts of the world.

The OSH Cancer Case-Control Studies

We are now extending the OSH Cancer Panel process beyond the review of individual cases to establish an ongoing series of registry-based case-control studies. This involves identifying and interviewing 300 general population controls each year over a two year period (2003-2004) to serve as controls for the cancer cases identified through the OSH system, and obtaining a work history for each control using the same standardised work history information that is obtained for the cases (as well as potential confounders and effect modifiers such as age, gender, ethnicity, and

smoking). These controls will be frequency matched for age and gender to obtain distributions similar to those of the cases. In addition, we will develop a population-based job-exposure-matrix to estimate historical exposures to potential occupational carcinogens in both cases and controls. Each case-control series will then be analysed as a population-based case-control study.

The cancer types included in the OSH Cancer Project are all known to have a significant association with occupational exposures, although the

epidemiological evidence for many of these associations remains inconclusive. In future it may be possible to extend the study to other cancer types of interest such as brain, prostate, testis and breast, although such an extension is beyond the scope of the present application.

The Project has the potential both to document the importance of known occupational causes of these cancers in the New Zealand context, as well as potentially to identify new occupational causes of cancer. The case-control study design is ideal for these purposes as it

permits the study of occupational cancer risks among all groups within the general population, i.e. in both male and female workers, in Māori and non-Māori, and in

that sizable proportion of the workforce that is employed in small enterprises. Investigations of occupational cancer may also provide information

on the potential cancer risks associated with the spread of exposures from the workplace to the general environment.

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Improving Occupational Health and Safety Policy Through Intervention Research

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Intervention research in occupational health and safety (OHS) addresses the development, implementation, and evaluation of OHS interventions (Goldenhar et al, 2001). Intervention research, with its applied focus, complements etiologic research in OHS (such as occupational epidemiology). It has tended to be under-emphasized historically in relation to more basic science-oriented etiologic research. The goal of intervention research in OHS is to translate basic research knowledge into public health action and benefits. As such, intervention research in OHS is often cross-disciplinary, drawing from a range of disciplines such as program evaluation, education, and social psychology in addition to

OHS and other branches of public health.

The US National Institutes for Occupational Safety & Health (NIOSH) presented a National Occupational Research Agenda (NORA) to improve OHS in 1996 (NIOSH, 1996; Rosenstock et al, 1998). NORA was based on input from over 500 stakeholder groups across the country and identified 21 priority research areas, one of which was Intervention Effectiveness Research (Rosenstock, 1996). For each priority research area, NIOSH assembled a Team of experts in the area, drawing from labour, industry, academia, and government. The Intervention Effectiveness Research Team developed a

conceptual model of intervention research in OHS (Goldenhar et al, 2001) in order to:

- Provide an integrating framework for diverse activities;
- Articulate relationships among various types of intervention research;
- Facilitate assessment of the current state of the field in order to guide strategic planning (e.g., specific requests for intervention research proposals); and
- Develop common language to facilitate communication.

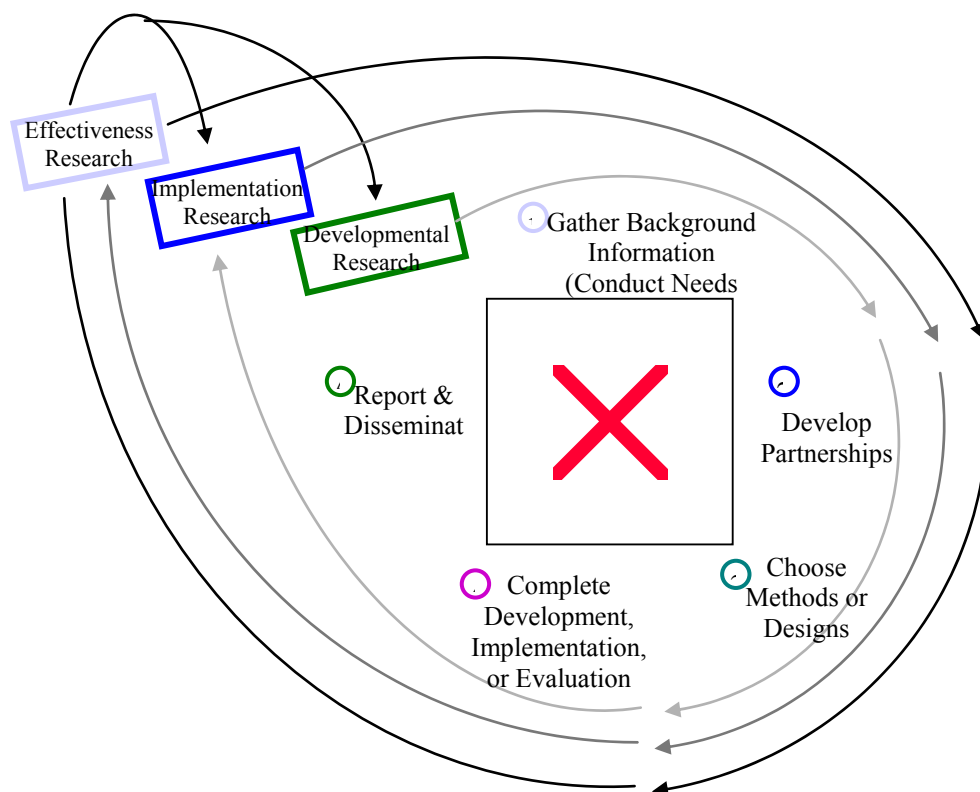
This model posits that the intervention research process is cyclical and progressive and involves three broad research phases of intervention development, implementation, and

evaluation (Figure 1) (Goldenhar et al, 2001). Further, it includes a set of five tasks that are important in any intervention research study: (i) gathering background information and conducting needs assessment on the

problem and the range of possible intervention strategies; (ii) developing partnerships with relevant stakeholder groups; (iii) choosing appropriate research methods and study designs; (iv) conducting the research; and (v)

reporting on and disseminating findings. Finally, intervention research can be conducted at levels ranging from simple worksite programs to national or international policy.

Figure 1: Intervention Research In OHS: A Conceptual Model



Focus On OHS Policy Intervention Research

Policy-level interventions include mandatory national or state/province-level regulations (e.g. regulations promulgated by the various state and territory Work Cover Authorities in Australia, European Union OHS directives) as well as voluntary guidelines recommended by respected professional, trade, research, or other authoritative groups (e.g. International Labour Organisation (ILO) Conventions, International Standards Organization (ISO) Standards, US National Institute for Occupational Safety & Health (NIOSH) guidelines). Despite the fact that regulatory interventions are often challenged by various groups, there has been relatively little peer-reviewed research published on the evaluation of such interventions (Goldenhar et al, 2001; LaMontagne, 2000). What little there is tends to address regulatory or legislative more than voluntary

policies, and occupational safety more often than occupational health policy interventions. Policy-level interventions are the particularly challenging to evaluate for many reasons, including the need for large-scale study, the lack of control over the intervention, and study design limitations imposed by ethical and other concerns (LaMontagne, 2000). For occupational health-focused policies in particular (e.g. regulations on occupational carcinogens), there are additional challenges in relating interventions to disease outcomes due to long latency periods from exposure to disease, non-work contributions to many disease that are also caused by occupation, and other issues. For example, despite regulatory actions against asbestos taking off in the 1970's in many industrialized democracies, most such countries have not yet

reached the peak of asbestos related mesothelioma and lung cancer. In Australia, for example, the peak of mesothelioma incidence is projected to occur around 2010 (Leigh et al, 2002) though regulatory interventions began in earnest in the 1970's.

Despite the numerous challenges to evaluating OHS policy interventions, such research will play an increasingly important role in political and economic environments that demand greater and greater justification for new regulations of any sort, as well as greater accountability for regulations that are already in place (LaMontagne and Kelsey, 1998). The remainder of this paper will focus on how OHS policy-making, implementation, and effectiveness can be improved through intervention research, with a particular focus on policies targeting health (versus safety) outcomes.

Evaluating OHS Policy Interventions: Implementation and Effectiveness

Policy-level interventions are usually developed based upon the best

available evidence regarding risks and how best to control them.

They thus have implied or explicit expectations about how requirements

or recommendations will be implemented, and in turn, the impacts of implementation. Fundamental evaluation questions thus concern implementation and effectiveness, as outlined below:

1. Was the policy implemented as intended (e.g., employer implementation of requirements, regulatory enforcement)?; and
2. Did implemented measures result in decreases in exposures and health effects of concern?

Implementation studies are important complements to effectiveness studies, and can also be quite valuable in their own right. Their value is often under-estimated due to the prevalent view that evaluation is synonymous with effectiveness. As examples, detailed population-based implementation studies have been conducted on the generic hazard communication (or ‘right-to-know’) and the agent-specific ethylene oxide standards in the US. The hazard communication evaluation showed, for example, that: (i) roughly one fourth of responding

employers provided no worker training, with small employers being the least likely to provide training; and (ii) the percent of non-compliant employers was 53%, 46%, and 41% with one or more training, Material Safety Data Sheet (MSDS), or labelling requirements, respectively (GAO, 1991). The ‘information for action’ yield of this study was aptly expressed in its title: “OSHA Action Needed to Improve Compliance with Hazard Communication Standard”.

The ethylene oxide evaluation showed that most hospitals had implemented the requirements for initial personal exposure monitoring, worker training, and medical surveillance (LaMontagne et al, 1996a; LaMontagne et al, 1997). However, workers at half the hospitals studied were also being exposed in accidental releases of EtO that were not being captured by personal monitoring, training was most commonly video-based, and OSHA’s Action Level trigger for medical surveillance—used in many health standards—was neither understood by employers nor related to providing surveillance

(LaMontagne et al, 1996b, 1997). These studies demonstrated the successes and shortcomings of the ethylene oxide standard, and were pivotal in the continuance of the standard when it was reviewed as test case for the expanded Regulatory Flexibility Act in 1997. This Act, combined with Small Business Regulatory Flexibility Act (SBRFA) mandated the review of OHS standards 10 years after their promulgation in order to determine whether they should be amended, continued without change, or rescinded (LaMontagne et al, 1998). In summary, process evaluation studies—when modelled on the implied or explicit logic of a particular policy—provide information needed for action to improve the policy’s implementation through enforcement, outreach, or information dissemination. Optimal implementation is a fundamental prerequisite to optimal effectiveness.

Effectiveness questions can be asked at three general levels:

1. Was implementation of the policy associated with decreased exposures to the hazard of interest?

2. Was implementation of the policy associated with decreases in health outcomes of interest?
3. Did the policy 'cause' observed changes in exposures and health outcomes?

Studies at the first two levels are observational with the usual limitations on causal inference. Combining qualitative and quantitative approaches, however, can greatly improve the interpretability of such observational studies (LaMontagne and Needleman, 1996; Zwerling et al, 1997). Examples of documented positive impacts at the first and second levels include: (1) a US Hazard Communication evaluation showing that interactive small group training methods were associated with positive changes in work practices and working conditions (proxies for decreased exposures (Robins et al, 1990); (2) decreases in blood lead (as a bio-marker of both exposure and health outcomes) after implementation of the US lead in construction standard (Levin et al, 1997); and (3) decreases in silicosis (health outcome) after implementation of the US respirable quartz standard (Stayner et al,

1996). Health outcome evaluations are particularly challenging for diseases with long latencies (e.g., asbestosis), multi-factorial aetiology (e.g., asthma), or both (e.g., lung cancer) (Stayner et al, 1996).

A recent example from a coordinated policy intervention to address occupational skin disease in Germany illustrates several important themes (Dickel et al, 2002). In Germany as well as other industrialized countries, there is a high incidence of occupational skin disease (OSD) among hairdressers and barbers (Dickel et al, 2001). A population-based register of OSD was set up in Northern Bavaria in 1990. Between 1990 and 1999, there were 856 confirmed (as occupational) initial reports of OSD in hairdressers. Reliable documentation of the OSD problem both strengthened the rationale for addressing it and enabled on-going health outcome evaluation of the impacts of any intervention. Regulatory interventions to address this problem were introduced in 1992 (Technical Rules for Hazardous Substances 530 'Hairdressing Trade') and in 1996 (Technical Rules for

Hazardous Substances 531 'Endangerment of the skin by work in the wet environment (wet work)'). In addition, the workers' compensation board executed an information campaign to support the new regulations. These efforts were complemented by a voluntary policy intervention: a 1995 agreement between hair cosmetics manufacturers and the hairdressers' guild to stop the use of glyceryl monothioglycolate in permanent wave solutions (sensitization to this agent had been previously determined to be common). Over the 1990-1999 period, the annual incidence of OSD steadily decreased from 194 to 18 cases per 10,000 workers, a statistically and clinically significant 10-fold decline (Dickel et al, 2002). The evidence of effectiveness of these combined efforts in reducing OSD is convincing. Concomitant process evaluation, which may be forthcoming, would help to sort out the relative contributions of the three complementary policy interventions (i.e., to what extent were each of the three policies implemented?).

The themes illustrated by the German OSD example include: (1) the high value of disease registries and public health surveillance systems in guiding policy-making and facilitating policy evaluation; (2) the potential for making positive change when all stakeholders are genuinely involved in the policy-making process (government, labour, and industry); (3) the need for both regulatory and voluntary policy

interventions to address OHS issues; and (4) the value of covering the full continuum of upstream (substitution of common sensitizing agent) and downstream (OSD surveillance) measures in addressing OHS issues.

Studies at the third level (did the policy ‘cause’ observed changes?) are rarely feasible due to the practical, ethical, and legal constraints of conducting randomized, controlled experiments in this context. Sufficient

levels of proof of policy effectiveness should correspond to these constraints. A sensible and economical approach to evaluating OHS interventions (of all types, including policy) has been proposed in which qualitative and quasi-experimental studies would be conducted, followed by—where both necessary and feasible—randomized, controlled trials (Zwerling et al, 1997).

Emerging Topics and Future Directions

Emerging topics in OSH policy evaluation research include moving upstream from exposures and health outcomes to safer technologies, which would call for the assessment preventive efforts as well as exposures. The UK Health and Safety Executive’s Control of Substances Hazardous to Health “COSHH Essentials” program is an example of more upstream-focused policy. While OHS policy efforts have progressed slowly over the last two neo-liberal dominated decades in the industrialized west, broader public support for environmental policy

efforts has enabled greater progress in that sphere, some of which crosses over into OHS. For examples, environmental pollution prevention policies have appropriately moved upstream from end-of-pipe approaches to the design of production processes. The US state of Massachusetts’ Toxics Use Reduction policy has resulted in some improvements in OHS conditions, though usually only as a side-benefit of environmental policy-driven actions (Roelofs et al, 2000). Opportunities exist for strengthening OHS considerations within such environmental

policies. Finally, the last decade has seen a rapid rise in OHS management systems or programs as the generic OHS intervention of choice for employers. These programs have been driven both by regulatory and voluntary policy interventions, yet evaluation research on this emerging topic is just beginning to take off (Frick et al, 2000; Quinlan, 1999).

Opportunities for future improvements in OSH policy evaluation are many. Traditional etiologic epidemiology perspectives need to be complemented by more eclectic and action-

oriented perspectives. Examples include borrowing more from the field of program evaluation, adopting alternative paradigms such as participatory action research, and expanding the use of qualitative research methods (Zwerling et al, 1997; Schulte et al, 1996). More population-based, rather than worksite-based, studies are needed. The scientific and quality and feasibility of evaluation studies would be greatly enhanced by planning evaluations in conjunction with policy development. In addition, policy evaluation studies are

greatly facilitated where population-based occupational exposure and disease surveillance systems are in place, as was illustrated by the example from Germany above. In addition, many impact and outcome measures have been under-utilized to date. For example, more economic studies are needed that focus on health costs to affected workers as well as implementation costs to employers (Boden et al, 2001). In addition, greater utilization of exposures, hazards, and biomarkers would provide more measurable performance metrics than health outcomes, as well

as greater feasibility of demonstrating impacts of policy-level interventions (Gomez, 1998; LaMontagne and Kelsey 2001; LaMontagne et al, 2002). Expanded evaluation research in these areas will foster the development of policies that are minimally burdensome to employers and maximally effective in reducing exposures and health effects. With a continued emphasis on generating information for action, OHS policy-level evaluation research will support the continuing improvement of policy development, implementation, and effectiveness.

OHS Intervention Research Resources

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Priorities for Future Research and Policy

Introductory Remarks

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There are three ideas about priorities that I would like to address in this final session. The first is to emphasize the broad view that we have taken today - we have considered a whole range of issues rather than focussing on the few that usually receive most of the publicity. We have covered health as well as safety. We have also covered both the traditional and the new emerging occupational hazards.

The second issue relates to the need to base occupational health and safety (OHS) activity on a firm evidential base, and that in order to do this we need to build and maintain a capacity for doing good quality research. As an example, I have been involved for the past few months in a project (conducted at the request of OSH) that is investigating whether it would be possible to locate a group of

employees in the New Zealand workforce who were heavily exposed to a particular chemical from a widely used process. OSH wants to find out what has happened to those people, as there have been anecdotal reports of ill health resulting from their occupational exposures. We were asked to see whether it would be possible to conduct an historical cohort study (which is the “gold standard” approach), and in order to do this we had to establish whether it was possible to assemble a study population of workers in the industry at that time. This needed to be comprehensive – i.e. everyone who worked in the industry (or in the industry in a particular plant or region) rather than a self-selected group of volunteers. This is normally achieved by finding old employment records, and for each plant included in the

study we need to find the complete set of personnel records.

The other thing we needed was some exposure information. We needed to be able to group the workforce into different exposure categories so that we could make comparisons between the highly exposed and those who had no exposure. It turned out that the government was actually one of the worst offenders with regards to exposures in this industry. They used the dirtiest process and the highest volumes of this particular chemical. If we could have found the people who worked for the New Zealand government twenty to twenty-five years ago they would have been a wonderful source of data - we could have done a very good study that would have contributed internationally as well as within New Zealand. However, since 1984 the New Zealand Government has gone through the

process of transforming government-owned industries into state owned enterprises, then eventually selling them off to the private sector. In the course of that process, any record of who used to work in these industries has gone. It may still exist, but no one knows where. We have telephoned about 50 ex-employees, we have gone to the National Archives, we have gone to the Ministry that's currently involved, and we have found nothing. In the end we did establish that there were sufficient records to enable a valid study to be done, but these were for private industry employees rather than for the former government employees.

The same story unfolded with the exposure information. There used to be a laboratory that did very good occupational exposure assessment work in New Zealand, i.e. the National Health Institute. They took exposure measurements and built up a very good database of exposure information. In the course of the 10 or 15 years of reform this database was transferred to the Department of Labour, which gave it to the DSIR, which became ESR, which became Agriquality. As you would expect, in the

course of all those changes of ownership those records have disappeared as well. We need to really look at improving our capability to identify or to develop data and to retain it. There is little point in lamenting what we have lost, but we do need to ensure that we don't repeat these mistakes.

My third point relates to equity and occupational health. I will use an example that came from Rashmi Rajan and Mary Adams' presentation on leptospirosis. There was a very good paper published this year by Thornley et al (2002), which examined the human epidemiology of leptospirosis in New Zealand. It was a very thorough investigation that used a combination of laboratory surveillance records and disease notification data to work out the leptospirosis incidence in the population. No one is sure why it is happening, but the incidence rate seems to be improving. We have gone from six cases per hundred thousand people per year down to about three in the course of a decade. Even so New Zealand doesn't actually compare very well to similar countries such as Australia and Ireland which have less than one

case per hundred thousand people.

However, once again population averages can conceal what is happening to specific groups within the population who may have much higher risks. Meat workers, for example, don't have an incidence of three per hundred thousand; they have an incidence of 165 per hundred thousand. If a meat worker worked in the industry for thirty years with a constant level of exposure, they carry a one in twenty risk of contracting leptospirosis of sufficient severity to seek medical attention during some stage of their career. The risk to the general population is insignificant, but the risk to the 20,000 meat or so-workers in this country is quite high. We need to really put an emphasis on equity in occupational health, and not necessarily just where the cost signals direct us to take action.

In summary, the issues that I would like to propose as priorities are: that we do take a broader view, that we really need an evidential base to what we are doing, and that we need to continuously strive for equity.

Employers and Manufacturers Association

David Wutzler

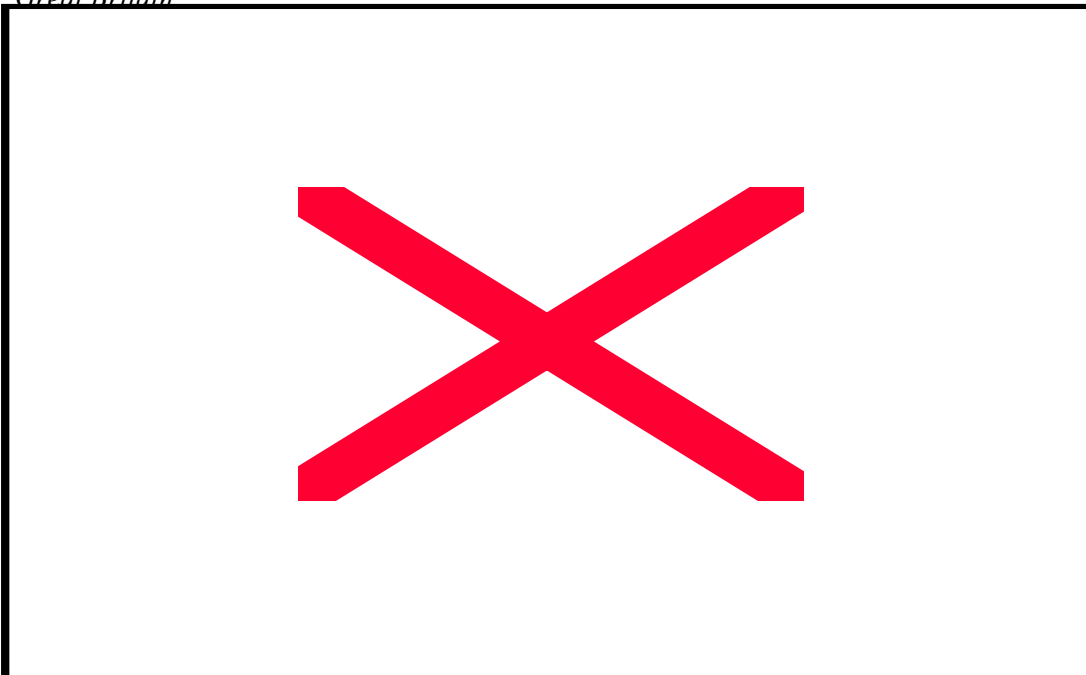
Bigger sticks or juicier carrots?

There have been many debates over the last year over how we make workplaces safer. How do we influence employers and employees to take steps

that will actually lower the injury rate in workplaces in NZ? The current proposals to change health and safety legislation focus on higher fines and more

regulation. Will this actually make a difference? Do other countries with higher fines and more specific legislation have lower injury rates than us?

Figure 1: Comparison of workplace injury rates between New Zealand, Australia and Great Britain



Our injury rates have dropped significantly over the past 10 years, however it appears this reduction may have stopped. I suggest we are focusing on the wrong approach. I don't think

any employer deliberately sets out to harm their employees, just as no employee deliberately inflicts a serious injury on themselves. Breaching health and safety

legislation is generally not something we intend to do as employees and employers. However it does happen.

Why?

Perhaps the answer lies deep inside the way we behave.

One of our design faults as humans is that we are not good at making accurate decisions about the actual risk we face in a situation with a possible negative result, this is the syndrome “it won’t happen to me”.

- I can drive safely at 120km/h, it’s everyone else who can’t
- I can clear that blockage without turning off the machine
- I’m a skilled operator
- I don’t need to tie off the ladder
- I’ll only be up it for a few minutes
- She’ll be right, no worries piece of cake.....

On the other hand, we put a great deal of effort into chasing perceived incentives or rewards. Look at the success of customer loyalty programmes such as Fly-Buys and Kachingo. The reward is often way out of kilter with the effort we put into trying to achieve the reward, but we still go for it. We do this sometimes even if the incentive is almost impossible to achieve, for example Lotto. The more you play, the more

you lose, but we keep buying tickets.

The point I’m making is that if you look at what motivates our behaviour, we are not always very good at avoiding penalties, but we often put a lot of effort into trying to achieve incentives, often out of proportion to the reward. Maybe we should exploit this more in our efforts at injury prevention? Incentives are a more powerful force for influencing behaviour change than penalties

I suggest a better direction for our health and safety legislation is to look at how we can create incentives for health and safety behaviour or performance. We do this to a small extent through Occupational Safety and Health’s (OSH’s) Workplace Safety management Practices (WSMP), and for those company’s who have taken up this incentive, I believe it has made a big difference to the quality of their health and safety systems, and hence their control of hazards. I can’t prove that yet, but as an auditor for the Accident Compensation Corporation (ACC) I have seen dramatic improvements in the systems companies involved in ACC’s

WSMP & Partnership Programmes (PP).

Realistically, WSMP applies to the minority of employers. What about the rest, how do we influence their behaviour, what incentives can we put in place? This is an area crying out for research & innovation.

Let me give you an example of what I mean. One of our poor performing occupations in terms of injury rates in Wellington is that of builders, many of who are self-employed or in small businesses. WSMP is not practical for these firms, and they are unlikely to develop comprehensive safety systems because we change the Health and Safety in Employment Act. So how could we try and apply positive incentives to change behaviour? Who influences the builder’s behaviour? Their customer. Can we give the customer an incentive to use a builder who is using a recognised safe working practice, as a way of giving builders an incentive to use safe working practices? Perhaps we can. If you, as a home builder or property developer could get a discount on say your building consent for using a builder with a recognised safe work

practices, you would be interested in using builders with those work practices. A builder would also have an incentive to use a form of safe work accreditation to get your business, so perhaps we get the result we want, builders using safe work practices, by

creating an incentive for the customer.

I believe the innovative creation of incentives will have a far better impact on influencing safety behaviour and development of safety systems than pumping up the penalties. The Health

and Safety in Employment Act requires a proactive approach in managing hazards before they cause harm, We should look for proactive approaches to influencing safety behaviour to avoid harm.

Council of Trade Unions (CTU)

Bella Pardoe

I work as an organiser for the Finance and Information Sector Union (Finsec).

Our members work in an environment that the primary driver is to increase profits by cutting costs, setting unachievable targets, and providing a service to customers. As a consequence many of our members suffer from OOS, gradual process injuries, musculo-skeletal disorders, and stress.

As organisers we have to deal with these issues:

- the ever continuing process of members being reviewed
- third party insurance companies and employers doubting that injury is work related

- continuing pressures from their employers to resign from their employment or resume to their full duties
- non-existence of light duties in their workplace

We find that a significant number of our members have left their employment out of stress created by their target driven employment. They have chosen to leave because of inevitable failure or, even worse, physical collapse. Some remain unemployable for a considerable period of time.

Part of our strategy at Finsec as been on educating our members on how to best deal with these issues and ensuring that we have active

health and safety reps involved in their work places.

When defining risks, occupational hygienists assess risks differently to workers. When workers talk about risk assessment it is in terms of being provided with all the information available on workplace hazards and then making an informed decision as to whether the risk is acceptable. We believe it is a fundamental right of workers to make that decision and that decision can only be made if workers have access to all the information available.

One area of occupational safety and health that requires a great deal of research is the effect of work organisation on

health and safety. There is a growing awareness that the way we organise and structure the work environment has significant impacts on health and safety.

Recent research from the University of New South Wales has shown a very real link between the trend towards insecure, temporary and casual work and detrimental effects on health and well being.

Implications

The results indicate that there is a very real connection between precarious employment and reduced workplace health and safety.

It also highlights a need for further research into the effects on workers in specific industries and specific groups or classes of workers. For example young workers whose only experience of work is temporary, casual, insecure employment. Many of them may not know what it is like to be employed by anything other than a labour hire company.

Further research is needed into why there is a clear association between the changing organisation of work and

To summarize some of the findings:

- A survey of 93 studies covering 11 countries published between 1986 and 2000 showed that 76 established a causal connection between precarious employment and a measurable deterioration in OSH.
- Of the 29 studies of sub-contracting/home-based work 23 found an

adverse effect on health and well being.

A review examined 66 studies on the health effects of downsizing/restructuring – with similar results in that 59 showed a casual connection between job insecurity and deterioration in health and well being of surviving workers.

deterioration in health and safety.

Potential causes are numerous and the following list of just some of them highlights how big the issue is and how there is a desperate need for quality research.

- Economic pressures, which result in contractors cutting corners in order to underbid.
- Work intensification resulting from down sizing
- Limited resources available to small business to devote to OSH
- Difficulties and/or unwillingness to train temporary workers in H&S

- High levels of labour turnover resulting in the disruption of informal flow of safety knowledge
- Out sourcing of labour
- Down sizing resulting in loss of experienced workers and multi-tasking for those who remain
- OSH legislation which is designed for a permanent workforce in large workplaces
- Erosion of minimum labour standards and poor enforcement of minimum standards
- Significant reduction in representation of workers resulting from a concerted attack on unions

- Failure to inform and educate workers on OSH legislation

These are just some examples of areas that could and should be the basis of substantive research.

At the most basic level we need to undertake serious research into the flip side of “flexible labour market”. We need to gain a better understanding of the psychological and emotional effects on those who are forced into low paying and insecure employment.

We need to understand the effects of 15 years of

dramatic labour market reform on the health and wellbeing of workers (both employed and unemployed).

We need to understand the effects on health and safety of:

- Casualisation
- Reduced union representation
- Reduced collective bargaining
- Increased working hours

We need to look beyond the “workplace” and examine the effects of the changing labour market on the health and

wellbeing of the wider community.

New Zealand has a higher rate of workplace deaths than the United States, Australia and Great Britain.

In the past two decades workplace deaths have reduced by 60-70% in Sweden, Japan, Germany and the United States. In New Zealand that figure is at best 30%. We need to know why.

As you can imagine Unions have a view on these issues but we need substantive research to be undertaken to support those views.

Policy

With a more worker friendly government we are beginning to see some positive initiatives. In terms of Health and Safety the CTU believes the proposed changes to the HSE Act are a step in the right direction.

It is vital that there is ongoing research to monitor the anticipated improvements to OSH to ensure the positive changes are not undone with a change in government.

Research can both assess the impact of policy and shape future policy. Researches therefore have a vital role in helping to shape policy to improve occupational health and safety.

Research

In recent years the issues of work life balance have become increasingly important to workers from all sectors of society. Unions around the world have taken the

lead in lobbying for legislative, regulatory, bargaining and cultural change which will enable workers to better fulfill their roles as workers, and as individuals,

parents, children, caregivers, partners, members of the community and so on.

In 2001 the CTU committed itself to work

in the area of work life balance, including conducting qualitative interviews with a range of workers on the issues of work hours, leave entitlement and balancing work and family.

The project, called “Thirty Families”, involved interviewing 30 workers and their families on the hours they were working and the impact this had on their personal lives. The people interviewed were from a range of occupations, including front-line workers in the hospitality industry,

teachers, doctors, production workers, drivers and lawyers. Most worked 45-55 hours a week. Some of the professionals worked in excess of 60 or 70 hours a week.

Many workers in the study talked about a work/eat/sleep cycle; that is, all they did was work, eat and sleep. Some who had families seldom had the opportunity to meet with their families as a whole, and one worker had to make specific arranged times to be with his partner and see his kids.

Even those whose hours were such that they did get to have regular time with their families, worked patterns of hours which meant that they were often exhausted when that family time came around.

The CTU's research is critically important in helping the NZ union movement develop innovative and effective responses to the needs of workers, their families and the broader community to achieve a better balance between work and life in New Zealand.

OSH

Bob Hill

Putting Occupational Health on the Policy Agenda

In New Zealand, as in most other countries, one of the largest strategic challenges concerning occupational health and safety is to ensure that the social and economic costs of poor practice are fully understood. So often, perception is reality. To ensure that occupational health and safety achieves a higher priority on the national agenda, there is a need for an increased

awareness among the public at large, among employers, workers, and other labour market participants, and among those engaged in public policy development.

Within that imperative of putting workplace health and safety on the map, is the need to ensure that occupational health is seen as a significant (and at least an equal) element

of the overall safety and health equation.

Today I wish to identify five reference points, which, in my view, are fundamental to raising awareness and achieving a priority for occupational health which is commensurate with the cost that it imposes on the New Zealand community as a whole.

The first point is that awareness is central to action. If occupational health is to be seen as a national priority (and a public policy priority) we need to raise awareness of the cost of work-related disease and illness. Too often proactive occupational safety and health management is seen as a business or compliance cost. We need to change this perception, so that good health and safety practice is recognised as a benefit to the community and an integral part of a healthy “quality centric” pattern of work. In my lifetime we have seen public perceptions about asbestos move from ignorance to a widespread understanding that its use represents an unacceptable risk. The challenge is to enhance public awareness and perception concerning other occupationally related health hazards.

The second point is that “data counts”. Quality data is the elixir of informed debate. It helps us identify emergent issues. It loosens the Gordian Knot of policy by anecdote and helps shape our perceptions and the potential for sound policy development and implementation. The

paucity of accurate well-defined data makes it extremely difficult to be specific about the scale and seriousness of many occupational health issues. This relative lack of good quality data makes it difficult to get occupational health on the public policy agenda. Research projects focussing on particular patches of hitherto uncharted workplace performance. In the longer run, the collating and reconciling of various administrative data sets (e.g. ACC, OSH, hospital accident and emergency figures) may offer the most realistic path forward. The integration and dissemination of the best available data (however imperfect) offers the best opportunity for informed debate and evidence-based policy advice. Providing this evidence base is a major challenge for the Government’s newly appointed Injury Information Manager.

My third point is that occupational health and safety is a means rather than an end in itself. In the past, occupational safety and health has often been seen as a merit good, deserving of being resourced by any “right thinking” community. We need to change this perception,

so that occupational health, in particular, is recognised as an essential ingredient of good business and innovative management. Healthy occupational practice represents an investment in human capital, with flow-on benefits for the wider community. As long as we focus on occupational health and safety intervention as something that is justified in its own right, then we must accept that it will be viewed by many as an unnecessary cost of compliance, an impost by central government and over-zealous bureaucrats. Well-rounded research has the potential to shape the context and thereby highlight the wider benefits of effective practice.

The fourth point I would make is that “safety” is the tip of the iceberg. The costs of occupational health lie largely below the waterline. Research commissioned by occupational health and safety agencies in Canada and Australia indicates that work-related ill health represents the submerged and larger part of the poor practice cost burden. The direct costs (at least) of work-related accidents are usually self-evident. How large is the “unseen”

occupational health cost component, relative to the “seen” occupational safety component? It is simply not possible to say. I note that the 2002-2012 strategic plan of the National Occupational Health and Safety Commission in Australia uses a health/safety fatality ratio as high as 10:1. Even if we think that that ratio overstates the position, it is clear that poor occupational health management results in a heavy quantum of hidden cost via our health and benefit systems, and in compromised quality of life for those suffering from occupational disease.

Occupational health programmes labour under the archetype malaise of all preventative programmes: how to demonstrate the cost of what might have been? Just as quality data helps inform the public policy debate and shape the agenda, so too does qualitative research play a vital part in rounding

out our understanding of the wider consequences of poor occupational health performance.

My fifth and final point is born of short-term pragmatism: the need to get “runs on the board”. Too often, in the occupational health and safety sector, we strain for technical or empirical perfection and fail to achieve even a glimmer of awareness in the minds of policy makers and the wider public. In these circumstances, to quote Voltaire, “*The best is the enemy of the good*”. Clearly, sustainable credibility depends on the very best research that we can resource. But, initially, it may be that “telling the story” through well selected case studies offers the most realistic way forward, a practical approach to opening windows of qualitative insight. Alternatively, “best practice” stories can demonstrate the potential policy returns of placing occupational health and safety practice in a wider management

and commercial context. It is not possible to win over an often-disinterested public to the full benefits of good occupational health practice across the board. We must first find ways of stimulating pockets of interest and working to “grow” the wider agenda and understanding.

These five points are not a complete prescription to put occupational health on New Zealand’s public policy agenda. Rather, I present them as pointers to a way forward, to building momentum and public awareness about occupational health issues, and to ensuring that our policy development in this area is as well informed as it can be. There is a virtuous linkage between the development of a research and public policy agenda for occupational health. We need to work to give that linkage practical living form.

References

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