

**NOHSAC**

National Occupational Health  
and Safety Advisory Committee  
*Komitii Tohitohu Mahi A-Motu Hauora me te Haumanu*

**INTERNATIONAL REVIEW OF METHODS AND SYSTEMS USED TO**

# **MEASURE AND MONITOR OCCUPATIONAL DISEASE AND INJURY**

**NOHSAC TECHNICAL REPORT 3**

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# Table of Contents

<b>Executive summary</b>	<b>3</b>
<b>1. Introduction and overview</b>	<b>5</b>
1.1 Objectives of the review	7
1.2 Scope of the review	7
<b>2. Occupational health surveillance</b>	<b>9</b>
2.1 Introduction	10
2.2 Design of surveillance systems	11
2.3 Issues specific to occupational disease	13
2.4 Issues specific to occupational injuries	15
2.5 Uses and limitations of surveillance systems	15
2.6 Occupational surveillance methods	17
2.7 Evaluating surveillance systems	21
2.8 Systems to rate strength of scientific evidence	24
<b>3. Review methodology</b>	<b>27</b>
Semi-structured interview	28
<b>4. Literature review</b>	<b>31</b>
<b>5. International review</b>	<b>37</b>
Canada	38
France	44
Finland	51
Sweden	66
United States	72
United Kingdom	89
Review rating table	103
European occupational surveillance and monitoring systems	104
<b>6. Conclusions and recommendations</b>	<b>115</b>
<b>7. Appendices</b>	<b>121</b>
7.1 Search strings used for literature review	122
7.2 List of useful resources discovered while conducting review	122
<b>8. Definitions and terminology</b>	<b>123</b>
<b>9. References</b>	<b>131</b>

## List of Tables

Table 1	OSH monitoring systems	22
Table 2	Checklist for evaluating public health surveillance systems	23
Table 3	Rating surveillance systems	103
Table 4	European occupational surveillance and monitoring systems	104
Table 5	Health and safety resources	122

## List of Figures

Figure 1	Data-driven Model	18
Figure 2	Concept-driven Model	19
Figure 3	Occupational Safety and Health system	52
Figure 4	Data flows into the Finnish register of occupational diseases	60

# Executive summary

This review provides a comprehensive international evidence-based review of methods and systems used to measure occupational disease and injury (excluding New Zealand) and assess the ability of surveillance systems to measure changes in work methods and work organisation. The method involved a literature review and survey of existing approaches.

The workplace is a significant and consistent contributor to injuries and illness and associated fatalities. Worker health is therefore fundamental to public health and to a healthy and productive society. Tracking systems form the cornerstone of injury and illness surveillance. Surveillance systems involve the ongoing and systematic collection, analysis, and interpretation of information so that appropriate preventive action may be taken.

Occupational surveillance systems have undeniable value and hold considerable potential for prevention approaches. However, most current systems rely on an unsatisfactory patchwork of data and systems.

The utility of any surveillance system rests on its ability to capture data from the largest possible proportion of the target population, and for that data to incorporate the widest possible range of potentially relevant variables. Data-driven systems have been built to take opportunistic advantage of information collected for other purposes. Concept-driven systems are rare, but stand as beacons of success for others to aspire to.

Integrated occupational surveillance systems are based on sound theoretical principles and have high data capture rates. They use multiple data capture methods that are integrated into the workplace, healthcare, and compensation/insurance and social security systems. Equal focus is placed on occupational disease and injury, thereby avoiding arbitrary divisions. Work environment is monitored, in addition to cases or incidents. Standardised definitions are used, allowing comparisons within and between systems. Comprehensive sets of indicators are used, with free text fields to augment. Bias is minimised. Data capture emphasises core attributes of sensitivity, specificity, representativeness, timeliness, simplicity, flexibility and acceptability, and includes reliability checks.

The most effective occupational surveillance systems have two unique characteristics. They are run within independent units or services, with the principal mission to provide epidemiological excellence. They also use independent oversight and expert advice. It is vital to separate the collection and interpretation of data from the commercial, political, or social agendas of organisations or groups that may collect it.

The most important conclusion is that we need to do better at occupational surveillance in order to realise the potential of these systems. None of the existing occupational surveillance systems in use around the world stands out as a shining example, but the ones that most closely approach the ideal are those with dedicated services that are independent, and charged with the mission to champion this cause. However, this alone is not sufficient. The system must also be comprehensive and emphasise occupational illness in addition to occupational injury. Of the systems reviewed, the Finnish approach is the one that currently most nearly attains these criteria, and it seems that New Zealand could learn a substantial amount from this model.

The following recommendations are offered by the reviewer, while acknowledging that some of these have resource implications. These recommendations outline a high-quality occupational surveillance system.

## **RECOMMENDATION 1. ESTABLISH AN INDEPENDENT EPIDEMIOLOGY BUREAU**

There should be an independent unit providing an epidemiology department with overall responsibility for surveillance systems. This epidemiology bureau should have an appropriate management structure that is entirely independent of any stakeholders or organisations that may hold their own agendas in order to avoid bias. It should be funded by contributions from stakeholders, including but not limited to the Ministry of Health, the Ministry of Social Development, the Accident Compensation Corporation, and private health insurers or underwriters.

Core tasks would be to:

- establish an integrated concept-driven surveillance system that is feasible
- vigorously champion data capture
- contribute directly to prevention initiatives
- function in a cost-effective manner.

#### **RECOMMENDATION 2. ESTABLISH AN EXPERT GROUP**

There should be an expert group, whose principal function is to advise the epidemiology bureau. Membership should be time-limited, allowing staged turnover to maximise fresh ideas. This group would advise the epidemiology bureau on key topics, including:

- case definitions, coding, categories, and key indicators
- data capture techniques, including those that might be mandatory
- analysis, especially of narrative fields
- priorities.

In addition, the expert group would function as an expert panel in the development of guidance on specific occupational health topics

#### **RECOMMENDATION 3. ESTABLISH AN INTEGRATED CONCEPT-DRIVEN SURVEILLANCE SYSTEM**

The core of this should be a national database that includes all occupational injuries and disease. This could be modelled on the Finnish equivalent. The epidemiologist(s) would be required to integrate data capture into the workplace and the ACC and health systems. The core database would be augmented with multiple data capture techniques, with consideration given to using a mixture of techniques, targeted carefully at specific issues. This might include sentinel systems, expert opinion, surveys, and laboratory reports, for example.

#### **RECOMMENDATION 4. ADOPT BEST PRACTICE PRINCIPLES FOR SURVEILLANCE**

The key features of high-quality surveillance systems are outlined in detail in this review. It needs to be emphasised that surveillance systems rapidly deteriorate into ineffective systems when compartmentalised or fragmented. The best practice requires a “systems approach”, without cutting corners. An expert group needs to be consulted to ensure that the surveillance system will result in useful outputs and can be continuously improved.

#### **RECOMMENDATION 5. PUBLISH SURVEILLANCE DATA**

Undertake wide dissemination of information on a regular basis.

#### **RECOMMENDATION 6. USE THE SURVEILLANCE SYSTEM TO EVALUATE THE EFFECTIVENESS OF INTERVENTIONS**

The surveillance system should be used to evaluate the effectiveness of interventions, such as prevention initiatives and improvements in work methods and work organisation. However, this can only be achieved if the system is sensitive to change. This will be contingent on development of an integrated surveillance system, built on the recommended principles of best practice outlined in this review.

SECTION ONE

# INTRODUCTION AND OVERVIEW

This review provides a comprehensive international evidence-based review of methods and systems used to measure occupational disease and injury (excluding New Zealand) and assess the ability of surveillance systems to measure changes in work methods and work organisation.

The workplace is a significant and consistent contributor to injuries and illness and associated fatalities<sup>1</sup>. A large number of New Zealanders develop or acquire work-related health problems and injuries each year, and some of these are fatal. Yet, this truism is difficult to support with hard factual data about the number of cases, the causes, and what can be done to prevent them.

Key problems within occupational health include estimation of incidence and prevalence of disease and injury; trends within these parameters; and distribution of disease and injury across variables such as occupational class, geographical location, or population subtype, for example. Reliable and valid determination of this data provides the critical foundation for important discoveries, such as causes and what might be done to prevent them.

Reduction in the burden of disease and injury within New Zealand is dependent on understanding the magnitude of that burden, its causes, and determining potential areas for efficient and effective deployment of resources.

Tracking systems form the cornerstone of injury and illness surveillance<sup>2</sup>. A diverse variety of methods and measures has been adopted in different countries and by their health and safety systems. These range from systematic and comprehensive, through to “ad hoc” and insufficient.

Worker health is fundamental to public health and to a healthy and productive society<sup>3</sup>. It is crucial to track the occupational health status of the New Zealand workforce. To achieve this, a set of reliable indicators is needed for use by governmental and quasi-governmental organisations as the basis for a meaningful occupational health surveillance programme.

Surveillance systems can be applied at the population, group, and/or individual level to assess relevant activities. Individual worker screening and monitoring is an example of a method for early detection of disease, and this is subsequently the basis for intervention steps to prevent further exacerbation.

The implementation of surveillance systems provides the foundation for a number of important strategic goals:

- It advances the usefulness of surveillance information at national level for prevention of occupational illnesses, injuries, and hazards.
- It strengthens the capacity of the labour, health, and accident compensation departments to conduct occupational surveillance.
- It strengthens surveillance of high-risk industries and occupations and of populations at high risk, including any special populations.
- It promotes the effective occupational safety and health surveillance conducted by employers, unions, and other non-governmental organisations.
- It facilitates, and thereby increases, research to improve occupational surveillance.

This information should assist the Department of Labour in the stated goal of ensuring “New Zealanders achieve high-quality working lives in thriving and inclusive communities through information, services and support for workplaces and communities”<sup>4</sup>.

There have been very few attempts to systematically review surveillance systems to date. No comprehensive international comparisons could be identified. Furthermore, a critical comparison of the quality and utility of measurement methods is unavailable. The available reviews of surveillance systems lament the lack of agreed standards for defining, reporting, and recording occupational diseases and injuries<sup>1</sup>. This makes comparisons between and across systems difficult and potentially misleading. Their potential to inform and evaluate prevention programmes is therefore compromised.

There is no doubt that surveillance methods have become more sophisticated over time, reflecting the imperative to improve disease detection and injury prevention. However, this increasing sophistication has involved greater complexity, and this requires epidemiologists to select both factors to be measured and methods to measure them<sup>5</sup>. Each of these choices represents sources of error and, most importantly, presents difficulties in making comparisons.

Ultimately, the quality of any surveillance system rests on its ability to capture data from the largest possible proportion of the target population, and for that data to incorporate the widest possible range of potentially relevant variables. The choice of what to include in a surveillance system is critical. The methods used to capture that data are equally pivotal, as are the ways that it is categorised and ultimately characterised.

Modern surveillance systems have probably benefited greatly from narrative data analysis, based on free-text entries to databases, and been enhanced by greater computing power<sup>6</sup>. There have also been improvements in the ability to link data sets from different sources and more implementation of surveillance systems that comprehensively cover entire populations (from the level of a single enterprise right up to that of a national population).

Adoption of surveillance systems is necessarily accompanied by a variety of barriers. New Zealand can learn vicariously the important lessons that other systems and nations have already discovered.

Surveillance systems are never stagnant, but continue to improve over time as the collective understanding enhances both efficiency and effectiveness. For this reason, it is important to monitor the output of key groups and task forces and the ongoing worldwide development of relevant methods and systems.

## **1.1 OBJECTIVES OF THE REVIEW**

There are two important questions for New Zealand: “Does the rest of the world have anything to offer that has not already been adopted locally?”, and “Can we identify information gaps to define what we do not know?” This was the focus of the current research, based on a literature review and survey of international practices.

## **1.2 SCOPE OF THE REVIEW**

Broadly, the review was to identify information about existing systems in countries other than New Zealand. Clearly, it is not possible to review every surveillance system in existence, hence selection was applied. Specific guidance on this topic was not provided by NOHSAC, and therefore the reviewer chose a number of countries that offered both some similarities and some contrasts with New Zealand. Within each of these countries, it was also necessary to select some examples. This was made more necessary by the often fragmentary nature of existing surveillance systems in current operation and lack of harmonisation of both inputs and outputs. In order to broaden the overall scope of the review, a brief overview of major systems operating in the European Union was also tabulated.



SECTION TWO

OCCUPATIONAL HEALTH

# SURVEILLANCE



## 2.1 INTRODUCTION

The workplace is a significant and consistent contributor to injuries and injury fatalities<sup>1</sup>. This provides an imperative to collect data that may be used to describe the development and causes of health problems, and to facilitate their prevention or remediation<sup>7</sup>. It is for this reason that the field of occupational health surveillance came into being.

There is a reasonable consensus that occupational health surveillance is best defined as “the ongoing and systematic collection, analysis, and interpretation of data related to either occupational exposures (hazard surveillance) or adverse health outcomes, including injuries, diseases or disorders, and the dissemination of information to those who need to know in order that action be taken”<sup>8-16</sup>, and this definition is adopted for the purposes of this review.

Occupational health surveillance is conducted and implemented as a “system”, a combination of related elements that provides a set of procedures aimed at achieving the desired goals. This term reflects the multidimensional nature and complexity of the task. Surveillance is observational in nature; it is not research. The latter involves experimental designs.

An occupational health surveillance system focuses on diseases and/or injuries that are either caused, or made worse by, engaging in work and productive activity. Such systems include the functional and operational capacity for data collection, and analysis and dissemination linked to occupational health programmes. The system should be designed to link with all relevant activities at individual, group, enterprise, community, regional and country levels to detect and assess any significant departure from health caused by working conditions and to monitor workers’ general health. Good quality occupational health surveillance programmes record instances of occupational exposures or work-related illness, injury or death and monitor trends in their occurrences across different types of economic activities, over time, and between geographical areas.

Surveillance systems have two important goals<sup>17</sup>. The first is to determine the magnitude of a specific occupational health or injury problem; the second is to examine temporal trends to determine whether the problem is increasing or decreasing. There are many types of data available that might potentially serve these two important purposes. Each has its strengths and weaknesses.

The utility of surveillance data and occupational epidemiology has a long history, with several notable successes. These include the surveillance of acute injuries, musculoskeletal disorders, lead overexposures, and workplace hazards.

Once surveillance data sets came into existence, it was quickly realised they might have additional value in evaluating the effectiveness of interventions<sup>18</sup>. It is assumed that surveillance is more important in times of rapid change in the economy and when resources for prevention may be limited<sup>17</sup>. Both of these conditions are relatively common in the modern world.

The ability to survey and assess the state of occupational health and safety has undoubtedly improved over time. However, occupational safety and health surveillance data remain fragmented, because they are collected for different purposes by different organisations using different definitions<sup>19-21</sup>. There is wide agreement that currently available data in most countries is “considered unreliable and insufficient to usefully inform policy formulation”<sup>2</sup>. This means it is difficult to make statements with the confidence that comes from knowing they are evidence-based, and this represents a considerable ongoing frustration for advocates of improved occupational safety and health prevention programmes<sup>1</sup>.

Despite these problems, surveillance data, along with expert opinion, is often used to inform policy initiatives at all levels. This is due to the imperative to effectively address important occupational safety and health issues. However, it remains something of a truism that “we don’t know how much we don’t know”<sup>22</sup>.

## 2.2 DESIGN OF SURVEILLANCE SYSTEMS

### OCCUPATIONAL HEALTH SURVEILLANCE

Occupational health surveillance should provide estimates of the extent and distribution of diseases and injuries, and relevant hazards and exposures, and be capable of monitoring changes over time. There are potentially many ways that surveillance systems could be established and implemented to achieve this.

It seems axiomatic that the system should provide surveillance of workers' health, since the economic development of any country depends on the wellbeing of its people. In order to be able to work maximally, people need to be healthy. Poor working conditions expose workers to hazards that may cause large human and material losses<sup>23, 24</sup>. This has the potential to add a burden to the productivity of national economies, as well as impact on the quality of life of individual workers and their families<sup>25-27</sup>. Therefore, surveillance of workers in industries can be considered an immensely important activity in any occupational health system.

However, direct surveillance of workers' health is not a simple or straightforward task, unless immense resources are available, since it requires detailed knowledge about many individuals. There are several options when selecting reporting mechanisms, and these may yield wide variations in results. Choices about what to focus on need to be made, but these depend on the characteristics of the condition(s) under consideration. This means that, in practice, most surveillance systems use pragmatic proxies for direct measures and sub-optimal data capture methods.

#### Work Environment Surveillance

Another option is to target surveillance of the work environment itself, in addition to surveillance of the health of the workers. A strong argument can be advanced that surveillance of the work environment should be carried out for the identification and assessment of health and safety hazards at the workplace<sup>28, 29</sup>. This requires the identification and, if possible, the qualification of the factors at work which may be hazardous to health.

In practice, the factors usually taken into consideration include:

- noise and its different characteristics, frequency, level, pulses, duration, and accompanying exposures, e.g. vibration
- vibration (which is analogous to noise)
- ionising radiation
- non-ionising radiation – ultraviolet and infrared
- lasers
- lighting
- ventilation, temperature, and humidity
- physical workload, heavy dynamic work, repetitive tasks, static muscular strains, and heavy lifting
- chemical hazards, e.g. solvents, toxic materials, metal fumes, organic and inorganic dusts, asbestos, and other mineral fibres
- ergonomic aspects, work postures and movements, organisation of work, use of muscular strength, and visual ergonomics
- work tools, machines, workrooms, gangways, lifting aids, trucks, lifts and cranes, etc
- working time issues and problems of shift work
- social relations at the workplace
- psychological factors, such as mental over-load or under-load, information load, isolated work, time pressure, customer pressure, and availability of support
- managerial issues, corporate philosophy, personnel policy, training and education, collaboration, and participation.

The ability of surveillance systems to provide data and information that can be compared with other systems is a laudable and worthy goal. However, there is no true consensus over a minimum data set that should be collected. In 1998, the International Labour Office (ILO) published *Technical and ethical guidelines for workers' health surveillance*<sup>30</sup>. These (non-binding to members) guidelines attempted to establish minimum standards for the design and operation of surveillance systems. Their stated purpose is “to assist all those who have responsibilities to design, establish, implement and manage workers' health surveillance schemes that will facilitate preventive action towards ensuring a healthy and safe working environment for all”. They provide advice about the process of operating surveillance systems, but only very general advice about the content of such systems or the methodology to be used. As such, they are welcome additions to the field, but provide only generic guidance. The situation has been further enhanced by the Protocol of 2002 to the Occupational Safety and Health Convention 1981 (No.155), which strengthens recording and notification procedures for occupational accidents and diseases and promotes “harmonisation” of recording and notification systems.

Epidemiologists wishing to estimate the severity of occupational illnesses and injuries face several measurement dilemmas. Direct measures of severity are not generally available for populations. This means that proxy measures are invariably used. Even if detailed clinical information were available to epidemiologists, it is unlikely that good measures of illness or injury severity could necessarily be made. This is due, in large part, to lack of a consensus over what constitutes “severity” and the potential complexity of multi-factorial measures needed. Most of the good quality generic measures designed to be independent of symptoms (e.g. the Sickness Impact Profile<sup>31</sup> and the anglicised version, the Functional Limitations Profile<sup>32, 33</sup>) are lengthy and impractical for regular use. Shorter options do exist, including the Medical Outcomes Study Short Form (SF-36)<sup>34</sup>, and the even briefer SF-12<sup>35, 36</sup>. However, even collection of this data is expensive, onerous, and intrusive, unless it is incorporated as part of a research study or audit process that is investigating issues such as outcomes and cost-effectiveness.

In practice, the most common proxy for injury severity used by epidemiologists is lost time from work. For example, in the US, the CDC and NIOSH approach is to estimate the severity of an injury or illness by using information provided by employers about the number of days away from work taken to recuperate from each disabling condition<sup>37</sup>. If, as a result of injury or illness, the worker did not return to work by the end of the survey year, the employer reports an approximate return date that, in conjunction with the date of injury or illness, yields an estimated number of days away from work for that case. Two basic measures of severity are used with the characteristics of days-away-from-work cases: (1) median days away from work (the point at which half of the days-away-from-work cases have a longer duration and half have a shorter duration); and (2) the distribution of days-away-from-work cases involving various lengths of absences from work, ranging from 1 or 2 days to 31 days or longer. The Bureau of Labor Statistics (BLS) uses a similar approach, with some important differences. They capture information on days away from work. However, they also capture days of restricted work activity and/or job transfer. They define cases involving days away from work as those requiring at least one day away from work with or without days of job transfer or restriction. Job transfer or restriction cases occur when, as a result of a work-related injury or illness, an employer or health care professional keeps, or recommends keeping, an employee from doing the routine functions of his or her job or from working the full workday that the employee would have been scheduled to work before the injury or illness occurred.

However, use of lost time at work as a severity indicator for occupational illnesses and injuries has a number of limitations. One of the most serious involves time of measurement. It has been shown that the BLS survey method outlined above results in significantly different results than those obtained directly from a workers' compensation database<sup>38</sup>. In this study, conducted in Michigan, it was estimated that the national BLS survey significantly underestimates the magnitude of time lost at work by a factor of between 4 and 8. This represents a serious discrepancy, and the study authors attributed it mainly to the BLS survey restricting the time of measurement to soon after the accident year.

Surveillance data may come from a variety of sources<sup>39,40</sup>. Most surveillance systems are publicly funded, and the expense is justified on a variety of grounds ranging from compliance with legislation and international treaties, through to prevention ideals. In addition to surveillance systems operated by governments and quasi-governmental organisations, these activities do often exist in the private sector. Occupational surveillance may be conducted by employers, unions, health professionals and institutions, and others using various methods to track illnesses, injuries, and hazards for the purpose of prevention and control activities. Innovation and the development of new approaches to surveillance in the private sector should probably be encouraged and supported. In addition, empirical evaluations of the impact of occupational surveillance in the private sector on worker safety, health, and productivity are needed in order to support recommendations and encourage best practices.

There is very little well-quantifiable data available to date on the occupational health and safety situation of small enterprises, even though the number of small enterprises in almost all countries is high. Dissemination of occupational health and safety information to small enterprises is sometimes given priority. For example, the Finnish Institute of Occupational Health runs a Small Enterprise Action Programme. However, there are fewer incentives for small enterprises to collect data or to inform statutory bodies. For example, the RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations) system in the UK has estimated that less than 5% of the self-employed (small enterprise) contribute data.

#### **Surveillance of Hazardous Products**

One other type of surveillance system, which is implemented in a variety of different ways in various countries, is to conduct surveillance of potentially hazardous products and devices at the time of their entry onto the market. This may have its origins in consumer protection legislation, such as is the case for the Food and Drug Administration (FDA) in the US and the various departments of the European Commission, including that which deals with the CE mark. An example of a more active approach functions in Finland. There, the Occupational Safety and Health Department and the Occupational Safety and Health Inspectorates of Finland supervise the conformity of machines, equipment, chemical substances, and personal protective equipment used at work with the means of market surveillance in order to ensure that only safe and conforming products are used at workplaces<sup>41</sup>. The Finnish authorities acquire products from the marketplace directly and investigate their potential hazard to health.

### **2.3 ISSUES SPECIFIC TO OCCUPATIONAL DISEASE**

Occupational disease is a conceptually challenging area<sup>42-48</sup>. It can be argued that this is the reason why currently available information on occupational disease is generally quite poor. By contrast, work-related injuries are often more overt and more easily identified with causes, unless they are gradual onset in nature.

Perhaps the most demanding task is to investigate causal relationships that might exist between occupational diseases and exposures<sup>49-58</sup>. In practice, this invariably has to be done with limited exposure data available.

The same disease can be caused by many factors. Furthermore, many occupational diseases that can be caused by work can also be caused by non-occupational exposures, and these cannot usually be distinguished on clinical grounds. In fact, there are few work-related diseases, especially those in modern industrialised societies, that are due exclusively to workplace exposures. This means that the level of work-related disease cannot be determined by simply counting the number of cases of a particular condition<sup>2</sup>. Careful clinical history-taking may elucidate temporal relationships, for example, in cases with problems such as occupational asthma or dermatitis. Specific biological measures, such as blood levels for lead or urine levels for mercury, may provide strong supporting evidence.

When investigating causation, a profoundly complicating aspect is the long latency observed between the time of exposure and onset of clinical signs and symptoms that may allow a diagnosis to be made<sup>59, 60</sup>. The relationship

between exposure and occupational disease in an individual is therefore very difficult to establish, although this determination may have important medico-legal consequences for the individual and their employer<sup>61-68</sup>. It is usually necessary to conduct specific epidemiological studies at a group or population level, in order to establish statistical relationships (absolute risk or relative risk) between exposure and the condition(s) under consideration<sup>69</sup>.

For advocates of prevention strategies, these circumstances are doubly frustrating, since any established links between workplace factors and the onset of occupational disease are invariably based on data and events that are now from years in the past<sup>70</sup>. Sometimes the information is one or more decades old. Furthermore, the success of any intervention aimed at prevention will not be known for years to come.

This may also present something of an ethical dilemma for those involved in occupational surveillance. It is obviously ethically appropriate to minimise exposure to known hazards. However, for suspected hazards, the situation is far less clear, since minimising exposure and associated impacts, such as on cost, may be unjustified. Furthermore, once the exposure has been minimised, the true relationship may not be able to be measured. This indicates the need to monitor exposures, as well as diseases, since changes in exposures can result in a more rapid prevention response.

A related concern involves privacy when monitoring exposures. The most effective method of monitoring exposures is at the level of the individual, although it is also possible, but less desirable, to conduct monitoring at the level of the industry, workplace, or occupational group. The problem is that it is the total or cumulative exposure that most commonly leads to risk of developing an occupational disease (e.g. cumulative radiation levels in workers exposed to ionising radiation), and, as noted, this may occur over a long period during which the individual will typically move from one job to another. This means that the occupational surveillance system may need some way of tracking the individual from one workplace to the next.

Any data system for occupational surveillance relies on case definition criteria to identify and classify cases. Establishing the presence of a disease in an individual can be difficult, and the diagnosis of occupational diseases may be imprecise and sometimes controversial<sup>55, 71-73</sup>. This is especially true for the cluster of “syndromes” that are assumed by some to be work-related, while others contest that a causal relationship exists. These include problems such as fibromyalgia syndrome (FMS), post-concussion syndrome (PCS), chronic fatigue syndrome (CFS, ME, etc), occupational overuse syndromes (OOS and multiple nomenclature variants such as RSI, CTD, etc), facet syndrome, carpal tunnel syndrome (CTS), stress, and whiplash syndrome, to list but a few.

A large part of the problem in making individual diagnoses is that subtle changes in levels of function, at the level of either the organ or the whole person, may not manifest as significantly at variance from the normal parameters observed in the wider population. An important change within an individual may not appear abnormal when compared to the wide variations between individuals in the population as a whole. Repeated measures within an individual would reveal such a change, but often the first opportunity to take measures will not occur until that person presents to a healthcare setting. In an ideal world, all relevant exposures would be measured before they commenced and would be repeated at regular intervals. However, the high cost of regularly taking an array of baseline measures for each individual cannot be justified without some rationale as to what measures to take.

Once an occupational surveillance system is established, it is always hoped that the data collected will allow for the avoidance of an epidemic or work-related disease, however, this does not often happen in the real world<sup>74</sup>. Historical examples, such as lung cancer and mesothelioma due to asbestos exposure, raise an unpleasant spectre. Epidemiologists may wish that they will be able to identify exposure-disease relationships through excellent vigilance, but this is invariably unlikely due to the long latency periods already discussed. In practice, vast amounts of baseline data with regular repeated measures in huge cohorts of workers would be needed in order to generate a system sensitive enough to yield sufficiently high positive predictive value<sup>57</sup>. Without this, effective prevention cannot happen. The unfortunate reality is that workers have to be exposed to hazards before

surveillance systems can gather sufficient data to sound alarm bells<sup>75</sup>. This has implications for what a surveillance system can achieve in practice, even when it is very well designed and operated.

Some sources of data may inadvertently deliver inaccurate or inappropriate information to a surveillance system<sup>76</sup>. Data on cases may be collected and used for entirely different purposes<sup>77</sup>. The most common are for administrative or financial reasons, such as payment of benefits or compensation. This happens in both the government welfare and the insurance sectors. However, the case definitions may be at considerable variance from those that are relevant to occupational surveillance. This may happen because the organisation in question has adopted policies for pragmatic administrative purposes. For example, an insurer may decide to accept all claims for cancer without question, or a social welfare department may decide to reject all cases of occupational stress. Administrative reasons may vary from accepting all claims because it is cheaper than contesting some, through to rejecting all initial applications so as to provide a hurdle for cost-containment purposes. Whatever the reason, this data no longer provides a true representation of actual cases of the disease under consideration.

Systemic disincentives, sometimes perversely, may discourage organisations or industries from establishing comprehensive surveillance systems. This might occur when it is perceived, rightly or wrongly, that the surveillance system will increase the probability of higher costs or greater liability for work-related diseases or injuries.

#### **2.4 ISSUES SPECIFIC TO OCCUPATIONAL INJURIES**

Data on occupational accidents is not available from all countries in the world. Furthermore, under-reporting, limited coverage by reporting and compensation schemes, and non-harmonised accident recording and notification systems undermine efforts to obtain world-wide information on occupational accidents<sup>1, 78</sup>. Most existing injury surveillance systems could probably be enhanced through improving the definition of populations at risk, hazard monitoring, injury process and event coding, reporting of health outcomes, analysing causal factors, expanding the coverage of fatality monitoring, and developing better intervention strategies and evaluation techniques<sup>79, 80</sup>.

#### **2.5 USES AND LIMITATIONS OF SURVEILLANCE SYSTEMS**

Surveillance systems describe where occupational injuries or illnesses are occurring, how frequent they are, whether they are increasing or decreasing, and whether our prevention efforts have been effective<sup>81</sup>. A general improvement in the range and usefulness of the statistical information base on occupational injuries and disease has occurred since the 1990s<sup>82</sup>.

The most common consumers of surveillance system information are public health workers, government officials, data providers, and clinicians<sup>83</sup>. The public health community tends to rely on surveillance information to set research and prevention priorities, but any critical gaps in existing systems might limit their usefulness. It is clear that many of these systems do need to be updated and expanded, and new systems and methodologies need to be developed. Data from these systems may then effectively contribute to the recognition and elimination of work-related morbidity and mortality.

The prevention of occupational disease and injury depends on the implementation of a variety of activities, including testing chemicals and tools before they are introduced into commerce, using engineering controls and personal protective equipment to limit exposures, and providing early diagnosis and effective therapy of injured

or ill workers to minimise disability when preventive measures have failed. Surveillance is the key to this system. Occupational safety and health surveillance systems collect, analyse, and disseminate relevant information about hazards found in the workplace, as well as about work-related diseases and injuries. Surveillance systems identify where the problems are and are not, how frequent the problems are, whether they are increasing or decreasing, and whether prevention efforts have been effective. The public health and occupational health communities rely on surveillance information to set priorities for prevention. Although there has been substantial progress in the last decade in development and field-testing of new data collection systems for occupational disease and injury surveillance, much remains to be done. Methods and systems for hazard surveillance are much less well developed.

A recurring problem has been the availability of robust statistical data on specific health and safety issues, particularly for work-related illness, at the level of particular sectors of the economy<sup>84</sup>. Large population-based surveys identify relatively small numbers of cases of interest for further analysis, and other sources of data are not as comprehensive in their coverage of hazards and risks. In virtually all individual cases of ill health, there is a question of the precise ascription of cause to the workplace or some other cause. The changing perceptions of the role of work in causing illness will influence the reporting of work-related cases, further complicating the assessment of trends.

Injuries and illness are relatively uncommon and may be susceptible to reporting biases, but other facets of the relationship between work and health affect all workers. Everyone at work is exposed to the prevailing health and safety climate in their workplace, and the proportion potentially exposed to particular hazards will usually be many more than the number who actually suffer an adverse consequence. Measuring precursors of adverse health and safety outcomes has statistical advantages in the sense that surveys of a particular size will generally provide more information to analyse by sector and other factors such as age, sex, geographical region, nature of employer/employee relationship, and company size.

In the context of the multifactorial diseases such as mental illness, musculoskeletal disorders, cancer, and asthma, measures of the prevalence of workplace precursors have the major added advantage of being more closely related to the workplace factors that can be influenced for the better. They can therefore present new and better opportunities for developing and monitoring policies and interventions, though they do not obviate the need for data on work-related injuries and illnesses themselves.

Surveillance systems may be used to identify indicators of occupational health and to generate profiles that may be compared<sup>85</sup>. Indicators are pointers that simplify phenomena and help to understand and monitor complex realities. An indicator can be generic, e.g. “noise”. A generic indicator indicates a subject of interest that needs to be assessed and monitored, although it may still lack operational definitions. A generic indicator can be operationalised in many ways, e.g. “prevalence of noise-induced hearing loss”. Indicators can be qualitative or quantitative, and sometimes the difference is not clear. Qualitative indicators are based on perceptions such as subjective assessments of the performance of occupational health services. In the beginning, quantitative indicators were more used, but now qualitative indicators are perhaps used even more often than quantitative indicators. To put too much emphasis on the scientific validity of an indicator may be counterproductive. It may discourage the development and use of indicators that are needed, but cannot fulfil the strict quality criteria. An indicator should be allowed to be an approximate indication or a “sign”. The indicator can be leading or lagging. An example of a lagging indicator is a health outcome indicator revealing exposure that has happened earlier. Quite appropriately, the current trend is toward leading indicators in order to prevent things.

Profiles are concise subject descriptions that usually also include quantitative indicators. A profile is more than a set of indicators, although it usually also includes quantitative and qualitative indicators. The purpose of a profile is to provide the professionals, administrators, and other actors with reasonable perception and awareness in an appropriate context.

Profiles and indicators of occupational health and safety can be used to describe states of affairs, provide early signals for problems in the workplace, monitor trends, assess the effectiveness of programmes, and present a baseline against which progress is measured<sup>86-91</sup>. A profile can be qualitative by nature, without complete scientific exactness.

Policy relevance is important, by linking the society interests and the profile together. Data on occupational health and safety indicators, such as work injuries and occupational diseases, are collected in some form in nearly every country, but comparisons across countries are difficult because of differences in legislation, criteria, and reporting systems. Sub-national profiles (province, district, etc) enable comparisons between different geographical areas or population segments. The major strength of a sub-national approach is that contextual parameters (culture, language, legislation, administrative procedures) usually are similar, unlike when comparing different countries. Profiles increase transparency and visibility of occupational health and safety and provide insights into the complexity of the affairs, priorities, and needs of countries.

## **2.6 OCCUPATIONAL SURVEILLANCE METHODS**

There are a number of potential sources of data for surveillance systems<sup>92</sup>. These include employers, workers, medical practitioners and other health workers, interested organisations such as trade unions or employee groups, government departments or organisations, and private sector groups such as insurers. Data can be collected at the level of the enterprise, the industry, a region, or for an entire nation<sup>56, 93-112</sup>.

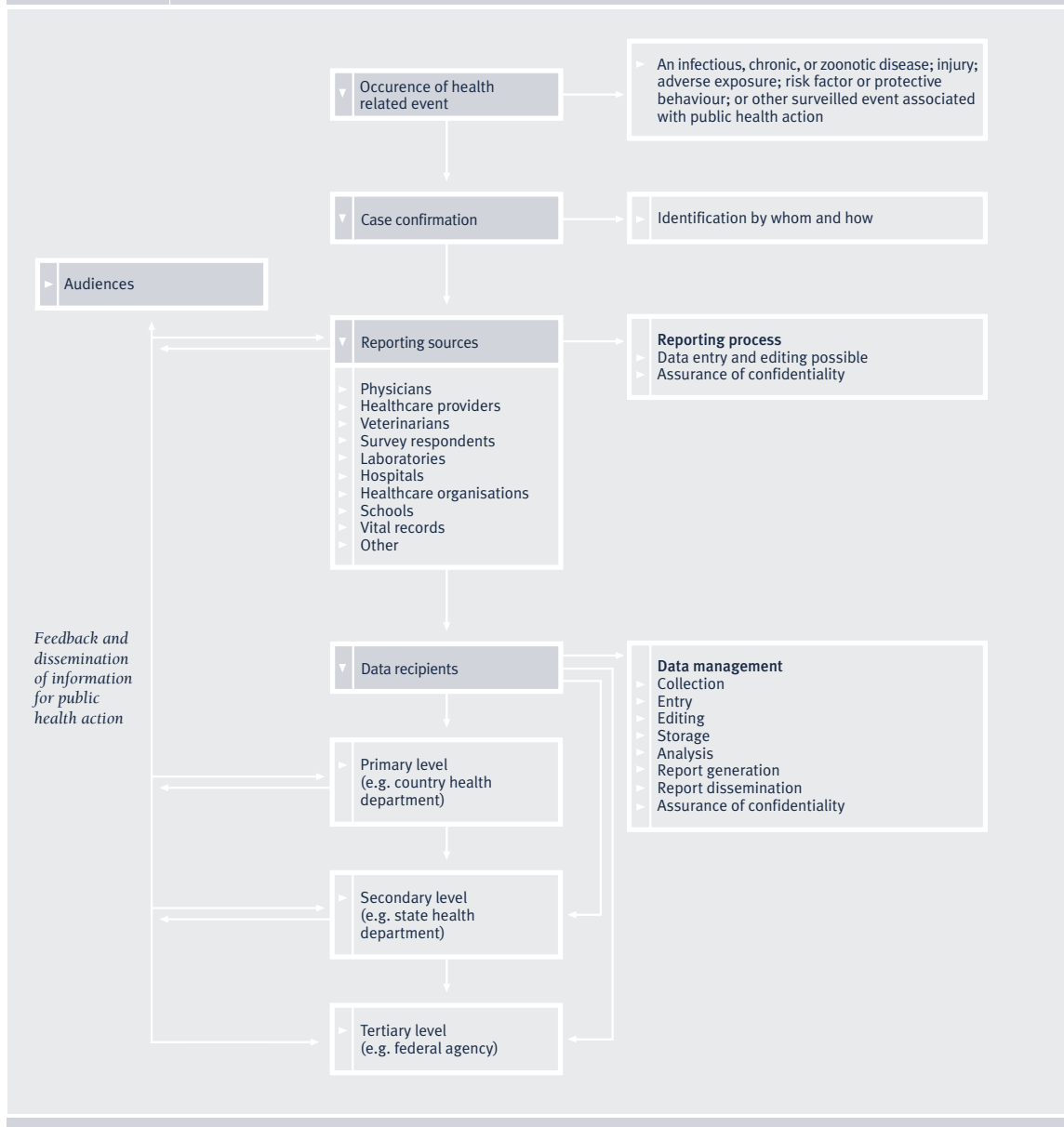
It seems that most surveillance systems originally arose somewhat opportunistically when it became practical to acquire potentially relevant data. In the first instance, this occurred when a system was established to collect data for administrative or financial purposes.

These are “data-driven” models of surveillance. They have singular strength in as much that they are feasible. Data can be obtained. However, they are fundamentally weak because the data may be incomplete and may lack relevance and basic reliability (e.g. inexpert coding by clerical staff).

The following figure illustrates a simplified flow chart for a generic surveillance system<sup>113</sup>. This model is linear and static and exemplifies a data-driven surveillance system.

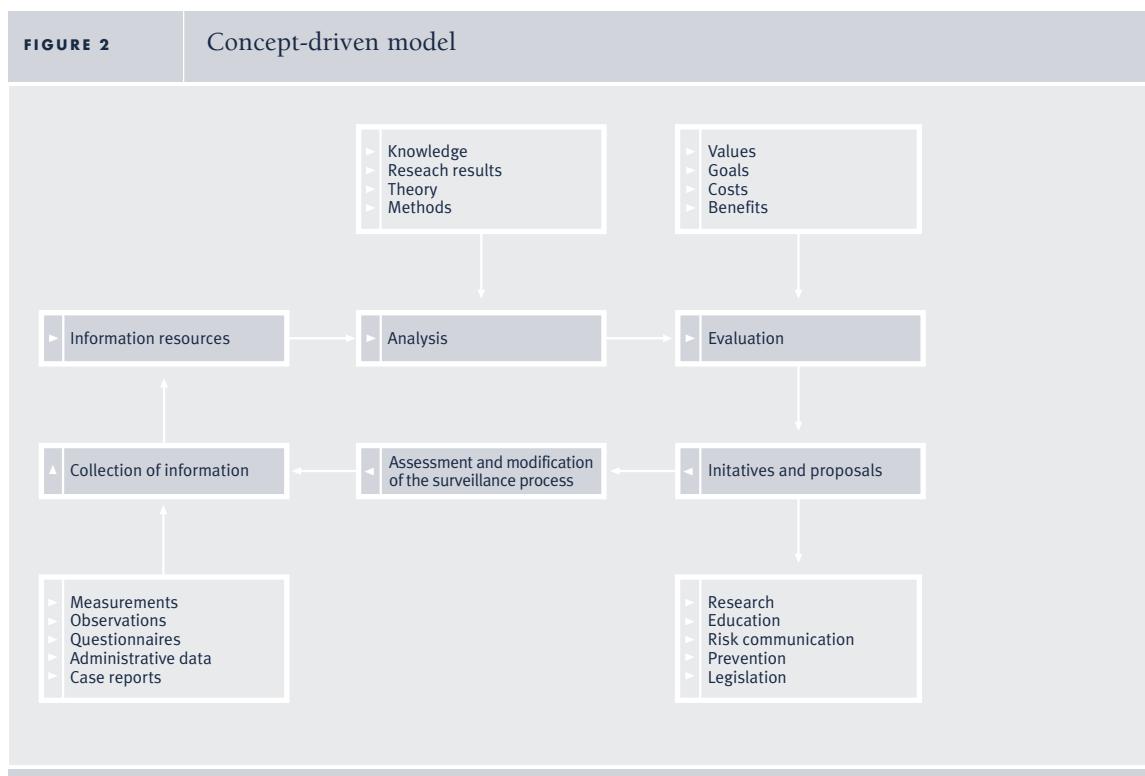
**FIGURE 1**

**Data-driven model**



By contrast, it is also possible to implement “concept-driven” surveillance systems. These are established on sound theoretical grounds, collecting just the right data that is sensitive and specific, and the system is solidly relevant to the types of questions posed by policy makers<sup>21</sup>. Concept-driven indicators are developed based on a conceptual framework irrespective of the availability of data. Theory determines an ideal set of indicators, which then are operationalised and measured. Concept-driven indicators are primarily science-based and valid, whereas data-driven are primarily feasible. An approach of theoretically and methodologically well-grounded indicators was adopted in the development of European social indicators<sup>114</sup>.

The following figure illustrates a concept-driven model<sup>21, 115</sup>. The surveillance process starts with data collection from various sources (registers, administrative sources, questionnaire-based surveys, expert assessment systems, etc.). The data is computerised, analysed statistically (e.g. displayed in tabular or graphical forms, providing distributions, time trends, means, or other statistics). Indicators are one method to present the state of occupational health and safety in a country or region. The data analysis phase is often followed by the interpretation and evaluation of the significance of findings carried out by experts familiar with the subject matter. The process continues into decision-making on direct prevention, dissemination of information, training, research, and other relevant activities. Because the resources for surveillance are limited as compared to the extent of the field, the approaches and methods applied are regularly assessed and modified before the next data collection. Ideally, the surveillance process is a loop that moves continuously to a more informative and cost-effective direction.



It is clear that the resources required for doing surveillance well should not be underestimated.

The major surveillance methods include the following:

- Mandatory disease or injury reporting by healthcare providers or facilities.
- Mandatory disease or injury reporting by employers or workplaces.
- Reports by laboratories.
- Sentinel surveillance.
- Periodic or ongoing prevalence surveys.
- Vital records.
- Secondary analysis of data sets collected for other purposes.
- Expert opinion.
- Mixed systems.

### **Mandatory disease or injury reporting by healthcare providers or facilities**

This is perhaps the oldest and most traditional approach. It tends to be more relevant for occupational disease than injury. The major strength is that it is based in an expert system, using clinicians to recognise specific diseases or injuries. The major weakness is low compliance. The proportion of cases that are reported may vary widely, but, in practice, most organisations operating a mandatory reporting system report very disappointing levels of compliance. There is frequently a problem of perception about why, and for whom, the data is being collected. Whether correct or not, many clinicians perceive that the primary function of surveillance systems is to enforce occupational health and safety legislation. There is also widespread cynicism that the data is actually used for any benefit. This gives healthcare providers little incentive to participate. Some organisations have tried to improve compliance by offering payments of small fees, however, this seems to be met with mixed success. It is worth noting that the more severe the disease or injury is, the more likely it is to be reported. Case definition may be influenced by the fact that clinicians tend to provide diagnoses and not necessarily highly specific information (e.g. the heavy metal or virus). Nevertheless, this type of surveillance alerts public health authorities to potential problems, especially when they manifest as a severe disease.

### **Mandatory disease or injury reporting by employers or workplaces**

This is a variation on the first approach, but uses employers or workplaces as the target for mandatory reporters. It tends to be more relevant to cases of occupational injury than diseases that may not be recognised by non-clinicians. The major strength is that the employer or workplace should have the best knowledge that an accident has occurred with injury. Most workplaces are required to maintain some form of accident record anyway. The major weakness is that it is perceived as having punitive results for the employer, namely, a visit from an inspector, if the accident was serious enough, and the potential for some form of sanction. It is worth noting that small and medium employers have much lower rates of compliance with reporting, and the self-employed tend to have even lower rates still. Again, this is likely to be due to the perception that only negative consequences might ensue, and there is no perception that it may be worthwhile.

### **Reports by laboratories**

Laboratories are usually highly compliant with reporting results, far more so than healthcare providers. This might be, at least in part, since they are set up to report results as their standard modus operandi. This means that the greatest strength, along with accurate identification of diagnosis and causes, is a high capture rate, but this is only for the population referred for laboratory testing. Hence, the greatest weakness is that this type of surveillance system is very limited in detecting meaningful problems in the wider population. In developing countries, diagnostic accuracy may be much lower, and the ability to communicate with other laboratories may be limited. However, in developed countries, pooling of surveillance findings from laboratories is an added strength, since this increases the chances of detecting potential problems while they are still at the stage of having small base rates.

### **Sentinel surveillance**

A sample of reporters, such as clinicians, laboratories and hospitals, are used in sentinel surveillance. This can be effective when the goal is to estimate the magnitude and trends of a disease or injury. It is less effective in detecting the earliest cases, or providing data on the entire population of cases. By focusing on a specific sample of reporters, the system has a good chance of obtaining accurate and higher-quality information. Sentinel surveillance systems should be sensitive enough to detect more common diseases, but may lack sensitivity to detect localised outbreaks or epidemics.

### **Periodic or ongoing prevalence surveys**

These can be used to assess prevalence trends over time and to help “fill the gaps” left by other types of surveillance systems, e.g. those that have low compliance for reporting. The major strengths of these surveys are as complementary approaches and when designed specifically to meet the needs of groups responsible for policy

formulation. They are able to help generate hypotheses and can also be used to evaluate the effectiveness of public health or occupational health and safety interventions.

### **Vital records**

This type of surveillance system uses records such as births and deaths to estimate the magnitude of certain diseases or injuries. It may be an under-used system. The major strength is the ability to track trends and help set priorities. The major weakness is that it is not suitable for less severe disease or injury.

### **Secondary analysis of data sets collected for other purposes**

Data are collected for myriad reasons by a host of agencies. The major advantage is that there are little or no extra resources required. However, data protection and privacy issues may be a problem.

### **Expert opinion**

When data is lacking, expert opinion may fill a vital role. It can be useful in generating hypotheses. However, it is known to be subject to systematic biases and current “fads” in both theory and practice, hence, it needs to be used with caution, but may be invaluable in the short term under certain circumstances.

### **Mixed systems**

Comprehensive modern surveillance systems usually deploy a mixture of the above techniques, in order to exploit the advantages of more than one approach and try to compensate for the weaknesses of others. The major strength of a mixed system is that it can be more comprehensive. However, the potential weakness is that it requires careful planning, design, implementation, and analysis.

## **2.7 EVALUATING SURVEILLANCE SYSTEMS**

To date, evaluation of surveillance systems has been limited in scope and content<sup>112, 113, 116</sup>. Perhaps this is because surveillance systems are generally considered as beneficent, with the potential to detect and prevent major outbreaks of occupational diseases or injuries. However, the question “Do these systems deliver?” needs to be answered.

The starting point for evaluating surveillance systems involves the key content of that system, namely, the data. Issues that need to be considered include the range of indicators included, methods for gathering data, and intended use of the data.

The attributes of good quality surveillance systems include sensitivity, specificity, representativeness, timeliness, simplicity, flexibility, and acceptability<sup>116</sup>. The sensitivity of a surveillance system is its ability to detect health events (completeness of reporting). Its specificity is inversely proportional to the number of false positives it reports. Reports of a disease that do not meet the case definition are false positives and may result in resources being wasted in investigating them. However, in circumstances where it is extremely important not to miss a single true case, a certain level of false positives may be acceptable. Representativeness can be measured by comparing surveillance data covering part of the population to either nationwide data, where available, or to random sample-survey data. A source may be representative for one particular disease or condition but not for another. Representativeness involves such factors as age, sex, ethnic group, socioeconomic status, and residence. Timeliness involves not only the interval between the occurrence of the event and the receipt of the report at the health agency, but also the time subsequently required for identifying a problem or epidemic and the initiation of control measures. Timeliness is relative to the event concerned; for example, for most infectious diseases, the response should be made in a matter of days, whereas for cancer surveillance, annual reporting may be adequate. Simplicity in a system means it is easy to understand and implement, and is therefore usually relatively cheap and flexible. A flexible system is easily adapted by adding new notifiable diseases or conditions or extending it to

additional population groups. However, care should be taken that the reporting burden is not thereby increased to an unacceptable level, leading to loss of data quality or timeliness. The acceptability of a system depends on the perceived public health importance of the event under surveillance, recognition of the contribution of individuals to the system, and the time required to make the reports. The surveillance method must be acceptable not only to the collectors of the data, for the reasons just mentioned, but also to the providers (both ill and well persons) in terms of confidentiality and cultural sensitivities. Thus, acceptability can be measured by the proportion of persons asked who actually complete a questionnaire. The attributes of surveillance discussed are interdependent. Increasing the sensitivity of a system to detect a greater proportion of a health event may improve representativeness and usefulness, but also increase the cost and lead to the reporting of more false positives. Paradoxically, the less frequent the event, the more expensive it may be to keep under surveillance.

Comprehensive cost data is difficult to collect. The cost of a system includes indirect as well as direct costs and ideally should be measured in relation to the benefits obtained, such as reduction of medical-care expenses and of time lost from work. Ideally, all elements of the system should be included in the cost: data collection, analysis, and dissemination.

The evaluation method used for this review needs to be an organised approach to the evaluation of epidemiological surveillance systems. The ultimate utility of a surveillance system is measured by whether it leads to prevention, control, or a better understanding of adverse health events. This measure could be qualitative, in terms of the subjective views of those using the system, or quantitative in terms of the impact of surveillance data on policies, interventions, or the occurrence of a health event.

Established surveillance systems should be regularly reviewed on the basis of explicit criteria of usefulness, cost, and quality; systems should be modified as a result of such review.

A report completed for the Nordic Council of Ministers (by Tüchsen) in 1998 recommended that surveillance systems be evaluated across at least six important domains<sup>21, 115</sup>. A report completed for the European Agency for Safety and Health at Work (EASHAW) in 2003 described use of a questionnaire to gather data on 23 different “OSH monitoring systems”<sup>117</sup>. This covered seven domains. A comparison of these two approaches is made in the following table:

TABLE 1		OSH monitoring systems	
TÜCHSEN <sup>21, 115</sup>		EASHAW <sup>117</sup>	
Collection of information		Basic information	
Information resources		Contents of the system	
Analysis		Methodology	
Evaluation		Internal use/aim of system	
Initiatives and proposals		External use of system	
Assessment and modification of the surveillance process		Costs of system	
		Future of system	

There are many similarities in the domains covered, with considerable overlap. However, the EASHAW approach reflects an essentially data-driven model for evaluating surveillance/monitoring systems, whereas the Nordic approach assumes more of a concept-driven model.

It is not possible to present a US column in this table for comparison, since it seems they have yet to devise a “joined-up” attempt at evaluation of surveillance systems. This is reflected in the standard array of relevant NIOSH publications that provide descriptions of systems, with minimal analysis or critical comparison<sup>19, 20, 118-124</sup>.

The CDC in the US issued guidelines for evaluating surveillance systems in 1988<sup>15</sup>, and these were updated in 2004<sup>113</sup>. This evaluation approach is checklist-driven.

<b>TABLE 2</b>		<b>Checklist for Evaluating Public Health Surveillance Systems</b>
<b>TASKS FOR EVALUATING A SURVEILLANCE SYSTEM *</b>		
<b>Task A</b>	Engage the stakeholders in evaluation	
<b>Task B</b>	Describe the surveillance system to be evaluated	
	1	Describe the public health importance of the health-related event under surveillance
	a	Indices of frequency
	b	Indices of severity
	c	Disparities or inequities associated with the health-related event
	d	Costs associated with the health-related event
	e	Preventability
	f	Potential future clinical course in the absence of an intervention
	g	Public interest
	2	Describe the purpose and operation of the surveillance system
	a	Purpose and objectives of the system
	b	Planned uses of the data from the system
	c	Health-related event under surveillance, including case definition
	d	Legal authority for data collection
	e	The system resides where in organisation(s)
	f	Level of integration with other systems, if appropriate
	g	Flow chart of system
	h	Components of system
	1)	Population under surveillance
	2)	Period of time of data collection
	3)	Data collection
	4)	Reporting sources of data
	5)	Data management
	6)	Data analysis and dissemination
	7)	Patient privacy, data confidentiality, and system security
	8)	Records management programme
	3	Describe the resources used to operate the surveillance system
	a	Funding source(s)
	b	Personal requirements
	c	Other resources
<b>Task C</b>	Focus the evaluation design	
	1	Determine the specific purpose of the evaluation
	2	Identify stakeholders who will receive the findings and recommendations of the evaluations
	3	Consider what will be done with the information generated from the evaluation
	4	Specify the questions that will be answered by the evaluation
	5	Determine standards for assessing the performance of the system
<b>Task D</b>	Gather credible evidence regarding the performance of the surveillance system	
	1.	Indicate the level of usefulness
	2.	Describe each system attribute
	a	Simplicity
	b	Flexibility
	c	Data quality
	d	Acceptability
	e	Sensitivity
	f	Predictive value positive
	g	Representativeness
	h	Timeliness
	i	Stability
<b>Task E</b>	Justify and state conclusions and make recommendations	
<b>Task F</b>	Ensure use of evaluation findings and share lessons learned	
* Adapted from Framework for Program Evaluation in Public Health [CDC, Framework for program evaluation in public health. MMWR 1999.48 (RR-11)] and the original guidelines [CDC, Guidelines for evaluating surveillance systems. MMWR 1988.37 (No. S-5)].		

For the purposes of the current review, a semi-structured interview and checklist was synthesised from the CDC, EASHAW, and Tüchsen approaches.

## 2.8 SYSTEMS TO RATE STRENGTH OF SCIENTIFIC EVIDENCE

Decisions are increasingly being made on research-based evidence, rather than on expert opinion or practical experience alone, and this is a compelling improvement in policy development. Not all evidence is equal, and therefore a number of classification systems have been devised to categorise the “level” or strength of evidence<sup>125-128</sup>.

The most rigorous method of compiling an evidence base is to conduct a systematic review<sup>126, 129, 130</sup>. This is a method of identifying all relevant evidence with a high likelihood that important information is not overlooked, and then grading it for quality into a pre-determined hierarchy. This means that the evidence under review is rated according to its “strength”.

Systematic reviews therefore represent a rigorous method of compiling scientific evidence to answer questions regarding important questions about treatment, diagnosis, and preventive services. Traditional opinion-based narrative reviews and systematic reviews differ in several ways. Systematic reviews (and evidence-based technology assessments) attempt to minimise bias by the comprehensiveness and reproducibility of the search for and selection of articles for review. They also typically assess the methodologic quality of the included studies (i.e. how well the study was designed, conducted, and analysed) and evaluate the overall strength of that body of evidence. Thus, systematic reviews and technology assessments increasingly form the basis for making individual and policy-level health care decisions.

Determining the level of evidence provides a basis for grading the strength of a recommendation. This, in turn, adds to the confidence, or lack thereof, in the recommendations<sup>5</sup>.

It was intended to apply the principles of evidence grading to the surveillance systems under review. However, the available information on surveillance systems is largely unpublished, and what little peer-reviewed literature is published tends to assume that the data used in that particular study is based on a reliable and valid surveillance system. This finding is disturbing.

In fact, little if any data is available on the completeness of data sets in current surveillance systems. Moreover, even less information is available on the reliability of that data. Given that a system cannot be valid unless it is reliable, this gives cause for considerable concern regarding the basis for making useful decisions on prevention initiatives.

As a result of this, the reviewer had to pragmatically adopt a simpler rating system of the surveillance systems considered.

There are two global questions about surveillance systems that subsume many of the other issues. The first is, “How well does the surveillance system capture the important information?” In effect, this question covers an array of others. For a surveillance system to perform well in this area, it needs to be well constructed and based on sound theoretical principles, as well as capable of performing in the real world. Ultimately, a surveillance system can only be as good as the information it is able to capture. However, this must be placed in a proper context, that is, the surveillance system should have a clear theoretical basis. Its strengths and weaknesses should be understood. It needs to be integrated into the workplace, healthcare, and the compensation and benefit systems. “Harmonisation” of data with other systems, or within regions or national boundaries, allows comparisons to be made, that is, it is not just the amount of data that is captured, but also the quality of that information.

The second pivotal question is, “How useful is the surveillance system for prevention?” Ultimately, the utility of a surveillance system does rest on its ability to inform us of problems that might be prevented, or at least better managed. Clearly, the utility of a surveillance system is dependent on the quality and quantity of data capture. This means that the rating for “utility” is unlikely to ever be higher than the rating for “data capture”. Again, this question incorporates a host of others. It refers heavily to the context of the surveillance system and its ability to integrate with any potential prevention system. It also covers issues of sensitivity, specificity, representativeness, timeliness, simplicity, flexibility, and acceptability.



SECTION THREE

REVIEW

# METHODOLOGY



The Review involved two main strategies. The first was a literature review described below. The second was a direct survey of suitable surveillance systems. The final utility of the survey was dependent on the ability to make realistic comparisons between systems on important variables. Ideally this would have been conducted on the basis of the strength of scientific evidence. However, as described above, this method had to be modified into a simpler rating system for pragmatic reasons.

For the purposes of the current review, a semi-structured interview and checklist was synthesised from the CDC, EASHAW, and Tüchsen approaches. The results of this and a summary of available descriptive material were summarised. The data collection framework was as follows:

#### SEMI-STRUCTURED INTERVIEW

<b>1. System description and overview</b>
<b>2. Information collection</b>
<b>3. Content of system</b>
<b>4. Method</b>
<b>5. Information resources</b>
<b>6. Costs</b>
<b>7. Analysis</b>
<b>8. Evaluation</b>
<b>9. Use, derivations</b>
<b>10. System improvement</b>

#### 1. System description and overview

Date established  
 Organisation/institute/owner/operator  
 (all relevant)  
 System resides where in organisation  
 Funding sources (with relevant details)  
 Personnel requirements to operate system  
 Target group/population

- Describe occupational health importance
- Describe occupational injury importance

Scope of the system (all that apply)

- National
- Regional
- Local (community)
- Enterprise

Date of significant modification(s), if any

#### 2. Information collection

Method(s), describe all measures observations, data sources, questionnaires, surveys, etc

- Documentation
- Data collection

Overall information system

- Well-structured

- Holistic
- Maps to policy
- Country profile possible

#### 3. Content of system

Conceptual model and definitions  
 Clear aims/goals  
 Occupational disease  
 Occupational injury  
 Concept-driven (explain)  
 Data-driven (explain)  
 Indicators used  
 Disability adjusted life year (DALY), if collected

- Method to calculate
- Cost of disability estimated
- Indices
  - Frequency
  - Severity
  - Costs associated with health/injury event

Relevance of indicators

- Health
- Prevention
- Work ability
- Wellbeing of workforce

- Planning
- Implementation of occupational health programmes
- Evaluation of occupational health programmes

#### Choice of indicators

- Comprehensive range
- Validity
- Objectivity
- Sensitivity (to change)
- Specificity (reflects changes only in situation/ phenomenon concerned)
- Priorities, e.g.
  - Stress, overload and pace of work, psychological factors, workplace relations and management
  - Problems caused by aging workforce, maintaining ability to work
  - Right-to-know, right to be informed, hazard communication
  - Chemical substances, carcinogens, asbestos
  - Ergonomics, repetitive work and musculoskeletal problems
  - Organisational issues and safety and health (quality) management issues
  - Preventive occupational health services, health promotion
  - New technologies
- Policy aims, relevance, e.g.
  - Directly related to specific question
  - Related to conditions that are amenable to action
  - Easily understood and applicable to potential users
  - Available soon after the event or period to which it relates
  - Based on data available at acceptable cost-benefit ratio
  - Selective, to help prioritise key issues in need of action
  - Acceptable to stakeholders

#### Health surveillance

- Mortality
- Work disability/ability
- Occupational diseases
- Occupational injuries
- Other work-related diseases
- Work absenteeism

- Occurrence of symptoms
- Lifestyle factors

#### Work environment surveillance

- Sanitary conditions
- Occupational hygiene conditions
- Work organisation
- Collective protective equipment
- Personal protective equipment
- Exposure to hazardous agents
- Control systems designed to reduce/eliminate hazardous agents

#### Worker health

- Ergonomics
- Accident prevention
- Disease prevention
- Occupational hygiene in the workplace
- Work organisation
- Workplace psychosocial

#### Exposure indicators (describe working conditions)

- Refer to working conditions and cover the major determinants of OH&S outcomes

#### Effect indicators (describe health outcomes)

- Refer to all OH&S outcomes

#### Prerequisite indicators (describe OH&S policy and infrastructure)

- Most important factors required for successful performance of national OH&S systems, e.g. quality of legislation, coverage of OH&S, characteristics of occupational health service system and safety inspection system, etc
- State of OH&S policy and infrastructure also has an effect on the availability and quality of exposure indicators and effect indicators

#### Priority hazards

- Physical agents
  - Noise
  - Ionising radiation
  - Vibration
- Chemical agents
  - Noise
  - Asbestos
  - Chemical agents (general)
  - Lead
  - Carcinogens
- Safety
  - Machine safety
  - Risk of falling
  - Electrical risks

- Psychosocial risks
  - Stress
- Ergonomic risks
  - Physical strain/manual handling

#### 4. Method

Source of data/indicators

- Systematic
- Ongoing
- Analysable/interpretable (distributions, time trends, means, variability)
- Administrative
- Questionnaire-based surveys
- Expert assessment systems

Describe population and/or sample

Active versus passive notification

Periodicity

Coverage (country/region/company)

Data management, storage

Data collection capacity

- Time required for data collection
- Data processing
- Data publishing

Privacy, confidentiality, data protection, security

#### 5. Information resources

Data “warehouse”

Access, who can use

Sub-group specific indicators

#### 6. Costs

Cost information collected

Cost of data

- Collection
- Analysing
- Publishing

Who pays

#### 7. Analysis

Capacity for analysis and dissemination

Methods to detect/estimate

- Under-reporting
- Over-reporting

Methods to overcome

Reliability data

Validity data

Research results

- Reports
- Reviews
- Publications, presentations

#### 8. Evaluation

Outline, description

- Specific purpose(s)
- Stakeholders who receive findings/recommendations

Relevant to

- Values
- Goals
- Costs
- Benefits

Data facilitates

- Priority setting

Data available

- External use
- Secondary analysis

#### 9. Use, derivations

Initiatives and proposals (generated/initiated)

- Research (agenda)
- Education
- Prevention
- Risk communication
- Legislation

Evaluation of effectiveness of policies/actions/campaigns

#### 10. System improvement

Process for assessing performance of system

Plans for improvement/modification

What are opinions of stakeholders/interested parties (e.g. government departments, unions, employer groups)

#### FURTHER INFORMATION

Describe/outline any further information that is relevant

SECTION FOUR

LITERATURE

# REVIEW



A literature search using multiple databases was undertaken, including the following: CISILO, EMBASE, HAPI, HSELINE, MEDLINE, Medline Daily Update, Medline Pending, OSHLINE & NIOSHTIC, and PsycINFO.

- CISILO – International occupational health and safety literature. Database is maintained by the International Occupational Safety and Health Information Centre in Geneva.
- EMBASE – A major biomedical and pharmaceutical database indexing over 3,500 international journals in the following fields: drug research, pharmacology, pharmaceuticals, toxicology, clinical and experimental human medicine, health policy and management, public health, occupational health, environmental health, drug dependence and abuse, psychiatry, forensic medicine, and biomedical engineering/instrumentation. There is selective coverage for nursing, dentistry, veterinary medicine, psychology, and alternative medicine. EMBASE is one of the most widely used biomedical and pharmaceutical databases because of its currency and in-depth indexing.
- HAPI – Health and Psychosocial Instruments provides ready access to information on measurement instruments (i.e. questionnaires, interview schedules, checklists, index measures, coding schemes/manuals, rating scales, projective techniques, vignettes/scenarios, tests) in the health fields, psychosocial sciences, organisational behaviour, and library and information science.
- HSELINE – Abstracts to worldwide literature on occupational safety and health. Includes coverage of all UK Health and Safety Commission (HSC) and Health and Safety Executive (HSE) publications as well as a wide range of periodicals, books, conference proceedings, reports, and legislation. Database is maintained by the Health and Safety Executive, London.
- MEDLINE (including MEDLINE DAILY UPDATE, and MEDLINE PENDING) – The United States National Library of Medicine’s premier bibliographic database. It contains bibliographic citations and author abstracts from more than 4,600 biomedical journals published in the United States and in 70 other countries. The database contains well over 12 million citations dating back to the mid-1960s, including more than 130,000 population-related journal citations (unique to the former POPLINE® database) that were added to MEDLINE in October of 2002. Although coverage is worldwide, most records are derived from English-language sources or have English abstracts. Abstracts are included for more than 75% of the records, which enhances efficient article selection.
- OSHLINE and NIOSHTIC – Provides coverage of documents, articles, reports and publications on occupational health and safety as well as related fields spanning over 100 years. The database is maintained by OSHA.
- PsycINFO – Contains citations and summaries of journal articles, book chapters, books, dissertations, and technical reports, all in the field of psychology and the psychological aspects of related disciplines, such as medicine, psychiatry, nursing, sociology, education, pharmacology, physiology, linguistics, anthropology, business, and law.

The search yielded 2,731 unique references that were hand searched for relevance.

The literature on surveillance systems is moderately large, but of highly variable quality. It is not unusual for a reviewer to observe this<sup>131, 132</sup>. In large part, this reflects the fashion to publish descriptive articles – “What I do in my practice” – rather than to address the fundamental questions of proof of reliability and validity, or true efficacy of that practice. Ideally, all surveillance systems could be assessed according to a set of *a priori* criteria. The relevant attributes of quality should likely include (i) sensitivity, (ii) specificity, (iii) representativeness, (iv) timeliness, (v) simplicity, (vi) flexibility and (vii) acceptability<sup>116</sup>. However, the available literature is almost unremitting in its silence on these topics.

The need for standardisation, or “harmonisation”, between surveillance systems has long been advocated<sup>91</sup>. However, limited progress has so far been made<sup>133-135</sup>.

Surveillance systems have been developed that attempt to capture national information across all types of populations and workplaces<sup>48, 136</sup>. Most are a patchwork of data sources that have arisen opportunistically<sup>137</sup>. The majority of the data comes from records, such as medical and employer records, which are of variable quality. Data on exposure to injury hazards is invariably nonexistent, although it would add substantially to the arsenal of tools in identifying high-risk workplaces.

They have also been developed with the goal of collaborating between countries<sup>133, 134</sup>. However, this is frequently problematic<sup>138</sup>. Highly-focused surveillance systems have been developed for specific problems and specific industries or enterprises<sup>139</sup>. For example, there are surveillance systems aimed at fatalities<sup>123, 140-144</sup>. Some of these deal with very specific problems, such as fatalities due to logs rolling off trucks<sup>108</sup>, or round bales of hay<sup>145</sup>, or those associated with forklifts<sup>146</sup>. Other systems have been designed to provide surveillance for specific industries, such as agriculture<sup>147, 148</sup> or construction<sup>149</sup>. There are even systems aimed at specific causes of fatalities, such as falls<sup>150-153</sup>, or electrocution<sup>154</sup>, or use of specific products such as pesticides<sup>155</sup>.

The development of sentinel surveillance systems has increased the sophistication of the overall systems<sup>156</sup>. These may be used for known potential problems, such as respiratory disease<sup>157-160</sup>, poisoning<sup>161</sup>, or influenza<sup>162</sup>. The most common approach is to use relevant healthcare providers as sentinels to report cases<sup>8, 9, 163</sup>. It is reasonable to conclude from the available data that these approaches add to the overall utility of surveillance systems<sup>164</sup>. However, data on their reliability is not available.

One of the potential uses of surveillance systems is analysis of trends<sup>12</sup>. However, this can only have utility when measurement error is minimised, with narrow confidence intervals.

Surveillance conducted by the Health and Safety Executive (HSE) in the UK has led them to conclude that injuries caused by “slips and trips” at work and at home are a leading cause of sickness absence and lost time at work. These are sometimes referred to as STF injuries – slip, trip, and fall. For this reason, they mounted a specific prevention campaign (see <http://www.hse.gov.uk/slips/>). The effectiveness of this campaign is unknown, since the surveillance system currently available in the UK (RIDDOR) is inadequate to provide any measure of change. One group of investigators attempted to discover if “slipperiness” could be isolated as a causal factor in STF injuries, from databases in the US, UK and Sweden<sup>165</sup>. However, these authors were forced to conclude that the design limitations of the surveillance systems prevented such an analysis and that this was largely due to the lack of free-text information about the circumstances surrounding the injury event.

In a related approach, a UK study attempted to determine if information about “near misses” and minor injuries in pre-school children could be used for an effective prevention programme<sup>110</sup>. However, they found that they could not distinguish between the precursors of near misses and actual injuries with the sample they had.

Surveillance systems can be successfully established within an enterprise<sup>93</sup>. However, empirical evidence of reliability and validity is very difficult to obtain in these systems, and they invariably lack predictive power due to small numbers and other problems<sup>72, 86</sup>. One issue that is particularly difficult to control for, or take into account, is the effect of staff turnover. In contrast, surveillance systems that cover large populations tend to have high positive-predictive value<sup>57</sup>.

Surveillance systems may also be established at specific points in the healthcare system, such as emergency rooms or accident and emergency departments of hospitals<sup>166, 167</sup>. Surveillance can also be drawn from injury claims<sup>168</sup>. However, both of these approaches can lead to significant under-reporting for a variety of reasons<sup>169</sup>. Outputs from these systems lack the ability to be generalised to the wider society, but may serve as useful ways to generate hypotheses worthy of further investigation.

The definition of what constitutes a “case” influences surveillance systems and may lead to variable patterns in what is observed<sup>86, 170</sup>. Even definitions of fatal work-related injuries are not standardised across countries, leading to variable estimates of incidence<sup>138</sup>. Internationally agreed standards for defining, reporting, and recording cases of occupational disease and injury are needed<sup>180</sup>.

There has been an ongoing debate about data capture methods, and it is clear that an ideal “gold standard” does not exist. Different methods of capturing data yield variable estimates<sup>171</sup>. Invariably, the problem for surveillance systems is significant under-reporting<sup>172</sup>. There are various techniques available to epidemiologists to improve data capture rates, such as the capture-recapture method<sup>159, 76, 148, 173-177</sup>. Combined measures are considered very useful. For example, combinations of hospitalisation, accident and emergency, and claims data has been used to estimate injury incidence<sup>56</sup>. Repeated measures at various time periods may also be used<sup>178</sup>. It has also been suggested that the use of user-friendly computer interfaces will enhance data capture rates<sup>23</sup>.

For example, the recording of fatalities seems straightforward enough, since it is a binary variable – dead/not dead. However, investigators have demonstrated that wide variations in capture rates are obtained using different data sources. One US study observed the following overall average capture rates from four different sources: death certificates, 81%; medical examiner records, 61%; Workers’ Compensation reports, 57%; and OSHA reports 32%<sup>140</sup>. Another U.S. study compared data from the National Institute for Occupational Safety and Health (NIOSH) National Traumatic Occupational Fatalities (NTOF) surveillance system and the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI). The NTOF uses only death certificates, while CFOI uses multiple sources for case ascertainment. It was found that the CFOI system captured a larger number of fatalities annually (the NTOF system only identified 84% of those identified by CFOI), but the additional fatalities did not follow a discernable pattern<sup>179</sup>. The same research group also investigated the relative costs of the two systems and found the CFOI to be slightly more cost-effective<sup>180</sup>. A more recent study has found consistent results, also noting that, while the magnitude of incidence is different, the overall injury mortality patterns appear to be similar between the systems<sup>37</sup>.

An Italian study investigated the reliability of fatality data over a five-year period<sup>148</sup>. The investigators checked the accuracy of three data sources, and these varied from 62% to 80%. Combining the three data sources resulted in 92% identification of cases. Therefore, this study provides empirical support for the use of combined data sources in an integrated system to generate the best estimate. An industry-based study from Shell Oil found significant differences in fatality data between the company surveillance system and a follow-up survey of terminated employees, among workers from a refinery<sup>181</sup>. These authors concluded that the surveillance system was unable to detect short-term effects of past exposures, or dose-response relationships.

Comparisons of work fatality rates between countries has also indicated the likelihood that differences in these rates may be mostly due to the different surveillance systems<sup>138</sup>. Despite these problems, occupational mortality data is generally considered as very useful in generating hypotheses and helping to set priorities, and this is a reasonable conclusion<sup>182</sup>.

Cancer registries offer a source of surveillance data, but have been found to suffer from incomplete data fields. Epidemiologists can use a number of methods of managing missing information within data sets<sup>69</sup>.

Comparisons between data capture methods are very informative, since they help to define the reliability and therefore the validity of the surveillance system<sup>135, 183</sup>. A Norwegian study compared data on 48,000 injuries obtained from medical records with information from a survey sample<sup>184</sup>. These authors concluded that a two-step approach that utilised combined data from both sources provided the most reliable estimate of annual injury rates. A study in Taiwan compared four systems that recorded work-related disease and injury<sup>185</sup>. These were the records of a labour-insurance compensation database, the physical examination of workers, the surveillance

system of the Department of Health, and the occupational injuries statistics of business units. All four systems were found to have limitations, but unfortunately were not compared with an estimate from a combined model.

There is a paucity of information on the reliability and validity of data from surveillance systems, despite its importance<sup>186, 187</sup>. Most published literature in the surveillance field that contains the term “reliability” refers to specific screening or diagnostic measures. These include measures such as questionnaires<sup>86, 188-190</sup> or x-rays<sup>191</sup>.

Pesticide intoxication can lead to serious health problems and is therefore considered a suitable target for surveillance systems<sup>96, 155, 192, 193</sup>. Despite this, no information on the reliability of data capture in this field could be identified.

A European case-control study using data from 8 countries attempted to detect known relationships between lung and blood cancers and various occupational exposures, using job titles as proxies<sup>194</sup>. The sample used was men aged 25 to 75 years with incident and prevalent cancer of the lung (190 cases), haematopoietic system (210 cases), or gastrointestinal tract (245 controls). The authors found that using job titles as a proxy for exposure is not sensitive enough to detect possible occupational risks. This finding underscores the need to directly measure work conditions and exposures, rather than rely on proxies such as job titles. A Canadian study attempted to define the sensitivity of a hospital-based childhood injury surveillance system<sup>195</sup>. These investigators found there were systematic errors in data capture and concluded that caution needs to be exercised in making etiologic or causal relationships. A study investigated the effectiveness of a surveillance system using laboratory results for blood levels in adults<sup>107</sup>. Not surprisingly, these investigators found that 100% of cases were identified.

The output from surveillance systems can be useful<sup>196</sup>. However, there is a paucity of studies that have evaluated prevention initiatives that stem from surveillance<sup>197</sup>.

## **CONCLUSIONS**

An integrated, comprehensive surveillance system is needed to understand causes of occupational injuries and diseases so that they may be prevented<sup>198</sup>. Data quality needs to be improved. Increased use of narrative data analysis and data set linkage is clearly indicated. Furthermore, the use of comprehensive surveillance systems based on multiple data sources is required. These should provide improved description of work exposures<sup>6</sup>.

Access to surveillance data needs to be improved. Surveillance systems can only be useful for prevention if the data is disseminated and used. However, there are some important aspects to this process. Data outputs from surveillance systems should be carefully considered and perhaps categorised according to their strength or quality. Information, and potential causal relationships between variables, cannot be assumed as always reliable and valid. This means that prevention approaches cannot be developed until the strength of the relationship is known. Some information can do little more than generate hypotheses. These can be usefully subjected to expert scrutiny to determine whether they may be spurious or worthy of further investigation.



SECTION FIVE

INTERNATIONAL

# REVIEW



A method for comparing multiple international systems was developed using a semi-structured interview, based on a comprehensive checklist. Checklist development was based on relevant literature and tested in pilot interviews. A selection of surveillance systems were reviewed.

## Canada

Canada is a confederation of 10 provinces and 3 territories, with a total population of approximately 33 million. Each province and territory has its own administration. Some Canadian systems function at a national or federal level, and others are provincially based. Health Canada runs the Canadian Centre for Occupational Health and Safety (CCOHS), which is a vehicle for dissemination and communication to stakeholders. It also runs the Public Health Agency of Canada (PHAC), which also maintains a high interest in both workplace health and injury prevention. Each province has a workers' compensation board, and each of these varies in function and approach. Both the health and injury systems conduct surveillance systems of various types. Health Canada conducted a review of available data sources from surveillance systems across Canada in 2004 and noted that there are the following 105 systems<sup>199</sup>:

- 
- Air Data and Management System (ADaMS) (British Columbia)
  - Air Quality Information System (AQUIS) (Ontario)
  - Air Quality and Meteorological Database (Northwest Territories)
  - Arctic Contaminants Database (Health Canada)
  - Asbestos Workers Registry (Ontario)
  - Banque de Données Commune (BDC) (Community Database, Québec)
  - Canadian Breast Cancer Screening Database (Health Canada)
  - Canadian Childhood Cancer Surveillance and Control Program: Economic Impact Study (Health Canada)
  - Canadian Childhood Cancer Surveillance and Control Program: Etiology Surveillance System (Health Canada)
  - Canadian Community Health Survey CCHS (Statistics Canada)
  - Canadian Heart and Stroke Surveillance System (CHSSS) (Health Canada)
  - Canadian Hospitals Injury Research and Prevention Program (CHIRPP)
  - Cancer Case Surveillance System (Health Canada)
  - Central Information System (CIS) (Occupational Health, Newfoundland)
  - Chemical Health Hazard Assessment Tracking System (Health Canada)
  - Chronic Respiratory Surveillance System (Health Canada)
  - Client File Database (Manitoba Environment Act)
  - Climatologie (Climatology Database, Québec)
  - CodeSTAT Database (Nova Scotia)
  - Compensation Assessment and Accident Prevention System (CAAPS) (Northwest Territories)
  - Comprehensive Record and Information System for Pesticides (CRISP) (British Columbia)
  - Connaissance et Surveillance de la Qualité de l'Air (CESPA) (Air Quality Knowledge and Surveillance Database, Québec)
  - Drinking Water Information Management System (DWIMS) (Ontario)
  - Drinking Water Quality Database (Nunavut)

- Drinking Water Web System (DWWS) (Ontario)
- Drugs and Controlled Substances Database (Health Canada)
- Economic Burden of Illness in Canada (Health Canada)
- Emergency Health Services of Nova Scotia (EHSNS) Quality Assurance Database
- Enteric Disease Surveillance System (EDSS) (Health Canada)
- Enteric, Food and Waterborne Disease Outbreak Surveillance (Health Canada)
- Environment Integrated System (Envl) (New Brunswick)
- Environmental Cancer Risk Surveillance System (Health Canada)
- Environmental Data Management System (EDMS) (Manitoba)
- Environmental Data Store (EDS) (Ontario)
- Environmental Monitoring Company (EMC) System Manager Central Data Management System (Manitoba)
- Environmental Monitoring Inventory Database (EMI) (Environment Canada)
- Environmental Monitoring System (EMS) (British Columbia)
- Equipment Registration Database (Newfoundland)
- Fichier des Tumeurs du Québec (J65) (Québec Tumour File)
- Geochemical Database (SMGV1\_Published) (Geological Survey of Canada)
- Global Public Health Intelligence Network (GPHIN) (Health Canada)
- Health Behaviour in School-Aged Children (HBSC) Database (Health Canada)
- Hedgehog Environmental Reporting System (HERS) (Health Canada)
- Hedgehog Environmental Systems (Yukon)
- Hospital Morbidity Database (Health Canada)
- Injury Surveillance [including Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP)] (Health Canada)
- International Circumpolar Surveillance (ICS) Database (Health Canada)
- Intoxications (Poisonings Database, Québec)
- Inventaire des Émissions Atmosphériques (INVSRC) (Inventory of Atmospheric Emissions, Québec)
- Inventory of Canadian Cardiovascular Disease Databases (ICDD) (Health Canada)
- Leak Test Sampling Database (British Columbia)
- Links Database of OHS Division Activities (Saskatchewan)
- Lotus Notes R5 ↑ Database (British Columbia)
- Merged Information System (MIS) (Ontario)
- Mine Medical X-Ray Database (Yukon)
- Municipal Information Management System (MIMS) (Newfoundland)
- Municipal Wastewater Database (New Brunswick)
- National Contaminants Information System (NCIS) (Fisheries and Oceans Canada)
- National Dose Registry (NDS) (Health Canada)
- National Enteric Surveillance Program (NESP) (Health Canada)
- National Environmental Monitoring of Radionuclides (Health Canada)
- National Health Care Worker Influenza and Hepatitis B Vaccine Coverage Survey (Health Canada)
- National Pollutant Release Inventory (NPRI) (Environment Canada)
- National Population Health Survey (NPHS) Asthma Supplement 1996/97 (Health Canada)
- National Surveillance for Enteric Pathogens from Food and Animals – Guelph Laboratory (Health Canada)
- Occupational Exposure Database Management (OEDM) (Ontario)
- (Occupational Health and Safety) Client-Generated Activities Database (Newfoundland)
- OnAIR Database (Ontario)
- Oracle Research Database of WCB Claims (Oracle/WCB) (Saskatchewan)
- Ozone-Depleting Substances (ODS 2000 FE) Database (New Brunswick)
- Pesticide Products Information System (PEPSIS) (Ontario)

- Physician Asthma Management Survey (PAMS) (Health Canada)
- Prairie Soils (1992) and Ontario Soils (1994) [(Pr92 and Ont94)] (Geological Survey of Canada)
- Prevention Services Information System (PSIS) (WCB of the Northwest Territories & Nunavut)
- Product Safety Information System (PSIS) (Health Canada)
- Radiation Exposure Report Database (Newfoundland)
- Rapid Risk Factor Surveillance System (RRFSS) (Ontario)
- Referentiel Territorial (M34) (Territorial Referential Database, Québec)
- Sample Results Data Store (SRDS) (Ontario)
- Saskatchewan Environment's Environmental Management System (SEEMS)
- Septage Database (New Brunswick)
- Site Information System (SITE) (British Columbia)
- Spatial Data Warehouse (SDW) (Health Canada)
- Special Waste Information System (SWIS) (British Columbia)
- Spills Database (Nunavut)
- Sport Fish Contaminant Monitoring Program Database (FISHBASE) (Ontario)
- Student Lung Health Survey (SLHS) 1995-96 (Health Canada)
- Surveillance Médico-Environnementale de la Santé des Travailleurs (SMEST) (Medico-Environmental Surveillance of Workers' Health, Québec)
- Système Informatisé Eau-Potable (LCH) (Drinking Water Information System, Québec)
- Système de Surveillance Épidémiologique sur les Maladies à Déclarations Obligatoires (MADO) (Epidemiological Surveillance System for Mandatory Reportable Diseases, Québec)
- Toxin (Toxin Database, Québec)
- Waste Manifest Database (Yukon)
- Water Quality Database (Newfoundland)
- Watertrax (British Columbia)
- West Nile Virus Database (Health Canada)
- Work Injuries and Diseases Database (NWISP) (Association of Workers' Compensation Boards of Canada)
- Year 2000 Emission Inventory Update (British Columbia)

Clearly, it was not possible to review all of these. A national combined system was selected as an exemplar – the Work Injuries and Diseases Database (NWISP) that collects data from all workers' compensation boards of Canada.

## **1. SYSTEM DESCRIPTION**

The Work Injuries and Diseases Database is known by the acronym NWISP. It was established in response to the large number of work-related injuries and diseases occurring in Canada every year, as well as rising costs to employers and employees affected by industrial injuries.

### **1.1 DATE ESTABLISHED**

The database was established in 1982.

### **1.2 ORGANISATION/INSTITUTE/OWNER/OPERATOR**

This surveillance system is run by the Association of Workers' Compensation Boards of Canada (AWCBC)

### **1.3 SYSTEM RESIDES WHERE IN ORGANISATION**

The NWISP system is maintained by the AWCBC, a non-profit organisation founded in 1919. It was established to facilitate the exchange of information between workers' compensation boards and commissions at a time when workers' compensation law, policy and administration were in their infancy. There were six founding members: Ontario, Nova Scotia, British Columbia, Manitoba, Alberta, and New Brunswick. Saskatchewan joined in 1929, Quebec in 1931, Prince Edward Island in 1949, and Newfoundland in 1950. Lastly, the Northwest Territories and Nunavut and Yukon Territory joined in 1974. Membership has expanded to include two honorary members and a number of associate members who are interested and focus on activities consistent with the AWCBC's vision for safe workplaces and healthy workers. The AWCBC is governed by its Constitution. Funding for the AWCBC comes from membership dues.

### **1.4 FUNDING SOURCES**

The NWISP system is funded by the AWCBC.

### **1.5 PERSONNEL REQUIREMENTS TO OPERATE SYSTEM**

No information was available.

### **1.6 TARGET GROUP/POPULATION**

All workers covered by workers' compensation.

### **1.7 SCOPE OF THE SYSTEM**

NWISP is a national system that attempts to inform across all levels – national, regional, local, and the enterprise. Occupational health data on the following are included in the database: noise, machinery, heavy metals, chemicals, and ionising radiation. Information on occupational injury and disease-related events is also included.

### **1.8 SIGNIFICANT MODIFICATION(S), IF ANY**

Appears to be unmodified.

## **2. INFORMATION COLLECTION**

The NWISP is not a primary data collection system, but uses data collected by its members.

### **3. CONTENT OF SYSTEM**

The database uses information derived from accepted claims from injured workers made to the various Canadian workers' compensation boards and commissions. It includes national, provincial, and territorial group-level or aggregate data. The database contains summary information on the number of accepted lost-time claims and fatalities by province.

### **4. METHOD**

Occupational data collected includes: fumes, dust, pesticides, solvents, chemicals, dangerous machinery, noise, ionising radiation, heavy metals, and other sources of injury and occupational disease-related events. Indicators collected include: sex, age, nature of injury, part of the body, source of injury, event, occupation, and industry. Data coding is completed according to classification standards: National Work Injuries Statistics Program Standard (CSA Z795); National Occupational Classification 1991; and the Standard Industrial Classification 1980.

### **5. INFORMATION RESOURCES**

The AWCBC produce an annual report on work injuries and diseases and also will produce statistical reports on request and payment of a fee.

### **6. COSTS**

Not available.

### **7. ANALYSIS**

The report yields a number of basic summary tables. The principal tables are: Number of accepted time-loss injuries by province, and number of fatalities by province. The number of accepted time-loss injuries are also available by sex and province, age group and province, nature of injury and province, part of body and province, source of injury and province, event and province, occupation and province, industry and province, nature of injury and industry division, part of body and industry division, source of injury and industry division, and event and industry division. The number of fatalities are also available by: sex and province, age group and province, nature of injury and province, part of body and province, source of injury and province, event and province, occupation and province, and industry and province. Most of these tables contain data for 3 years only. For purposes of these tables, "time-loss injury" means an injury (or disease) where an employee is compensated for a loss of wages following a work-related accident, or exposure to a noxious substance, or receives compensation for a permanent disability with or without any time lost in his or her employment (for example, if an employee is compensated for a loss of hearing resulting from excessive noise in the workplace). "Fatality" means a death resulting from a work-related incident that has been accepted for compensation by a workers' compensation board or commission.

**8. EVALUATION**

The AWCBC point out that, within each jurisdiction (i.e. province or territory), the data are consistent over time and comparisons may be made. However, between jurisdictions there are potential difficulties since coverage of industry type may vary. Variances arise because the Acts and Regulations administered by jurisdictions are not identical, and because each jurisdiction has unique operating procedures.

**9. USE, DERIVATIONS**

The database is aimed at informing injury prevention initiatives. However, it is very limited in achieving this goal due to the lack of ability to make comparisons as outlined above.

**10. SYSTEM IMPROVEMENT**

Information not available.

## France

France is a geographically large country with a population of approximately 61 million. In France, the prevention of occupational injury and disease is the responsibility of the State and the social insurers. The Labour Ministry is responsible for overall national public policy, and the social security bodies define the measures and means to promote prevention in the workplace under the general social security scheme. The company manager is solely and personally responsible for employee safety and health. Provisions for workers' health and safety are integrated within two fundamental laws: the Labour Code and the Social Security Code. Measures on hygiene, safety, and working conditions, and on the functioning of workers' representation on health and safety, are part of the Labour Code that is the main instrument upon which the Labour Inspectorate relies to perform its tasks. The Social Security Code provides for the compensation-based requirements necessitated by work-related accidents and occupational illness. The scope of the Labour Code does not cover many employees in the public sector and separate provisions extend a broadly similar protection to employees in this area.

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### 1. SYSTEM DESCRIPTION

Health and Safety in general is under the responsibility of the Ministry of Employment and Solidarity (Ministère de l'Emploi et de la Solidarité). Its Sector in Charge of Work (Secteur Chargé du Travail) publishes new or updated Limit Values (Valeurs Limites) as amendments to the Annex of the Circulaires du 19 Juillet 1982. The consolidated list is published by Institut National de Recherche et de Sécurité (INRS). There are other pieces of legislation dealing with health and safety in general, chemicals, individual substances such as asbestos, or groups of substances such as carcinogens. The Recommendations for Limit Values (Valeurs Limites) are developed and updated by an expert group under the direction of the Ministry in Charge of Work (Groupe Scientifique pour la surveillance des Atmosphères de Travail, translated as Scientific Group for the Surveillance of the Working Atmosphere/Environment). This expert group (groupe scientifique) is attached to the Higher Council for the Prevention of Occupational Risks (Conseil Supérieur de la Prévention des Risques Professionnelles), a quadripartite Advisory Committee of the Ministry, representing, amongst others, the Social Partners and various affected administrations. The same scientific expert group also deals with the scientific basis and the principles for the application of Biological Exposure Indicators (Indicateurs Biologiques d'Exposition – IBE). The Labour Inspectorate (l'Inspection du Travail) of the Ministry is responsible for the surveillance and enforcement of the legislation. In addition, the organisations for social security exert, within the framework of their function as insurance companies, a system of specific control and incentives to ensure the application of the legislation at enterprise level.

In France, occupational risk prevention is the responsibility of the Ministries in charge of Labour and Social Security. It is a dual system: State authorities on one side and social insurance on the other. The Ministry in charge of Labour, more specifically the Labour Relations Branch (DRT – Direction des Relations du Travail), is in charge of the national public policy for prevention at the workplace: it prepares, develops and implements regulations in this

field. The Higher Council for the Prevention of Occupational Risks (CSPRP – Conseil Supérieur de la Prévention des Risques Professionnels) assists the Ministry in Charge of Labour as a consultative body. It groups the representatives of State authorities, workers and employers, and qualified individuals. It can propose all measures for prevention at the workplace and is consulted for all bills or draft regulations related to occupational risk prevention. In the field, the Regional and Departmental Labour, Employment and Vocational Training Directorates (DRTEFPs – Directions Régionales du Travail, de l'Emploi et de la Formation Professionnelle and DDTEFPs – Directions Départementales du Travail, de l'Emploi et de la Formation Professionnelle), and Labour Medical Inspectorate relay the Labour Relations Branch (DRT). The French Labour Code states that the regional medical inspectors “must take permanent action to protect the physical and mental health of workers at the workplace and contribute to the health monitoring for the benefit of the workers”. Control and supervision missions, as well as information and consulting as regards the enforcement of legislation and regulations related to working conditions, health and safety at the workplace, are mainly carried out by the Labour Inspectorate.

The role of the Social Security Directorate (DSS – Direction de la Sécurité Sociale) is to set the rating rules and conditions for workers' compensation for occupational accidents and diseases. It contributes, liaising with the Ministry in Charge of Labour, to elaborating the prevention policy. It is supported at national level by the National Health Insurance Fund for Salaried Employees (CNAMTS – Caisse Nationale de l'Assurance Maladie des Travailleurs Salariés). It defines the means and measures to promote occupational risk prevention in firms under the General Social Security Scheme. In terms of occupational risk prevention, the powers of the CNAMTS are transferred to the Occupational Accident and Disease Commission (CATMP – Commission des Accidents du Travail et des Maladies Professionnelles), a joint committee made of worker and employer representatives.

The National Technical Committees (CTNs – Comités Techniques Nationaux) assist the CATMP in its mission; they are grouped by profession or group of professions. They comprise worker and employer representatives, study risks specific to their activities, and make technical recommendation proposals per economic sector.

While the Ministry in Charge of Labour and its branches take action essentially through regulations, the CNAMTS triggers actions focused on practical recommendations, financial incentives, supervision, technical assistance and consulting for companies to implement appropriate prevention measures, or to promote training and information on health and safety at work.

Sixteen Regional Health Insurance Funds (CRAMs – Caisses Régionales d'Assurance Maladie) and four General Social Security Funds (CGSSs – Caisses Générales de Sécurité Sociale) relay the CNAMTS. They adapt the CNAMTS guidelines to regional realities. Besides supervising, the CRAM and CGSS agents support and guide companies on technical means to be implemented to prevent occupational accidents and diseases. It is important to note that, in the same way that the CTNs assist the CATMP, the Regional Technical Committees (CTRs – Comités Techniques Régionaux), grouped by profession or group of professions, assist the CRAMs and CGSSes in occupational risk prevention.

The National Research and Safety Institute (INRS – Institut National de Recherche et de Sécurité) for the Prevention of Occupational Accidents and Diseases works for employees and companies under the General Social Security Scheme, according to directives set by the CNAMTS. It provides technical assistance: studies and research, training in prevention, technical and documentary assistance, information disseminated via periodicals, posters, brochures, audiovisuals, and a (French-language) web site.

Other technical assistance organisations contribute to this national prevention action. These include the National Agency for the Improvement of Working Conditions (ANACT – Agence pour l'Amélioration des Conditions de Travail). It is supervised by the Ministry in Charge of Labour. Its mission is to contribute to the development of research to improve working conditions, collect and disseminate information in this field, and help companies to assess and prevent occupational risks. There is also the Occupational Risk Prevention Organisation for the

Building and Civil Engineering Industries (OPPBTP – Organisme Professionnel de Prévention du Bâtiment et des Travaux Publics). It is supervised by the Ministry in Charge of Labour. It contributes to prevention in all building and civil engineering firms. Finally, there is Eurogip, a public interest grouping created by the CNAMTS and INRS. This complements the overall French system by coordinating, developing and promoting activities at European level, particularly in the field of standardisation.

The so-called “social partners” and professionals are considered to be an integral part of the French system. The social partners assist the State authorities, via the Higher Council for the Prevention of Occupational Risks. They manage the occupational accidents and diseases sector via the Occupational Accident and Disease Commission (CATMP – Commission des Accidents du Travail et des Maladies Professionnelles). They constitute the INRS Board of Directors. The professionals (employers, workers, federations or professional unions) are involved in the development of rules and measures that affect them. This is done by making them part of the Higher Council for the Prevention of Occupational Risks (CSPRP), National Technical Committees (CTNs), and Regional Technical Committees (CTRs).

At least two cross-sectional worker surveys are conducted regularly in France: the Working Conditions Survey (Enquête Nationale Conditions Travail), and the Medical Monitoring of Exposure and Risks (SUMER). In 1994, the French Ministry of Employment and Solidarity initiated the worker survey called SUMER (Surveillance Médicale des Risques Professionnels/Medical Surveillance of Occupational Risks). This was designed to provide an estimate of the risks to which workers are exposed. It involves an annual survey of 48,000 workers via a network of industrial physicians who consults these workers every year. L'UMRESTTE (Unité Mixte de Recherche Épidémiologique et de Surveillance Transport Travail Environnement, which translates as the Transport, Work and Environment Epidemiology and Health Observatory Laboratory) is responsible for conducting the survey. The results are used to compile a compendium of the risks to which workers are exposed by: organisation and methods, physical constraints and biological and chemical risks. Apparently, an employment exposure matrix is being developed, reflecting the links between the workers' activities and the chemical products to which they are likely to be exposed. The data have already been widely used to analyse the exposure of workers to carcinogens. The French history of implementing measures relating to the use of chrysotile asbestos and its various applications was completed in several stages and illustrates the use of the occupational surveillance database EVALUTIL<sup>200</sup>. The process began from the date when the carcinogenic nature of asbestos was recognised by the IARC (International Agency for Research on Cancer) in 1977. The first phase, covering the 1970s, was centered on the production sector, in the course of which France laid down specific rules for the use of asbestos in the manufacturing sector and transformation of asbestos-based products and restricted its use with a view to protecting the population. A second phase, covering the period of the 1980s and the first half of the 1990s, centred on restrictions on use, during which the European directives came in: strengthening workers' protection in the manufacturing and transformation sectors, setting down rules for protection in the case of removal of asbestos, progressively eliminating the most dangerous varieties of asbestos, prohibiting the most dangerous uses, and restricting the use of asbestos in general, including the use of chrysotile. A third phase, from 1995 onwards, was centered on the repair and maintenance sectors, in the course of which France managed to take into account the risks faced by repair and maintenance workers, strengthen workers' protection on sites where asbestos was removed and in certain residual asbestos processing centres, and strengthen protection of the public. The database called EVALUTIL was set up to evaluate exposure to asbestos among users of products containing asbestos. This database showed up the very high level of exposure of certain construction workers in the course of operations (“exposure peaks” during operations such as cutting asbestos cladding containing 5 per cent chrysotile, cutting up fireproof doors coated in asbestos, for example). Following the publication of studies that showed the increase in the number of mesotheliomas and the significant risk to the population of workers in the maintenance and repair sectors, the French authorities convened an expert group in 1994. The deliberations of these experts highlighted a number of scientific doubts and a number of loopholes in the French regulations then in force. The expert group's conclusions led the authorities to draw up its first “asbestos plan” that ultimately led to the implementation of a French ban.

The major occupational health surveillance database is called *Système de Collecte des Données Recueillies par les Laboratoires de Chimie de l'INRS et des CRAM* and is known by the acronym COLCHIC.

The National Health Insurance (Caisse National d'Assurance Maladie – CNAM) under the supervision of the Ministry of Health has been responsible for the compensation of industrial accidents and the administration of occupational risks and occupational diseases since 1945. CNAM's mission is also to prevent occupational accidents and occupational diseases by technical and financial means. CNAM administers the national fund for prevention, which is based on the contributions levied from enterprises. The prevention service and its regional offices and services is financed out of this fund, as well as the work of the INRS, the National Institute of Research and Safety. At regional level, inspectors and consulting engineers have the same access and inquiry right as the national labour inspectors have. They perform risk assessments and give advice on prevention and protection measures in consultation and co-operation with the Committee for Hygiene, Security and Working Conditions – CHSCT. They can also refer to specialised laboratories. If an employer fails to follow the advice given, the inspectors have the right to take all the necessary measures they consider justifiable under the circumstances, and, if necessary, they can issue improvement or enforcement notices. CRAM is able to impose higher contributions on a branch or a certain enterprise based on the annual numbers of occupational accidents etc. in the branch or because of infringements by a certain company. On the other hand, reductions in contributions because of an outstanding OHS performance of a company are also possible. CRAM has the power to change the financial contribution for occupational accidents the companies are due to pay in a certain branch of industry. CRAM also organises information and training courses for employers and for employees, campaigns to tackle specific problems, and publishes journals and brochures. The data about occupational injuries, accidents, and diseases, as well as all other data gathered and collected during the visits, are taken into consideration when designing policy priorities in the field of occupational health and safety at ministerial level.

### **1.1 DATE ESTABLISHED**

COLCHIC was established in 1987. The INRS (Institut National de Recherche et de Sécurité) was created in 1947, and the ANACT (Agence Nationale pour l'Amélioration des Conditions de Travail) was founded in 1973.

### **1.2 ORGANISATION/INSTITUTE/OWNER/OPERATOR**

The INRS (Institut National de Recherche et de Sécurité), and the ANACT (Agence Nationale pour l'Amélioration des Conditions de Travail).

### **1.3 SYSTEM RESIDES WHERE IN ORGANISATION**

INRS is a non-profit organisation, subject to State financial supervision and created in 1947 under the auspices of the CNAMTS. It operates on behalf of the employees and companies coming under the general social security scheme. It is supported by the regional health insurance funds (CRAM) in metropolitan France and General Social Security Funds (CGSS) in French overseas administrative departments, and it provides its expertise to other prevention partners such as occupational physicians and Labour Inspectorate services. Its activities are programmed in accordance with directives from the National Salaried Workers' Health Insurance Fund (CNAMTS) and policies defined by the Ministry of Employment and Solidarity. It is managed by a joint board of directors representing employers and employee trade unions.

ANACT is a publicly owned body under the surveillance of the Ministry of Employment and Solidarity. It is administered by an Administrative Council, representing all workers' and employers' confederations, three experts in health and safety, nominated for a period of three years, and representatives of various ministries affected by its work.

#### **1.4 FUNDING SOURCES**

INRS is funded almost entirely from the National Occupational Accident and Disease Prevention Fund. This fund is provisioned by a share of the occupational accident and disease contributions paid by firms and managed by the CNAMTS. ANACT is funded by the government.

#### **1.5 PERSONNEL REQUIREMENTS TO OPERATE SYSTEM**

INRS employs about 600 people. Details are not available for ANACT.

#### **1.6 TARGET GROUP/POPULATION**

All individuals working in France covered by the general social security system, except for public service employees (estimated as 14% of the workforce), local authority employees (Departments, Communes, and others), agricultural employees (currently estimates as 3% of the workforce), and employees covered by a special system (this includes national railway (SNCF) workers, coal workers, miners, some electricity workers, Parisian public transport workers, and the merchant navy).

##### **1.6.1 Occupational health importance**

It is concerned with health risks affecting employees and, in particular, with occupational hazards. The system is designed to allow a directive preventive role with employers at the regional level, and to support prevention of accidents and diseases and improvement of health and safety at work at the national level.

##### **1.6.2 Occupational injury importance**

It is concerned with risks affecting employees and, in particular, with occupational hazards. The system is designed to allow a directive preventive role with employers at the regional level, and to support prevention of accidents and diseases and improvement of health and safety at work at the national level.

#### **1.7 SCOPE OF THE SYSTEM**

COLCHIC is a national system that attempts to inform across all levels – national, regional, local, and the enterprise. The specialist departments of the INRS and the prevention services of CRAM carry out sampling operations in workplaces covered by the general social security system. The COLCHIC system allows a systematic record of visits and sampling carried out in these workplaces. It contains information about the companies, the job(s) concerned, the samples collected, and their outcomes. The system facilitates the local work of inter-regional laboratories by supplying them with better processed information, which is more accessible and more efficiently filed. Those running the system believe it allows a better harmonisation between all stakeholders involved in sampling or analysis of physical and chemical substance, as it favours a more homogeneous collection of data. Finally, at national level, it can supply information, useful both for prevention (profiles of exposures/polluting agents) and for research (inclusion of exposure data in epidemiological studies).

### 1.8 SIGNIFICANT MODIFICATION(S), IF ANY

In the 1970s, analyses of samples collected in workplaces by CRAM's prevention services were performed either by one of the four inter-regional laboratories or by the INRS. In 1983, the Commission for the Prevention of Occupational Accidents and Diseases proposed a doubling of the number of these laboratories. To improve centralisation of information by the INRS, it was decided at the same time that a new system, the COLCHIC database, should be set up. It has operated since 1987 and records some 1,600 test sheets per year, corresponding to a total of about 1,600 product analyses and 11,000 ancillary air samplings.

## 2. INFORMATION COLLECTION

It is a continuously updated database. The basic information comes from CRAM sampling staff or from INRS researchers for specific studies. CRAM forwards it to their inter-regional laboratory or to the INRS. The information gathered is contained first in a report describing the analyses requested. These analyses are then recorded in the laboratory, after being validated and possibly checked by the sampler, and constitute the "current" files. When analysis results are available, they are validated in the place where they have been prepared and are filed. Then the file moves from the "current" area to the archive area; it is transmitted by telephone link to the INRS and is not further modified.

## 3. CONTENT OF SYSTEM

The information collected includes: workplace (SIRET number, identifying the establishment according to INSEE's national nomenclature); name, address, and telephone; 5-digit social security hazard number, designated by CRAM, corresponding to the economic activity carried out by the largest number of employees; National Technical Committee sector of activity matching a grouping of hazard numbers under 15 headings; circumstances of sampling (including place, collector of sample, origin of request, reason for intervention, symptoms observed (although in practice these fields are hardly ever populated), number of workers exposed to hazards, number of cases); product analysis – name of product name and address of producer, name and address of seller, labelling used, consumption by time unit, description of sample, method of collection, workshop/job, analyses requested; means of sampling – sampling method, workshop/job time of commencing sampling, duration of sampling, volume collected, analyses requested; ventilation – nature of premises (open, partially open, closed), volume and height of premises, source (point, level or in volume) and mode of generation of polluting agent (continuous or discontinuous), catchment (if applicable) and type of catchment, ventilation (if applicable) and type of ventilator, percentage of sources without catchment in the premises for the polluting agent under consideration, purification and type of purification, approximate temperature.

## 4. METHOD

Collection of most of the indicators is compulsory, and the codes used are taken from specific dictionaries, known as reference files. These files were drawn up with the aid of the specialists involved. They are not immutable and can therefore evolve with the emergence of new technologies, new jobs, new substances, and others. For files which require a very high level of homogeneity, e.g. files covering substances and jobs, maintenance is carried out at national level. For the other files, it takes place at local level. It should be specified that the job file has a special structure. General jobs (type A) and specific jobs (type B) are considered. The former category can exist in various economic sectors (soldering or cleaning, for example), whereas the second type only exists in one specific sector. At the most widely accepted level, the categories are as follows: A1 Storage and transport; A2 Grinding and

sorting; A3 Mixing, compressing, moulding; A4 Fusion, calcination, grilling, drying, pouring; A5 Machine finishing, assembly, soldering, glueing; A6 Preparation, treatment, protection; A7 Filling bottles, filling casks, spooling, measuring doses; A8 Monitoring, cleaning, preparation; B1 Steelworking and metalworking in general; B2 Foundries; B3 Building and public works; B4 Textiles; B5 Printing, silkscreen printing, document reproduction. As for the substances file, it takes as key the international CAS (Chemical Abstract Services) number. Several synonyms may have the same code (name in use and name according to IUPAC: International Union of Pure and Applied Chemists). The results of the analysis constitute the final group of indicators recorded for each file held.

## **5. INFORMATION RESOURCES**

Little information is available on the specific information resources stored. Information is available in French, with little or none available in English.

## **6. COSTS**

Little information is available.

## **7. ANALYSIS**

Statistics are made available regularly to regional and national stakeholders. Access to the database is restricted. The quality of data is not measured. The INRS believe that the major advantage of the COLCHIC system is that it provides for the centralisation of previously dispersed information. However, there is little or no linkage with other databases, and the regional nature of some of the indicators means it is still not possible to provide occupational exposures at a national level. Furthermore, it is highly focused on chemical exposures, and there is virtually no linkage to medical or other clinical or accident records. This seriously limits the ability of the system to advise and inform preventive initiatives.

## **8. EVALUATION**

Data is made available to sections of occupational health and safety administration in France, however, this is of limited practical value due to the reasons outlined above.

## **9. USE, DERIVATIONS**

The intended users are control and engineering staff in CRAM, prevention services, trainers, INRS researchers, other interested researchers (epidemiologists and others), medical practitioners.

## **10. SYSTEM IMPROVEMENT**

Little information is available.

## Finland

Finland is an independent republic with a population of just over 5 million people, divided into 5 provinces and 455 municipalities. The Finnish workforce is about 2.5 million<sup>201</sup>. Occupational safety and health matters fall largely under the responsibility of the Ministry of Social Affairs and Health<sup>202</sup>. However, the Federation of Accident Insurance Institutions is also an important stakeholder, since employers are obliged to take out statutory workers' compensation insurance. The Finnish Institute of Occupational Health is funded by the Ministry of Social Affairs and Health, and governed by a board of directors responsible to the Minister. It was founded in 1945 and has approximately 600 permanent staff and about 300 project contractors. There is a surveillance division, headed by Timo Kauppinen. The Occupational Safety and Health Inspectorates and the Occupational Safety and Health Department of the Ministry of Social Affairs and Health are the enforcement authorities of occupational safety and health legislation concerning workplaces<sup>202</sup>. Control of products used at work is also exercised by these authorities, in response to Finnish membership of the EU. In the European economic area, goods move freely across national borders. This presupposes that they conform to requirements concerning them. The Occupational Safety and Health Department and the Occupational Safety and Health Inspectorates supervise the conformity of machines, equipment, chemical substances, and personal protective equipment used at work by means of market surveillance, in order to ensure that only safe and conforming products are used at workplaces. In market surveillance, the Occupational Safety and Health Department co-operates with TUKES, the Safety Technology Authority, the National Product Control Agency for Welfare and Health, and the National Consumer Administration.

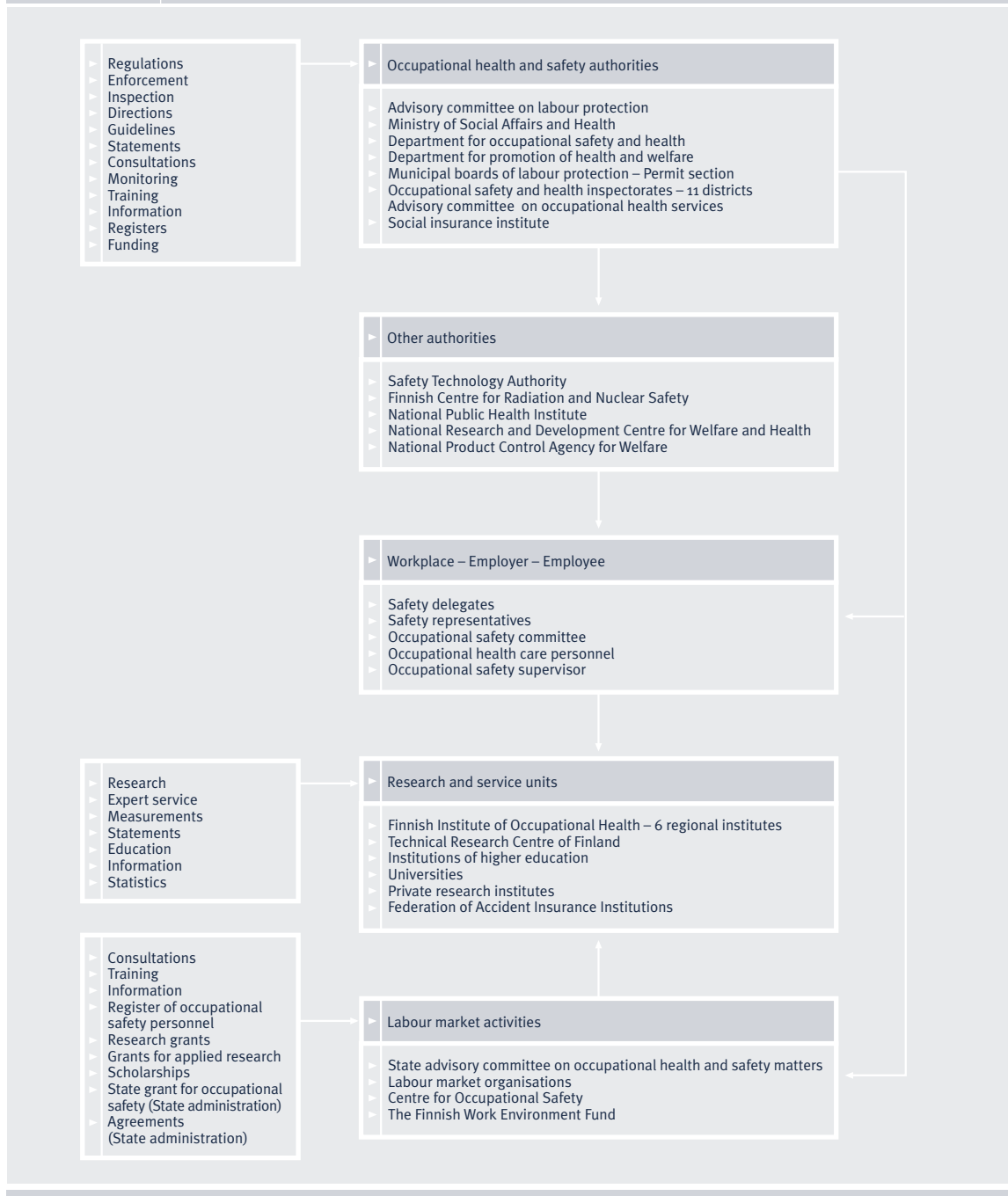
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The full list of institutions responsible for occupational safety and health in Finland is as follows<sup>41</sup>:

- Centre for Occupational Safety
- Consumer Agency
- Federation of Accident Insurance Institutions (FAII/VAKES)
- Finnish Institute of Occupational Health
- Finnish Work Environment Fund
- Ministry of Labour
- Ministry of Social Affairs and Health
- National Product Control Agency for Welfare and Health (SSTV)
- Occupational Safety and Health Inspectorates
- Radiation and Nuclear Safety Authority
- Safety Technology Authority (TUKES)
- Technical Research Centre of Finland (VTT)

**FIGURE 3**

**Occupational safety and health system**



There are several Finnish surveillance systems, registers, and related surveys in operation. These include the following:

- The Finnish Working Life Barometer
- Registry of Biological Monitoring
- Registry of Employees Occupationally Exposed to Carcinogens
- Dose Register of Occupational Radiation Exposures
- Registry of Industrial Hygiene Measurements
- Database of Descriptions of Severe Occupational Injuries
- Living Conditions and Causes of Death 1985 Database, Disability Database
- Noise Register MELU
- Occupation/Cancer Incidence Database
- Finnish Register of Occupational Diseases
- Database of Occupational Injuries
- Product Register
- The Quality of Working Life Survey
- IARC Database of Industrial Hygiene Measurements in Pulp and Paper Industries
- The Finnish Register of Congenital Malformations
- Labour Force Survey
- Finnish Job-Exposure Matrix
- Register of Occupational Injuries and Diseases in Finland
- (Finnish) Cancer Registry

Information on occupational diseases is held in a number of databases. The principal one is the Finnish Register of Occupational Diseases (FROD), and this is supplemented by other important registers e.g. the Finnish Cancer Registry. All occupational diseases are supposed to be reported to FROD.

Keeping track of occupational injuries has largely been devolved to the insurers providing compulsory cover for workers. The principal database is the Database of Occupational Injuries (FINOCCINJB). All accidents that result in three or more days off work are supposed to be included. It is worth noting that the insurer is obliged to provide the register with data on every case reported to them, regardless of compensation decisions. A supplementary source of information is the Database of Descriptions of Severe Occupational Injuries (FININJDESC). This is designed to capture information on all severe accidents that are examined by statutory inspectors.

There is a combined register that is supposed to capture data on all accidents at work or occupational disease in Finland – the Register of Occupational Injuries and Diseases in Finland (Tyotapaturna – ja ammattitautirekisteri, TPSR). This system is run by the Federation of Accident Insurance Institutions and should contain information on all injuries and diseases that have been compensated on the basis of statutory workers' compensation. This means that, in theory, the system contains data of all accidents at work or occupational diseases in Finland that have been compensated. All insurance companies practising statutory accident insurance in Finland are under an obligation by law to deliver this data. The database is updated quarterly. This system was set up in 1991–1992 by the Federation of Accident Insurance Institutions. The detailed data in the current databases was derived from the earlier database run by Finnish Insurance Data Ltd since 1975. The general aim of TPSR is to provide statistics of accidents at work and occupational diseases over a long period of time. Statistics can then be provided on the basis of numerous variables. These include the injured body part, means of transport (if the accident happened while commuting), primary cause of the disease and its medical diagnosis, as well as the amount of compensation paid. These can be cross-referenced freely. The system does not contain text fields, so its main use is in the creation of numeric statistical information on the basis of which conclusions can be made and appropriate actions taken. The intended users are government officials, insurance companies, the FIOH, and other interested parties.

The information is considered reliable, since the database has a long continuous history and a relatively high capture rate. The main limitation occurs where coding has changed at various points in time.

The Finnish Cancer Registry (FCR) was started in 1953. It contains limited information about the individual but quite detailed information about the cancers. It is run by the Cancer Society of Finland, on behalf of the National Research and Development Centre for Welfare and Health. It was established with the goal of producing statistics about cancer and the ability to make forecasts, to facilitate evaluations of interventions, and to support analytical epidemiology. Cancer cases are reported by hospitals, laboratories, and medical practitioners from both the public and private sectors. Finland also participates in the CAREX (CARcinogen EXposure) database<sup>203-206</sup>. CAREX is an international information system on occupational exposure to known and suspected carcinogens. The database, constructed with support from the Europe Against Cancer programme of the European Union (EU), provides selected exposure data and documented estimates of the number of exposed workers by country, carcinogen, and industry. CAREX includes data on 139 agents evaluated by the International Agency for Research on Cancer (all agents in Groups 1 – carcinogenic to humans, and 2A – probably carcinogenic to humans, and selected agents in Group 2B – possibly carcinogenic to humans e.g. inorganic lead, glasswool, styrene, methylene chloride, cobalt, pentachlorophenol, carbon tetrachloride), displayed across the 55 industrial classes of the United Nations system (ISIC Revision 2). The 1990–93 occupational exposure to these carcinogens was estimated for the fifteen countries of the EU in two phases. First, estimates were generated automatically by the CAREX system on the basis of national workforce data and exposure prevalence estimates from two reference countries (the United States and Finland). These estimates are adjusted for the economic structure (workforce distribution) of each country individually, but do not take into account country-specific exposure patterns that may deviate from those of the reference countries. For selected countries, these estimates were then refined by national experts in view of similarity/dissimilarity to the perceived exposure patterns in their own countries<sup>203</sup>. The second phase involved a network of national experts in 1997 assessing these estimates in view of their similarity/dissimilarity to the perceived exposure patterns in their own countries. The CAREX system permits these experts to select appropriate “first-phase” estimates or to generate and document modifications of these estimates.

A product register (FINPRODREG) is maintained by the Occupational Health and Safety Division of the Ministry of Labour in order to keep track of all activities that might place hazardous products or equipment on the market in Finland. The product register was set up in 1980. This is achieved through market surveillance of machinery, electrical equipment, personal protective equipment, explosives, aerosols, gas burning appliances, chemicals, and simple pressure vessels. The purpose of the surveillance carried out by authorities is to ensure that the regulations are followed and no dangerous or deficient products are available on the market. When necessary, dangerous products are withdrawn from the market<sup>207</sup>. The safety data sheets (SDS) are compiled for every potentially hazardous product or device by every Finnish manufacturer or importer, who must send two copies of each SDS to the Ministry of Labour before the chemical is put on the market or brought into use: Then the contents of the sheets are checked and, if they have been found satisfactory, they are recorded. The safety data sheets contain various information on hazardous chemicals (e.g. trade name, purpose of use, identification data of the manufacturer or importer, classification, hazardous components in the preparation, physical and chemical data, ways of exposure, local effects, effects of short term exposure etc). This system is not available commercially. Anyone outside the labour protection authorities needs a permit to use the register.

## **FINNISH REGISTER OF OCCUPATIONAL DISEASES (FROD)**

### **1. SYSTEM DESCRIPTION**

The FROD system contains records of occupational diseases. All cases of occupational disease are supposed to be registered. However, this assumes diagnostic clarity, causal certainty, and medical compliance, none of which is fully applicable.

Occupational diseases are supposed to be reported by medical practitioners, whereas injuries are primarily reported by employers who have to take out statutory workers compensation insurance. Since 1992, the accident insurance companies have been obliged to keep statistics on work accidents and occupational diseases. However, this statistical information was collected voluntarily before that date. The Federation of Accident Insurance Institutions (FAII/VAKES) comprises 12 companies and 2 state organisations. This Federation produces an annual publication on the work accidents and occupational diseases, and supplies the authorities, researchers and other interested parties with the information.

The Federation of Accident Insurance Institutions is the owner of the register, but it is maintained by the Finnish Institute of Occupational Health, a private institution funded by the government. The system contains records of occupational diseases reported by physicians and/or insurance companies. All employees and farmers are covered by the system. The unit of observation in the register is a filed claim of an occupational injury or disease<sup>208</sup>.

The aim of the FROD system is to provide statistical information of occupational diseases for labour protection, occupational health care, and research. Intended users include administrative and field personnel in the labour protection and health care organisations and researchers of occupational health.

#### **1.1 DATE ESTABLISHED**

The Finnish Register of Occupational Diseases (FROD) was established in 1964. The register's status as a research register was consolidated in Finnish legislation in 1993.

#### **1.2 ORGANISATION/INSTITUTE/OWNER/OPERATOR**

The Finnish Register of Occupational Diseases (FROD) is maintained by the Surveillance section of the Finnish Institute of Occupational Health (FIOH). This is government-funded institution. However, the actual owner of the register is the Federation of Accident Insurance Institutions.

#### **1.3 SYSTEM RESIDES WHERE IN ORGANISATION**

The Finnish Institute of Occupational Health is funded by the Ministry of Social Affairs and Health, and governed by a board of directors responsible to the Minister. It was founded in 1945, and has approximately 600 permanent staff and about 300 project contractors. The surveillance division is headed by Timo Kauppinen.

#### 1.4 FUNDING SOURCES

Government and insurance funded.

#### 1.5 PERSONNEL REQUIREMENTS TO OPERATE SYSTEM

Details are not available.

#### 1.6 TARGET GROUP/POPULATION

Any individual with an occupational disease, among the entire population of employed persons in Finland. The relevant legislation is as follows<sup>201</sup>:

##### **Occupational Diseases Act (1343/88)**

- 1 An occupational disease that is entitled to compensation according to the Accident Insurance Act (608/48) or the Act on Agricultural Workers' Accident Insurance (102/81) or the Act entitling persons employed in public service or holding public office to compensation in the event of an accident (154/35), is a disease caused by any physical factor, chemical substance or biological agent encountered in the course of work done under contract of employment, in the public service or in public office or as an agricultural entrepreneur, as prescribed in those Acts. What is stated in the first subsection on occupational diseases, shall also be applied to notable worsening of another disease or injury than occupational during the period of this deterioration.
- 2 The ordinance states that the causal connection between the disease mentioned in the first subsection of paragraph 1 and a physical, chemical or biological factor in work is regarded as existing when such a factor has been present in the work to such an extent that it principally can cause the disease designated by the Act.
- 3 Liability for compensation, the amount of compensation payable, and the procedure to be followed for that purpose shall be governed by the Accident Insurance Act, the Act on Agricultural Workers' Accident Insurance, and the Act entitling persons employed in public service or holding public office to compensation in the event of accident. For this purpose, the date on which the disease manifests shall be equated with the date of occurrence of the accident. If other specific reasons do not require it, the date of manifestation of the disease shall be determined as the date when a person has sought medical advice, for the first time, from a doctor concerning a later diagnosed occupational disease. The time limit within which compensation must be claimed shall invariably be reckoned as beginning on the date on which the disease is diagnosed or the incapacity of the person begins. When a worker, agricultural entrepreneur, or person employed in public service or holding public office is not, on the appearance of an occupational disease, engaged in a process that could have been the cause of the disease, liability for compensation shall be determined on the basis of the employment, agricultural entrepreneurship, public service, or public office in which they were last engaged in a process that could have been the cause of the disease.

##### **Ordinance on Occupational Diseases (1347/88)**

- 1 Diagnosis of a disease as an occupational disease requires such medical examination where there is sufficient knowledge about exposure in the work and where, in the case of occupational diseases designated by the Act on Occupational Diseases in paragraph 2, a specialist in the field is in charge.
- 2 A disease shall be deemed as occupational according to section 2 and the first subsection of section 4 and later in section 3, when the physical, chemical or biological factor mentioned in the paragraph is present in a person's work, and is covered by subsection 1 of section 1 in the Act on Occupational Diseases, to such an

extent that its exposure effect is sufficient to cause the disease in question, unless it is stated that the disease has been clearly caused by exposure outside work.

3 The following are the diseases and the physical, chemical and biological factors referred to in Paragraph 2:

#### ***Physical factors***

- Vibration – Typical forms of disease: White finger syndrome; polyneuropathy of the upper limb.
- Noise – Typical forms of disease: Cochlear type of deterioration of hearing.
- Overpressure – Typical forms of disease: Direct effects of changes of pressure, such as maxillary haemorrhages and tympanal ruptures; indirect effects of pressure such as nitrous inebriation and diver's disease; as a long-term effect an aseptic bone necrosis of big joints.
- Ionising radiation – Typical forms of disease: Bone marrow injuries, lens opacities, skin changes (eczemas, wounds, scars, skin cancer).
- Infrared radiation – Typical forms of disease: Lens opacities, e.g. glassblower's cataract; skin changes (connective tissue changes, telangiectasies).
- Ultraviolet radiation – Typical forms of disease: Conjunctivitis and keratitis of the eye; skin changes (light eczema, light contact eczema).

#### ***Chemical factors***

- Arsenic and its compounds – Typical forms of disease: Acute arsenic intoxication (gastro-intestinal, respiratory, and nervous symptoms); long-term respiratory, mucous membrane symptoms; conjunctival irritation of the eye; skin changes like chronic eczema, skin pigmentation, hyperkeratosis, skin cancer; pulmonary cancer; peripheral neuropathies.
- Beryllium and its compounds – Typical forms of disease: Irritation of mucous membranes; chemical pneumonitis in high exposure; chronic berylliosis; skin changes (contact eczema, foreign body reaction e.g. granuloma); pulmonary cancer.
- Mercury and its compounds – Typical forms of disease: Irritation of mucous membranes and gastro-intestinal tract in acute intoxication, sometimes chemical pneumonitis. In sub-chronic or chronic intoxication, the symptoms vary according to individual factors and form of exposure: symptoms of the mouth (gingivitis), peripheral and central nervous injuries (e.g. shake, psychic changes, renal injuries (albuminuria) and in connection with the injuries, elevated mercury levels in urine and blood; skin changes (contact eczema, eczema or other wide-spread rash).
- Phosphorus and its compounds – Typical forms of disease: Injuries of bone and liver; respiratory irritation; central nervous symptoms; caustic injuries of the skin; depression of cholinesterase activity of the tissues in organic phosphorous compound intoxications
- Cadmium and its compounds – Typical forms of disease: Acute intoxication with strong respiratory symptoms (chemical pneumonitis); chronic intoxication (renal injuries, emphysema); skin changes (contact eczema); pulmonary cancer.
- Cobalt and its compounds – Typical forms of disease: Skin changes (contact eczema); rhinitis and asthma due to cobalt allergy; hard metal lung.
- Chromium and its compounds – Typical forms of disease: Local dermatic or mucosal irritation or corrosion caused by chromium (chrome wounds); skin changes (contact eczema); rhinitis and asthma due to chromium compound allergy; pulmonary cancer; sinus cancer.
- Lead and its compounds – Typical forms of disease: The first sign of subchronic or chronic inorganic lead intoxication is disturbed haemoglobin synthesis, later anaemia, reticulocytosis, peripheral nerve injuries, gastrointestinal symptoms, liver and kidney injuries, and central nervous symptoms. Organic lead intoxication is characterised by central nervous symptoms. In inorganic lead intoxication, symptoms are associated with elevated blood lead level and elevated erythrocyte protoporphyrin values, and in organic lead intoxication, elevated lead levels in blood and urine.

- Manganese and its compounds – Typical forms of disease: Acute chemical pneumonitis; chronic manganese intoxication (manganism), dominated by nervous symptoms.
- Nickel and its compounds – Typical forms of disease: Skin changes (contact eczema); rhinitis and asthma due to nickel allergy; chemical pneumonitis caused by nickel carbonyl; sinus and pulmonary cancer.
- Zinc and its compounds – Typical forms of disease: Zinc fever; skin changes caused by zinc chloride (contact eczema, corrosion).
- Vanadium and its compounds – Typical forms of disease: Irritation of respiratory tract (chemical pneumonitis, bronchial constriction).
- Halogens and their inorganic compounds (chlorine, bromine, fluorine) – Typical forms of disease: Irritation and corrosion of mucous membranes and conjunctiva; chemical pneumonitis; bone changes caused by fluorine compounds (fluorosis); fever caused by fluorine polymer dispersion products (polymer fever); skin changes (contact eczema, corrosion caused by fluorides).
- Cyanide compounds – Typical forms of disease: Acute cyanide intoxication, chronic intoxication (respiratory symptoms, nervous symptoms); respiratory diseases caused by isocyanates (asthma).
- Carbon disulfide – Typical forms of disease: Acute intoxication with mainly central nervous symptoms; chronic intoxication by carbon disulfide with central and peripheral nervous symptoms, possibly associated with coronary heart disease.
- Hydrogen sulfide – Typical forms of disease: Acute intoxications with mainly respiratory and central nervous symptoms, and pulmonary oedema.
- Sulfur dioxide and sulfuric acid – Typical forms of disease: Irritative and inflammatory symptoms of mucous membranes and respiratory organs; corrosion of teeth and eyes; skin changes (contact eczema, corrosion).
- Nitrogen oxides, nitric acid and ammonia – Typical forms of disease: Acute respiratory irritation symptoms; pulmonary oedema; local irritation or corrosion of mucous membranes; skin changes (contact eczema, corrosion).
- Carbon monoxide – Typical forms of disease: Acute intoxication caused by carbon monoxide with mainly central nervous symptoms. The clinical picture is associated with elevation of carbon monoxide haemoglobinemia.
- Phosgene – Typical forms of disease: Acute irritative symptoms of respiratory tract and conjunctival tissues; pulmonary oedema.
- Inorganic bases and their anhydrides – Typical forms of disease: Skin changes (contact eczema, corrosion); acute irritation or corrosion symptoms of conjunctiva, mucous membranes, respiratory or gastro-intestinal tract.
- Aliphatic, aromatic and alicyclic hydrocarbons – Typical forms of disease: Acute and chronic mainly central and peripheral nervous intoxications; skin changes (contact eczema); leukaemias caused by benzene; hemangiosarcoma of the liver caused by vinyl chloride.
- Halogen derivatives of hydrocarbons – Typical forms of disease: Acute and chronic mainly nervous system intoxications; skin changes (contact eczema); cardiac arrhythmias and irritative respiratory symptoms caused by freons.
- Nitrous and amino derivatives of hydrocarbons – Typical forms of disease: Acute intoxications associated with methemoglobinemia; haemolytic anaemia, liver and eye changes caused by trinitrotoluene; skin changes (contact eczema); asthma caused by amines; cancer of urinary bladder caused by aromatic amines.
- Nitroglycerine and nitroglucol – Typical forms of disease: Central nervous and circulatory symptoms (i.e. hypotension, vasodilatation) caused either by acute or by chronic intoxication; skin changes (contact eczema).

- Aldehydes, ketons, alcohols ethers and esters – Typical forms of disease: Skin changes (contact eczema); asthma and rhinitis caused by formaldehyde; acute mainly central nervous intoxications caused by alcohols, ketons, ethers and esters; leukaemias caused by ethyleneoxyde.
- Organic acids and acid anhydrides – Typical forms of disease: Irritation and corrosion of skin and mucous membranes; asthma and rhinitis caused by acid anhydrides (i.e. phtalic acid, maleinic acid and trimellitic acid anhydrides).
- Phenol and its homologues and their halogen and nitro derivates – Typical forms of disease: Acute intoxications with respiratory, hepatic, renal and central nervous symptoms; chronic intoxication with central nervous and gastrointestinal symptoms; skin changes (contact eczema, changes in pigmentation); haemolytic anaemia; methemoglobinaemia; hepatic cancer caused by polychlorinated biphenyls.
- Antibiotics – Typical forms of disease: Skin changes (contact eczema); respiratory allergies.
- Cancer drugs: Alkylating substances (cyclophosphamede, chlorambusil, semustil, kermustine, lomustine) and antimetabolitis (atsathioprine) – Typical forms of disease: Leukaemias, lymphohaematopietic cancers and bladder cancer.
- Plastics and synthetic resins and the substances and intermediates involved in their production – Typical forms of disease: Respiratory diseases (asthma, rhinitis); skin changes (contact eczema).
- Organic dusts and exposures i.e. flours, corn, wood dusts and materials, animal epithelia, excretions and other exposures of animal origin, dusts of natural fibres and enzymes, natural resins, india rubber – Typical forms of disease: Skin changes (contact eczema, contact urticaria, protein contact eczema); allergic rhinitis, conjunctivitis or pulmonary asthma caused by organic dust, Monday fever (byssinosis) caused by raw cotton.
- Mineral dusts – Typical forms of disease: Pulmonary diseases caused by quartz and asbestos dust (pneumoconioses); pulmonary cancer and mesothelioma caused by asbestos; consequences of pneumoconioses in respiratory and circulatory organs.
- Tiuramines, carbamates, derivates of paraphenylenediamines – Typical forms of disease: Skin changes (contact eczema).
- Reactive and dispersion dyes – Typical forms of disease: Skin changes (contact eczema); asthma and rhinitis caused by reactive dyes.
- Aflatosins – Typical forms of disease: Cancer of liver.

#### ***Biological factors***

- Spores released by bacteria and molds and other biologically active substances – Typical forms of disease: Allergic alveolitis; asthma and rhinitis caused by molds; humidifier fever.
  - Tuberculosis bacilli – Typical forms of disease: Different forms of tuberculosis.
  - Viruses, bacteria, fungi, protozoa and schistosomes • Typical forms of disease: Hepatitis B, anthrax, erysipelas, ringworm, brucellosis, listeriosis, dermatic mycosis, toxoplasmosis, malaria, bilharziosis.
- 4 Tenovaginitis and humeral epicondylitis in subsection two of section 4 in the Act on Occupational Diseases are compensated as occupational diseases caused by a physical factor when caused by performing repetitive, monotonous or strained movements as designated in subsection one of section 1 of the Act on Occupational Diseases.

#### ***Statute on Certain Injuries Compensable as Occupational Accidents (852/48)***

- 1 According to the Statute on Certain Injuries Compensable as Occupational Accidents (852/48), passed in 1948, the following conditions are to be compensated in the same manner as occupational diseases or accidents, i.e. if they are caused by work factors:
- sores and galls
  - lesion caused by a corrosive substance

- lesion due to inhalation of a dangerous gas
- inflammation of the patella or elbow due to repeated or unusual pressure
- tendinitis crepitans due to repeated or monotonous work movements if it is not a complication of some defect, injury or illness that is not compensable under the Occupational Accident Insurance Act
- lesion attributable to extreme temperatures, for example, frostbite or sunstroke
- lesion due to considerable fluctuation in air pressure.

### 1.7 SCOPE OF THE SYSTEM

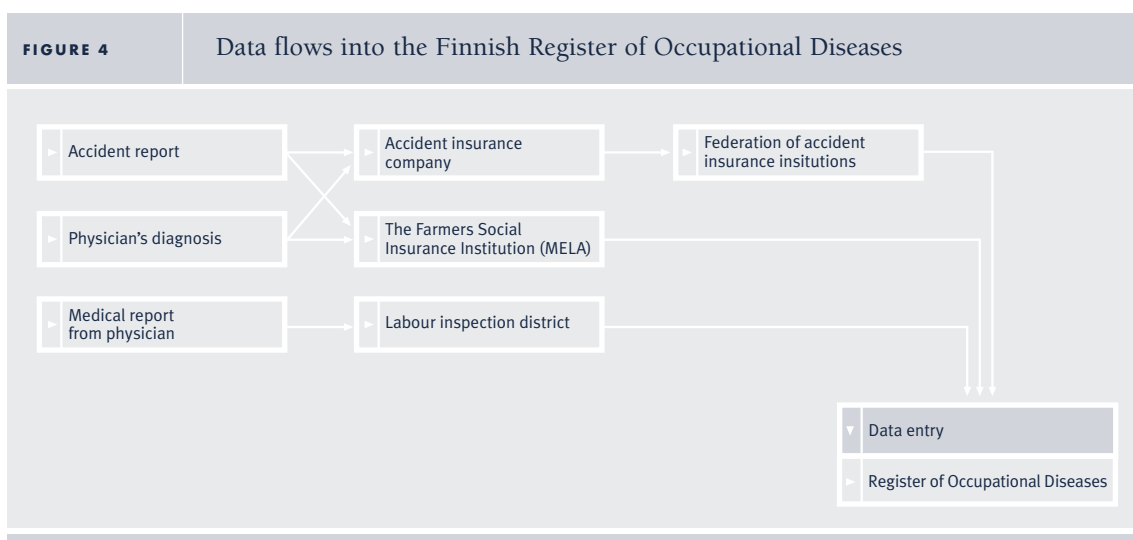
FROD is a national system that attempts to inform across all levels – national, regional, local, and the enterprise. Employers and doctors are subject to mandatory reporting requirements. The detailed classification of information makes FROD potentially very useful for the prevention of occupational diseases. Links to other information systems are possible using the Finnish Social Security Number.

### 1.8 SIGNIFICANT MODIFICATION(S), IF ANY

In 1975, the register also began to receive notification of occupational diseases that are reported by medical practitioners under the provisions of the Supervision of Labour Protection Act. Until 1981, the system covered employees only. Since 1982, farmers have also been included in the system and, at that time, became entitled to compensation for occupational injuries.

## 2. INFORMATION COLLECTION

The objects of registration are notification of new occupational diseases. There are two sources of information<sup>208</sup>. Insurance companies send reports of cases where compensation is claimed for occupational disease. The Ministry of Labour sends reports of cases received from medical practitioners on the basis of the Act on the Supervision of Labour Protection. The database system helps ensure that each new case is recorded only once. The information received by FIOH is checked and stored in the database.



### 3. CONTENT OF SYSTEM

A reasonably large amount of data is collected. A recorded case of an occupational disease contains identification data on the person (personal ID number, name, sex, age, occupational title), information on the employer (name, industry, location), description of the disease (diagnosis, date of diagnosis), information on causes (exposures and exposure times), and information on compensation and severity. Data on costs of claims and cases is not held in the register.

### 4. METHOD

A diagnosed case of occupational disease is the statistical unit of observation<sup>201</sup>. Diseases are identified with codes from the Finnish edition of *International Classification of Diseases, 1975* (9th Edition). Causes of diseases are represented using the *Exposure Classification of The Institute of Occupational Health, 1990* revision. Occupational diseases are classified by “diagnosis” and “cause” into the following disease groups:

#### **Hearing loss**

Noise-induced hearing loss refers to the deterioration of hearing due to prolonged exposure to noise or sometimes also due to momentary impulse noise.

#### **Repetitive strain**

A repetitive strain injury is a musculoskeletal disease, caused by injury non-physiological stress in work (repetitive and monotonous work, unusual working postures). The group includes tenosynovitis, peridentinitis, epicondylitis, bursitis and mononeuropathy.

#### **Allergic respiratory**

Allergic respiratory diseases include asthma, allergic rhinitis, allergic alveolitis, and organic dust toxic syndrome (ODTS).

#### **Skin diseases**

Occupational skin diseases are caused by chemical agents or micro-organisms in the work environment; the most important diseases in this group are irritant contact dermatitis, allergic contact dermatitis, and protein contact dermatitis/contact urticaria.

#### **Asbestos-induced**

This group includes all occupational diseases caused by asbestos, pleural adhesions and calcifications being the most frequent. Cancer and asbestosis are the most severe diseases in this group.

#### **Others**

This group includes infectious diseases, conjunctivitis, vibration syndrome, and various types of poisoning.

### 5. INFORMATION RESOURCES

Little information is available on the specific information resources stored. Information is available in Finnish, Swedish, and English.

### 6. COSTS

Little information is available on the costs of administering the system.

## **7. ANALYSIS**

Annual statistics are available from the FIOH. The annual statistics contain a review in text and graphs of main trends, and a collection of statistical tables where occupational diseases are classified according to sex, age, diagnosis, cause, profession, trade, and location in different combinations. In certain years, an English edition of the statistics is published. Tailor-made statistical reports are produced on demand, in print or on computer media. Other summary reports are published regularly, and specific statistical analyses are available on request. Statistical analyses are also available from the Finnish Federation of Accident Insurance Institutions (FAII). However, the statistics published by the FIOH differ somewhat from the statistics maintained by the FAII. In FIOH statistics, cases are included according to the date of diagnosis, whereas in the FAII statistics the reported cases of occupational disease are included according to the administrative date of occurrence as defined by the insurance legislation, which may differ greatly from the actual date of diagnosis, e.g. in cases of asbestos-induced disease and cases of hearing loss. The FIOH statistics also include occupational diseases of farmers, which are not included in the FAII statistics.

The interpretation of the FIOH statistics is presented transparently. For example, “In 2002, for every 10,000 employed workers, 20 cases of occupational disease were reported. The association between employment and the number of occupational diseases is complex, as some diseases take longer to develop than others. Workplace noise, for example, leads to a slow deterioration in hearing over a number of years, whereas a large proportion of the repetitive strain injuries and irritant contact dermatitis develop rapidly. The cases reported in 2002 thus reflect the working conditions of the 1990s or the first years of the 2000s. Furthermore, some occupational diseases may not manifest themselves before the general retirement age (65 years), for example asbestosis and lung cancer. In spite of these problems, the incidence rates are calculated using the employment figures of the same year in which the case was reported. There has been a slight but steady decline in the incidence of occupational diseases per number of employed workers”<sup>201</sup>.

## **8. EVALUATION**

Data is rapidly made available to all sections of occupational health and safety administration in Finland. Since the system does not wait for compensation decisions, statistics are available very quickly. However, this means that compensation status will not be known for all cases.

## **9. USE, DERIVATIONS**

The intended users of the system include administrative and field personnel in labour protection, and healthcare and research organisations. The detailed classification of information in FROD makes the register potentially very useful for the prevention of occupational diseases. The major limitation to the data set is the lack of any information on costs of claims or cases. It is known that coverage of the register is “incomplete” since both medical practitioners and insurance companies sometimes neglect to report occupational diseases to the system.

## **10. SYSTEM IMPROVEMENT**

The FROD is well designed and implemented. Impending modifications are not reported at present.

## **FINNISH REGISTER OF OCCUPATIONAL INJURIES (FINOCCINJB)**

### **1. SYSTEM DESCRIPTION**

The FINOCCINJB system contains records of occupational injuries. Injuries are reported by employers. In Finland, an employer is obliged to take out statutory workers' compensation insurance if an employee works for at least 12 days a calendar year. An insurance institution cannot reject an application for an insurance policy. Since 1992, the accident insurance companies have been obliged to keep statistics on work accidents and occupational diseases. However, this statistical information was collected voluntarily before that date. The Federation of Accident Insurance Institutions (FAII/VAKES) comprises 12 companies and two state organisations. This Federation produces an annual publication on the work accidents and occupational diseases and supplies the authorities, researchers, and other interested parties with the information.

Employers are obliged to notify those occupational accidents causing more than three days absence from work to their insurance company. It is worth noting that the Federation of Accident Insurance Institutions is obliged to provide the register with data on every case reported to them, regardless of compensation decisions. The Federation of Accident Insurance Institutions is the owner of the register, but it is maintained by the Finnish Institute of Occupational Health, a private institution funded by the government. The system contains records of occupational diseases reported by physicians and/or insurance companies. All employees and farmers are covered by the system. The unit of observation in the register is a filed claim of an occupational injury<sup>208</sup>.

The aim of the FINOCCINJB system is to provide statistical information of occupational injuries for labour protection, occupational health care, and research<sup>209,210</sup>. Intended users include administrative and field personnel in the labour protection and health care organisations and researchers of occupational health. Each year there are approximately 120,000 occupational injuries recorded. The number of fatalities is in the range of about 50 cases.

#### **1.1 DATE ESTABLISHED**

The Finnish Register of Occupational Injuries (FINOCCINJB) was established in its current form in 1992. Originally, all the statistical material was coded by the Ministry of Labour, but nowadays it is generated by the Federation of Accident Insurance Institutions. This change occurred in 1992. Statistics are available from 1989.

#### **1.2 ORGANISATION/INSTITUTE/OWNER/OPERATOR**

The Finnish Register of Occupational Injuries was previously maintained by the Occupational Safety and Health Division of the Ministry of Labour. Currently it is owned by the Federation of Accident Insurance Institutions and run by the FIOH.

#### **1.3 SYSTEM RESIDES WHERE IN ORGANISATION**

Figure 3 above that illustrates the occupational safety and health system in Finland. Surveillance registers are the responsibility of the Ministry of Social Affairs and Health, and epidemiological expertise is provided by the Finnish Institute of Occupational Health.

#### **1.4 FUNDING SOURCES**

Funded by compulsory insurance and the government.

#### **1.5 PERSONNEL REQUIREMENTS TO OPERATE SYSTEM**

Details are not available.

#### **1.6 TARGET GROUP/POPULATION**

All employed persons in Finland.

#### **1.7 SCOPE OF THE SYSTEM**

FINOCCINJB is a national system that attempts to inform across all levels – national, regional, local, and the enterprise. Employers are subject to mandatory reporting requirements. The detailed classification of information makes FINOCCINJB potentially very useful for the prevention of occupational diseases. Links to other information systems are possible using the Finnish Social Security Number.

#### **1.8 SIGNIFICANT MODIFICATION(S), IF ANY**

Until 1981, the system covered employees only. Since 1982, farmers have also been included in the system and became entitled to compensation for occupational injuries.

### **2. INFORMATION COLLECTION**

The objects of registration are notification of new occupational injuries. By law, the insurance companies have to provide data to the surveillance register.

### **3. CONTENT OF SYSTEM**

A reasonably large amount of data is collected. A recorded case of an occupational injury contains identification data on the person (personal ID number, name, sex, age, occupational title), information on the employer (name, industry, location), description of the accident, type of accident, injured part of the body, type of injury, severity of the accident, and the NACE code. Data on costs of claims and cases is not held in the register. The NACE-code system is based on the European standard for industry classifications and was introduced in 1970. In 1990, a revised version became applicable. NACE means Nomenclature Générale des Activités Économiques dans l'Union Européenne (General Name for Economic Activities in the European Union). The first four digits of the code are the same in all European countries. The fifth digit might vary from country to country and further digits are sometimes placed by suppliers of databases. The 16 markets (manufacturers, agriculture, etc.) are denoted by letters from A

to Q. A further 59 principals groups have been given two-digit NACE codes, which can then be subdivided into 640 individual groups (four-digit NACE codes).

#### **4. METHOD**

A statistical event is an accident that has occurred to an employee at work or in connection with work. Fatal accidents form a separate register dating back to 1975. The Finnish Database of Descriptions of Severe Occupational Injuries (FININJDESC) contains information about all severe injuries that were examined by labour inspectors. Accident reports include a description of the analysis of causes. Each labour protection department has access to its own database.

#### **5. INFORMATION RESOURCES**

Little information is available on the specific information resources stored. Information is available in Finnish, Swedish, and English.

#### **6. COSTS**

Little information is available.

#### **7. ANALYSIS**

Statistics are made available regularly. Access to the database is restricted. The quality of data is not measured. The FIOH are open in suggesting that there are reasons to believe it is not of high quality. The codes that are used to categorise accidents are not considered good. However, when compared with neighbouring Nordic countries, they believe that the coverage of accidents is good. Nearly all accidents that result in three or more days off work are likely to be included in the system. The system can be used to measure how many accidents occur in different industries, occupations, etc. However, it provides scant information about how the accidents happened and the probable causes. The exceptions to this are the serious injuries that are attended by labour inspectors, but the quality of this data is dependent on the ability of the inspectors to make useful analyses of the accidents. This is believed to be variable.

#### **8. EVALUATION**

Data is rapidly made available to all sections of occupational health and safety administration in Finland.

#### **9. USE, DERIVATIONS**

The intended users of the system include administrative and field personnel in labour protection and healthcare and research organisations.

# Sweden

## Informationssystemet om arbetsskador (ISA), The Work Injury Information System

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### 1. SYSTEM DESCRIPTION

All gainfully employed persons in Sweden are insured for work injury under the Work Injuries Insurance Act (LAF)<sup>211</sup>. The Employment Injury Insurance Act was replaced by the Work Injury Insurance Act on 1 July 1977. All economically active persons – employees, employers, and self-employed persons, regardless of nationality, are compulsorily insured for occupational injuries. Persons undergoing training are also insured for occupational injuries insofar as their training involves any such risk.

The work injury insurance scheme presents a general description of what is to be considered as occupational injuries. The concept is taken to comprise injuries resulting from accidents or other harmful influences at work. The term “harmful influence at work” refers to factors in the working environment that, with a high degree of probability, can be the cause of the type of injury that the insured has. The requirement for a high degree of probability was introduced in 1993. At the same time, the terms of the work injury insurance were tightened up in an additional respect. If it is clear that the insured has suffered an accident or some other harmful influence at work, their injury must be presumed to be a result from the harmful influence only if there are stronger grounds for such a presumption than the contrary. Before 1993, this rule of evidence was inversely formulated, i.e. the presumption was made if there was no stronger evidence against it. According to a transitional rule connected to the tightening up of the Work Injury Insurance Act, reports received by June 1993 would be judged according to the earlier rules, if the injury had appeared before 1 January 1993. Intense campaigns by the trade unions, among others, contributed to a doubling of the number of reported occupational diseases in 1993 compared to 1992. The frequency rate of occupational diseases for 1998 is still less than half of that for 1992, in spite of an increase compared to 1997.

On 1 July 1993, the rules concerning compensation for occupational injuries were also changed. The work injury insurance is now fully coordinated with the general health insurance, and there is no extra compensation for occupational injuries. The injured person receives the same health insurance benefit as others, i.e. medical care on the conditions of the general health insurance and a sickness benefit after two weeks of absence. Before that, the employer provides sick pay to all, according to the Sick Pay Act. However, the insurance still includes an annuity for persons whose work capacity has been permanently reduced as the result of an occupational injury. In principle, this annuity provides full compensation for loss of earnings. The abolition of the higher work injury benefit means that, in most cases, there is no longer an incentive to report occupational injuries. The obligation for employers to report all injuries remains, however.

Occupational injuries are taken to include accidents occurring on the way to or from a workplace (commuting accidents) on condition that the journey was occasioned by, and was closely connected with, the insured person’s work.

The work injury insurance, like the general social insurance in Sweden, does not regulate questions concerning compensation for incapacity and injury and other such inconveniences. In these respects, instead the injured employee is able to obtain compensation under special social security insurance agreements which have been concluded between employers’ associations and trade unions and which include most employees in Sweden.

A system for collecting information on occupational injuries was instituted in January 1979. It is called Informationssystemet om arbetsskador (ISA), which translates as the Work Injury Information System.

The purpose of ISA is to provide the basic information required for injury prevention measures in industry. The system is based on the work injury insurance form drawn up by the National Social Insurance Board in co-operation with the Swedish Work Environment Authority. The official statistics on occupational accidents and diseases mainly encompass the same population and nomenclature as the work injury insurance scheme.

Employers are responsible for reporting all work injuries to the Social Insurance Office. The Social Insurance Office is required to send a copy of the report to the Work Environment Inspectorate, where reports are examined, coded, and registered. If a report is incomplete, the employer is contacted for further information. Reports are then sorted, encoded, and computer-recorded. In the case of injuries classed as work-related diseases, the administrative data are encoded and computer-recorded, after which the report is sent to the head office of the Swedish Work Environment Authority for further encoding and computer recording.

#### **1.1 DATE ESTABLISHED**

The current ISA system began operating in 1979.

#### **1.2 ORGANISATION/INSTITUTE/OWNER/OPERATOR**

The system operates under the Swedish Work Environment Authority, formed in 2001 through the amalgamation of the ten districts of the Labour Inspectorate and the National Board of Occupational Safety and Health. ISA was operated by the National Board of Occupational Safety and Health from 1979. Prior to that date, the National Social Insurance Board had been responsible for the statistics on occupational injuries.

#### **1.3 SYSTEM RESIDES WHERE IN ORGANISATION**

ISA is a national system for the whole of Sweden.

#### **1.4 FUNDING SOURCES**

Government funded.

#### **1.5 PERSONNEL REQUIREMENTS TO OPERATE SYSTEM**

Details are not available.

#### **1.6 TARGET GROUP/POPULATION**

The system covers all economically active persons in Sweden, approximately 4 to 5 million people.

### **1.6.1 Occupational health importance**

All occupational diseases are supposed to be registered.

### **1.6.2 Occupational injury importance**

Not all injuries have to be reported. Occupational accidents – except those involving dental injuries, acute hearing impairment, acute psychic reaction (by threat, violence, robbery etc) – are registered only if the injured person is absent from work for at least one day after the day of the accident.

Work injuries are divided, according to type of injury, into three groups: occupational accidents, commuting accidents, and work-related diseases. This is done on the following basis:

- Occupational accidents are accidents occurring at the workplace or at another place where the injured person was present in the course of, or for the purpose of, work.
- Commuting accidents are accidents occurring during the direct daily journey to or from work.
- Work-related diseases are work injuries which have resulted from a harmful influence other than an accident. Harmful influences of this kind include, for example, exposure to chemical substances, radiation, one-sided movements, or mentally strenuous working conditions.

## **1.7 SCOPE OF THE SYSTEM**

ISA is a national system that attempts to inform across all levels – national, regional, local, and the enterprise. The system contains information about the injured person e.g. age, sex, occupation, workplace, the working conditions, and the nature and extent of the injury and external agencies involved, e.g. machines, tools, equipment. The general aim of ISA is to provide a basis of information required for prevention, produce information for the inspectorate to use in supervision of work, and to use statistical information to identify risk groups and risk factors to be used for directing efforts to prevent occupational injuries.

## **1.8 SIGNIFICANT MODIFICATION(S), IF ANY**

The ISA system does not appear to have been modified significantly.

## **2. INFORMATION COLLECTION**

Information is collected from employers. The basic input for the system is the information from the injury report form. This document gives information about the injured person and their occupation, employment status and work situation, as well as about the nature and extent of the injury sustained.

## **3. CONTENT OF SYSTEM**

The following information on occupational injuries is included on the form:

- The enterprise, including the economic activities and the number of employed at the establishments.
- The injured person's details, including age, occupation, length of service, etc.
- The working conditions – form of pay, experience of the injured person, etc.

- The nature and extent of the injury – part of body injured, nature of injury, number of days of absence from work and final diagnosis (from the National Insurance Office).
- Circumstances of the injury – special sections suited to the requirements of worker protection are provided. Both codes and free-text descriptions are used. This makes it possible to identify the place where the injury occurred, the activity of the injured person when the accident occurred, the events leading up to the accident, and the external agencies such as tools, equipment, machinery, materials, work-pieces etc that influenced the event

For the purpose of official statistics, one main event and one principal agency is chosen according to a rating system based on ILO's recommendations for classification of accidents. This means that one event is selected as the principal cause of the injury. To this event is linked the external factor that has mainly contributed towards or affected the course of the injury occurring. The term "external factors" refers to machinery, implements, materials, substances etc.

The economic-branch classification used is the Swedish Standard Industrial Classification, 1992, SE-SIC 92, which is based on the statistical classification of economic activities in the European Community, the revised version NACE Rev. 1. Data on economic branch of industry at establishment level within different enterprises are obtained from the Central Register of Enterprises, which is compiled by Statistics Sweden (SCB). The occupation of the injured person is classified according to SSK, the Swedish version of ISCO88 COM that is used in The Swedish Labour Force Survey (AKU). Data concerning the number of gainfully employed persons, used for the calculation of relative frequencies, are taken mostly from the Labour Force Surveys (LFS), except for those connections where frequencies are presented by branches of economic activity at a somewhat more detailed level. For these, data concerning the number of gainfully employed persons have instead been taken from the register-based labour market statistics (RAMS) for 1998. LFS is based on random samples of the population, which means that the data are estimates with a degree of uncertainty depending, among other things, on the size of the group concerned. This publication gives relative frequencies only for groups comprising at least 1,000 gainfully employed persons, regardless of whether the employment data are taken from LFS or RAMS.

#### **4. METHOD**

Quite a large number of variables are collected for entry into the ISA database. They are entered as a mixture of codes and free text. The former is useful for summary statistics, and the latter is made available for research that is more detailed.

Data collected includes the following, in addition to personal details of the injured individual: time of the injury; number of years in occupation; number of years in the enterprise; the professional situation of the injured (i.e. employee, self-employed); if immigrant; main language (only coded until 1991); number of years in Sweden (only coded until 1991); employer/self-employed and workplace; workplace details (location, etc); industry type; number of people employed; occupational health service; in training at work (only coded until 1991); information provided about risks (only coded until 1991); experience and practice; regular hours of work; working schedule; method of wage payment; extent of injuries; injured parts of the body; kind and nature of the personal injury; illness or other injuries; severity of injury (absence from work); description of the injury event; step by step description and specification of the accident in question (includes place, activity, main event, previous events and main external agency are described both with a code and with free text); place where the injury occurred; the injured person's activity; whether the injury occurred outdoors or indoors (only coded until 1991); whether the workplace was temporary (only coded until 1991); whether the person was engaged in solitary employment (only coded until 1991); machine, material, vehicles, substances etc. involved in the injury; external agencies, coded and

given in free text; whether machines/material functioned as usual; description of the injury and possible causes or, if an illness, the suspected causes; other factors that could have caused the injury; and measures taken preventing repetition of injury.

## **5. INFORMATION RESOURCES**

Little information is available.

## **6. COSTS**

Little information is available.

## **7. ANALYSIS**

Statistics are available from the Swedish Work Environment Authority (SWEA), and several different types of information on injuries have been developed to assist with planning. The SWEA have reported on the use of their occupational accident and disease database. They noted that in Sweden the demand for, and use of, statistical information on occupational accidents and diseases has increased over the years. Use includes general statistics to identify risk groups to highlight, show the need for, and give priority to, preventive measures. The content and structure of the Swedish Accident and Disease Database (ISA) has therefore developed during its 20 years of existence.

One approach to identify risk groups is to analyse trends of injuries by economic activity, occupation, or material agent. The statistics are in general available by sex, age, and regional distribution. The information is used for further studies of aggregated cases to identify risks and deviations to prioritise within a field. Another way of utilising the database is to identify specific, previously unknown problems through the study of specific accidents.

## **8. EVALUATION**

The Labour Inspectorate has direct online access to the database. They have software that gives aggregated statistics at the regional level down to the company and workplace level. The Labour Inspectors also handle the forms for notification of occupational injuries. More specifically, the Inspectorate, in their annual planning, look at trends by branch of activity to see where to place the priority. Finding a high-risk branch leads to a more detailed study of events and external agents causing accidents. It is also possible to study lists of workplaces sorted by highest ratios of accidents per employee. External users can only access the detailed national publications from the website but they cannot access the ISA database.

## 9. USE, DERIVATIONS

The main users of ISA are the Swedish National Board of Occupational Safety and Health and the ten regional Labour Inspectorates, but there are also various external users. For example, the SWEA noted that, in 1999, 400 requests for statistics on injury were dealt with. These requests involved more than a telephone question or a quick answer obtained from the publications of the Statistics division. The documented requests refer to jobs including everything from 30 minutes work, up to weeks of search and compilation of statistics. 40% of the tasks were carried out for external users and the remaining 60% were carried out for internal users. The proportion of external users by type was as follows:

- Press, TV, radio, and other media 23%
- Organisations, unions, employers 17%
- Companies 17%
- Governmental agencies 16%
- International requests 9%
- Research organisations 8%
- Other external users 10%

They note that the requests for statistics from the media call for comprehensible statistics, with few values, which are clearly explained. Organisations often ask for information on the occurrence of occupational injuries among their members; the information is often derived from matching data from the organisation's member file and the database of ISA. Companies in general ask for rates on specific economic activity, to relate their internal statistics on injuries. Governmental requests are dealt with using statistics from publications and other general sources. The requests from international bodies have increased and include questions about the Swedish system, general official statistics and micro-data. Requests for statistical information from researchers are fewer but, in general, they take much more time and effort to deal with.

## 10. SYSTEM IMPROVEMENT

The information in the Swedish National Occupational Accident and Disease Database is based on the notification form from the National Insurance and the Labour Inspectorate. The form is filled in by employers at workplaces where an occupational injury has occurred. In Sweden, employers are obliged to report all work-related injuries. Owing to less compensation for the injured, there is a problem with under-reporting from the employers.

This means that accident coverage in ISA is probably good, but coverage of diseases is less well known. The quality of coding is checked through control coding, both of accidents and of diseases, and has been found to be acceptable. Some ad hoc studies concerning under-reporting to the system have been carried. One study completed in 1988 showed that over 70% of individuals that visited the hospital and had at least one day of absence from work were also reported to ISA.

## United States

The United States is a federal republic of 50 separate states and 1 district, with a total population approaching 300 million. Each state has its own legislature, and many government and quasi-governmental systems operate at both the federal and state levels. This makes for considerable variation in the implementation of most regulatory systems and services between states. The situation is further complicated by the duplication and overlapping interests of organisations and services. Some of these appear to compete for the same “territory”, and effective co-operation or collaboration does not always occur.

This makes reviewing occupational surveillance systems in the US a very complex task. There are organisations at both federal and state level that run various systems, in addition to a myriad of systems run at the regional enterprise levels. Many of the latter exist only within the private sector. Given the large population of the US, it is worth noting that state and regional systems may serve populations that are as large, if not larger, than other national systems. This means that a singular focus on federal surveillance systems is inappropriate for this review. In fact, some might argue that the federal systems are unwieldy and suffer from poor coordination, leading to reduced utility. Therefore, in addition to a review of federal approaches in the US, examples from the state and regional levels will be included.

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### **FEDERAL APPROACHES TO OCCUPATIONAL SURVEILLANCE IN THE US**

The National Institute for Occupational Safety and Health (NIOSH) is the principal federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH is part of the Centers for Disease Control and Prevention (CDC) in the Department of Health and Human Services.

Other important federal agencies include the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA). Both OSHA and MSHA are part of the US Department of Labor. OSHA's declared mission is to “assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health”. OSHA publishes standards and enforces them. Among these are standards for occupational exposures, e.g. heavy metals and chemicals such as benzene, vinyl chloride, etc. Part of OSHA's enforcement approach is to require medical surveillance and/or biological monitoring, and employers may be required to fund this in both the present and for a defined period into the future. Therefore, OSHA's data contributes importantly to surveillance at the level of the individual, in specific working circumstances. MSHA has a similar role, focused on the mining industry and exposures to important substances such as mineral dusts and heavy metals. A more recent attempt by OSHA to implement an ergonomic standard for all US workplaces was met with intense debate and controversy, ending ultimately in failure. The ergonomic standard was released in November 2000. The business community almost immediately rallied against it, saying compliance would cost

them anywhere from \$20 billion to more than \$100 billion a year. They also argued that it federalised the workplace, and was a standard based on “junk science”. Meanwhile, trade unions praised the standard as “the most important action ever by OSHA”, although many would have preferred it to be tougher still. In March 2001, Congress overturned the standard, requiring OSHA to start over again.

NIOSH, OSHA, and MSHA are all engaged in a wide array of activities, including surveillance of occupational hazards, diseases, and injuries. Tracking occupational injuries, illnesses, hazards, and exposures has been an integral part of NIOSH since its creation by the Occupational Safety and Health Act in 1970. NIOSH currently defines public health surveillance as “the ongoing systematic collection, analysis, and interpretation of health data for purposes of improving health and safety. Key to public health surveillance is the dissemination and use of data to improve health. Occupational health surveillance can be viewed as the tracking of occupational injuries, illnesses, hazards, and exposures. Occupational surveillance data are used to guide efforts to improve worker safety and health, and to monitor trends and progress over time”. Furthermore, they add, “Surveillance includes both population- or group-based activities and individual-based activities. The latter are often referred to as worker screening and monitoring functions and are undertaken for the detection of early disease in individuals followed by intervention steps to prevent further exacerbation”.

NIOSH’s initial surveillance work focused on occupational hazards and health effects. The initial hazard surveillance efforts included the National Occupational Hazard Survey (NOHS) of general industry, conducted in the early 1970s. NOHS used a representative sample of 5,000 establishments and identified more than 9,000 potential workplace hazards. NIOSH conducted a second survey of potential hazards in general industry – the National Occupational Exposure Survey (NOES) – in the early 1980s and a similar survey of potential hazards in the mining industry – the National Occupational Health Survey of Mining (NOHSM) – in the late 1980s. Competing priorities within the Institute, as well as cost considerations, have kept further surveys from being conducted on a regular basis. In recent years, NIOSH hazard surveillance efforts have also included dissemination of surveillance reports that incorporate results of OSHA and MSHA inspection sampling. NIOSH believe that important hazard data has been generated because of investigation activities carried out under various programmes<sup>118</sup>.

Currently NIOSH runs the Health Hazard Evaluation (HHE) programme to respond to requests for workplace evaluations from employers, employees and their representatives, and other agencies. Through the HHE programme, NIOSH attempts to identify current hazards and to derive practical and scientifically valid recommendations solutions for reducing exposures and preventing disease, injury, and subsequent disability. NIOSH use a recent outbreak of a rare respiratory disease at a microwave popcorn processing plant in Missouri as an example of one of their successes. NIOSH determined that the workers’ illness was caused by exposure to inhaled vapors from artificial butter flavorings. The company instituted NIOSH recommendations to protect its workers, and NIOSH scientists provided laboratory and outreach efforts to further characterise the nature and the scope of the problem.

However, NIOSH acknowledges that hazard surveillance systems are currently less well developed than those that track injuries and diseases. They remain the most compelling, but least well researched approach<sup>212</sup>. Hazard surveillance is considered important since it could serve as the basis for the primary prevention of work-related morbidity and mortality because it is directed at earlier recognition of risks than are systems that simply tabulate injuries and illnesses once they have occurred. A lack of hazard surveillance systems creates a serious gap in the type of data necessary to prevent occupational disease, injury, and death. It is suggested that hazard surveillance systems might help improve worker safety and health by<sup>213</sup>:

- identifying and quantifying exposure to occupational safety and health hazards associated with chemical, physical, and biological agents; biomechanical stress; unguarded machinery; elevated work surfaces; electrical energy; and psychosocial factors or job stressors
- targeting high-risk groups for interventions

- evaluating the effect of engineering technologies on the mitigation of exposures
- anticipating morbidity and mortality
- disseminating important safety and health information.

Initial health surveillance efforts by NIOSH involved the analysis of data primarily from the National Center for Health Statistics (NCHS) National Health Interview Survey (NHIS), the Social Security Administration (SSA) disability award files, and the NCHS Vital Statistics Death Certificate Data files. Data were also analysed from the NIOSH-administered Coal Workers' X-Ray Surveillance Program (CWXSP), a national programme that has involved over 300,000 examinations of active underground coal miners since 1970. In the early 1980s, NIOSH collaborated with NCHS and state vital statistics departments to develop the National Occupational Mortality System (NOMS), which enables the use of the national mortality statistics programme for periodic surveillance of cause-specific mortality by decedents' usual industry and occupation. In the late 1980s, NIOSH established the National Surveillance System of Pneumoconiosis Mortality (NSSPM), providing annually updated information on all deaths in the United States with pneumoconiosis listed as a cause of death. In the 1990s, NIOSH began the periodic publication of the Work-Related Lung Disease Surveillance Report, which presents data from the NSSPM and other sources. Collaboration between NIOSH and states related to occupational safety and health surveillance began with the Surveillance Cooperative Agreements between NIOSH and States (SCANS), a programme that increased state health department capacities in the area of occupational safety and health.

Initial injury surveillance efforts within NIOSH began in the early 1980s with analyses of data collected by other agencies (e.g., Bureau of Labor Statistics – BLS workers' compensation-based Supplementary Data System – SDS) and other collaborative efforts (e.g., interagency agreement between NIOSH and the Consumer Product Safety Commission – CPSC to collect work-related injury data in the National Electronic Injury Surveillance System – NEISS). NIOSH also developed the National Traumatic Occupational Fatalities (NTOF) Surveillance System to fill a gap in basic information on fatal occupational injuries, providing information on all work-related deaths in the United States based on death certificates. In 1993, NIOSH published a major surveillance report summarising NTOF system data<sup>214, 215</sup>.

The current NIOSH surveillance programme remains diverse and focused on all three major areas of interest: hazards, diseases, and injuries. There are a number of divisions within NIOSH that focus on surveillance.

- The Surveillance Branch in the Division of Respiratory Disease Studies (DRDS) analyses and collects data on occupational respiratory disease.
- The Surveillance and Field Investigations Branch in the Division of Safety Research (DSR) analyses and collects data on occupational injuries in general.
- The Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS) analyses and collects data on non-respiratory diseases and illnesses, such as dermatitis, lead and pesticide poisoning, and cancer.
- The Pittsburgh and Spokane Research Laboratories analyse and collect data on the mining industry.

The NIOSH surveillance programme involves external collaborations in addition to these internal activities. At first glance, this appears something of a “patchwork quilt” approach. NIOSH state that they complement the statistical or surveillance activities carried out by other federal agencies (including the Bureau of Labor Statistics, the Occupational Safety and Health Administration, the Mine Safety and Health Administration, and the National Center for Health Statistics), state governments, and private sector groups such as employers. Specific programmes that contribute to injury and disease surveillance include the National Health Interview Survey and the National Health and Nutrition Examination Survey of the National Center for Health Statistics, the Annual Survey of Occupational Injuries and Illnesses of the Bureau of Labor Statistics, and the National Electronic Injury Surveillance System of the Consumer Product Safety Commission. However, many other systems may also be used to contribute. The Centers for Disease Control and Prevention reported in 1996 through its National Occupational Research Agenda (NORA) that, “Assorted data sources and models of surveillance exist in the public and private sectors, but most still await implementation as comprehensive, integrated national systems. This is an important

research need, because NIOSH and its partners in the private and public sectors have limited data to assess, nationally or locally, the impact of intervention efforts on worker safety and health. Targeting high-risk populations for interventions using existing surveillance systems is also difficult<sup>212</sup>.

The list of NIOSH survey and surveillance programmes includes the following:

- Adult Blood Lead Epidemiology and Surveillance (ABLES) programme
- Census of Fatal Occupational Injuries (CFOI)
- The Center to Protect Workers' Rights (CPWR)
- 1998 Childhood Agricultural Injury Survey (CAIS)
- Coal Workers' X-Ray Surveillance Program (CWXP)
- Current Population Survey (CPS)
- Mine Safety and Health Research at NIOSH
- 2000 Minority Farm Operator Childhood Agricultural Injury Survey (M-CAIS)
- Multiple-Cause-of-Death Data
- National Agricultural Workers' Survey (NAWS)
- National Electronic Injury Surveillance System (NEISS)
- National Notifiable Diseases Surveillance System (NNDSS)
- National Occupational Respiratory Mortality System (NORMS)
- National Surveillance System for Health Care Workers (NaSH)
- National Surveillance System for Pneumoconiosis Mortality (NSSPM)
- National Traumatic Occupational Fatality (NTOF) Surveillance System
- Sentinel Event Notification System for Occupational Risk (SENSOR)
- Surveillance of Health Care Workers with AIDS
- Surveillance for Tuberculosis (TB) Infection in Health Care Workers
- Survey of Occupational Injuries and Illnesses (SOII)
- Traumatic Injury Surveillance of Farmers (TISF) Survey.

Three of these surveillance systems currently conducted by NIOSH to track occupational injuries and diseases can be described as “flagships”. They are federal in design and operation, but they are necessarily state-based for implementation. However, uptake across states has been variable to date. The first is the Sentinel Event Notification System for Occupational Risks (SENSOR)<sup>8, 9, 82, 155, 164, 216-231</sup>. This is a collaborative effort with state health departments aimed at improving the recognition and prevention of occupational sentinel health events, such as asthma, silicosis, amputations, burns, dermatitis, and noise-induced hearing loss. The second is the Adult Blood Lead Epidemiology and Surveillance (ABLES) programme in over two-thirds of the states<sup>225, 232-240</sup>. ABLES is designed to enable states to track and respond to cases of excessive lead exposure and to develop broader intervention activities. The third is the NIOSH National Traumatic Occupational Fatalities Surveillance System (NTOF), which identifies occupational injury fatalities based on death certificates and allows description of causes of death and comparison of rates among industries and occupations as well as trends over time. The NIOSH Fatality Assessment and Control Evaluation (FACE) programme is designed to provide in-depth field investigations of individual occupational fatalities and is effective in identifying and disseminating prevention information.

#### **SENTINEL EVENT NOTIFICATION SYSTEM FOR OCCUPATIONAL RISK (SENSOR)**

In 1987, NIOSH began the SENSOR programme. The goal was to develop models for state-based disease or injury condition-specific surveillance and enhance the capability of the participating states to direct appropriate and effective intervention and prevention efforts. In addition to ongoing disease and injury surveillance, NIOSH/state collaborative efforts have supported the standardisation of variables collected by the state programmes, the creation of software to facilitate capacity building of surveillance systems by additional states, the evaluation and

comparison of SENSOR surveillance data with other surveillance data sources, and publication and dissemination of SENSOR reports. There is already a moderate amount of literature on the SENSOR system<sup>8, 9, 82, 155, 164, 216-231</sup>.

The Washington State Department of Labor and Industries runs the Safety and Health Assessment and Research for Prevention (SHARP) programme. This currently conducts surveillance for a limited range of injuries and diseases as part of the SENSOR system. These are: asthma, hospitalised burns, dermatitis, adult blood lead levels, traumatic head and brain injuries, workplace violence, and work-related musculoskeletal disorders. Occupational dermatitis is used as the example for this review.

SHARP summarises the SENSOR programme as follows:

(<http://www.lni.wa.gov/Safety/Research/OccHealth/Derm/default.asp>)

#### **PUBLIC HEALTH IMPORTANCE OF OCCUPATIONAL DERMATITIS**

The skin plays an important role as a barrier to workplace chemicals and other contaminants. Occupational skin disorders, mostly in the form of irritant and allergic dermatitis, are one of the most common types of occupational disease. In 1997, occupational skin disorders constituted 13.5% of all occupational illnesses reported to the Bureau of Labor Statistics. The annual estimated costs of occupational skin disorders nationally may reach \$1 billion.

From 1990 through 2000, 11,084 skin disorder state fund claims were accepted by the Washington State workers' compensation system. Fifteen percent of the claims involved four or more lost workdays, and the cumulative cost of all skin disorder claims to the Washington workers' compensation state fund system was \$7.5 million. Industries with the highest claims incidence rate are Agriculture, Forestry and Fishing, and Manufacturing.

Work-related dermatitis is preventable. Engineering controls, personal protective equipment, and employer/employee education are all potential strategies that can be used to prevent this serious illness.

In 2000, Washington State discontinued a SENSOR project for dermatitis. Many publications and prevention materials originated from this programme.

#### **PURPOSE AND OPERATION**

##### **Purpose**

The purpose of this system is the identification of patterns and trends that can be used to reduce, through prevention, the risks associated with occupational dermatitis and work-related burns that result in hospitalisation or death.

##### **Objectives**

- Describe the incidence and prevalence of work-related dermatitis.
- Identify high risk occupations and industries.
- Identify useful prevention strategies.
- Generate hypotheses about causative agents and factors.

##### **Planned uses**

- Identifying outbreaks of work-related dermatitis.
- Analysing risks by occupation and industry.
- Tracking trends in incidence and prevalence.

- Sharing information with health care providers, public health professionals, and labour and industry stakeholders.
- Measuring progress in achieving Healthy People 2010 Objectives 20-8 regarding reducing occupational skin diseases or disorders among full-time workers.

#### **Case definition**

A case is any worker who receives benefits for a claim with an ANSI Z16.2 nature of injury code 180 – unspecified dermatitis, 181 – infection of the skin or subcutaneous tissue, 182 – dermatitis, 183 – other inflammatory condition of the skin, 184 – disease of the sebaceous gland, or 189 – other diseases and disorders of the skin and subcutaneous tissues.

#### **Legal authority**

No additional legal authority was needed to create and operate this surveillance system.

#### **Organisational location**

The surveillance system is located within the Safety and Health Assessment and Research for Prevention (SHARP) programme of the Washington State Department of Labor and Industries.

### **SYSTEM COMPONENTS**

#### **Population under surveillance**

Workers employed within the state of Washington.

#### **Time period of data collection**

October 1 2000 to present.

#### **Collection and reporting sources**

Workers' compensation claims data are available on a continuing basis from the Labor and Industries Industrial Insurance System.

#### **Data management**

Case information is extracted from the claims management system.

#### **Data analysis and dissemination**

The current system evolved from the SENSOR programme, which ended on September 30 2000. An educational report was published in July 2001 to assist employers and employees in the health care setting in preventing hand dermatitis. This report and others dealing with occupational dermatitis can be found on SHARP's publications list.

#### **Patient privacy, data confidentiality, and system security**

All data collected are used solely for surveillance and prevention purposes. All hard copies of case reports are stored in locked filing cabinets. The Access database is password protected. Passwords to the database are issued only to authorised SHARP personnel. Additionally, the physical access to the building and the access to individual computers are controlled as part of the Department of Labor and Industries security systems.

It is of interest to note that, in 2001, SHARP published a report stating "as a result of the sentinel network [comprising 64 physicians], we have developed prevention efforts aimed at dermatitis caused by composite materials in the aircraft industry, chronic hand dermatitis from exposure to soaps/water and latex in the health care industry, and dermatitis in agricultural workers, especially exposure to poison oak/ivy"<sup>241</sup>. However, to date, no information has been published about the impact of this initiative on rates of dermatitis, or even on claim rates.

## ADULT BLOOD LEAD EPIDEMIOLOGY AND SURVEILLANCE (ABLES) PROGRAM

Since 1987, NIOSH and the CDC have sponsored the ABLES programme to track laboratory-reported blood lead levels (BLLs) in adults. The public health goal of the ABLES programme is to reduce the number of adults with work-related BLLs equal to or greater than 25 micrograms per decilitre ( $\mu\text{g}/\text{dL}$ ). For the states that report data to ABLES, the primary sources of BLL reports are public and private laboratories; physician reporting may supplement laboratory reporting. ABLES requires the laboratory reporting of BLL results, both occupational and non-occupational. These laboratory reports include basic demographic information, including personal identifiers, to differentiate between incidence and prevalence cases and to account for multiple reports for the same person. In coordination with the ABLES programme, the Council of State and Territorial Epidemiologists (CSTE) has adopted a surveillance case definition for adult BLLs to be reported. The definition provides that “(an) adult blood lead level that should be maintained under surveillance is defined as an adult (16 or older) with a venous (or comparable) blood lead level equal to or greater than 25 micrograms per decilitre ( $\mu\text{g}/\text{dL}$ ) of whole blood”<sup>242</sup>. The ABLES programme aims to achieve its objective by building capacity at the state level to initiate or improve surveillance programmes that can accurately measure trends in adult BLLs and intervene to prevent further exposures to lead. Nationwide data and findings from the ABLES program are periodically published by the CDC.

For the sake of comparison, Washington State’s surveillance system on adult blood levels (ABLES) is used for the purposes of this review.

## PUBLIC HEALTH IMPORTANCE OF ELEVATED BLOOD LEAD LEVELS IN ADULTS

Ninety to ninety-five percent of adults with elevated blood lead levels (BLLs) are exposed to lead in the workplace. In 2000, about 10,361 adults were reported by 24 states to have blood lead levels (BLLs) greater than or equal to 25 micrograms per decilitre ( $\mu\text{g}/\text{dL}$ ).

An Occupational Lead Exposure Registry (Registry) has operated in Washington State since May 1993. Through June of 2001, the Registry received 46,291 BLL reports from 32,049 individuals. Approximately 3 percent of the cases, representing 1,092 individuals, had BLLs greater than or equal to 25  $\mu\text{g}/\text{dL}$ .

Adults exposed to lead can experience anaemia, nervous system dysfunction, kidney problems, hypertension, decreased fertility, and increased level of miscarriages.

Workers can bring lead home from their workplace and expose their families. Approximately two to three percent of children with blood lead levels of 10  $\mu\text{g}/\text{dL}$  or greater were exposed by lead brought home from work. Children exposed to low levels of lead may exhibit symptoms of neurologic damage, including learning disabilities and short attention spans.

## PURPOSE AND OPERATION OF THE SURVEILLANCE SYSTEM

### Purpose

The purpose of the Registry is to identify patterns and trends in elevated blood lead levels in adult workers. This information is used to target high-risk workplaces, industries, and occupations for prevention activities focused on reducing lead exposures.

### Objectives

- Describe the incidence and prevalence of elevated blood lead levels in the workplace.
- Identify high risk occupations and industries.

- Identify useful prevention strategies.
- Generate hypotheses about causative agents and factors.

#### **Planned uses**

- Identifying outbreaks of occupational lead poisoning.
- Analysing risks by occupation and industry.
- Tracking trends in the incidence and prevalence associated with occupational lead poisoning; sharing information with the public, health care providers, public health professionals, and labour and industry stakeholders.
- Evaluating efforts to reduce lead as an occupational risk.
- Measuring progress in achieving Healthy People 2010 Objective 20-7, reducing the number of persons who have elevated blood lead concentrations from work exposures.

#### **Case definition**

A case of occupational lead overexposure is defined as an adult (15 years of age or older) with a BLL greater than or equal to 25 µg/dL. All workers employed in Washington State that undergo blood lead testing are included in the Registry, except self-employed individuals and those who fall under federal OSHA's jurisdiction (for example, longshoremen, federal workers, and contractors at federal facilities).

#### **Legal authority**

On July 12, 2000 the Washington State Board of Health adopted revisions to the Washington Administrative Code Chapter 246 Section 101 (WAC 246-101) making elevated blood lead levels a reportable condition. The Department of Labor and Industries was given authority to maintain a surveillance system that can include direct reporting from laboratories, health care providers and health care facilities; develop routine dissemination mechanisms; and provide consultation and technical assistance to health departments, business and labour organisations.

#### **Organisational location**

The Registry is located within the Safety and Health Assessment and Research for Prevention (SHARP) programme of the Washington State Department of Labor and Industries.

### **SYSTEM COMPONENTS**

#### **Population under surveillance**

Workers aged 15 years of age or older who are exposed at Washington State workplaces, except self-employed individuals and those who fall under federal OSHA's jurisdiction (for example, longshoremen, federal workers, and contractors at federal facilities).

#### **Time period of data collection**

May 1993 to the present.

#### **Collection and reporting sources**

Data format and case reporting requirements are specified in WAC 246-101. Laboratories or health care facilities send blood lead level reports to the Washington State Department of Health, where case reports for individuals 15 years of age or older are forwarded to SHARP. A telephone or mail interview is conducted with cases to obtain details about the workplace exposure and other demographic information. Health care providers are encouraged to have their patient complete a blood lead testing form at the time of the blood draw, which is designed to collect additional demographic information.

### **Data management**

The Registry is maintained in a secure Microsoft Access database. This relational database management system has the tools needed to perform automated edit checks during data entry; eliminate duplicate records; add, delete and update records; and perform the queries needed to maintain the database and create a variety of outputs.

### **Data analysis and dissemination**

Dissemination of educational information is a routine part of case follow-up. The type of follow-up is dependent upon the patient's elevated blood lead level:

- Between 25 and 39 µg/dL – the individual is mailed informational material and a brief interview form. If the individual consents, informational material is also sent to the employer.
- Between 40 and 59 µg/dL – the individual is mailed informational material and interviewed via telephone. If the individual consents, SHARP contacts the employer and mails informational material. The employer is provided with three suggestions for technical help: free-of-charge assistance from SHARP or WISHA Consultation services, or enlist the services of a private industrial hygiene company.
- 60 µg/dL or greater – the individual is mailed informational material, interviewed via telephone, and a physician from SHARP provides an occupational medicine consultation. If the individual consents, SHARP contacts the employer and mails informational material. The employer is offered the same three options described above, but SHARP reserves the right to report the employer to WISHA Compliance services if the employer takes no action.
- If the circumstances surrounding the lead exposure are critical, (e.g. a temporary worksite, many exposures), there is an immediate referral to WISHA Compliance services for regulatory action.

An annual report is submitted to the Adult Blood Lead Epidemiology and Surveillance programme at the National Institute for Occupational Safety along with an Access file of new case reports. Analysis of Registry data has identified seven industries with the highest risks for occupational lead exposure. The prevention index calculated from Registry data for these industries has been used to prioritise the use of intervention resources. Alerts for workers, employers, and health care providers have been published for case follow-up and use in other preventive strategies. These publications are available from SHARP's Publications page.

### **Patient privacy, data confidentiality, and system security**

All records containing or accompanied by patient identifying information are confidential. These records are used solely for surveillance and prevention purposes. All hard copies of case information data are kept in secure file cabinets. Access to the Registry is controlled with its own password protection. Passwords are issued only to authorised personnel within SHARP. Physical access to the building and access to individual computers are controlled as part of the security systems of the Department of Labor and Industries.

## **NATIONAL TRAUMATIC OCCUPATIONAL FATALITY (NTOF) SURVEILLANCE SYSTEM**

The NTOF Surveillance System was developed in the 1980s by NIOSH to fill gaps in the knowledge of work-related injury deaths in the United States. Data was first being collected for calendar year 1980. NTOF supports descriptive and analytical epidemiologic uses of the data, such as describing the nature and magnitude of occupational injuries and fatal injury trends, identifying risk factors, testing hypotheses, and setting safety research priorities. For a case to be included in NTOF, the death certificate must meet three criteria: (1) the decedent must be aged 16 or older; (2) the external cause of death is classified as E800–E999 (ICD–9); and (3) the Injury at Work item on the death certificate is marked positive by the certifier. The NTOF data system contains 30 variables useful for describing characteristics of victims, as well as injury circumstances. Data elements include coded characteristics such as age, sex, race, occupation, and cause of death. In addition, narrative text for industry, occupation, causes of death and

injury characteristics are entered and maintained for focused research studies. In the NIOSH Chartbook<sup>243</sup>, fatality rates are computed using NTOF data as numerators and Bureau of Labor Statistics (BLS) Current Population Survey (CPS) data to estimate employed groups. This is a sample survey of the civilian non-institutional population. The employment data used for rate calculations are based on the number of workers rather than hours of work (or full-time equivalents). Fatality rates were calculated as average annual deaths per 100,000 workers. Rates were not calculated for cells with fewer than three cases because of the instability of rates based on small numbers. Frequencies and rates are presented only for the civilian workforce because denominator data are not easily obtainable for military personnel. It has been pointed out that this “denominator technique” is most useful for injuries or diseases with moderate to high rates, and much less useful for those with low frequency of occurrence, such as disasters or catastrophic events (e.g. mine explosions, aircraft crashes)<sup>244</sup>. The surveillance technique provided by NTOF would suggest that little or no resources should be allocated to these incidents as a matter of priority. However, these events may cause very high impact on workers and their families and communities.

There are a number of other limitations to the NTOF system. Firstly, only 67–90% of all fatal occupational injuries can be identified using death certificates as the source of case identification<sup>245</sup>. Second, standardised guidelines for coding the Injury at Work item on US death certificates were only introduced in 1992. As a result, earlier application of this item may have been inconsistently applied<sup>245</sup>. Third, information derived solely from death certificates lacks the level of detail found in multi-source databases, resulting in increased potential for misclassification. Finally, the rates presented in this report do not reflect the difference in exposure for groups that commonly work <40 hours per week (e.g. youth and older workers).

Another US surveillance system for occupational injury fatalities is the Bureau of Labor Statistics (BLS) Census of Fatal Occupational Injuries (CFOI). The NTOF uses only death certificates, while CFOI uses multiple sources for case ascertainment. For a fatality to be included in the census, the decedent must have been employed (that is working for pay, compensation, or profit) at the time of the event, engaged in a legal work activity, or present at the site of the incident as a requirement of his or her job. These criteria are generally broader than those used by federal and state agencies administering specific laws and regulations. Fatalities that occur during a person’s commute to or from work are excluded from the census counts. Data for the CFOI are compiled from various federal, state, and local administrative sources. This includes death certificates, workers compensation reports and claims, reports to various regulatory agencies, medical examiner reports, and police reports, as well as news and other non-governmental reports. This is because studies have shown that no single source of data captures all job-related fatalities<sup>179</sup>. For example, a direct case-by-case comparison between the NTOF and CFOI databases for the period 1992 through 1994 found that there was only an 88% agreement, and that the NTOF reported an average of only 84% of the number of traumatic occupational fatalities reported in CFOI<sup>179</sup>. Similar results were obtained in a more recent comparison of the two systems over a 6-year time period, with NTOF reporting about 85% of the fatalities reported by CFOI<sup>37</sup>. This finding of a higher capture rate by CFOI was consistent across the six years of the study, indicating that it is a systematic difference. The average occupational injury mortality rates were 4.5 per 100,000 full time equivalent workers from NTOF and 5.2 from CFOI.

The current NIOSH strategic plan for surveillance systems was last updated in 2001<sup>118</sup>. It established the laudable, but lofty, goal of providing “national and world leadership to prevent work-related illness, injury, and death by gathering information, conducting scientific research, and translating the knowledge gained into products and services”. The operational focus at the federal level is on improving communication and collaboration between the multiple agencies that engage in surveillance activities, and deployment of standardised coding systems.

Information obtained from surveillance systems in the US has been consolidated into a single report monumental by NIOSH, entitled the *Worker Health Chartbook*<sup>124, 246</sup>. A previous edition was published in 2000<sup>20</sup>, with separate reports focusing on mining<sup>119</sup>, nonfatal illness<sup>120</sup>, nonfatal injury<sup>121</sup>, fatal illness<sup>122</sup>, and fatal injury<sup>123</sup>. The most recent edition contains 382 pages, and was published in 2004. The introduction states, “This document consolidates information from the network of tracking systems that forms the cornerstone of injury and illness

surveillance in the United States. The Chartbook is intended to fulfill the NIOSH strategic goals for preventing occupational injury and illness and to guide research and prevention efforts". In brief, the Chartbook is a "descriptive epidemiologic reference on occupational morbidity and mortality in the United States". It purports to describe the magnitude, distribution, and trends of the nation's occupational injuries, illnesses, and fatalities.

The *Worker Health Chartbook, 2004* contains five chapters and three appendices:

- Chapter 1 describes the US labour force and the health status of workers.
- Chapter 2 focuses on the demographic characteristics of workers (age, sex, occupation, industry, and case severity) and 33 types of occupational injuries and illnesses that affect them: amputations; anxiety, stress, and neurotic disorders; asbestosis; asthma; back, including spine and spinal cord; bloodborne infections and percutaneous exposures; bruises and contusions; byssinosis; carpal tunnel syndrome (CTS); coal workers' pneumoconiosis (CWP); cuts and lacerations; dermatitis; disorders due to physical agents; disorders associated with repeated trauma; dust diseases of the lungs; fatal injuries; fractures; hearing loss; heat burns and scalds; hypersensitivity pneumonitis; lead toxicity; mesothelioma; musculoskeletal disorders; nonfatal injury; pneumoconioses; poisoning; respiratory diseases; respiratory conditions due to toxic agents; silicosis; skin diseases and disorders; sprains, strains, and tears; tendonitis; and tuberculosis. Chapter 2 also examines the magnitude, trends, and geographic distribution of these conditions.
- Chapter 3 focuses exclusively on agriculture, presenting data on fatal and nonfatal injuries among adults and children in agriculture and examining selected health conditions of farm workers.
- Chapter 4 concentrates on high-risk industries and occupations and reflects NIOSH research priorities in mining and construction.
- Chapter 5 addresses special populations, exploring available occupational injury and illness data on young workers, older workers, and Hispanic workers.

The three appendices complement the chapters with details about source data and programmes. Appendix A describes the 21 survey and surveillance programmes used by the contributors; it includes programme contacts and reference citations for follow-up by users. Appendix B examines various aspects of data collection, analysis methods, and dissemination practices that limit the uses and inferences of data. Appendix C provides a bibliography of reference materials from the public domain, including data tables, report forms and documentation, government news releases, and research articles.

#### STATE APPROACHES TO OCCUPATIONAL SURVEILLANCE IN THE US

A comprehensive survey was performed in 2003 to identify the occupational health surveillance systems currently operating in the United States<sup>247</sup>. Sixteen states reported that they do little or no occupational health surveillance. Two hundred and fifty surveillance systems were identified in 30 states. The surveillance systems operating in the greatest number of states (i.e. fatalities and lead exposure) are supported by federal funding through the National Institute for Occupational Safety and Health (NIOSH). Survey information was obtained from the state epidemiologist. It was found that the primary impediments to conducting occupational health surveillance were staffing and funding problems. Lack of technical expertise did not appear to be a critical issue in most states. The states that do conduct occupational surveillance were found to be more likely to have perceived access to data sources such as vital statistics, workers compensation, and Bureau of Labor Statistics data than those without occupational health surveillance activities. A number of states reported that they would like to develop surveillance systems. Nine states wanted to develop systems for work-related musculoskeletal disorders, and seven wished to focus on agricultural injuries and illnesses. It was of interest to note that some state epidemiologists actually failed to identify occupational health surveillance programmes known to be operating within their states. The survey authors suggested that this oversight probably reflects poor communication within, and between, the various state agencies.

It appears that the priority to establish and maintain occupational health surveillance systems varies widely between states within the US. For example, the Washington State Department of Labor and Industries' philosophy represents an orthodox view that state-based occupational health surveillance is essential to public health in order to identify risk factors for occupational injuries and illness, clusters of occupational injuries, and to establish trends for evaluating the impact of initiatives to reduce injury and illness rates. As mentioned above, Washington State through the Safety and Health Assessment and Research for Prevention (SHARP) programme currently conducts surveillance for a limited range of injuries and diseases. These are: asthma, hospitalised burns, dermatitis, adult blood lead levels, traumatic head and brain injuries, workplace violence, and work-related musculoskeletal disorders. However, a surprisingly limited number of US states have the capacity to track important health-related events through a surveillance system.

To continue using Washington State, for comparison purposes in this review, it is worth mentioning the SHARP process for determining research priorities. These are based on their internal "MUSTCURE" criteria. They refer to the: **M**agnitude of the problem; **U**rgency; **S**eriousness of the hazard or injury; **T**echnology transfer opportunities for prevention; **C**ost; **U**nder-reporting potential; **R**esearch gaps to fill; and **E**merging hazard, disease, or injury. It is not surprising to observe that work-related musculoskeletal disorders were identified as a high priority, due in part to the high volumes but also due to the high cost burden<sup>248</sup>. Work-related musculoskeletal disorders provide some unique challenges to surveillance systems. Among these are significant problems with case definitions, under- and over-reporting due to various incentives<sup>173, 249</sup>, and multifactorial complexity<sup>250</sup>.

An example of a state-based surveillance system is from North Carolina. Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has maintained an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system to describe the public health consequences associated with the release of hazardous substances. Since 1991, the North Carolina Division of Public Health has participated in this surveillance system<sup>251</sup>. Information on acute hazardous substances emergency events was collected. The types of data collected included general information on the event, substance(s) released, number of victims, number and types of adverse health effects experienced by the victims, and number of evacuations. Several data sources were used to obtain the maximum amount of information about each event. These sources included, but were not limited to, the Division of Emergency Management (DEM), Department of Crime Control and Public Safety; the National Response Center (NRC), US Coast Guard; the Hazardous Materials Information System (HMIS), US Department of Transportation; and the media. Secondary notification sources are the Division of Water Quality, Department of Environmental and Natural Resources and the Department of Agriculture's Food and Drug Protection Division, Structured Pesticide Control Division, and Plant and Industrial Division. Prior to January 2000, the data obtained were computerised using an ATSDR-provided data entry system and were sent to ATSDR quarterly. Beginning in January 2000, data were entered into a web-based data entry system that allows for real-time data entry. The NC HSEES program reported 1,087 events for 1998–2001. Approximately 372 (34.2%) of the events occurred at fixed facilities, and 715 (65.8%) were transportation-related. Human error 487 (40.7%) was the contributing factor for the majority of the releases. In 1,041 (95.8%) of the events, only a single substance was released. The most commonly reported categories of substances were other (287, 24.2%), volatile organic compounds (228, 19.2%), acids (169, 14.2%), and other inorganic compounds (155, 13.0%). During this reporting period, 106 events (approximately 9.7% of all reported events) resulted in 417 victims. The adverse health effects most frequently experienced by victims were respiratory irritation (264, 37.1%), eye irritation (100, 14.0%), gastrointestinal problems (68, 9.6%), and trauma (42, 5.9%). Four persons died because of all events, and 138 (12.7%) events required evacuations. The findings regarding the distribution of the types of events, numbers of events with victims and evacuations, and the injuries reported have changed in several areas since the inception of the HSEES programme. The number of transportation events has increased due to additional reporting sources. The percentage of events with victims, as well as the number of evacuations, is declining. Respiratory irritation continues to be the most frequently reported adverse health effect experienced by victims.

In Michigan, reporting of occupational diseases and adult lead toxicity is mandated under the state Public Health Code, similar to the long-standing mandate for reporting communicable diseases<sup>252</sup>. Under the federal and Michigan Occupational Safety and Health Act, most employers are required to keep logs of work-related illnesses and injuries of their employees and, if requested, report this information. By Executive Order from the Governor, “a physician, hospital, clinic or employer must report known or suspected cases of occupational diseases or workplace aggravated health conditions to the Michigan Department of Labor and Economic Growth within 10 days after discovery of the disease or condition on a report form furnished by the department”<sup>253</sup>. This requirement does not apply to occupational injuries. In Michigan, “occupational disease” means an illness of the human body arising out of and in the course of an individual’s employment and having one or more of the following characteristics:

- It is caused by a frequently repeated or continuous exposure to a hazardous substance or agent or to a specific industrial practice which is hazardous and which has continued over an extended period of time.
- It is caused by an acute exposure to a hazardous substance or agent.
- It presents symptoms characteristic of an occupational disease known to have resulted in other cases from the same type of specific exposure.

The following guidance is provided for the classification of occupational diseases:

#### **Occupational skin diseases or disorders**

Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitisers or poisonous plant; oil acne; chrome ulcers, chemical burns or inflammations, etc.

#### **Dust diseases of the lungs (pneumoconiosis)**

Examples: Silicosis, asbestosis, coal worker’s pneumoconiosis, byssinosis, siderosis, and other pneumoconiosis.

#### **Respiratory conditions due to toxic agents**

Examples: Pneumonitis, pharyngitis, rhinitis or acute congestion due to chemicals, dusts, gases, or fumes; farmer’s lung, etc.

#### **Poisoning (systemic effect of toxic materials)**

Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals; poisoning by carbon monoxide, hydrogen sulfide, or other gases; poisoning by benzol, carbon tetrachloride, or other organic solvents; poisoning by insecticide sprays such as parathion, lead arsenate, poisoning by other chemicals such as formaldehyde, plastics, and resins, etc.

#### **Disorders due to physical agents (other than toxic materials)**

Examples: Heat stroke, sunstroke, heat exhaustion, and other effects of environmental heat; freezing, frostbite and effects of exposure to low temperatures; caisson disease; effects of ionising radiation (isotopes, x-rays, radium); effects of non-ionising radiation (welding flash, ultraviolet rays, microwaves, sunburn); etc.

#### **Disorders associated with repeated trauma**

Examples: Noise-induced hearing loss; synovitis, tenosynovitis, and bursitis; Raynaud’s phenomena; and other conditions due to repeated motion, vibration or pressure.

Existing health data sources in Michigan that are used in occupational health surveillance include data from death certificates, hospital discharge records, emergency room visits, the cancer registry, communicable disease reports, workers’ compensation claims, and calls to poison control centres. All of these data sources have limitations in terms of completeness, timeliness, and usefulness for occupational health surveillance. Some of the condition-specific occupational disease surveillance systems described in Michigan use multiple data sources in order to

overcome some of the limitations of individual data sources. However, Michigan epidemiologists believe that their data on occupational disease and injury is considerably more accurate than federal surveillance data. They attribute this to “strong enforcement and education and training programmes to ensure effective recordkeeping and reporting of occupational injuries and illnesses by employers”<sup>252</sup>.

#### REGIONAL APPROACHES TO OCCUPATIONAL SURVEILLANCE IN THE U.S.

Surveillance is sometimes conducted at the enterprise level, and there may be significant advantages to this approach<sup>30, 254</sup>. This is often described as a “medical surveillance programme”. For example, a business may call on a GP or an occupational physician to provide employee health services at the work site or in the clinician’s office. These services might include medical screening for the detection of dysfunction or disease before an employee would ordinarily seek medical care. They may also include medical surveillance to provide analysis of health information to identify workplace problems that require targeted prevention. Such services can transform acute care and routine screening activities into opportunities for primary prevention when they are integrated into the broader framework of work-site safety and health programmes<sup>255</sup>. Primary prevention in the workplace in this context might be described as preventing known hazards from coming into contact with vulnerable employees. Success would depend on appropriately implemented engineering and administrative controls. For example, properly functioning fume capture hoods and ventilation design can prevent exposures to lead, known effective exhaust ventilation for silica can prevent silicosis, and creative ergonomic materials handling design can reduce the probability of upper-extremity cumulative trauma disorders and re-injury. In some circumstances, GPs who are involved in occupational medicine services may have a unique opportunity to sound an alarm when a workplace has a problem<sup>255</sup>.

In 1989, the American College of Occupational and Environmental Medicine (ACOEM) published a consensus statement on medical surveillance in the workplace<sup>256</sup>. This states that the College supports establishment of medical surveillance programmes for employees exposed to hazardous agents and believes that, in addition to optimal engineering controls and personal protective measures, medical surveillance is a valuable tool for assuring and maintaining a healthful workplace environment. The primary activity of medical surveillance involves collection of specific exposure data, familiarity with routes of exposure and toxic doses, and selection and application of appropriate medical examinations. Special skills and knowledge are needed to formulate, interpret, and make recommendations regarding risk-based occupational medical surveillance. The College therefore adopts the position that:

- medical surveillance should be done primarily for the benefit of the individual employee, and immediate co-workers and employees should be informed by a knowledgeable medical professional of the surveillance results
- programmes for medical surveillance should not be substituted for collection of exposure information
- medical surveillance should not be used for employment purposes such as hiring and firing
- the employer should be responsible for the cost of medical surveillance and the conduct of the programme to include maintenance of medical records. In such circumstances, the employer should be responsible for developing a unique medical programme for related specific hazards and exposures utilising a physician qualified and experienced in the practice of occupational medicine.

Examples of in-house occupational safety and health programmes run by employers for their staff are far too numerous to document. However, this important source of occupational surveillance data should not be neglected; nor should the opportunity to deliver effective primary prevention programmes directly into the workplace be forgotten<sup>73, 74, 257-288</sup>.

## **PUBLISHED INFORMATION**

There is a vast amount of published information available from federal organisations such as NIOSH<sup>19</sup>, and from state epidemiological departments. In addition, much of this has been turned into operational requirements to be enforced by organisations such as OSHA. The CDC and NIOSH provide a good summary of the available information on their website (<http://www.cdc.gov/niosh/database.html>).

## **CHEMICAL**

### **Immediately Dangerous to Life and Health (IDLH)**

Provides the immediately dangerous to life or health air concentration values (IDLHs) for substances and the criteria and information sources that have been used to determine these values.

### **International Chemical Safety Cards (WHO/IPCS/ILO)**

ICSC cards summarise essential health and safety information on chemicals for their use at the “shop floor” level by workers and employers in factories, agriculture, construction and other work places.

### **Manual of Analytical Methods (NMAM)**

NMAM is a collection of methods for sampling and analysis of contaminants in workplace air, and in the blood and urine of workers who are occupationally exposed.

### **NIOSH Pocket Guide To Chemical Hazards (NPG)**

The NPG is intended as a source of general industrial hygiene information on several hundred chemicals/classes for workers, employers, and occupational health professionals.

### **Occupational Safety and Health Guidelines for Chemical Hazards**

Summarises information on permissible exposure limits, chemical and physical properties, and health hazards. It provides recommendations for medical surveillance, respiratory protection, and personal protection and sanitation practices for specific chemicals that have federal occupational safety and health regulations.

### **OSHA 1988 Permissible Exposure Limits (PELs)**

PELs are OSHA comments from the January 19, 1989 Final Rule on Air Contaminants Project extracted from 54FR2332 et. seq. This rule was remanded by the US Circuit Court of Appeals and the limits are not currently in force.

### **Specific Medical Tests Published in the Literature for OSHA Regulated Substances (MEDTEST)**

The MEDTEST database lists the specific medical tests published in the literature for OSHA regulated substances. Updates of OSHA mandated tests (July 1 2000) and NIOSH/OSHA recommendations are included.

## **INJURY, ILLNESS AND HAZARDS DATA AND INFORMATION**

### **Hearing Protector Device Compendium**

This compendium, as of June 2003, contains data from 23 manufacturers nationwide (down from 53 in the 1994 compendium) on 292 hearing protectors (up from 241 in the 1994 compendium).

### **Health Hazard Evaluations (HHEs)**

NIOSH conducts Health Hazard Evaluations (HHEs) to find out whether there are health hazards to employees caused by exposures or conditions in the workplace.

### **National Occupational Exposure Survey (NOES)**

NOES contains data collected by NIOSH from 1981 to 1983 on potential occupational exposures to chemical, physical, and biological agents in a broad spectrum of US industries. It can be used to associate potential exposures with industry types, occupations, observed exposure conditions, and other parameters.

### **National Occupational Respiratory Mortality System (NORMS)**

An interactive query system designed to generate statistics, charts, and maps relating to mortality from occupationally-related lung diseases.

### **Noise and Hearing Loss Prevention: NIOSH Power Tools Database**

An informational database on commonly used power tools in occupational settings. This database contains such information as sound power levels, sound pressure level and downloadable exposure files.

### **Worker Health Chartbook, 2004**

The Worker Health Chartbook, 2004 is a descriptive epidemiologic reference on occupational morbidity and mortality in the United States. A resource for agencies, organisations, employers, researchers, workers, and others who need to know about occupational injuries and illnesses, the Chartbook includes more than 400 figures and tables describing the magnitude, distribution, and trends of the nation's occupational injuries, illnesses, and fatalities.

### **Work-Related Injury Statistics Query System (Work-RISQS)**

Work-RISQS provides a web-based public access query system for obtaining national estimates (number of cases) and rates (number of cases per hours worked) for nonfatal occupational injuries and illnesses treated in US hospital emergency departments. Users may interactively query based on demographic characteristics, nature of injury/illness, and incident circumstances for the years 1998 and 1999.

### **Work-Related Lung Disease (WoRLD) Surveillance Report**

The WoRLD report presents information on various work-related respiratory diseases and associated exposures in the United States, and describes where these diseases are occurring (by industry and geographic location), who is affected (by race, sex, age, and occupation), how frequently they occur, and temporal trends.

### **Standardized Occupation and Industry Coding (SOIC)**

The Standardized Occupation and Industry Coding (SOIC) software automates the coding process for industry and occupation (I&O) narratives from death certificates, cancer registries, and other record systems. The software assigns codes according to the 1990 Bureau of the Census industry and occupation codes and supplemental codes from the National Center for Health Statistics. This site provides a downloadable version of the SOIC software and user's manual as well as other SOIC information and installation resources.

## **PUBLICATIONS**

### **Common Information Service System (CISS)**

CISS is an information system provided as a public service by NIOSH Mining Safety and Health Research (formerly the US Bureau of Mines). Thousands of publications are stored in this searchable database in bibliographic form and include abstracts.

### **NIOSHTIC-2**

NIOSHTIC-2 is a bibliographic database of occupational safety and health publications, documents, grant reports, and other communication products supported in whole or in part by the National Institute for Occupational Safety and Health.

## RESPIRATORS AND OTHER PERSONAL PROTECTIVE EQUIPMENT

### **CBRN APR NIOSH Approved Respirators**

This site provides information for determining if a given air purifying respirator (APR) is certified by the National Institute for Occupational Safety and Health (NIOSH) for use by emergency responders in a potential CBRN situation. It also provides a list of devices that have been certified by NIOSH for such use.

### **CBRN SCBA NIOSH Approved Respirators**

This site provides information from the National Institute for Occupational Safety and Health (NIOSH) on testing and certifying self-contained breathing apparatus (SCBA) for use by emergency responders in chemical, biological, radiological, and nuclear (CBRN) environments.

### **Certified Equipment List (CEL)**

The CEL is a database of all NIOSH certified respirators and coal mine dust personal sampler units.

### **NIOSH-Approved Disposable Particulate Respirators (Filtering Facepieces)**

Provides a listing of NIOSH-approved disposable particulate respirators that health care workers can use to help protect themselves from diseases potentially spread through the air, such as SARS or tuberculosis.

### **Recommendations for Chemical Protective Clothing**

Provides assistance in identifying potentially appropriate types of chemical barrier material for protection against skin contact with the chemicals listed in the NIOSH Pocket Guide to Chemical Hazards.

## AGRICULTURE

### **National Agriculture Safety Database (NASD)**

NASD is a collection of information about health, safety, and injury prevention in agriculture. The information in the database was contributed by safety professionals and organisations from across the nation in an effort to promote safety in agriculture.

### **Farm Family Health and Hazard Surveillance**

The FFHHS programme surveyed the health status of agricultural workers and their families, as well as the work-related risk factors and conditions of exposure to potentially hazardous agents and events.

## CONSTRUCTION

### **Electronic Library of Construction Safety and Health (ELCOSH)**

ELCOSH provides a wide range of materials on construction safety and health. The goal is to improve safety and health for construction workers by making such information easier to obtain than in the past.

## United Kingdom

The United Kingdom is a unitary state and has a population of approximately 60 million. Responsibility for the health of British citizens has lain with the National Health Service (NHS) since its inception in 1948, under the auspices of the Department of Health. It is entirely taxpayer funded, and provides free healthcare to the populace through both primary care and secondary services. Small part charges are currently applied to prescriptions dispensed by pharmacies, although there are complex sets of regulations governing reductions and waivers. Dentistry is also provided by the NHS, but faces a chronic under-supply of providers. Recent government policy has resulted in target-driven methods of managing burgeoning waiting lists, and a widespread public perception that health services were declining in quality. Devolution of government in Wales and Scotland means that NHS services and prescription charges now have regional variations. Sickness absence from work, whether due to disease or injury, is funded through a complex array of regulations. This means that employers fund substantial amounts of sick leave. However, the Department of Work and Pensions (DWP) funds a variety of social security benefits. The Incapacity Benefit (IB) may be provided after six months, and has had very significant growth in the last one or two decades. Recent British government policy has been aimed at reducing this expenditure through initiatives such as “Pathways to Work”. Ill health or injury that is work-related is subject to common law remedies, and this is generally slow and involves high costs. Road traffic accidents are compensated by insurance, and the government runs a central fund to ensure that those who are not insured still have some basic cover. Private medical insurance appears to have reached a stable plateau at about 15%. The vast majority of this covers treatment costs only, and does not have to cover wage-replacement costs. The DWP is responsible for workplace health and safety and has overall responsibility for the Health and Safety Executive (HSE).

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### 1. SYSTEM DESCRIPTION

Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), the statutory reporting system for the United Kingdom, is run by the Health and Safety Executive (HSE). Requirements are placed on employers and medical practitioners.

Reporting accidents and ill health at work is a legal requirement as described by RIDDOR. The information is supposed to enable the enforcing authorities to identify where and how risks arise and to investigate serious

accidents. This should allow the enforcing authorities to help and advise on preventive action to reduce injury, ill health and accidental loss<sup>289</sup>. RIDDOR requires immediate reporting to the enforcing authority in case of any accident connected with work, any employee or self-employed person working on work premises who is killed or suffers a major injury, or when a member of the public is killed or taken to hospital.

Employers have a mandatory requirement to make reports of injuries to RIDDOR, however, this does not extend to employees or medical or other healthcare providers. The latter are “advised” to make a report to the enforcing authority. In most cases, this will be the Health and Safety Executive, but there are also various local authority bodies responsible for specific workplaces.

For listed occupational diseases, there is a mandatory requirement for doctors to make reports to RIDDOR. If a doctor notifies an employer that one of their workers suffers from a reportable work-related disease, they must report it to the enforcing authority.

### **1.1 DATE ESTABLISHED**

The current RIDDOR system began operating on 1 April 1996, following the passing of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations in 1995. These regulations form part of the Health and Safety at Work Act, which was originally enacted in 1974.

### **1.2 ORGANISATION/INSTITUTE/OWNER/OPERATOR**

The Health and Safety Executive (HSE) and the Health and Safety Commission (HSC) have overall responsibility for managing and implementing RIDDOR, including policy and operations. RIDDOR is therefore integrated into occupational health and safety functions conducted by local authorities and the HSE itself. For example, the RIDDOR group provides information that may result in HSE inspectors visiting a workplace or the scene of an accident.

### **1.3 SYSTEM RESIDES WHERE IN ORGANISATION**

RIDDOR has national Incident Contact Centres that are responsible for all of England, Scotland, and Wales. A separate reporting system currently operates for Northern Ireland, although this may be integrated into a UK wide system in the future.

### **1.4 FUNDING SOURCES**

Entirely government funded, no private-sector involvement (e.g. insurance).

### **1.5 PERSONNEL REQUIREMENTS TO OPERATE SYSTEM**

Details are not available.

## 1.6 TARGET GROUP/POPULATION

England, Scotland, and Wales. The system targets both occupational injuries and occupational disease.

### 1.6.1 Occupational health importance

Reportable occupational diseases are described in Schedule 3 of the Regulations as follows:

#### *Conditions due to physical agents and physical demands of work*

- Inflammation, ulceration or malignant disease of the skin due to ionising radiation.
- Malignant disease of the bones due to ionising radiation.
- Blood dyscrasia due to ionising radiation. Activity: Work with ionising radiation.
- Cataract due to electromagnetic radiation. Activity: Work involving exposure to electromagnetic radiation (including radiant heat).
- Decompression illness.
- Barotrauma resulting in lung or other organ damage.
- Dysbaric osteonecrosis. Activity: Work involving breathing gases at increased pressure (including diving).
- Cramp of the hand or forearm due to repetitive movements. Activity: Work involving prolonged periods of handwriting, typing, or other repetitive movements of the fingers, hand, or arm.
- Subcutaneous cellulitis of the hand (beat hand). Activity: Physically demanding work causing severe or prolonged friction or pressure on the hand.
- Bursitis or subcutaneous cellulitis arising at or about the knee due to severe or prolonged external friction or pressure at or about the knee (beat knee). Activity: Physically demanding work causing severe or prolonged friction or pressure at or about the knee.
- Bursitis or subcutaneous cellulitis arising at or about the elbow due to severe or prolonged external friction or pressure at or about the elbow (beat elbow). Activity: Physically demanding work causing severe or prolonged friction or pressure at or about the elbow.
- Traumatic inflammation of the tendons of the hand or forearm or of the associated tendon sheaths. Activity: Physically demanding work, frequent or repeated movements, constrained postures, or extremes of extension or flexion of the hand or wrist.
- Carpal tunnel syndrome. Activity: Work involving the use of hand-held vibrating tools.
- Hand-arm vibration syndrome. Activity: Work involving:
  - the use of chain saws, brush cutters or hand-held or hand-fed circular saws in forestry or woodworking
  - the use of hand-held rotary tools in grinding material or in sanding or polishing metal
  - the holding of material being ground or metal being sanded or polished by rotary tools
  - the use of hand-held percussive metal-working tools or the holding of metal being worked upon by percussive tools in connection with riveting, caulking, chipping, hammering, fettling, or swaging
  - the use of hand-held powered percussive drills or hand-held powered percussive hammers in mining, quarrying or demolition, or on roads or footpaths (including road construction)
  - the holding of material being worked upon by pounding machines in shoe manufacture.

#### *Infections due to biological agents*

- Anthrax. Activity: work involving handling infected animals, their products, or packaging containing infected material; or work on infected sites.
- Brucellosis. Activity: Work involving contact with animals or their carcasses (including any parts thereof) infected by brucella or the untreated products of same or laboratory specimens or vaccines of or containing brucella.
- Avian chlamydiosis. Activity: Work involving contact with birds infected with chlamydia psittaci, or the remains or untreated products of such birds.

- Ovine chlamydiosis. Activity: Work involving contact with sheep infected with chlamydia psittaci or the remains or untreated products of such sheep.
- Hepatitis. Activity: Work involving contact with human blood or human blood products or any source of viral hepatitis.
- Legionellosis. Activity: Work on or near cooling systems which are located in the workplace and use water or work on hot water service systems located in the workplace which are likely to be a source of contamination.
- Leptospirosis. Activity: Work in places which are or are liable to be infested by rats, fieldmice, voles or other small mammals; work at dog kennels or involving the care or handling of dogs; or work involving contact with bovine animals or their meat products or pigs or their meat products.
- Lyme disease. Activity: Work involving exposure to ticks (including, in particular, work by forestry workers, rangers, dairy farmers, game keepers and other persons engaged in countryside management).
- Q fever. Activity: Work involving contact with animals, their remains, or their untreated products.
- Rabies. Activity: Work involving handling or contact with infected animals.
- Streptococcus suis. Activity: Work involving contact with pigs infected with streptococcus suis, or with the carcasses, products, or residues of pigs so affected.
- Tetanus. Activity: Work involving contact with soil likely to be contaminated by animals.
- Tuberculosis. Activity: Work with persons, animals, human or animal remains or any other material which might be a source of infection.
- Any infection reliably attributable to the performance of the work specified in the entry opposite hereto. Activity: Work with micro-organisms; work with live or dead human beings in the course of providing any treatment or service or in conducting any investigation involving exposure to blood or body fluids; work with animals or any potentially infected material derived from any of the above.

***Conditions due to substances***

Poisonings by any of the following:

- acrylamide monomer
- arsenic or one of its compounds
- benzene or a homologue of benzene
- beryllium or one of its compounds
- cadmium or one of its compounds
- carbon disulphide
- diethylene dioxide (dioxan)
- ethylene oxide
- lead or one of its compounds
- manganese or one of its compounds
- mercury or one of its compounds
- methyl bromide
- nitrochlorobenzene, or a nitro- or amino- or chloro-derivative of benzene or of a homologue of benzene
- oxides of nitrogen
- phosphorus or one of its compounds.

Cancer of a bronchus or lung. Activity: Work in or about a building where nickel is produced by decomposition of a gaseous nickel compound or where any industrial process which is ancillary or incidental to that process is carried on; or work involving exposure to bis(chloromethyl) ether or any electrolytic chromium processes (excluding passivation) which involve hexavalent chromium compounds, chromate production, or zinc chromate pigment manufacture.

Primary carcinoma of the lung where there is accompanying evidence of silicosis. Activity: Any occupation in:

- glass manufacture
- sandstone tunnelling or quarrying
- the pottery industry
- metal ore mining
- slate quarrying or slate production
- clay mining
- the use of siliceous materials as abrasives
- foundry work
- granite tunneling or quarrying
- stone cutting or masonry.

Cancer of the urinary tract.

Work involving exposure to any of the following substances:

- beta-naphthylamine or methylene-bis-orthochloroaniline
- diphenyl substituted by at least one nitro or primary amino group or by at least one nitro and primary amino group (including benzidine)
- any of the substances mentioned above if further substituted by halogeno, methyl or methoxy groups, but not by other groups
- the salts of any of the substances mentioned above. Activity: The manufacture of auramine or magenta.

Bladder cancer. Activity: Work involving exposure to aluminium smelting using the Soderberg process.

Angiosarcoma of the liver. Activity: Work in or about machinery or apparatus used for the polymerisation of vinyl chloride monomer, a process which, for the purposes of this sub-paragraph, comprises all operations up to and including the drying of the slurry produced by the polymerisation and the packaging of the dried product; or work in a building or structure in which any part of the process referred to in the foregoing sub-paragraph takes place.

Peripheral neuropathy. Activity: Work involving the use of handling of or exposure to the fumes of or vapour containing n-hexane or methyl n-butyl ketone.

Chrome ulceration of the nose or throat, or the skin of the hands or forearm. Activity: Work involving exposure to chromic acid or to any other chromium compound.

Folliculitis. Activity: Work involving exposure to mineral oil, tar, pitch, or arsenic.

Acne. Activity: Work involving exposure to mineral oil, tar, pitch, or arsenic.

Skin cancer. Activity: Work involving exposure to mineral oil, tar, pitch, or arsenic.

Pneumoconiosis (excluding asbestosis). Activity:

- The mining, quarrying, or working of silica rock or the working of dried quartzose sand, any dry deposit or residue of silica, or any dry admixture containing such materials (including any activity in which any of the aforesaid operations are carried out incidentally to the mining or quarrying of other minerals or to the manufacture of articles containing crushed or ground silica rock).
- The handling of any of the materials specified in the foregoing sub-paragraph in or incidentally to any of the operations mentioned therein or substantial exposure to the dust arising from such operations.
- The breaking, crushing or grinding of flint, the working or handling of broken, crushed or ground flint or materials containing such flint or substantial exposure to the dust arising from any of such operations.

- Sand blasting by means of compressed air with the use of quartzose sand or crushed silica rock or flint or substantial exposure to the dust arising from such sand blasting.
- Work in a foundry or the performance of, or substantial exposure to the dust arising from, any of the following operations: the freeing of steel castings from adherent siliceous substance; or the freeing of metal castings from adherent siliceous substance by blasting with an abrasive propelled by compressed air, steam or a wheel; or by the use of power-driven tools.
- The manufacture of china or earthenware (including sanitary earthenware, electrical earthenware, and earthenware tiles) and any activity involving substantial exposure to the dust arising therefrom.
- The grinding of mineral graphite or substantial exposure to the dust arising from such grinding.
- The dressing of granite or any igneous rock by masons, the crushing of such materials, or substantial exposure to the dust arising from such operations.
- The use or preparation for use of an abrasive wheel or substantial exposure to the dust arising therefrom.
- Work underground in any mine in which one of the objects of the mining operations is the getting of any material; the working or handling above ground at any coal or tin mine of any materials extracted therefrom or any operation incidental thereto; the trimming of coal in any ship, barge, lighter, dock, or harbour or at any wharf or quay; or the sawing, splitting, or dressing of slate or any operation incidental thereto.
- The manufacture of work incidental to the manufacture of carbon electrodes by an industrial undertaking for use in the electrolytic extraction of aluminium from aluminium oxide and any activity involving substantial exposure to the dust therefrom.
- Boiler scaling or substantial exposure to the dust arising therefrom.

Byssinosis. Activity: The spinning or manipulation of raw or waste cotton or flax, or the weaving of cotton or flax, carried out in each case in a room in a factory, together with any other work carried out in such a room.

Mesothelioma.

Lung cancer.

Asbestosis. Activity:

- The working or handling of asbestos or any admixture of asbestos.
- The manufacture or repair of asbestos textiles or other articles containing or composed of asbestos.
- The cleaning of any machinery or plant used in any of the foregoing operations and of any chambers, fixtures, and appliances for the collection of asbestos dust.
- Substantial exposure to the dust arising from any of the foregoing operations.

Cancer of the nasal cavity or associated air sinuses. Activity:

- Work in or about a building where wooden furniture is manufactured; work in a building used for the manufacture of footwear or components of footwear made wholly or partly of leather or fibre board; or work at a place used wholly or mainly for the repair of footwear made wholly or partly of leather or fibre board.
- Work in or about a factory building where nickel is produced by decomposition of a gaseous nickel compound or in any process which is ancillary or incidental thereto.

Occupational dermatitis. Activity: Work involving exposure to any of the following agents:

- epoxy resin systems
- formaldehyde and its resins
- metalworking fluids
- chromate (hexavalent and derived from trivalent chromium)
- cement, plaster or concrete
- acrylates and methacrylates

- colophony (rosin) and its modified products
- glutaraldehyde
- mercaptobenzothiazole, thiurams, substituted paraphenylene-diamines, and related rubber processing chemicals
- biocides, anti-bacterials, preservatives, or disinfectants
- organic solvents
- antibiotics and other pharmaceuticals and therapeutic agents
- strong acids, strong alkalis, strong solutions (e.g. brine) and oxidising agents, including domestic bleach or reducing agents
- hairdressing products, including in particular dyes, shampoos, bleaches and permanent waving solutions,
- soaps and detergents
- plants and plant-derived material including in particular the daffodil, tulip and chrysanthemum families, the parsley family (carrots, parsnips, parsley and celery), garlic and onion, hardwoods and the pine family,
- fish, shell-fish, or meat
- sugar or flour
- any other known irritant or sensitising agent including in particular any chemical bearing the warning, “May cause sensitisation by skin contact” or “Irritating to the skin”.

Extrinsic alveolitis (including farmer’s lung). Activity: Exposure to moulds, fungal spores or heterologous proteins during work in:

- agriculture, horticulture, forestry, cultivation of edible fungi or malt-working
- loading, unloading, or handling mouldy vegetable matter or edible fungi whilst same is being stored
- caring for or handling birds
- handling bagasse.

Occupational asthma. Activity: Work involving exposure to any of the following agents:

- isocyanates
- platinum salts
- fumes or dust arising from the manufacture, transport, or use of hardening agents (including epoxy resin curing agents) based on phthalic anhydride, tetrachlorophthalic anhydride, trimellitic anhydride, or triethylene-tetramine
- fumes arising from the use of rosin as a soldering flux
- proteolytic enzymes
- animals, including insects and other arthropods, used for the purposes of research or education or in laboratories
- dusts arising from the sowing, cultivation, harvesting, drying, handling, milling, transport, or storage of barley, oats, rye, wheat, or maize, or the handling, milling, transport, or storage of meal or flour made therefrom
- antibiotics
- cimetidine
- wood dust
- ispaghula
- castor bean dust
- ipecacuanha
- azodicarbonamide
- animals, including insects and other arthropods, (whether in their larval forms or not) used for the purposes of pest control or fruit cultivation or the larval forms of animals used for the purposes of research or education or in laboratories

- glutaraldehyde
- persulphate salts or henna
- crustaceans or fish or products arising from these in the food processing industry
- reactive dyes
- soya bean
- tea dust
- green coffee bean dust
- fumes from stainless steel welding
- any other sensitising agent, including in particular any chemical bearing the warning, “May cause sensitisation by inhalation”.

### 1.6.2 Occupational injury importance

Not all injuries have to be reported under the RIDDOR system. Those which are not reportable include: road traffic accidents involving people travelling in the course of their work, which are covered by road traffic legislation; accidents reportable under separate merchant shipping, civil aviation and air navigation legislation; accidents to members of the armed forces; and fatal injuries to the self-employed arising out of accidents at premises which the injured person either owns or occupies. Work-related incidents required by law to be reported are<sup>290</sup>:

- deaths
- major injuries
- over-3-day injuries (where an employee or self-employed person has an accident and the person is away from work or unable to work normally for more than three days)
- injuries to members of the public where they are taken to hospital
- work-related diseases
- dangerous occurrences (where something happens that does not result in a reportable injury but which could have done).

Reportable dangerous occurrences are:

- collapse, overturning, or failure of load-bearing parts of lifts and lifting equipment
- explosion, collapse, or bursting of any closed vessel or associated pipework
- failure of any freight container in any of its load-bearing parts
- plant or equipment coming into contact with overhead power lines
- electrical short circuit or overload causing fire or explosion
- any unintentional explosion, misfire, failure of demolition to cause the intended collapse, projection of material beyond a site boundary, or injury caused by an explosion
- accidental release of a biological agent likely to cause severe human illness
- failure of industrial radiography or irradiation equipment to de-energise or return to its safe position after the intended exposure period
- malfunction of breathing apparatus while in use or during testing immediately before use
- failure or endangering of diving equipment, the trapping of a diver, an explosion near a diver, or an uncontrolled ascent
- collapse or partial collapse of a scaffold over five metres high, or erected near water where there could be a risk of drowning after a fall
- unintended collision of a train with any vehicle
- dangerous occurrence at a well (other than a water well)
- dangerous occurrence at a pipeline
- failure of any load-bearing fairground equipment, or derailment or unintended collision of cars or trains

- a road tanker carrying a dangerous substance overturns, suffers serious damage, catches fire, or the substance is released
- a dangerous substance being conveyed by road is involved in a fire or released.

Dangerous occurrences that are reportable except in relation to offshore workplaces are:

- unintended collapse of: any building or structure under construction, alteration or demolition where over five tonnes of material falls; a wall or floor in a place of work; or any false-work
- explosion or fire causing suspension of normal work for over 24 hours
- sudden, uncontrolled release in a building of: 100 kg or more of flammable liquid; 10 kg of flammable liquid above its boiling point; 10 kg or more of flammable gas; or 500 kg of these substances if the release is in the open air
- accidental release of any substance which may damage health

Note: additional categories of dangerous occurrences apply to mines, quarries, relevant transport systems (railways etc), and offshore workplaces.

Reportable major injuries as described by RIDDOR include:

- fracture other than to fingers, thumbs, or toes
- amputation
- dislocation of the shoulder, hip, knee, or spine
- loss of sight – temporary or permanent
- chemical or hot metal burn to the eye or any penetrating injury to the eye
- injury resulting from an electric shock or electrical burn
- any other injury requiring admittance to hospital for more than 24 hours
- acute illness requiring medical treatment, or loss of consciousness arising from absorption of any substance by inhalation, ingestion, or through the skin.

### 1.7 SCOPE OF THE SYSTEM

RIDDOR is a national system that attempts to inform across all levels – national, regional, local, and the enterprise. Employers and doctors subject to mandatory reporting requirements are advised, “Reports are submitted to the health and safety enforcing authorities and the information used to target action to improve ill health prevention and control”.

### 1.8 SIGNIFICANT MODIFICATION(S), IF ANY

A review of RIDDOR is currently under way (see below). The last review, of the 1985 system, was conducted in 1994 just before the current system came into force.

## 2. INFORMATION COLLECTION

Information is collected by a variety of sources. The main source is via the Incident Contact Centre, which provides non-geographical phone numbers charged at national call rate. Reports can also be made using an online form, or sent in as hard copy on one of about 14 forms. These are available from the HSE, or as PDF downloads. Information

can also be submitted to RIDDOR via specialist companies that provide health and safety consultant services. Some of these also offer online input (e.g. Health and Safetysmart). All employers with 10 or more employees are obliged to maintain an accident book. However, this requirement is mostly to satisfy potential social security issues. For example, a check may be made if an employee applies to the Department of Work and Pensions for an Industrial Injury Benefit.

### **3. CONTENT OF SYSTEM**

Quite a large amount of data is collected. Fourteen forms for reporting are currently available from the HSE (<https://www.hse.gov.uk/forms/incident/index.htm>), but five of these are duplicates in the Welsh language. The information collected from these forms is held in the RIDDOR database. For example, responses to the questions in Report of an Injury (using F2508) populate 50 fields in the database including:

- eight identifying questions on the employee and the workplace
- four questions about the incident
- eight questions about the injured person
- four questions about the injury
- one question about the accident
- one free text question about what happened.

This allows the HSE to publish statistics for occupational injuries and diseases.

### **4. METHOD**

The HSE admit that RIDDOR currently functions moderately well for occupational injuries and much less well for occupational diseases. Injury rates for employees produced by HSE are based on employment estimates produced by the Office for National Statistics.

The major problem for the RIDDOR system is under-reporting. They have evidence from a study conducted in the 1990s that then only about 33% of cases were reported. They have reason to believe that this has increased to approximately 40% now. However, for the self-employed, they believe that only about 5% of cases are reported.

There appear to be two main reasons for this situation. The first is a lack of any incentive. Reporting exists primarily for the collection of statistical information and does not occur within any other context such as insurance or actuarial needs. That is, there is no reward for reporting to RIDDOR, except reducing the fear of prosecution for failing to do so. However, this is apparently a very rare event. The second reason is the existence of an apparent disincentive. It is widely perceived by those who report to RIDDOR that their action may trigger an investigation or, at the least, an inspection by HSE or local authority inspectors. That is, there is the perception of likely negative consequences from filing a report. The policy group responsible for RIDDOR feel this perception is unjustified, but acknowledge it exists nevertheless.

Two methodological strategies have been used to try to overcome the weaknesses of the RIDDOR system due to low reporting rates. One of these addresses injuries and the other diseases. Both approaches supplement the information available from the RIDDOR database with survey data. This means the statistics are derived from a number of different sources, some of which are surveys and are therefore subject to sampling errors (because the estimates are based on a sample rather than the whole population). The HSE commendably, where possible, reports 95% confidence intervals indicating the range of uncertainty due to this.

For occupational injuries, the Labour Force Survey (LFS) is used. HSE developed the LFS as a source of information on workplace injury, to complement the flow of the injury reports made by employers and others under RIDDOR. Detailed supplementary questions on workplace injury were first placed in the LFS in 1990, and a limited set of injury questions have been placed annually since 1993. The LFS gives estimates on the levels of workplace injury which are not subject to under-reporting and, together with the rates of reported injury, give estimates of the levels of reporting of injuries in industries. LFS injury rates are presented as three-year moving averages, to reduce annual fluctuations that stem from sampling error.

For occupational diseases, the surveys of Self-reported Work-related Illness (SWI) are conducted in conjunction with the Labour Force Surveys. The SWI attempts to measure work-related illness based on individual perceptions. To date four surveys have been completed in 1990, 1995, 2001/2, and 2003/4. A further survey was commissioned by the European Union Statistical Office (EUROSTAT) in 1998/99. This included most member states, but an error introduced in the UK survey restricted the coverage to people working in the past 12 months rather than people ever employed. These surveys provide an indication of the overall prevalence of work-related illness and its distribution by major disease groups and a range of demographic and employment-related variables. Responses obviously depend on lay people's perceptions of medical matters, but such perceptions are of interest and importance in their own right. However, they cannot be taken directly as an indicator of the "true" extent of work-related illness. People's beliefs may be mistaken: they may ascribe the cause of illness to their work when there is no such link and may fail to recognise a link with working conditions when there is one. Since the LFS (on which the SWI surveys are based) reflects only a sample of the population (around 1 in 400), responses are weighted on the basis of sub-national population totals by age and sex to give estimates for the entire population.

Comparison of the occupational disease estimates obtained by HSE with those for disablement benefit under the Industrial Injuries Scheme (IIS) for the corresponding diseases prescribed by the Department for Work and Pensions (DWP) suggests that there is still substantial under-reporting under RIDDOR, particularly for diseases with long induction periods (for example, the pneumoconioses and occupational cancers). The IIS compensates workers who have been disabled by a prescribed occupational disease. Again, it seems that the criteria that need to be fulfilled in order for a case to be reported, together with the reporting mechanism itself, are largely responsible for this under-reporting.

Other sources of information about occupational diseases in the UK are available from voluntary reporting by specialist doctors. In 1989, the first of several clinically-based reporting schemes for occupational disease was developed at the National Heart and Lung Institute in London. This scheme, the Surveillance of Work-related and Occupational Respiratory Disease (SWORD), relies on systematic, voluntary and confidential reporting of all new cases seen by consultant chest physicians. EPI-DERM, a scheme for surveillance of occupational skin disease by dermatologists, was begun in 1993, followed in 1996 by Surveillance of Infectious Disease At Work (SIDAW) by consultants in communicable disease control (CCDCs).

Three other schemes were started more recently – OSSA (Occupational Surveillance Scheme for Audiologists), MOSS (Musculoskeletal Occupational Surveillance Scheme), and SOSMI (Surveillance of Occupational Stress and Mental Illness). In MOSS and SOSMI, unlike the other specialist schemes, the physicians are advised to report cases either caused or made worse by work. In all the schemes, a very high proportion of physicians in the relevant specialities participate systematically and voluntarily.

Occupational physicians reported to SWORD from its inception and to EPI-DERM from 1994. In 1996, the Occupational Physicians Reporting Activity (OPRA) was established as a separate scheme for all types of work-related disease and, in 1998, all seven schemes were brought together and run from the University of Manchester as constituents of the Occupational Disease Intelligence Network (ODIN). From April 2002, the network, still run from the University of Manchester, has been known as The Health and Occupation Reporting network (THOR).

In most of these schemes (SIDAW and OSSA being the exceptions), there is a sampling process whereby most participating doctors are asked to send in reports for one month in each year, and the numbers of cases that they report are multiplied by 12 in arriving at the estimated annual totals. (In MOSS, all participants were originally included on this “sample” basis, but from January 2002 some rheumatologists reported cases every month throughout the year). To avoid any systematic seasonal biases, the sampled doctors are randomly allocated their reporting month, and this allocation changes from year to year. Not all reporting doctors are sampled; some are so called “core” reporters, who report cases every month throughout the year. Cases reported by them are included in the estimated annual totals without any scaling up. The estimated annual totals are generally based on smaller (often considerably smaller) numbers of actual reported cases and are subject to random variation due to sampling error.

Many cases of work-related disease will fall outside the catchment of the THOR schemes, since many workers will not have access to an occupational physician at their place of work, and other specialists such as chest physicians, dermatologists, psychiatrists, etc, will largely see only the more serious or difficult-to-resolve cases that are referred to them by other doctors. (They do, however, see patients over a wider age range than the occupational physicians, who almost exclusively see patients who have not yet retired). Therefore, figures from the THOR schemes should be regarded very much as minimal estimates of the true incidence of work-related disease.

Figures published by HSE relate to Great Britain only, although the THOR schemes do collect reports from doctors throughout the UK.

The incidence rates for THOR cases, per 100,000 workers in each occupation or industry, are calculated using denominators from the Labour Force Survey (LFS). The analyses by occupation now use the Standard Occupational Classification (SOC) 2000 rather than SOC 92, on which previous annual statistics have been based.

The fact that in many industries few, or even no, sufferers will have access to occupational physicians means that incidence rates based on or including OPRA reports cannot be used as a fair basis of comparisons between industries or occupations that have different degrees of coverage by such doctors. Comparisons between industries or occupations are best made by using rates based only on reports by “disease specialists” (e.g. dermatologists, chest physicians, etc). Such specialists are accessible via the NHS to patients with all kinds of employer (including small businesses and the self-employed).

## **5. INFORMATION RESOURCES**

Little information is available.

## **6. COSTS**

Little information is available.

## **7. ANALYSIS**

Statistics are available from the HSE. This includes technical notes describing minor coding changes that may affect historical comparisons. It is important to remember that not all injuries are reportable to RIDDOR. Those excluded include: road traffic accidents involving people travelling in the course of their work, which are covered by road traffic legislation; accidents reportable under separate merchant shipping, civil aviation and air navigation legislation; accidents to members of the armed forces; and fatal injuries to the self-employed arising out of accidents at premises which the injured person either owns or occupies.

Data is broken down by location, industry and occupational group, and disease/injury category.

Injuries are divided into three categories:

- fatal
- major
- over-3-day.

Diseases are grouped into one of eleven categories:

- asbestos-related
- cancer
- deafness
- infections
- lead exposure
- lung-related
- musculoskeletal disorders
- skin disorders and dermatitis
- stress
- vibration-related disorders
- violence at work.

## **8. EVALUATION**

Data is made readily available to all parts of the HSE, and to external parties with little or no delay.

## **9. USE, DERIVATIONS**

The Health and Safety Commission states, “RIDDOR information helps identify incidents that may require investigation in accordance with the HSC Strategy, HSC Enforcement Policy Statement, the HSE Enforcement Management Model and Incident Selection Criteria... This sort of information is needed quickly so that the enforcing authorities can ensure that duty holders take action to deal immediately with serious risks; and where duty holders fail in their responsibilities, they can be held to account. The enforcing authorities’ minimum requirements are for real-time reports of incidents that allow inspectors to make the right interventions when the consequences of exposure to risk arise. The HSC Strategy commits the enforcing authorities to continue to identify circumstances that require investigation and possible enforcement action. Some information is needed quickly, e.g. from major accidents, to ensure that duty holders deal with the most serious risks and can be held to account, as necessary. Currently, the enforcing authorities target investigations of incidents through Incident Selection Criteria that reflect the principles of the HSC Enforcement Policy Statement. Inspectors consider the severity and scale of potential or actual harm, the seriousness of any potential breach of law, knowledge of the duty holder’s past health and safety performance, the wider relevance of the incident and any general public concern, and current enforcement priorities”<sup>291</sup>. Furthermore, the Health and Safety Commission states, “Information from RIDDOR reports is also used to inform the enforcing authorities’ planning processes, the development of strategies, and provides information etc. that allows them to plan, organise and target their regulatory work in accordance with the HSC Strategy. This information enables them to target industries, occupations, and areas where there are high numbers of incidents and/or a higher level of risk and to focus on industry-specific issues. It is also essential for developing HSC/E’s strategic programmes and for evaluating their impact and helping identify where inspectors and duty holders need guidance”<sup>291</sup>.

The policy group responsible for RIDDOR were not able to provide much in the way of examples of how the system has contributed proactively to injury or disease prevention initiatives. They acknowledge that RIDDOR is primarily designed to support enforcement of health and safety legislation. However, they suggested that the development of the HSE's current "Slips and Trips" project benefited from data from RIDDOR. This initiative (<http://www.hse.gov.uk/slips/>) estimated that falls at work cost employers about £512 million per year and the health service another £133 million per year.

## **10. SYSTEM IMPROVEMENT**

A review of RIDDOR is currently underway. The Health and Safety Commission (HSC) published a discussion document via the Health and Safety Executive (HSE) on 31 March 2005<sup>291</sup>. The consultation period was due to end on 30 June 2005.

The review document acknowledges, "RIDDOR is one of the most important sources of information for the enforcing authorities and guides some, but not all, regulatory activity. However, the case has yet to be made as to whether RIDDOR is really the best means of gathering information on occupational health and for the purposes of health and safety statistics, or whether we could rely on other mechanisms to collect this information".

The main questions posed in the review are:

- Should RIDDOR trial alternative penalties (for not reporting) such as administrative fines or fixed penalty notices?
- How should RIDDOR's reporting and recording requirements be used to drive or influence duty holder behaviour?
- Should the collection of statistical information be disconnected from other RIDDOR objectives?

## Review rating table

The ten surveillance systems reviewed in detail were rated by the reviewer according to two key criteria as defined above:

- How well does the surveillance system capture the important information?
- How useful is the surveillance system for prevention?

Rating was completed on a five-point scale as follows:

- 1 = Very low
- 2 = Low
- 3 = Average
- 4 = High
- 5 = Very high

<b>TABLE 3</b>		
Rating surveillance systems		
COUNTRY/SYSTEM	CAPTURE	UTILITY
Canada/NWISP	2	1
France/COLCHIC	2	1
Finland/FROD	4	3
Finland/ FINOCCINJB	4	3
Sweden/ISA	3	2
US/SENSOR	4	3
US/ABLES	4	3
US/NTOF	2	2
US/HSEES	4	3
UK/RIDDOR	2	1

*Only a few of the systems can demonstrate even reasonable capture rates, and this inevitably yields less than satisfactory utility.*

There is a very large number of systems in current use throughout Europe. The following table comprehensively summarises the major systems.

European occupational surveillance and monitoring systems						
TABLE 4	WORKERS' SURVEYS	EXPOSURE DATABASES	REGISTERS OF ACCIDENTS AND DISEASES	REGISTERS OF SICKNESS LEAVE OR ABSENTEEISM	MULTI-SOURCE/POLICY-DIRECTED SYSTEMS	INTERVENTION- AND OSH MANAGEMENT-RELATED SYSTEMS
AUSTRIA	<ul style="list-style-type: none"> <li>Special Programmes of the Microcensus concerning working conditions of Statistics Austria (Statistik Austria)</li> <li>Questionnaire on the contentment with working conditions of the Chamber of Labour Upper Austria (Arbeitsklimaindex der Arbeiterkammer Oberösterreich) and the research institute IFES</li> </ul>		<ul style="list-style-type: none"> <li>Statistical Data of the Main Association of Austrian Social Security Institutions: accidents and occupational diseases, sickness leave and retirement (Hauptverband der Sozialversicherung)</li> </ul>	<ul style="list-style-type: none"> <li>Statistical Data of the Main Association of Austrian Social Security Institutions: accidents and occupational diseases, sickness leave and retirement (Hauptverband der Sozialversicherung)</li> </ul>	<ul style="list-style-type: none"> <li>Annual reports of the Austrian labour inspectorates (Tätigkeitsberichte der Arbeitsinspektione)</li> </ul>	
BELGIUM	<ul style="list-style-type: none"> <li>Benchmark on Questionnaire on the Experience and Assessment of Work</li> </ul>	<ul style="list-style-type: none"> <li>Federal Ministry of Labour and Employment – administration of occupational hygiene and medicine</li> </ul>	<ul style="list-style-type: none"> <li>Fund for occupational accidents (Fonds voor Arbeidsongevallen / Fonds des accidents du travail)</li> <li>Fund for occupational diseases (Fonds voor beroepsziekten / Fonds des maladies professionnelles)</li> </ul>	<ul style="list-style-type: none"> <li>National Institute for Statistics referring to a survey made by SD Works (Nationaal Instituut voor statistiek – Institut national de Statistique)</li> </ul>	<ul style="list-style-type: none"> <li>Belgian Safety Index</li> </ul>	<ul style="list-style-type: none"> <li>Benchmark on the Questionnaire on the Experience and Assessment of Work</li> </ul>

BULGARIA				<ul style="list-style-type: none"> <li>Accidents register</li> </ul>			<ul style="list-style-type: none"> <li>Year report and three months activity accounts of Executive Agency General Labour Inspection (GLI)</li> </ul>	
CZECH REPUBLIC			<ul style="list-style-type: none"> <li>Injuries at Work Database (Fatal and Other) (IS SOD CÚBP)</li> </ul>					
DENMARK	<ul style="list-style-type: none"> <li>Danish Working Environment Cohort Study (Nationale arbejdsmiljøkohorte/ NAK)</li> <li>Health and Diseases Survey (Sundhed og sygelighed i Danmark)</li> </ul>	<ul style="list-style-type: none"> <li>Register of Imported and Produced Chemical Products (Produktregisteret)</li> </ul>	<ul style="list-style-type: none"> <li>Register of Occupational Accidents (Registret for arbejdsulykker)</li> <li>Accidents Treated in Hospital First Aid Units (Skadestuerregisteret)</li> <li>Register of Occupational Diseases (Registret for arbejdsbetingede lidelser)</li> <li>Common Statistics on Recognised and Reported Accidents and Diseases (Fælles arbejds-skadestatistik)</li> <li>The Danish Cancer Register (Cancerregistret)</li> <li>Occupational Cancer Surveillance</li> </ul>			<ul style="list-style-type: none"> <li>Surveillance of Progress in Action Programme for a Clean Working Environment 2005 (Overvågning af Handlingsprogram for et rent arbejdsmiljø år 2005)</li> <li>Surveillance of Progress in Activities in Companies within the Seven Visions included in the Danish Government Action Plan (Overvågning af virksomhedernes forebyggende aktiviteter)</li> </ul>		

	WORKERS' SURVEYS	EXPOSURE DATABASES	REGISTERS OF ACCIDENTS AND DISEASES	REGISTERS OF SICKNESS LEAVE OR ABSENTEEISM	MULTI-SOURCE/POLICY-DIRECTED SYSTEMS	INTERVENTION- AND OSH MANAGEMENT-RELATED SYSTEMS
			<p>(Kræftsygelighed i arbejdsmiljøet gennem 30 år)</p> <ul style="list-style-type: none"> <li>Occupational Hospitalisation Register (Erhvervsindlæggelsesregistret)</li> <li>Occupational Mortality Survey (Dødelighed og erhverv)</li> <li>Medical Birth Register and Registry of Congenital Malformations (Misdannelsesregisteret)</li> </ul>			
ESTONIA	<ul style="list-style-type: none"> <li>Working Environment Survey, March 2000 (Töökeskonna uuring)</li> <li>Living Conditions Study in Estonia 1999 (Elutingimuste uuring Eestis 1999 aastal)</li> <li>Register of workplaces (Töökeskonna ankeet)</li> </ul>		<ul style="list-style-type: none"> <li>Register of occupational accidents and diseases (Tööõnnetuste ja kutsehaiguste register)</li> </ul>			

EUROPE	<ul style="list-style-type: none"> <li>European Working Conditions Survey</li> <li>Labour force survey</li> </ul>	<ul style="list-style-type: none"> <li>European statistics on accidents at work (ESAW)</li> </ul>	<ul style="list-style-type: none"> <li>The State of Occupational Safety and Health in the European Union – Pilot Study</li> </ul>		
FINLAND	<ul style="list-style-type: none"> <li>Finnish Work and Health Survey (Työ ja terveys Suomessa)</li> <li>Working Conditions Study (Työolotutkimus)</li> <li>Finnish Working Life Barometer (Working Conditions Poll Study) (Työolobarometri)</li> <li>Barometer of Maintenance of Work Ability (TYKY – barometri)</li> </ul>	<ul style="list-style-type: none"> <li>Register of Occupational Hygiene Measurements (Työterveyslaitoksen työhygieenisten mittausten rekisteri)</li> <li>Register of Biological Monitoring Results (Työterveyslaitoksen biomonitointilaboratorion analyysien vuosiyhteenveto)</li> <li>Register on Employees Exposed to Carcinogens (ASA – Ammatissaan syöpäsairauden vaaraa aiheuttaville aineille altistuvien rekisteri)</li> </ul>	<ul style="list-style-type: none"> <li>Register of Occupational Accidents (Työtapaturma- ja ammattitautitilasto)</li> <li>Register of Occupational Diseases (Työperäisten sairauksien rekisteri)</li> <li>Finnish Cancer Registry (Suomen Syöpärekisteri)</li> </ul>	<ul style="list-style-type: none"> <li>Statistics on Sickness Absences (Kansaneläkelaitoksen tilastokatsaukset: sairauspoissaolot)</li> <li>Statistics on Work Inability Pensions (Eiäketurvakeskuksen työkyvyttömyyseläketilastot)</li> </ul>	<ul style="list-style-type: none"> <li>Labour Inspectorate's Workplace Information System (Valvontatietojärjestelmä VATI)</li> </ul>
FRANCE		<ul style="list-style-type: none"> <li>COLCHIC. Available in French.</li> <li>EVALUTIL. Available in French.</li> </ul>	<ul style="list-style-type: none"> <li>Database of very serious or fatal work-related accidents, based on the Labour Inspectorate's reports also available in French. (Base de données des accidents du travail très graves)</li> </ul>		

	WORKERS' SURVEYS	EXPOSURE DATABASES	REGISTERS OF ACCIDENTS AND DISEASES	REGISTERS OF SICKNESS LEAVE OR ABSENTEEISM	MULTI-SOURCE/POLICY-DIRECTED SYSTEMS	INTERVENTION - AND OSH MANAGEMENT-RELATED SYSTEMS
GERMANY		<ul style="list-style-type: none"> <li>Chemical exposure database MEGA (Messdaten zur Exposition gegenüber Gefahrstoffen am Arbeitsplatz)</li> </ul>	ou mortels, fondée sur les signalements de l'inspection du travail)		<ul style="list-style-type: none"> <li>Safety and Health at work (Sicherheit und Gesundheit bei der Arbeit)</li> </ul>	
GREECE			<ul style="list-style-type: none"> <li>Social Security Institute: Annual Labour Accident Statistics</li> <li>Annual Labour Accident Statistics of the Labour Inspection Authorities of the Ministry of Labour and Social Affairs</li> <li>Social Security Institute Record of Occupational Diseases</li> </ul>			
HUNGARY			<ul style="list-style-type: none"> <li>Annual report on the evaluation of occupational diseases (Foglalkozási megbetegedések éves jelentése és értékelése)</li> </ul>			

IRELAND						<ul style="list-style-type: none"> <li>List of promotion and campaign activities</li> <li>Labour inspectorate interventions (A part of SAFE system – System for Accidents and Field Enforcement)</li> </ul>
ITALY	<ul style="list-style-type: none"> <li>Labour Force Survey (ISTAT) (Indagine sulle Forze di lavoro)</li> <li>Census of Industry and Services Sectors and Census of Agricultural Sector (ISTAT) (Censimento dell'Industria e dei Servizi)</li> </ul>		<ul style="list-style-type: none"> <li>Statistic bulletin (INAIL) (Notiziario statistico)</li> <li>Online databank of accidents and diseases (INAIL) (Banca dati statistica)</li> <li>Atlas of Accidents (ISPESL) (Atlante degli infortuni)</li> <li>Report on occupational diseases (ISPESL – Regions) (Rapporto ISPESL – Regioni sulle malattie professionali)</li> <li>National Mesothelioma Registry (ISPESL) (Registro Nazionale dei Mesoteliomi)</li> </ul>			<ul style="list-style-type: none"> <li>Annual Report (INAIL, National Workers Compensation Authority) (Rapporto annuale)</li> </ul>

	WORKERS' SURVEYS	EXPOSURE DATABASES	REGISTERS OF ACCIDENTS AND DISEASES	REGISTERS OF SICKNESS LEAVE OR ABSENTEEISM	MULTI-SOURCE/POLICY-DIRECTED SYSTEMS	INTERVENTION- AND OSH MANAGEMENT-RELATED SYSTEMS
LITHUANIA		<ul style="list-style-type: none"> <li>Register of dangerous chemical substances and preparations (Pavojingu cheminiu medžiagu ir preparatu registras)</li> <li>State Register of Potentially Dangerous Equipment (Valstybinis potencialiai pavojingu irenginiu registras)</li> </ul>	<ul style="list-style-type: none"> <li>Database of accidents at work (Nelaimingu atsitikimų darbe duomenų bazė)</li> <li>National Register of Occupational Diseases (Profesinių ligų valstybės registras)</li> </ul>			
NETHERLANDS	<ul style="list-style-type: none"> <li>Working conditions: monitoring by individuals (Arbomonitoring via personen)</li> </ul>		<ul style="list-style-type: none"> <li>Het Signaleringsrapport Beroepsziekten (Monitoring Report on Occupational Diseases)</li> </ul>		<ul style="list-style-type: none"> <li>OSH Balance: risks, effects and measures (Arbobalans: risico's, effecten en maatregelen)</li> </ul>	<ul style="list-style-type: none"> <li>OSH Monitor (Arbomonitor)</li> </ul>
POLAND			<ul style="list-style-type: none"> <li>The statistical accident at work form and the accident treated as being equivalent to the accident at work Z-KW (Statystyczna karta wypadku przy pracy oraz wypadku traktowanego na równi z wypadkiem przy pracy Z-KW)</li> </ul>		<ul style="list-style-type: none"> <li>Report on working conditions. Z-10 (Sprawozdanie o warunkach pracy. Z-10)</li> </ul>	

PORTUGAL	<ul style="list-style-type: none"> <li>Working Conditions Survey (Condições de Trabalho em Portugal)</li> </ul>	<ul style="list-style-type: none"> <li>Information on Accidents at work (Informação Estatística dos Acidentes de Trabalho)</li> <li>Insurance Statistics (Estatísticas dos Seguros)</li> <li>Social Security Statistics (Estatísticas da Segurança Social)</li> <li>Social Balance (Balanço Social)</li> </ul>			<ul style="list-style-type: none"> <li>IDICT's Activity Report (Relatório de Actividades do IDICT)</li> <li>Annual Report on Activities of the General Labour Inspection (Relatório Anual de Actividades da IGT)</li> </ul>	<ul style="list-style-type: none"> <li>Organisation of the Prevention Services (Organização dos Serviços de Prevenção)</li> </ul>
SLOVENIA	<ul style="list-style-type: none"> <li>Labour Force Survey (Anketa o delovni sili)</li> </ul>		<ul style="list-style-type: none"> <li>Register of Injuries at Work (Evidenca poškodb pri delu)</li> <li>Register of Accidents at Work (Evidenca nezgod pri delu)</li> <li>Sick Leave Register (Zbirka podatkov o zacasnih nezmožnosti za delo)</li> </ul>		<ul style="list-style-type: none"> <li>Register of Licensed Safety at Work Services (Spisek pravnih oziroma fizicnih oseb, ki imajo dovoljenje za delo za opravljanje strokovnih nalog s področja varnosti in zdravja pri delu)</li> <li>Annual Report of the Labour Inspectorate of the Republic of Slovenia (Porocilo o delu Inšpektorata Republike Slovenije za delo)</li> <li>Register of Preventive Health Care of Workers, Traffic</li> </ul>	

	WORKERS' SURVEYS	EXPOSURE DATABASES	REGISTERS OF ACCIDENTS AND DISEASES	REGISTERS OF SICKNESS LEAVE OR ABSENTEEISM	MULTI-SOURCE/POLICY-DIRECTED SYSTEMS	INTERVENTION- AND OSH MANAGEMENT-RELATED SYSTEMS
SPAIN	<ul style="list-style-type: none"> <li>National Working Conditions Survey (Encuesta Nacional de Condiciones de Trabajo)</li> </ul>		<ul style="list-style-type: none"> <li>Occupational accidents and diseases statistics (Estadísticas de accidentes de trabajo y enfermedades profesionales)</li> </ul>		Participants and Sportsmen (Evidencia preventivnega zdravstvenega varstva delavcev, udeležencev v prometu in športnikov)	
SWEDEN	<ul style="list-style-type: none"> <li>Work environment study (Arbetsmiljöundersökningen)</li> <li>Study of work-related health problems (Undersökningen om arbetsorsakade besvär)</li> </ul>	<ul style="list-style-type: none"> <li>Registry of occupational hygiene measurement (Exponeringsdatabasen)</li> </ul>	<ul style="list-style-type: none"> <li>The Work Injury Information system (Informations-systemet om arbetsskador (ISA))</li> </ul>			
SWITZERLAND			<ul style="list-style-type: none"> <li>Statistics of the Accident Insurers (Statistik der Unfallversicherung UVG)</li> </ul>			

UK	<ul style="list-style-type: none"> <li>• Accident and ill health questions in the Labour Force Survey</li> <li>• Self-reported work-related illness surveys (SWI)</li> <li>• Self-reported work-related conditions (SWC)</li> </ul>	<ul style="list-style-type: none"> <li>• National Exposure Database (NEEDB)</li> </ul>	<ul style="list-style-type: none"> <li>• Employers and self-employed people notify HSE and local authorities (through an electronic and telephone system). Regulations are called RIDDOR <ul style="list-style-type: none"> <li>• Mesothelioma and asbestosis register</li> <li>• Compensatable occupational disease (IIS)</li> <li>• Medical reporting of work-related illness (ODIN/THOR)</li> </ul> </li> </ul>												
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# CONCLUSIONS AND RECOMMENDATIONS



Occupational surveillance systems have undeniable value and hold considerable potential for prevention approaches. We know that the workplace is a significant and consistent contributor to injuries and illness and associated fatalities, and that worker health is fundamental to public health and to a healthy and productive society. Tracking systems form the cornerstone of injury and illness surveillance. A diverse variety of methods and measures has been adopted in different countries and by their health and safety systems. These range from systematic and comprehensive, through to “ad hoc”, and insufficient. Many rely on a patchwork of data and systems<sup>137</sup>.

Surveillance is observational in nature and is not research. In practice, surveillance systems involve the ongoing and systematic collection, analysis, and interpretation of information so that appropriate preventive action may be taken. Surveillance systems vary widely in scope and in quality. Unfortunately, robust evidence-based comparisons of surveillance systems in different countries are not available and cannot be easily made based on currently available information. Despite this conclusion, some important observations can be made.

Quality of any surveillance system rests on its ability to capture data from the largest possible proportion of the target population, and for that data to incorporate the widest possible range of potentially relevant variables. Data capture is the lifeblood of a surveillance system. In order to achieve higher capture rates, many surveillance systems have been built upon existing data systems, although these were designed for other purposes. While providing some level of feasibility, it significantly weakens confidence in real world application of the system. To be most effective, data capture needs to be tightly integrated into workplace, healthcare, compensation, and benefit systems. The key players need appropriate incentives and motivation to participate in a surveillance system and to populate the database fields. Without these, the efficiency and the reliability of any output will inevitably plummet. There may sometimes be a role for the use of mandatory reporting, however, this certainly does not guarantee higher data capture rates than voluntary approaches (at least, unless there are sanctions that are consistently applied).

Single methods of data capture are invariably inadequate, since they yield an incomplete picture. They are invariably less able to narrow down fine-grained detail. For this reason, combined methods of data capture may be required. This has important resource implications and indicates the need for excellence in design of a surveillance system.

Policy makers should expect to be able to formulate decisions based on surveillance systems. There is little doubt that surveillance systems have gradually become more sophisticated over time, and this is especially true since the early 1990s. However, many systems remain vulnerable to the twin problems of low or unknown rates of data capture and weak capability to allow comparisons across time or between categories. These two fundamental problems impair the potential to inform effective prevention approaches. Furthermore, they undermine the ability of a surveillance system to be able to detect the effectiveness of interventions, such as a prevention initiative.

The greatest utility is derived from a concept-driven system, rather than a data-driven one. The opportunistic use of data collected for other reasons is seductive, but the serious limitations of this approach must be acknowledged. Furthermore, surveillance systems should not be designed to be stagnant, but rather to improve over time.

It is apparent that the key features of a high-quality occupational surveillance system include the following. Note, these are not ranked in importance.

- Both worker health, and injury, are monitored with an equal focus on occupational disease and injury. The division between “health” and “injury” is arbitrary and depends on the context existing in each jurisdiction. Surveillance systems that focus on only one or the other are necessarily weakened by the types of boundary disputes over causation and responsibility that occur. Furthermore, the received wisdom in occupational health is that injury data is far more easily and readily collected, but data on illness is a more subtle and demanding challenge that is all too often ignored.

- Work environment is comprehensively monitored, in addition to worker health status (due to illness or injury). Surveillance systems' potency is derived from observing correlations between factors in the work environment and workers' health status. Systems that are unable to marry these up are very weak indeed.
- Case definitions are standardised and accurately applied. These should probably be based on the best available standard international classifications, augmented by expert consensus.
- The system of defining cases needs to be able to effectively manage ill-defined health and injury problems, such as the spectrum of clinical "syndromes" over which there may not be either clinical or administrative consensus. This requires development of a classification system that has forward flexibility, allowing inclusion of more detailed sub-categories as soon as expert agreement can be obtained.
- A standardised minimum data set should be used, that conforms as much as possible with international trends for data collection, allowing "harmonised" data to be compared and contrasted meaningfully.
- The system should provide suitable incentives to maximise data capture. The types of incentives used can range from providing contributors with information on why the surveillance system exists, right through to mandatory reporting requirements.
- The system should comply with legislation and international treaty obligations.
- The system should have a core concept-driven design based on excellent theoretical models, but also take advantage of opportunities to collect secondary data wherever possible. This means it should make use of multiple data sources, including opportunistic and custom-designed ones. That is, the pragmatic solution is to use a mixed data-driven and concept-driven solution, with a strong philosophical ethos to move steadily toward a concept-driven approach whenever possible.
- The system should be capable of effectively managing data collected for other purposes, to minimise bias. This indicates the need for independent oversight.
- The system uses a comprehensive range of selected indicators and, wherever possible, collects information in free-text fields.
- Multiple data capture techniques are used, in a targeted and intelligent manner, including:
  - mandatory disease or injury reporting by healthcare providers or facilities
  - mandatory disease or injury reporting by employers or workplaces
  - reports by laboratories
  - sentinel surveillance
  - periodic or ongoing prevalence surveys
  - vital records
  - secondary analysis of data sets collected for other purposes
  - expert opinion
  - mixed systems.
- The system needs to be well designed and implemented with the core attributes of sensitivity, specificity, representativeness, timeliness, simplicity, flexibility, and acceptability. It should also include appropriate reliability checks.
- Data should be included from national, regional, and enterprise levels.
- Independent and unbiased oversight for the system. This is best provided by situating the system in an independent unit or service.
- Expert input, through an advisory group or panel. Ideally, this should involve rolling membership in order to maintain a fresh approach.
- There should be an equal focus on public and private sectors, and enterprises ranging from large through small.
- The system includes market surveillance of new products.
- The system should be effective at managing ethical matters, such as privacy issues arising from tracking workers across job changes.

- The system should be capable of rapid response to emerging problems.
- Those responsible for managing the system should act responsibly to minimise both false positives and false negatives. The strength of evidence underlying estimates from the surveillance system should be reported.
- It should be cost-effective.
- Ongoing system improvement should be based on usefulness, cost and quality.

With regards to the implementation of occupational surveillance systems, it should be noted that the better surveillance systems in the world have at least two unique characteristics. First, there is a dedicated unit or service. Competition between departments, organisations, or institutes does not appear to add anything useful. This may be, in part, because there are already far too many competing systems around the world, many of which consequently lack adequate resources such as skills and funding. Second, the structure of the system has been well thought out and is integrated directly with the workplace and health and social systems. This means that data capture is maximised, and the surveillance system has some accountability to these key stakeholders to produce relevant information.

There is no ideal way of attaining the highest rate of data capture. This is because it must be matched to specific contexts. That is, a high-quality surveillance system will need to use multiple methods. The basic method may be a reporting system, but this might be augmented with “snapshot” samples, surveys, etc. Mandatory reporting may be appropriate for problems such as serious infectious diseases or injuries leading to fatalities. There is likely to be high compliance for these. However, it would be over-zealous for more minor problems, likely leading to low compliance rates. For these, it may be appropriate to adopt a reporting system where any individual with an index of suspicion that their health status has been affected by work can make a report. This would yield the best capture rate of all, but require a filtering system to ensure that only relevant cases are used.

None of the existing occupational surveillance systems in use around the world stands out as a shining example. In part, this is because they are all legacy systems in one way or another, having inherited historical approaches from predecessors. Most, if not all, have noble intentions. They set out to make the workplace safer and to contribute to prevention initiatives. It is rare to observe any successes, however.

Perhaps the over-arching conclusion must be that we need to do better at occupational surveillance – much better. We need up-to-date concept-driven systems that have high rates of data capture. Only then will the potential utility of these systems be fully realised.

It is clear that the systems that are currently approaching this ideal most closely are those that have dedicated services who are independent and charged with the mission to champion this cause. However, this alone is not sufficient. The system must also be comprehensive and emphasise occupational illness in addition to the more easily noticed occupational injury. Of the systems reviewed, the Finnish approach is the one that currently most nearly attains these criteria, and it seems that New Zealand could learn a substantial amount from this model.

## RECOMMENDATIONS

The following recommendations are offered by the reviewer, while acknowledging that some of these have resource implications. These recommendations outline a high-quality occupational surveillance system.

### RECOMMENDATION 1. ESTABLISH AN INDEPENDENT EPIDEMIOLOGY BUREAU

There should be an independent unit providing an epidemiology department with overall responsibility for surveillance systems. This epidemiology bureau should have an appropriate management structure that is entirely independent of any stakeholders or organisations that may hold their own agendas, in order to avoid bias. It should be funded by contributions from stakeholders, including but not limited to the Ministry of Health, the Ministry of Social Development, the Accident Compensation Corporation, and private health insurers or underwriters. Core tasks would be to:

- establish an integrated concept-driven surveillance system that is feasible
- vigorously champion data capture
- contribute directly to prevention initiatives
- function in a cost-effective manner.

### RECOMMENDATION 2. ESTABLISH AN EXPERT GROUP

There should be an expert group, whose principal function is to advise the epidemiology bureau. Membership should be time-limited, allowing staged turnover to maximise fresh ideas. This group would advise the epidemiology bureau on key topics, including:

- case definitions, coding, categories, and key indicators
- data capture techniques, including those that might be mandatory
- analysis, especially of narrative fields
- priorities.

In addition, the expert group would function as an expert panel in the development of guidance on specific occupational health topics

### RECOMMENDATION 3. ESTABLISH AN INTEGRATED CONCEPT-DRIVEN SURVEILLANCE SYSTEM

The core of this should be a national database that includes all occupational injuries and disease. This could be modelled on the Finnish equivalent. The epidemiologist(s) would be required to integrate data capture into the workplace and the ACC and health systems. The core database would be augmented with multiple data capture techniques, with consideration given to using a mixture of techniques, targeted carefully at specific issues. This might include sentinel systems, expert opinion, surveys, and laboratory reports, for example.

#### **RECOMMENDATION 4. ADOPT BEST PRACTICE PRINCIPLES FOR SURVEILLANCE**

The key features of high-quality surveillance systems have been outlined in detail above, so they are not repeated here. It needs to be emphasised that surveillance systems rapidly deteriorate into ineffective systems when compartmentalised or fragmented. The best practice requires a “systems approach”, without cutting corners. An expert group needs to be consulted to ensure that the surveillance system will result in useful outputs and can be continuously improved.

#### **RECOMMENDATION 5. PUBLISH SURVEILLANCE DATA**

Undertake wide dissemination of information on a regular basis.

#### **RECOMMENDATION 6. USE THE SURVEILLANCE SYSTEM TO EVALUATE THE EFFECTIVENESS OF INTERVENTIONS**

The surveillance system should be used to evaluate the effectiveness of interventions, such as prevention initiatives and improvements in work methods and work organisation. However, this can only be achieved if the system is sensitive to change. This will be contingent on development of an integrated surveillance system, built on the recommended principles of best practice.

# APPENDICES



## 7.1 SEARCH STRINGS USED FOR LITERATURE REVIEW

Boolean search using the Ovid web interface for Medline, Medline Daily Update, Medline Pending, EMBASE, and PsycINFO.

1. surveillance.mp
2. occupational and environmental medicine
3. 1 and 2
4. occupational health.mp
5. occupational injury.mp
6. 4 or 5
7. 1 and 6

For databases CSILO, HSELINE, OSHLINE and NIOSHTIC, HAPI keywords used included “surveillance”, “system”, “epidemiology”, “occupational”, “work”, “health”, “disease”, and “injury”. The search yielded 2,731 unique citations.

## 7.2 LIST OF USEFUL RESOURCES DISCOVERED WHILE CONDUCTING REVIEW

This list is not exhaustive and does not include major organisations that are well known, such as NIOSH in the US or the HSE in the UK.

TABLE 5		Health and Safety Resources
ORGANISATION	WEB ADDRESS	
Baltic Sea Network on Occupational Safety and Health	<a href="http://www.balticseaosh.net/finland/fibellc.shtml">http://www.balticseaosh.net/finland/fibellc.shtml</a>	
California Fatality Assessment and Control Evaluation (FACE) program	<a href="http://apha.confex.com/apha/129am/techprogram/paper_23066.htm">http://apha.confex.com/apha/129am/techprogram/paper_23066.htm</a>	
Canadian Centre for Occupational Health and Safety	<a href="http://www.ccohs.ca/">http://www.ccohs.ca/</a>	
CDC	<a href="http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm">http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5013a1.htm</a>	
Council of State and Territorial Epidemiologists	<a href="http://www.cste.org/occupationalhealth.htm">http://www.cste.org/occupationalhealth.htm</a>	
European Agency for Safety and Health at Work	<a href="http://agency.osha.eu.int/">http://agency.osha.eu.int/</a>	
Eurosurveillance	<a href="http://www.eurosurveillance.org">http://www.eurosurveillance.org</a>	
Finnish Institute of Occupational Health	<a href="http://www.occuphealth.fi/internet/english">http://www.occuphealth.fi/internet/english</a>	
Finnish Ministry of Labour	<a href="http://www.mol.fi/english/">http://www.mol.fi/english/</a>	
Global Health Council	<a href="http://www.globalhealth.org/">http://www.globalhealth.org/</a>	
Health Canada	<a href="http://www.hc-sc.gc.ca/english/index.html">http://www.hc-sc.gc.ca/english/index.html</a>	
INRS, France	<a href="http://en.inrs.fr/">http://en.inrs.fr/</a>	
Institute of Medicine	<a href="http://www.iom-world.org/">http://www.iom-world.org/</a>	
Institute of Occupational and Environmental Medicine	<a href="http://www.pcpoh.bham.ac.uk/ioem/">http://www.pcpoh.bham.ac.uk/ioem/</a>	
IOSH, UK	<a href="http://www.iosh.co.uk/">http://www.iosh.co.uk/</a>	
Labor and Economic Growth, Michigan	<a href="http://www.michigan.gov/cis">http://www.michigan.gov/cis</a>	
National Occupational Research Agenda (NORA)	<a href="http://www.cdc.gov/niosh/nora/">http://www.cdc.gov/niosh/nora/</a>	
OH&S Sites	<a href="http://www.asosh.org/WorldLinks/QuickLinks/OHS.htm">http://www.asosh.org/WorldLinks/QuickLinks/OHS.htm</a>	
Swedish Work Environment Authority	<a href="http://www.av.se/press/2003/030116_2.shtm">http://www.av.se/press/2003/030116_2.shtm</a>	
THOR, UK	<a href="http://www.coeh.man.ac.uk/thor/">http://www.coeh.man.ac.uk/thor/</a>	
UCLA Dept of Epidemiology	<a href="http://www.ph.ucla.edu/epi/faculty/britz/Epi261Occ/ritz_Epi261_occ%20surveillance.html">http://www.ph.ucla.edu/epi/faculty/britz/Epi261Occ/ritz_Epi261_occ%20surveillance.html</a>	
Washington State Department of Labor and Industries	<a href="http://www.lni.wa.gov/default.asp">http://www.lni.wa.gov/default.asp</a>	
Work-related Injury Statistics Query, CDC	<a href="http://www2.cdc.gov/risqs/default.asp">http://www2.cdc.gov/risqs/default.asp</a>	
Worksafe	<a href="http://www.worksafe.org/">http://www.worksafe.org/</a>	

# DEFINITIONS AND TERMINOLOGY



Brief description of definitions<sup>30</sup> used for key concepts, terminology, methodology, etc. This list is not intended to be exhaustive.

### **Health**

Health is defined in the Preamble of the Constitution of the WHO as a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. In 1978, WHO-EURO (Copenhagen) referred to health as a dynamic process that depends largely on the individual capacity to adapt to the environment; to be healthy means to maintain an intellectual and social activity despite any disorders or handicaps.

### **Healthcare**

Those services provided to individuals or communities by agents of the health services or professions, for the purpose of promoting, maintaining, monitoring, or restoring health. Health care is broader than, and not limited to, medical care, which implies therapeutic action by or under the supervision of a physician. The term is sometimes extended to include self-care.

### **Health indicator**

A variable, susceptible to direct measurement, that reflects the state of health of persons in a community. Examples include infant mortality rates, incidence rates based on notified cases of disease, disability days, etc. These measures may be used as components in the calculation of a health index. (see Last 1988)

### **Health services**

Services that are performed by health care professionals, or by others under their direction, for the purpose of promoting, maintaining, or restoring health. In addition to personal health care, health services include measures for health protection and health education. (see Last 1988)

### **Health professionals**

Health professionals are persons who have been accredited through appropriate procedures to practise a profession in health (e.g. medicine, nursing).

### **Health statistics**

Aggregated data describing and enumerating attributes, events, behaviours, services, resources, outcomes, or costs related to health, disease, and health services. The data may be derived from survey instruments, medical records, and administrative documents. Vital statistics are a subset of health statistics.

### **Indicator**

A thing that serves to give an indication or suggestion of something else. Evaluations cannot always be made by aggregating numerical values alone. Qualitative indicators are therefore often used, for example, to assess people's involvement and their perception of their health status. WHO has proposed four categories of indicators: health policy indicators; social and economic indicators; indicators of health care delivery; and indicators of health status, including quality of life. It should be emphasised that, while indicators help to measure the attainment of targets, they are not in themselves targets. Indicators have to be selected carefully to make sure that they are responsive to current trends of development and that they are useable for the analysis of ongoing activities. When selecting indicators, full account has to be taken of the extent to which they are valid, objective, sensitive and specific. Validity implies that the indicator actually measures what it is supposed to measure. Objectivity implies that, even if the indicator is used by different people at different times and under different circumstances, the results will be the same. Sensitivity means that the indicator should be sensitive to changes in the situation or phenomenon concerned. However, indicators should be sensitive to more than one situation or phenomenon. Specificity means that the indicator reflects changes only in the situation or phenomenon concerned. Another important attribute of an indicator is its availability, namely that it should be possible to obtain the data required without undue difficulty.

**Medical data**

Medical data are those data collected for medical purposes, i.e. for the purpose of practising medicine; such data are those collected by a physician or by a health professional (for instance, a nurse or a paramedic) working under a physician's responsibility and should only be used for medical purposes.

**Medical surveillance**

The process of evaluating the health of employees as it relates to their potential occupational exposures to hazardous agents. The health of workers is monitored through regularly scheduled and post-incident medical examinations. Medical surveillance may be required to determine the suitability of workers to perform a certain type of job (for example, to wear a respirator), to establish a baseline medical status of a worker, or to identify potential changes in the overall health status of workers.

**Occupational health professionals**

Persons who have been accredited, through appropriate procedures, to practise a profession related to occupational health or who provide occupational health services according to the provisions of relevant regulations. Occupational health professionals include all those who, by profession, carry out occupational safety and health activities, provide occupational health services, or who are involved in occupational health practice, even if only occasionally. They may be occupational health physicians, nurses, occupational safety and health inspectors, occupational hygienists, occupational psychologists, and specialists involved in ergonomics, accident prevention, and the improvement of the working environment, as well as in occupational health and safety research. Many others, in addition to occupational health and safety professionals, are involved in the protection and promotion of the health of workers, e.g. management and workers' representatives.

**Notifiable disease**

A disease that, by statutory requirements, must be reported to the public health authority in the pertinent jurisdiction when the diagnosis is made.

**Occupational health data**

Occupational health data are those data collected for occupational health purposes; such data are collected by an occupational health professional. In most circumstances, health data is covered by medical confidentiality.

**Occupational healthcare**

Occupational healthcare refers to the care of the health of workers. It includes preventive health care, health promotion, curative health care, first aid, rehabilitation, and compensation, where appropriate, as well as strategies for prompt recovery and return to work.

**Occupational safety and health**

Occupational safety and health is identified as the discipline dealing with the prevention of work-related injuries and diseases as well as the protection and promotion of the health of workers. It aims at the improvement of working conditions and environment. Members of many different professions (e.g. engineers, physicians, hygienists, nurses) contribute to occupational safety, occupational health, occupational hygiene, and improvement of the working environment.

**Occupational health**

Since 1950, the ILO and WHO have had a common definition of occupational health. This definition was adopted by the Joint ILO/WHO Committee on Occupational Health at its First Session (1950) and revised at its 12th Session (1995): Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from

factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological capabilities; and, to summarise, the adaptation of work to man and of each man to his job. The main focus in occupational health is on three different objectives: (i) the maintenance and promotion of workers' health and working capacity; (ii) the improvement of working environment and work to become conducive to safety and health; and (iii) development of work organisations and working cultures in a direction which supports health and safety at work and, in doing so, also promotes a positive social climate and smooth operation and may enhance productivity of the undertakings. The concept of working culture is intended in this context to mean a reflection of the essential value systems adopted by the undertaking concerned. Such a culture is reflected in practice in the managerial systems, personnel policy, principles for participation, training policies, and quality management of the undertaking.

### **Occupational health practice**

Consists not only of the activities performed by the occupational health service. It is multidisciplinary and multisectoral activity involving, in addition to occupational health and safety professionals, other specialists both in the enterprise and outside, as well as competent authorities, the employers, workers, and their representatives. Such involvement requires a well-developed and well-coordinated system at the workplace. The necessary infrastructure should comprise all the administrative, organisational, and operative systems that are needed to conduct the occupational health practice successfully and ensure its systematic development and continuous improvement.

### **Occupational health services**

The ILO Convention No. 161 specifies that occupational health services should include those of the following functions that are adequate and appropriate to the occupational risks at the worksite<sup>292</sup>:

- Identification and assessment of the risks from health hazards in the workplace.
- Surveillance of the factors in the working environment and working practices which may affect workers' health, including sanitary installations, canteens, and housing where these facilities are provided by the employer.
- Advice on planning and organisation of work, including the design of workplaces, on the choice, maintenance, and condition of machinery and other equipment and on substances used in work.
- Participation in the development of programmes for the improvement of working practices, as well as testing and evaluation of health aspects of new equipment.
- Advice on occupational health, safety, and hygiene and on ergonomics and individual and collective protective equipment.
- Surveillance of workers' health in relation to work.
- Promoting the adaptation of work to the worker.
- Contributing to measures of vocational rehabilitation.
- Collaborating in providing information, training, and education in the fields of occupational health and hygiene and ergonomics.
- Organising first aid and emergency treatment.
- Participating in analysis of occupational accidents and occupational diseases.

### **Occupational health surveillance system**

A system that includes a functional capacity for data collection, analysis, and dissemination linked to occupational health programmes. It refers to all activities at individual, group, enterprise, community, regional, and country levels to detect and assess any significant departure from health caused by working conditions and to monitor workers' general health. Occupational health surveillance programmes record instances of occupational exposures or work-related illness, injury, or death and monitor trends in their occurrences across different types of economic activities, over time and between geographical areas.

**Occupational surveillance**

The ongoing and systematic collection, analysis, and interpretation of data related to either occupational exposures (hazard surveillance) or adverse health outcomes including injuries, diseases, or disorders.

**Periodic medical examinations**

Assessment of health status conducted at predetermined intervals, e.g. annually or at specified milestones in life, such as pre-employment or pre-retirement. This form of medical examination generally follows a formal protocol, e.g. employing a set of structured questions and/or a predetermined set of laboratory tests.

**Personal data**

Personal data are any information related to an identified or identifiable person.

**Primary healthcare**

Health care that begins at the time of first encounter between a patient and a provider of health care. The WHO definition of primary health care includes much more: Primary health care is essential health care made accessible at a cost the country and the community can afford, with methods that are practical, scientifically sound, and socially acceptable. Everyone in the community should have access to it, and everyone should be involved in it. Related sectors should also be involved in it, in addition to the health sector. At the very least, it should include education of the community on the health problems prevalent and on methods of preventing health problems from arising or of controlling them; the promotion of adequate supplies of food and of proper nutrition; sufficient safe water and basic sanitation; maternal and child health care, including family planning; the prevention and control of locally endemic diseases; immunisation against the main infectious diseases; appropriate treatment of common diseases and injuries; and the provision of essential drugs.

**Profile**

A verbal, arithmetical, or graphic summary or analysis of the history, status, etc, of a process, activity, relationship, or set of characteristics; a biochemical profile of a patient's blood; a profile of national consumer spending; a set of characteristics or qualities that identify a type or category of person or thing.

**Public health**

Public health is one of the efforts organised by society to protect, promote, and restore the people's health. It is the combination of sciences, skills, and beliefs that is directed to the maintenance and improvement of the health of all the people through collective or social actions. The programmes, services, and institutions involved emphasise the prevention of disease and the health needs of the population as a whole. Public health activities change with changing technology and social values, but the goals remain the same; to reduce the amount of disease, premature death, and disease-produced discomfort and disability in the population. Public health is thus a social institution, a discipline, and a practice.

**Qualitative data**

Observations or information characterised by measurement on a categorical scale, i.e. a dichotomous or nominal scale, or, if the categories are ordered, as ordinal scale. Examples are sex, hair colour, death or survival, and nationality.

**Register, registry**

In epidemiology, the term "register" is applied to the file of data concerning all cases of a particular disease or other health-relevant condition in a defined population, such that the cases can be related to a population base. With this information, incidence rates can be calculated. If the cases are regularly followed up, information on remission, exacerbation, prevalence, and survival can also be obtained. The register is the actual document, and the registry is the system of ongoing registration.

**Risk**

The probability that an event will occur, e.g. that an individual will become ill or die within a stated period of time or age. Also, a non-technical term encompassing a variety of measures of the probability of a (generally) unfavourable outcome. Exposure to the chance of injury or loss. Risk assessment: The qualitative or quantitative estimation of the likelihood of adverse effects that may result from exposure to specified health hazards or from the absence of beneficial influences. Risk factor: An aspect of personal behaviour or lifestyle, an environmental exposure, or an inborn or inherited characteristic that, on the basis of epidemiological evidence, is known to be associated with health-related condition(s) considered important to prevent. Risk indicator: An attribute that is associated with an increased probability of occurrence of a disease or other specified outcome and that can be used as an indicator of this increased risk. Not necessarily a causal factor. Risk management: The steps taken to alter, i.e. reduce, the levels of risk to which an individual or a population is subject.

**Safety**

The state of being safe; freedom from the occurrence of risk or injury, danger, or loss; the quality of averting or not causing injury, danger, or loss.

**Standard**

Something that serves as a basis for comparison; a technical specification or written report drawn up by experts, based on the consolidated results of scientific study, technology, and experience, aimed at optimum benefits and approved by a recognised and representative body.

**Standardisation**

A set of techniques used to remove, as far as possible, the effects of differences in age or other confounding variables, when comparing two or more populations.

**Survey**

An investigation in which information is systematically collected but in which the experimental method is not used.

**Surveillance**

The ongoing and systematic collection, analysis, and interpretation of data and the appropriate dissemination of such data. Occupational health surveillance is the ongoing systematic collection, analysis, interpretation, and dissemination of data for the purpose of prevention. Surveillance is essential to the planning, implementation, and evaluation of occupational health programmes and control of work-related ill health and injuries and the protection and promotion of workers health. Occupational health surveillance includes workers' health surveillance and working environment surveillance.

**Surveillance of the working environment**

A generic term that includes the identification and evaluation of environmental factors that may affect workers' health. It covers assessments of sanitary and occupational hygiene conditions, factors in the organisation of work that may pose risks to the health of workers, collective and personal protective equipment, exposure of workers to hazardous agents, and control systems designed to eliminate and reduce them. From the standpoint of workers' health, the surveillance of the working environment may focus on, but not be limited to, ergonomics, accident and disease prevention, occupational hygiene in the workplace, work organisation, and psycho-social factors in the workplace.

**Validity**

The property of being genuine, a true reflection of attitudes, behaviour, or characteristics. A measure (such as a question, series of questions, or test) is considered valid if it is thought to measure the concept or property which it claims to measure.

**Variable**

Any attribute, phenomenon, or event that can have different values.

**Workers' health surveillance**

A generic term that covers procedures and investigations to assess workers' health in order to detect and identify any abnormality. The results of surveillance should be used to protect and promote the health of the individual, collective health at the workplace, and the health of the exposed working population. Health assessment procedures may include, but are not limited to, medical examinations, biological monitoring, radiological examinations, questionnaires, or a review of health records.



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