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ALBERTA OCCUPATIONAL MEDICINE NEWSLETTER

EDITORIAL COMMENTS

By the time this Spring issue of the newsletter reaches you, the warmer weather should have reached even the coldest parts of the province. The observant readers may have noticed that it is not just the tulips that have lain dormant all winter, only to be rejuvenated in the spring. This newsletter, too, has not appeared since last Summer's Volume 3, Number 2 issue, due to a temporary lapse in funding. However, through funds generously made available by Alberta Workers' Health, Safety and Compensation, we are able to resume its publication. We hope that the many readers who have commented on missing the newsletter will continue to find it a helpful and informative publication.

In the time elapsed since the last issue, some changes have occurred with the newsletter staff. Most notably, the past editor, Dr. Bill Csokonay, has taken a position in occupational medicine with private industry in Calgary, and will not be continuing in his editorial post. We wish him well in his new role, and thank him for the significant contribution he has made as editor over the past two years. We are happy to report, however, that Bill will continue to contribute to the newsletter as a member of the editorial advisory committee and, we hope, as an author frequently read on these pages.

An editorial advisory committee exists to assist in decisions regarding the content and format of the newsletter. In addition to the current editor, it consists of:

1. Dr. W. M. Csokonay, Medical Director, Shell Canada Resources Limited, Calgary, Alberta.
2. Dr. G. G. Jamieson, Senior Medical Consultant, Medical Services Branch, Occupational Health and Safety Division, Alberta Workers' Health, Safety and Compensation, Calgary Alberta.
3. Dr. E. J. Love, Professor and Head, Department of Community Health Sciences, Faculty of Medicine, The University of Calgary.

These individuals have all made major contributions to the newsletter in the past, and I am very pleased to have their ongoing support and comments.

I would like to take this opportunity to encourage you, as a reader, to have input into the newsletter in any of a number of ways. Your comments on past or desired topics and articles would be welcomed, as would the submission of papers from your own experience or knowledge. Our goal is to publish information that will be of value to the professionals who are involved in any way with the practice of occupational health in the province. This includes those individual physicians seeing patients, whose concerns and problems are often occupationally related, in the context of their regular daily practice, as well as the many professionals employed fully or part-time in the field of occupational health. Your thoughts and feedback will help us meet the needs of this diverse audience.

Finally, may we remind you that due to space restrictions of the newsletter format, we will be continuing the practice of not publishing entire reference lists for each article. However, if you wish to obtain any of these, please contact us at the above address, and we will happily send them to you.

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This issue contains several articles of interest. Paul Gray and Kirk Barber, in related articles, present useful information on the properties and clinical impact of those oft-mentioned chemicals, the PCB's. From Ron Dufresne and Tinie van Schoor, we have another in their popular series of "State-of-the-Art" papers. This one deals with the common problem of Carpal Tunnel Syndrome and its potential relationship to the workplace. The combined talents of individuals from Alberta Workers' Health, Safety and Compensation and the Alberta Cancer Board have resulted in a brief and fascinating overview of the history of studying occupationally related cancers; some of the early data from an ongoing Alberta study is also presented. Herb Buchwald's contribution, which he has graciously allowed to us abstract from the text of a most interesting and topical address to the Western Compensation and Human Resources Conference, The Conference Board of Canada, is valuable in providing perspective on the current magnitude of occupational disease and injury in Alberta. Some proposals are presented on how to address this problem.

Take a few minutes to browse, and then sit down to read ... we are sure you will be rewarded with some new and useful information.

Heather Bryant, M.D., Ph.D., C.C.F.P.
Editor

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ANNOUNCEMENT

The Occupational and Environmental Health Clinic has opened in The University of Calgary Medical Clinic, under the medical direction of Dr. Don Johnston, occupational health physician. Also associated with the clinic is Dr. Ken Yoshida, occupational hygienist, who will be providing worksite and individual consultation.

Referrals will be accepted from family physicians and employers (particularly small businesses); self-referrals from workers are also accepted. More information can be obtained from Anne Greco, occupational health nurse, at (403) 220-4274.

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Prepared in the Department of Community Health Sciences, Faculty of Medicine, The University of Calgary through funding from Alberta Workers' Health, Safety and Compensation

PCB's - AN OVERVIEW

Paul A. Gray, M.H.Sc.

WHAT ARE PCB'S?

Polychlorinated biphenyls (PCB's) fall into the chlorinated hydrocarbon family. They are synthetically produced by attaching chlorine atoms to a biphenyl molecule. First synthesized in 1881, PCB's were not manufactured on a commercial scale until 1929.

PCB's vary from oily liquids (lower chlorinated compounds) to darker resins (highly chlorinated compounds). Used PCB'S often have a different physical appearance than the unused form in that they may be contaminated with carbon particles (black). Being oily, they are somewhat slippery and are heavier than water. The vapour smells bitter and is invisible. PCB's are extremely stable and non-corroding. They have low solubility in water, low vapour pressure, low flammability, low electrical conductivity (excellent electrical insulating property), and high heat capacity. Because of these properties, they were manufactured specifically as dielectric fluids.

PCB liquid which has been used in electrical equipment is referred to as "Askarel," which is a complex mixture of PCB's, chlorinated benzenes and trace contaminants. Brand names for PCB's in Canada and the USA include Arochlor, Askarel, Inerteen, Montar, Pydraul, Pyranol, and Therminol F.R.

WHERE ARE PCB'S USED?

PCB's can potentially be found in electrical transformers and associated electrical equipment, electrical capacitors, electro-magnets, heat transfer equipment, hydraulic equipment, and vapour diffusion pumps. Although non-electrical equipment will not contain pure PCB's, it may contain fluids contaminated with PCB's.

Several applications for PCB's other than electrical equipment have been developed. These include uses in waxes, paints, adhesives, lubricants, heat exchange fluids, printing inks, pesticides, cutting oils, caulking compounds and carbonless copying paper. Current regulations, however, have severely curtailed the uses of PCB's in North America.

WHY ARE PCB'S A PROBLEM?

The properties which make PCB's ideal for industrial and commercial use have contributed to their becoming environmental contaminants. In particular, three features account for their widespread distribution and persistence in the environment:

1. They are very stable and therefore do not decompose or biodegrade significantly in the natural environment.
2. They migrate widely through atmospheric and water transport mechanisms.
3. They dissolve readily in oils and fatty tissues and thereby are able to move through the food chain.

PCB's can enter the environment through landfill sites and dumps (via junked plastics, paints and electrical equipment), combustion (via incomplete incineration of PCB waste), leaking PCB equipment, oiling of roads with contaminated oil (i.e., as a dust suppressant) and from illegal dumping or disposal into sewage systems.

WHAT ARE THE HEALTH EFFECTS?

Industrial Accidents

Industrial accidents have allowed a number of persons to be observed following PCB ingestion. The most extreme case occurred in Japan in 1968 and is known as the "Yusho" incident. In this instance, more than 1500 people consumed rice oil contaminated with PCB's and its derivatives. With a total intake of 0.5 - 2.0 grams, the symptoms observed included chloracne, increased eye discharge and systemic gastrointestinal symptoms with jaundice, edema, and abdominal pain. The chloracne was very persistent with some patients still affected after three years of follow-up.

Low-Level Exposures

Long-term, low-level exposures of laboratory animals to PCB's have demonstrated that PCB's can produce malignant liver tumours and other liver diseases in addition to eye, skin, and fetotoxic effects.

Because of these demonstrated toxic effects on animals, NIOSH (National Institute for Occupational Safety and Health) conducted a retrospective cohort mortality study of over 2500 workers who were employed in two plants where PCB's were used in the manufacture of electrical capacitors. All workers included in the study were working for at least three months in areas where PCB's were used. Based on an accumulation of over 39,000 person-years of exposure, the study found all-cause mortality and all-cancer mortality were lower than expected. Excess mortality was noted for rectal cancer and for liver cancer, although neither excess was statistically significant. One of the plants also showed an excess mortality due to cirrhosis of the liver.

Other studies have demonstrated that PCB's may produce demonstrable changes in serum liver enzymes and plasma lipids in the absence of clinically demonstrable effects.

Further studies are ongoing due to public concern over PCB's and the demonstrated long-term toxic effects in exposed laboratory animals. In addition, since laboratory research has shown that PCB's may cause cancer in animals, PCB's must be classified, toxicologically, as a suspected human carcinogen.

WHAT GOVERNMENT CONTROLS/GUIDELINES EXIST?

The Federal government has implemented detailed controls/guidelines regarding PCB use, handling, storage, and disposal. As of July 1, 1980, PCB's were not permitted to be used in the operation of any product, machinery or equipment *except*:

- electrical equipment, heat transfer equipment, hydraulic equipment, electromagnets and vapour diffusion pumps that were
  (1) designed to use PCB's and
  (2) were in use in Canada prior to September 1, 1977.
- in machinery or equipment designed to destroy PCB's.

PCB's are prohibited from use as a constituent in any electrical equipment manufactured in or imported into Canada after July 1, 1980 and for use in any operation that may involve food or food additive handling.

Equipment containing PCB's can therefore still be used as long as that equipment is in good repair and was in use prior to September 1, 1977. If repairs are required in PCB-containing equipment, they can be made but any fluids that are used to "top-up" the equipment must be non-PCB. In addition, any substance that contains more than 0.005% (50 ppm) by weight of PCB is considered to be contaminated and must be treated as a PCB substance.

WHAT IDENTIFIES PCB-CONTAINING EQUIPMENT?

Transformers may be located inside a building (normally along a wall), enclosed within a concrete vault or electrical room, on the roof, outside on a concrete pad, or on a utility pole. The transfers can normally be identified as to their contents by the nameplate located on the outer casing. Not all transformers contain PCB as the coolant; many will contain mineral oil or special non-PCB substitutes which have lesser hazardous properties.

Capacitors, on the other hand, all contain PCB's except where clearly indicated (as a non-PCB alternative) on the nameplate of the equipment.

WHAT ARE THE PROCEDURES IN CASE OF CONTACT?

Skin Contact

For persons accidentally exposed to PCB's, wash the affected skin with soap and water for at least 15 minutes following removal of clothing (which must then be safely disposed of) and seek medical help.

Eye Contact

Flushing the eyes with clean, running water for 15 minutes is the first priority followed by medical assistance.

Ingestion

Vomiting should be induced unless he/she is convulsing or comatose or has lost the gag reflex. Medical assistance should be sought.

Inhalation

The person should be removed to fresh air and medical aid sought if any discomfort persists.

HOW ARE PCB's DESTROYED?

A large number of methods exist and are being developed for PCB destruction. These include high temperature incineration, plasma incineration, chemical reduction, microwaves and microbial biodegradation. No single method is receiving absolute preference; therefore, large stockpiles of PCB's are being stored in central locations (e.g., Alberta Special Waste Management Corporations's Secure Storage Facility in Nisku, Alberta).

For information relating to PCB equipment removal, storage or disposal, contact the Alberta Special Waste Management Corporation, Edmonton, Alberta (1-800-272-8873).

**Occupational Health/Hygiene Programs, Dome Petroleum Limited, Calgary; Lecturer, Department of Community Health Sciences, The University of Calgary.*

RASH STATEMENTS - 8

Kirk Barber, M.D., F.R.C.P.(C).*

CHLORACNE

Recent news media interest in polychlorinated biphenyls (PCB's) and other types of toxic waste has sparked a degree of panic in the population. Over the past year, I have been asked to evaluate a number of individuals for cutaneous signs of sytemic toxicity from PCB's. The degree of exposure varied widely: from being in the same room as a spill, to cleaning up the spill, to working with electric transformers and being immersed in PCB's up to the elbows for thirty years.

WHAT DO YOU LOOK FOR?

Acne - *Chloracne!*

A comprehensive review of chloracne appears in the Journal of the American Academy of Dermatology (October 1985). To summarize the salient features:

1. Chloracne may be defined as an acneiform eruption due to poisoning by halogenated aromatic compounds having a specific molecular shape (e.g., PCB's).
2. Chloracne is always a sign of systemic poisoning.
3. The primary cutaneous lesion is the comedo. Characteristically the lesions are most prominent over the lateral malar prominences extending onto the temple and behind the ear. Progression of the illness leads to involvement of the remainder of the face (sparing the nose usually), and then the genitalia and trunk. Secondary lesions include small pale yellow cysts intermingled with the comedones. In the most severe cases inflammatory lesions develop.
4. Senile comedones, solar degenerative phenomena, and oil and tar acne must be considered in the differential diagnosis. Obviously, the history and case clustering will be helpful.

WHAT CAUSES IT?

The more common chloracnegens include:

1. Dioxins - Chlorinated phenols are produced in large amounts and are used in insecticides, fungicides, herbicides and in dyes and pigments. The dioxins are contaminants formed accidentally in the manufacture of these substances. They are considered to be some of the most dangerous chemicals known to man.
2. Polyhalogenated biphenyls (PCB's, PBB's) -PCB's are no longer used except in closed systems such as electrical transformers. They were in widespread use from 1929 and may be found throughout the environment.
3. Polyhalogenated naphthalenes - The fumes of these compounds are potent chloracnegens. They were widely used as insulation waxes in the electronics industry, and as wood preservatives under the tradename of "Halowax" in the U.S. They have been replaced by plastics and silicones in the past ten years.

WHY WORRY ABOUT IT?

There remain large gaps in the knowledge of the systemic effects of these chemicals. The major systemic effects of exposure to chloracnegens are reported as hepatotoxicity, teratogenicity, fetotoxicity, and carcinogenicity. Unfortunately we must await further industrial accidents or long-term studies of low grade exposure from the environment to gain more knowledge.

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* *Dermatologist, Calgary; Clinical Lecturer, Departments of Community Health Sciences and Medicine, Faculty of Medicine, The University of Calgary.*

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UPCOMING EVENTS

The Occupational Medical Association of Canada's Fourth Annual Conference will be held in Vancouver, British Columbia, from June 30 to July 2, 1986 in conjunction with the Canada West Medical Congress. In addition, two Postgraduate Seminar/Workshops will be held on June 29 at The University of British Columbia campus. For further information on the main program, contact:

Convention Department:
BCMA
1807 West 10 Avenue;
Vancouver, B.C. V6J 2A9:

For the Seminar/Workshops, contact:

OMAC Campus Program
Division of Occupational and
Environmental Health
Mather Building
The University of British Columbia
5804 Fairview Avenue
Vancouver, B.C. V6T 1W5
Telephone: (604) 228-2772

A word of advice: Accommodation is at a premium due to EXPO, so register soon if you intend to attend!

* * *

CHALLENGES IN OCCUPATIONAL HEALTH AND SAFETY

Herbert Buchwald, Ph.D., M.Sc., F.R.I.C.*

(This article is condensed from the text of an address to the Western Compensation and Human Resources Conference, The Conference Board of Canada, held in Calgary, Alberta, on November 7, 1985)

I have been asked to discuss the leading-edge practices in the field of occupational health and safety. The term "leading-edge" is one of the "buzz-words" for the 1980's. In my experience, the leading edge is the one which becomes blunted most quickly, so this is the last time I shall use the phrase. I will, however, address the most important challenges which face those who attempt to implement occupational health programs, and to discuss some of the strategies which are being adopted by the more enlightened employers to cope with the rising costs of losses, both human and fiscal, from work-related accidents, injuries, ill-health and sickness absence.

Many special programs are topical and relevant to this discussion: stress management, employee assistance, counselling, fitness on-the-job and the non-smoking office. These all contribute to employee satisfaction, performance and productivity after certain basic needs have been met. They represent the frosting and filling that make the productivity cake more interesting and attractive, but contribute little to the nutrition that may be needed for the undernourished work site.

THE CHALLENGE

Firstly, we must identify the magnitude of the challenge that faces us. In the report of the Royal Commission on the Economic Union and Development Prospects of Canada (The Macdonald Commission), under the heading "The Dimensions of the Problem", we were told that in 1983, job-related injuries or illnesses killed 761 Canadians and caused the loss of 15 million working days in Canada. There were 952,000 work injury claims, a figure indicating that about one worker in nine was hurt on the job during the course of the year. The costs are clearly very high. While the human cost is obviously the suffering of the victim and the victim's family, and the fiscal cost to the worker is loss of income, nevertheless the main economic impact is to the employer and society. This impact includes not only compensation costs, but the loss of production, physical damage and down time, as well as the retraining costs which accompany most major job-related injuries.

By way of comparison, 4.4 million work days (or less than one-third of those resulting from injury) were lost because of work stoppages (strikes and lock-outs) in 1983. Lost work days from work stoppages have been decreasing steadily during the past five years, while time lost due to disabling injury has been increasing. However, work stoppages continue to receive far more media and political attention than health and safety issues.

Just a few more statistics to convince you that we are dealing with a major economic issue. In Alberta, during 1984, employers paid a whopping 270 million dollars for Workers' Compensation, and that was after deduction of merit rebates. There were 55,732 new claims, including 41,106 lost-time claims and 2,513 awards for permanent disability. The lost time claim rate has risen by 5.5 percent in 1984 to 5.8 claims per 100 person-years worked. The increases in lost time claim rates in the traditionally high risk industries (such as oil well drilling and servicing) are up by an alarming margin.

The average number of working days lost for each lost-time injury claim has been rising steadily during the past five years. In Alberta, 33.7 days were lost per claim in 1983, compared to 23.1 days in 1980. Similar increases are being reported in other provinces. There are no simple explanations for these increases; they are the result of a complex combination of circumstances which are beyond the scope of the present discussion. However, one clear conclusion can be reached — the only way of reducing compensation costs is to reduce the rate and severity of disabling injuries at work.

The losses from industrial disease and sickness absence are almost impossible to com-

pute on a collective basis. It is difficult to separate the workplace contribution to a disease when that disease is the result of a combination of life, lifestyle and work related factors. For example, lung cancer can be related to smoking, air pollution, exposure to asbestos and other factors. How can we separate the occupational component in an individual with a history of exposure to all the risk factors? Also, it is difficult to establish that workplace exposure was responsible for disease having a latency period of many years. Nevertheless, more attention is being paid to the causes of industrial disease and sickness absence as a result of the increasing information on potentially hazardous substances and processes.

COMPONENTS OF SUCCESSFUL SYSTEMS

What are the key components of a successful corporate or work site health and safety responsibility system which really works? We have studied the systems adopted by some of the more successful corporations in North America. Some of the systems have well-known names such as "5-star", "MORT" and "Total Loss Control". Most of these systems are very similar, but have to be adapted to suit each individual employer, depending on the nature of the work site, processes used, hazards present and the skills of the workforce. Here are some basic questions which the successful employer will be able to answer:

- What is the corporate health and safety policy?
- What organizational structure is in place to achieve this policy?
- What system is in place to ensure that potential and actual health and safety hazards are identified, evaluated and priorized?
- What systems are in place to ensure that identified hazards are effectively controlled?
- What systems are in place to ensure that controls continue to be effective during normal and special operations and emerc gencies?
- What worker health monitoring systems have been established?
- What first aid services are in place?
- What employer education, information and training programs are provided?
- How does the employer evaluate the effectiveness of the program?
- How will the employer communicate with the government on an ongoing basis, both routinely and for emergency situations?

The health and safety internal responsibility system is especially useful for companies with ongoing or repetitive hazards, or companies with complex operations. The advantages of an effective system are numerous. With a systematic, planned approach to health and safety, employers have less need for continued "firefighting" and have assurance of emergency preparedness. Most importantly, workers are assured of the highest level of protection on the job.

SMALL BUSINESS NEEDS

One of our greatest concerns, to which we have no agreed solution at this time, is how to implement such responsibility systems in small businesses.In Alberta, small business activity is increasing. By our definition, a small business employs 40 or less workers. About 96 percent of Albertan employers are in the small business category, employing between 35 and 40 percent of the workforce. The lost-time injury rate for small employers is consistently between 10 and 20 percent higher than the rate for larger employers in the same industrial sector.

The larger corporate employers, particularly those employing more than 250 workers, and employing 34 percent of the workforce, generally have the resources to implement effective preventive systems. It is the smaller employers who simply do not have the managerial expertise or the technical and fiscal resources to consider meaningful preventive programs. Is there a societal responsibility for the larger employer to share technical expertise and know-how with the small employer to accomplish the goal of injury prevention?

One way of accomplishing this is for all employers to support the establishment of sectoral safety associations, funded through the mutuality of assessments made by the Workers' Compensation Board. These associations would provide technical expertise and educational programs to all employers, large or small, in given industrial sectors. Such associations have been operating in Ontario for many years with varying degrees of success. In Alberta, we have just begun promoting the establishment of such associations with the help of changes in the Workers' Compensation legislation. The Alberta Construction Association has been the first organization to respond with a proposal to establish an Alberta Construction Safety Association.

SPECIFIC INITIATIVES

I do not want to take time expanding on the individual components of the responsibility system outlined above, except to note that initiatives such as employee assistance and counselling, fitness and health promotional programs fall into one or more of the components. There are, however, two initiatives that I want to address.

The first is in the realm of education and training. Analysis of the human factors associated with many serious accidents indicates that the skills and competencies of the involved workers are crucial factors. Training, education, pep talks, safety meetings, notices and posters which are the stock-in-trade of traditional preventive programs are of limited value if:

(a) they are not thoroughly reinforced on the job,
(b) they are not properly understood by the worker,
(c) they are not incorporated into the competency tests applied to workers as part of their performance evaluation.

Many progressive employers with high risk operations have realized the importance of a thorough analysis of each job to clearly define the knowledge and skills needed to do these jobs competently and safely. Ideally, no worker should be permitted to undertake a potentially dangerous job without the employer's being assured that the worker meets the minimum level of competency required to do that job. I believe that a real breakthrough could be achieved, not only in injury prevention but in loss control and productivity, if we could ensure that workers are competent to undertake the work that is expected of them.

Secondly, I would like to recommend the value of "off-the-job" safety and health promotion programs. In general, Canadian workers spend only about 20 percent of their working life actually at work. It seems inefficient that we should expect individuals to adopt preventive attitudes and behavour at work only and then ignore the 80 percent of their time spent elsewhere. Competent and productive workers are real assets to their employers. To lose their services from accidents and ill health not due to their work, represents a serious loss to the employer. In addition, one cannot expect workers who alternately shift from safe to unsafe behaviour patterns to maintain a continuing safe behaviour pattern at work only. Although some good "off-the-job" safety programs have been developed, there is a need for considerable research and development in this area.

An innovative initiative being undertaken by many progressive employers falls under the heading of "quality management". The current renaissance in management practices dictates a renewed commitment to the business performance values of quality, productivity and cost competitiveness. All types and sizes of companies must come to terms with these values and implement them into their corporate culture. This demands commitment, understanding and acceptance from every level of management. Success in implementing quality management programs generally leads to considerable improvement in health and safety performance. The Quality Management Institute developed recently under the sponsorship of the Canadian Standards Association is one organization devoted to promoting quality management as a business tool.

GOVERNMENT'S ROLE

Lastly, a word about government's role in occupational health and safety, as administered by my department, Alberta Workers' Health, Safety and Compensation.

Our primary objective is to work closely with employers and workers to promote, establish and maintain safe and healthful working environments. Employers, workers and government all share responsibility in preventing illness and injury on the job. Government cannot--and should not--attempt to do everything for everyone. Instead, it must exercise its role of setting standards, monitoring performance to ensure those standards are met, and investigating incidents where health and safety was compromised. Government also has a role in undertaking research on new hazards or development of better approaches to hazard control, and providing education and advice. The main responsibility for day-to-day health and safety performance rests with parties at the work site. Employers must ensure that systems are in place to adequately protect workers. Workers must cooperate with employers in protecting their health and safety and the health and safety of others at the work site.

Government does not wish to intrude unnecessarily into management of the work site, provided basic health and safety standards are met. In line with this, we have moved towards

"performance" oriented regulations, which identify the objective or end result, but do not specify precisely how the employer must go about achieving those results. In this way, the employer is given flexibility in identifying the best way to achieve the objective within the specific characteristics of the work site situation.

Many companies, by virtue of the nature of the hazards or the complexity of the organization, require a planned program to ensure continuing control. Without this, a limited duration of hazard reduction following government inspection is observed. At some sites, hazards have been seen to recur in as little as two to three months. Thus, in order to review the effectiveness of employer performance, we need to review an employer's overall system or program. Health and safety assessment, therefore, is moving toward program review rather than relying entirely on hazard inspection.

CONCLUSION

In this short article, I have attempted to identify the challenge that faces us, and to briefly touch upon some of the initiatives which will allow the new Canadian worker to accept this challenge. Employers, workers and government must face the challenge together to have any chance of real success.

(References available upon request)

Alberta Workers' Health, Safety and Compensation.

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PUBLICATIONS ON GUIDELINES FROM ALBERTA WORKERS' HEALTH, SAFETY AND COMPENSATION

AWHSC has recently released the first three issues of a planned series of suggested guidelines for a wide range of occupational exposures. These vary in length and in target audience, but all include information rarely available in a single source textbook. The first three, currently available, are:

1. Guideline for Use of Contact Lenses in Industry.
3. Guideline on the Medical Aspects of Exposure to Isocyanates at the Workplace.
5. Guideline on Treatment of Hydrogen Sulphide Poisoning.

(Numbers 2 and 4, and subsequent issues are at press or in preparation, and will be announced as they become available.)

These can be obtained free of charge by writing to:

Alberta Workers' Health, Safety and Compensation
Education and Program Development Branch
5th Floor, Donsdale Place
10709 Jasper Avenue
Edmonton, Alberta T5J 3N3

(Please note the Newsletter as your source of information)

STUDIES OF OCCUPATIONAL CANCER USING MORTALITY RECORDS AND CANCER REGISTRATIONS

Brian Alleyne, M.Sc.*
Sharon Campbell, M.N.**
Shirley Fincham, M.A.**
Gerry Hill, M.B., Ch.B., M.Sc.**
Jonas Kalnas, M.D.*

Efforts to extract information on occupational risks from routine mortality and morbidity records have a long history. In fact, the idea, like many others in medical statistics, originated with William Farr in 1851, though the application to cancer mortality began in 1891. Although such analyses have continued throughout this century, regularly in Britain and sporadically elsewhere, the main thrust in occupational cancer epidemiology has moved towards cohort studies of particular industries and case-control studies of individual cancer sites. However, the use of routine statistics has obvious attractions in terms of cost. In particular, it could potentially provide useful information, supplementary to that from analytical studies. In this paper, we discuss the historical development of occupational mortality statistics and give some results based on the statement of occupation available on cancer registry records. We also outline a more recent development in which detailed occupational histories are obtained from cancer patients.

The method introduced by Farr in 1855 was brilliantly simple. If a statement of occupation is obtained at death, then the numbers of deaths in a particular occupation over a period spanning a census of the population can be related to the number enumerated in that occupation, giving a mortality rate specific for that occupation. There are, of course, many possible sources of bias in this approach. The information on occupation is not collected in the same way at census and death. As with any cross-sectional study of occupation, there is a strong possibility of selection bias, both into and out of a given occupation. Confounding factors such as smoking are also a problem, since this information is not available routinely.

Although Farr produced the first estimates of occupational mortality, he did not examine cancer mortality. This was left to one of his successors, Tatham, who analysed occupational mortality in relation to the censuses of 1891 and 1901. Table 1 shows some results from the 1901 analysis. The high rate for chimney sweeps was presumably due to skin cancer, but the results were not disaggregated by site. It is interesting to note the high risk for chemical and rubber workers. Was this a reflection of the bladder cancer risk already noted clinically by Rehn in 1895?

As the twentieth century progressed, the decennial occupational mortality analyses in Britain became more elaborate. Detailed classifications of both occupation and cause of death were defined, and statistical methods for adjusting for age differences developed. The procedures and jargon changed over time, but eventually the standardized mortality ratio (SMR), calculated by the method of indirect standardization, became the most favoured statistical index, at least for ages 25-64. The SMR measures the risk of dying from a particular disease in a given occupation as a percentage of the risk for the population as a whole, the comparison being made separately for men, married women (classified according to the occupation of the husband), and single women. The analysis for married women was made primarily to measure differentials by social class, derived from occupation, but by comparing the SMR's for men and married women for the same occupation one can make some allowance for general social class differences when searching for specific occupational risks.

For people past the age of retirement, the correspondence between the statements of occupation on the death record and census return was less reliable. To overcome this problem, the numbers of deaths from all causes were used as proxy for the populations at risk, and a proportional mortality ratio (PMR) calculated in the same way as the SMR. The PMR for a particular disease has the same interpretation as the SMR, but may be biased, usually towards 100, by the overall risk of mortality in a given occupation. The use of the PMR in the absence of estimates of person-years at risk has also found a place in the analysis of deaths occurring in industrial settings. A similar index was used to analyse the statement of occupation on cancer registration records in England and Wales, and more recently in Alberta (see below).

In Canada, as in Britain, a statement of occupation is present on the death record, but this has not been coded routinely at the national level. The data for male deaths in 1931-1932 were coded and related to the 1931 census population in a special report published in 1937. Age-standardized rates for all cancer deaths at ages 20-64 years were included and these have been converted to SMR's in Table 2. Also shown are the numbers of deaths involved in the cal-

Table 1
Cancer Mortality by Occupation
Males, 1901, England and Wales

High Risk	SMR[1]	Low Risk	SMR
Chimney Sweep	216	Coal miner	81
Brewer	178	School teacher	78
Furrier, skinner	176	Clergyman	76
General labourer	176	Gardener	76
Merchant seaman	163	Farm labourer	71
Inn, hotel servant	140	Lock fitter	65
Chemical manufacturer	135	Wheelwright	63
India rubber worker	130	Copper miner	62
Wood turner, cooper	127	Paper manufacturer	62
		Tanner	52

[1]*Standardized Mortality Ratio*
All occupied males = 100

culation of the SMR, since the precision of the SMR increases with the number of deaths on which it is based. In fact, interpretation is easier using the Z-value calculated from the SMR and the number of deaths, using the formula $Z = (R-1)\sqrt{(D/R)}$, where R = SMR/100 and D = number of deaths. If the true SMR = 100 then Z is approximately a normal variate with mean = 0 and variance = 1, as in the usual statistical tables. For any occupation considered *a priori*, the SMR would be 'significant' if the numerical value of Z exceeded 2. However, if a large number of occupations is being scanned *a posteriori*, then a more stringent criterion would be appropriate. In this table, the elevated risks for bakers, tanners, non-metallic mineral workers, painters and labourers might be considered important. At that time, most cancer deaths were due to tumors of the digestive system.

Since the 1937 report, no national analysis of occupational mortality has been made in Canada. A sample of the death records for males has been analysed using a case-control approach, and the national mortality data base has been linked to a 10 percent sample of the Canadian labour force. Occupation on the death certificate has been coded routinely in British Columbia and an analysis of these data will be published shortly.

Many cancer registries attempt to capture occupation, but the information is usually derived from hospital records and is often missing or incomplete. The occupation data on the Alberta Cancer Registry has been coded since 1978, but is available for only about half the males and even fewer females. The data for males registered in 1978-1982 were analysed using the PMR approach, with registrations for all cancer sites taking the place of deaths from all causes. Table 3 shows, for each occupational group, those cancer sites for which the Z-value was numerically greater than 2. It is an inescapable feature of this criterion that we can only find "significant" results for the larger occupational groups. Some of the findings are readily explicable in terms of the varying prevalence of smoking among occupational groups. The high risk for non-melanotic skin cancer among the professionals is possibly an artifact of the PMR analysis.

The poor quality of the occupational data on routine registration records led to the initiation in 1983 of a special project in which all male cancer patients aged 25-74, diagnosed in Alberta, are sent a questionnaire which includes a complete occupational history and a smoking history. The same questionnaire is sent to a 25 percent sample of female patients to ascertain whether useful occupational histories can be obtained. The response to the questionnaire has been quite good — about 75 percent overall, varying considerably by cancer site due to differences in prognosis.

The complete occupational history allows one flexibility in the definition of occupation, e.g., 'where ever worked', or 'worked more than x years' and so on. The analytic approach is similar to that of a case-control study, the 'cases' being those with a particular cancer site, or group of sites, and the 'controls' being all other sites. The PMR is then the odds-ratio adjusted for age and, appropriate, smoking history.

Table 4 shows the results for the first 751 males. Whether or not they had ever worked in a particular occupation was used as a criterion so that each patient can occur more than once in the analysis. The sample size is too small to provide precise estimates even with this aggregation. The elevated risk of cancer of the respiratory tract for construction workers (seen also in Table 3) persists after adjusting for smoking.

This approach to improving the occupational information on cancer registration appears to work well and is not very expensive. Similar methods are in use in British Columbia and Montreal. As data accumulate, valuable information should be forthcoming.

Table 2
Cancer Mortality by Occupation Among Canadian Males Aged 20-64 in 1931-32

Occupation	SMR	(#deaths)	Z-value
Farmers	94	(1,167)	-2.1
Fishermen	81	(35)	-1.2
Lumbermen	129	(47)	1.8
Coal miners	121	(38)	1.2
Other miners	132	(38)	1.7
Bakers & confectioners	179	(20)	2.6
Tanners & leatherworkers	162	(44)	3.2
Textile workers	136	(47)	2.1
Woodworkers	132	(47)	1.9
Compositors & printers	126	(16)	0.9
Other printing & publishers	66	(5)	-0.9
Blacksmiths, forgemen	118	(36)	1.0
Machinists, toolmakers	138	(63)	2.6
Motor mechanics	134	(39)	1.8
Other metal workers	123	(79)	1.8
Non-metallic mineral workers	226	(19)	3.7
Stationary engineers & firemen	100	(49)	0.0
Brick & stone masons	119	(23)	0.8
Carpenters	100	(157)	0.0
Electricians & wiremen	131	(22)	1.3
Painters, decorators & glaziers	142	(72)	3.0
Plumbers, gas & steam fitters	152	(29)	2.3
Conductors etc., steam railways	134	(30)	1.6
Locomotive engineers & firemen	95	(22)	-0.2
Chauffeurs, drivers & deliverymen	78	(56)	-1.9
Commercial travellers	114	(39)	0.8
Other salesmen	92	(77)	-0.7
Police	122	(19)	0.8
Barbers	131	(25)	1.4
Other personnel service	87	(86)	-1.3
Clergymen	122	(32)	1.1
Lawyers	110	(16)	0.4
Physicians, surgeons	79	(15)	-0.9
Professional engineers	152	(31)	2.3
Professors & teachers	66	(14)	-1.6
Other professional workers	134	(60)	2.3
Owners & managers	94	(357)	-1.2
Office workers	119	(170)	2.3
Labourers (exc. agriculture)	135	(696)	7.9

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(References available on request)

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We invite your input!

The Newsletter can best serve you, its readers, if your opinions and thoughts are known to its staff. We invite your comments on current content, ideas for future topics, or short articles from your own knowledge and experience. Please send your letters to the Editor (at the address on page 1). Your comments will be appreciated, and will help direct future issues of the Newsletter.

Table 3
Association Between Occupation and Registered Site of Cancer in Alberta Males, 1978-82

Occupational Group	Sites with High PMR†		Sites with low PMR†	
Managerial	Colon	(131)*		-
	Skin**	(125)		
Natural Sciences	Skin	(139)		-
Social Sciences	Skin	(231)	Lung	(25)
Teaching	Skin	(180)	Buccal cavity	(41)
			Lung	(36)
Medicine	Skin	(199)	Lung	(61)
	Melanoma	(313)		
Service	Buccal cavity	(154)	Skin	(77)
	Lung	(132)	Prostate	(69)
Farming	Buccal cavity	(138)	Lung	(73)
	Prostate	(131)		
	Leukemia	(130)		
Mining & Oil	Lung	(267)	Rectum	(52)
			Skin	(50)
Processing	Lung	(170)		-
Machining	Lung	(168)	Skin	(71)
			Prostate	(61)
Construction	Stomach	(137)	Colon	(70)
	Larynx	(169)	Skin	(71)
	Lung	(139)		
Transport	Rectum	(149)	Prostate	(67)
	Bladder	(155)	Lymphoma	(61)
	Hodgkin's	(216)		

†Z value numerically greater than 2 and number of cases greater than 5
**PMR in brackets: all occupations = 100*
***Non-melanotic skin cancer*

Table 4
Association (PMR[1]) between Occupation and Registered Site of Cancer in Alberta Males, 1983-85

	Cancer Sites						
Occupation[2]	Lip Oral Cavity and Pharynx	Digestive Organs and Peritoneum	Respiratory and Intrathoracic Organs	Bone Connective Tissue Skin	Genito-Urinary Organs	Lymphatic and Hemato-poietic	Other and Unspecified Sites
White Collar	59	124	93	139	79	126	108
Farming, Fishing and Forestry	116	126	92	62	127	48*	83
Mining, Processing Machining and Assembling	90	99	107	91	104	104	146
Construction	53	78	174*	151	117	70	74
Transport	99	71	163	164	99	113	68
Other	79	80	154	147	94	101	172

[1] All PMR's adjusted for age and smoking
[2] Using occupational history - "ever worked"
** Adjusted Z value greater than 2.0*

CARPAL TUNNEL SYNDROME —ETIOLOGY AND PATHOGENESIS— 'STATE-OF-THE-ART'

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INTRODUCTION

This common syndrome frequently presents itself spontaneously or in association with systemic or local disease. Many cases, however, follow either acute or chronic repetitive trauma, thus presenting the possibility of a causal relationship to the workplace. As in all conditions of multifactorial origin, a clearer understanding of the etiology and pathogenesis is helpful to resolve the question of whether or not carpal tunnel syndrome is work-related.

Other peripheral nerve entrapment syndromes have many features in common with carpal tunnel syndrome. These neuropathies cause significant pain and disability but the impairment of nerve function is usually reversible in the early stages. For an excellent review of the subject, the article "Peripheral Nerve Entrapment Syndromes" by M. Prabhakar Reddy, M.D., in The American Family Physician Volume 28, number 5, November 1983, is strongly recommended.

DEFINITION

Carpal tunnel syndrome was first described by Paget in 1853 and is a neurapraxia of the median nerve where it passes through the carpal tunnel, deep to the transverse carpal ligament and superficial to the flexor tendons.

CLINICAL PRESENTATION

Carpal tunnel syndrome can present itself at any age, but is most frequently seen in the fifth or sixth decade, with women being affected five times as frequently as men. There is a predilection for the dominant side suggesting some relationship to physical activity.

Paresthesia may precede the onset of acute symptoms by several months, and pain may radiate anywhere along the distribution of the median nerve from its origin in the neck to its most distal branches in the medial three and a half fingers. Symptoms are often worse at night and may wake the patient from sleep. Swelling of the wrist is occasionally noted and symptoms may be relieved by dangling the arm over the side of the bed, or shaking or rubbing the affected hand.

Wasting is seen only in advanced cases. Sensory changes usually appear before motor problems, and two-point discrimination is retained until almost no sensory function is left.

Physical examination may reveal weakness of the thenar muscles. Hypesthesia is usual over the palmar aspect of particularly the distal second finger. An electric shock sensation may be experienced with percussion of the median nerve at the wrist (Tinel's sign). If acute flexion of the wrist is sustained for approximately a minute, a tingling sensation may be produced in the radial three-and-a-half digits (Phalen's sign). These signs may not be positive in advanced cases of carpal tunnel syndrome.

DIFFERENTIAL DIAGNOSIS

Other problems that may be confused with carpal tunnel syndrome include cervical spondylosis, thoracic outlet syndrome, biceps tendinitis or shoulder sprains, and pronator teres syndrome.

PATHOGENESIS

For the sake of convenience, the causes of carpal tunnel syndrome can be classified as developmental, hormonal, degenerative and traumatic.

1. Developmental

A congenitally narrow carpal tunnel has been suspected as an etiologic agent for some time. Recent studies with computed tomography have shown women to have significantly smaller carpal tunnels than men. There also seems to be an association between the cross-sectional diameter of the carpal tunnel and the symptoms of carpal tunnel syndrome. No correlation between age and size of the canal has been observed. Unfortunately, these measurements have not taken into account other parameters such as height, weight or bone structure. It is interesting to note that women, who are generally smaller than men and consequently have narrower spinal canals, do not suffer from spinal cord compression more often than men.

2. Hormonal

A definite association has been established between the carpal tunnel syndrome and a history of pregnancy, the use of contraceptive pills, hysterectomy or oophorectomy. Entrapment neuropathies are also more common in patients with underlying susceptibility to nerve dysfunction such as those with diabetes mellitus or hypothyroidism.

3. Degenerative

There is an uncommonly frequent occurrence of carpal tunnel syndrome in patients with degenerative arthritis of the wrist and, in particular, with rheumatic disease with associated arthritis or tendinitis. When no history of trauma is obtained, the possibility of a rheumatic condition must be investigated.

4. Traumatic

i) Physical disruption of the carpal tunnel following wrist fractures may induce immediate or delayed onset of carpal tunnel syndrome, although this is rare. The syndrome is most commonly associated with immobilization of a fracture with the wrist in the flexed position, which elevates the pressure inside the carpal tunnel.

ii) Repetitive low grade trauma due to flexion of the wrist appears to be a significant factor. When the digital flexors are under tension (especially with the wrist in the flexed position) there is an increase in pressure in the carpal tunnel. This is particularly evident during repetitive hand activities involving pinch and grasp actions. A high prevalence has been found in individuals employed in poultry processing plants (particularly in the boning department), and in individuals who do knitting by hand.

iii) The use of vibratory tools appears to induce swelling and erythema of soft tissues with the possibility of a subsequent carpal tunnel syndrome.

iv) Epidemiologic studies have suggested an increased risk for carpal tunnel syndrome in typists, hairdressers, butchers and truck drivers.

ELECTRODIAGNOSTIC STUDIES

These studies include nerve conduction times and electromyography. Nerve conduction studies help localize the site of entrapment, estimate the severity of the damage and differentiate between peripheral nerve entrapment and radiculopathy. Sensory conduction is the most sensitive test, but in early or mild cases even this may be normal. In cases of severe compression, EMG studies may show fibrillation potentials, positive sharp waves and polyphasic potentials in the adductor pollicis brevis and opponens pollicis muscles. In experimental tissue compression, sensory conduction block occurs consistently before motor block, and two-point discrimination remains normal until the last stages of preserved sensory fibre conduction. In some series, nerve conduction studies were found to be abnormal in 81 percent of cases, whereas clinical sensory examination was abnormal in only 66 percent of cases of symptomatic individuals. It has been suggested that symptomatic patients with normal electrodiagnostic findings should be re-evaluated after five minutes of wrist flexion—the "median nerve stress test."

When the electrodiagnostic findings differ from accurate reproducible clinical findings, the clinical evaluation should be regarded as paramount. However, electrophysiologic observations in rock drillers reveal statistically significant changes in latency, duration and amplitude of especially sensory action potentials, when compared to a control group. In addition, the prevalence of carpal tunnel syndrome in these workers was six times that of the control group. This strongly suggests a correlation between electrodiagnostic tests and clinical findings.

PREVENTION

For those interested in prevention through application of ergonomic principles in hand tool design, an excellent article by E. R. Tichauer and H. Gage in the American Industrial Hygiene Association Journal, Vol. 38, p.622, November 1977 is recommended.

SUMMARY

Because of the anatomical structure of the carpal tunnel, the median nerve is at risk for pressure injury. Surprisingly, most of us go through life without ever experiencing symptoms of median nerve compression. When this does occur, it is often without any definable precipitating cause.

In a number of cases, developmental, hormonal, degenerative or traumatic precipitators can be identified. In addition, some high risk professions have been identified, suggesting a category of "occupational disease." In many cases, however, the picture is unclear, and extensive investigation of both the individuals' health status and the activities performed at the workplace is necessary before an opinion can be voiced as to whether, for this individual, there is a work-related cause of carpal tunnel syndrome.

Alberta Workers Compensation Board.