RICHMOND FIRE FIGHTERS ASSOCIATION
Local 1286 of the International Association of Fire Fighters

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CANCER PRESUMPTION

PREPARED FOR
COMMUNITY SAFETY COMMITTEE

DECEMBER 2003

Affiliated with:
The International Association of Fire Fighters • The B.C. Professional Fire Fighters Association
B.C. Federation of Labour • Canadian Labour Congress

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December 3, 2003

Cancer Presumption

City of Richmond
Community Safety Committee

Dear Councillors,

Enclosed for your information is a package of documentation supporting a legislative initiative on the part of the provincial government to enact a fire fighter cancer occupational disease presumption by legislation or specific regulation.

The package contains the following:

- A report prepared for the British Columbia Fire Fighters Association by Dr. Guidotti, an expert in the area of Fire Fighter Cancers.
- BCPFFA Delegate Briefing Notes
- Extracts from the 1994 Ontario IDSP report
- Government of Manitoba News Release and Bill 5
- CP story and Bill 202, Alberta
- Summary of U.S. Legislation
- Throne Speech, March 18, 2003, Saskatchewan

Please feel free to contact myself or Tim Wilkinson if you have any questions.

Respectfully Yours,

Cory Parker
Secretary
IAFF Local 1286

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Richmond City Council
6911 No. 3 Road
Richmond BC V6Y 2C1

Dear Councillors:

This is a proposed resolution for which we request your support. We urge you to consider this important issue.

1. Richmond City Council express to the Workers Compensation Board its support for the concept for presumption of a number of cancers in full-time urban firefighters who have been regularly exposed to the hazards of a fire scene for a specific length of time.

Thank you for your consideration of this matter.

Respectfully,

Tim Wilkinson
President – IAFF, Local 1286

Memorandum

To: Bob Brett, BCPFFA

From: Stan Guenther

Date: 3/26/03

Re: Firefighter/Cancer WCB Presumption Initiative

Attached is a package of documentation supporting a legislative initiative on the part of the provincial government to enact a firefighter cancer occupational disease presumption by legislation or specific regulation.

The points to be emphasized are:

- The new report prepared for the BCPFFA by Dr. Guidotti confirms that medical and scientific evidence is strengthening in proof of the heightened occupational risk of various forms of cancer for firefighters.
- The range of cancers for which firefighters are at significantly increased risks is also broadening, now including brain, bladder, kidney, testicular, colon, lung and lymphatic cancer, as well as myeloma and leukemia. The medical evidence supports the need for presumptive assistance.
- Many U.S. states have presumptive legislation. Ontario adopted presumptive FF cancer policies in 1994. Manitoba recently enacted presumptive legislation, now in effect. Alberta is in the process of enacting presumptive legislation, and Saskatchewan has very recently promised such legislation.

The attached documents support those propositions. Included are:

1. BCPFFA Delegate Briefing Notes, **Highlights** (4 pages)
2. BCPFFA Delegate Briefing Notes, **Briefing Paper** (9 pages)
3. Appendix "A", Extracts from the 1994 Ontario IDSP report
4. Appendix "B", Report to the BCPFFA, Dr. Tee Guidotti, March 26, 2003
5. Appendix "C", News Release and Bill 5, Manitoba
6. Appendix "D", Summary of U.S. legislation
7. Appendix "E", CP story and Bill 202, Alberta
8. Throne Speech, March 18, 2003, Saskatchewan

Report to the British Columbia Professional Fire Fighters Association

Evaluating the Association Between Selected Cancers And Occupation as a Fire fighter

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26 March 2003

Executive Summary

Certain types of cancer present unique issues and methodological problems with interpreting epidemiological data. Recently, the British Columbia Professional Fire Fighters' Association requested our assistance in evaluating the association of specific types of cancer with fire fighting: brain, bladder, kidney, testicular, non-Hodgkins lymphoma (often referred to as "lymphatic cancer") together with myeloma and leukemia (often referred to as "haematopoietic cancer") and lung. Evidence available since 1994 suggests that it is reasonable given the available scientific evidence to adopt a policy of presumption for brain cancer, bladder cancer, kidney cancer, testicular cancer, non-Hodgkins lymphoma (lymphatic cancer) and leukemia (haematopoietic cancer) for claims associated with occupation as a fire fighter. Collateral evidence and a close analysis of the problem suggests that it is reasonable to establish a presumption for lung cancer among fire fighters who do not smoke cigarettes. It is acknowledged that such a presumption based on smoking status presents practical problems in adjudication. Colon cancer among fire fighters is also worth considering for addition to a presumption list.

The presumption for bladder cancer, kidney cancer and testicular cancer are based firmly on evidence for an excess in the literature. The presumption for brain cancer, non-Hodgkins lymphomas and leukemias are based on the inference that within the overall category there are specific disorders for which the evidence suggests an elevated risk but it is not possible to discern which among several are in excess. The presumption for lung cancer is limited to non-smokers and presents a particularly difficult problem in disentangling the attributable risk from fire fighting from the strongly confounding effect of cigarette smoking. The evidence does not support a presumption that lung cancer in fire fighters who smoke cigarettes arises out of occupation more often than not. However, there is evidence that occupation as a fire fighter is associated with some attributable risk and that in non-smoking fire fighter this risk is sufficiently elevated to justify a presumption. General guidelines for latency and elapsed time are also discussed.

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Introduction

The occupational health problems of fire fighters have been extensively studied, to the point that the world epidemiological literature on this topic is among the most complete and detailed available for any occupation. Despite this detail, intense interest and relative completeness, there are many unresolved issues. Whether fire fighters are at increased risk for cancer, in particular, has been an active topic of investigation.

Past efforts at meta-analysis did not successfully identify several cancers for which later cohort studies provided strong evidence for a probable increased risk, such as kidney and bladder (Howe and Burch, 1990). Pooled studies with large populations but limited resolution have not fully resolved these issues, either (Burnett, 1994). Since the rate of publication of studies on fire fighters appears to be slowing from a peak in the early 1990's, these issues are highly unlikely to be resolved by more data in the near term (Guidotti, 2000). Indeed, further studies using existing databases and the same methodology are likely to replicate the pattern of past studies of fire fighters, which are among the most complete, detailed and comprehensive studies available on any occupation.

We suggest that these issues represent a class of problem in occupational epidemiology that is best approached rigorously by examining the structure of the problem outcome by outcome. In this report we make an initial effort to do so.

Background

Because of their occupational exposure to a variety of toxic agents, fire fighters may be at risk for a number of exposure-related diseases (Guidotti, ed., 1998). A major unproven hypothesis is that risk increased following the introduction in the 1950's of combustible plastic furnishing and building materials known to generate toxic combustion products (Guidotti, 1992). Collateral toxicological evidence suggests that certain cancers are likely to be associated with fire fighting because of the exposures that fire fighters sustain, specifically lung cancer and genitourinary cancers. However, to date there has not been an unequivocally clear and consistent demonstration of excess risk due to occupational exposure for the most anticipated outcomes, including lung cancer, and for certain uncommon cancers, including leukemias, lymphomas and myeloma.

In 1994, the Industrial Disease Standards Panel of Ontario (ISDP, 1994) produced a widely-quoted report designed to identify candidate conditions for occupational disease presumptions in workers' compensation.

We published a similar analysis in 1995 (Guidotti, 1995). We concluded the following for various cancers of concern:

- Lung cancer: There is evidence for an association but not of sufficient magnitude for a general presumption of risk. We suggested that a presumption be considered for non-smoking fire fighters.
- Cancers of the genitourinary tract, including kidney, ureter, and bladder: The evidence is strong for both an association and for a general presumption of risk.
- Cancer of brain: Incomplete evidence strongly suggests a possible association at a magnitude consistent with a general presumption of risk.
- Cancer of lymphatic and haematopoietic tissue: As a group, there is some evidence for both an association and a general presumption or risk. However, the aggregation is medically meaningless. We therefore recommended a case-by-case approach.
- Cancer of the colon and rectum: There is sufficient evidence to conclude that there is an association but not that there is a general presumption of risk.

In 2002 we prepared a report on the health risks to fire fighters for the Government of Manitoba at the request of the Minister for Labour and Immigration, who is also responsible for the Workers' Compensation Act, The Hon. Becky Barrett. Based on that report, Bill 5 was introduced into the Manitoba Legislature to facilitate claims for certain chronic diseases (stated as cancers of bladder and kidney, cancer of the brain, haematopoietic cancers and lymphatic cancers) and was passed into law. The report was also mentioned by the Lieutenant Governor of Manitoba, The Honourable Peter Liba, in his Speech from the Throne in November. This report has garnered much attention in the press and from other governments. The Workers Compensation Board of Manitoba later requested guidance on the adjudication of claims involving certain types of cancer. This guidance was intended to support proposals for the amendment of the Workers' Compensation Act with respect to establishing presumption for occupational disease among fire fighters. We here present the evidence and rationale for our recommendations.

There were three parts to the review. The first was to identify evidence for an association that was sufficient in magnitude and circumstances to be causal and not appreciably confounded. The second was to evaluate whether the magnitude of the association, in context, was consistent with equal odds, or a doubled risk compared to an unexposed reference population. The third was to advise on latency periods that would be deemed plausible for work-related cancers. For fire fighters, as for most occupations, the only practical basis for such a criterion is duration of employment. We did not advise on criteria for specific job assignments or cumulative number of alarms for fire stations to which fire fighters were assigned, as these are generally not well documented.

This report also draws on evidence submitted to the workers' compensation boards and tribunals in Alberta and British Columbia for some of the same selected cancers and for lung cancer.

The present report was prepared for the British Columbia Professional Fire Fighters' Association, with special reference to the *Protocol for the Assessment of Medical/Scientific Information* of the Workers' Compensation Board of British Columbia, 1993. There is no accepted, appropriate and transparent forum for obtaining open peer review and discussion of methodology that applies to policies rather than research. Few peer-reviewed scientific journals are interested in receiving such papers. The next best option is to present the concept at an open scientific meeting to obtain reaction and feedback. The rationale described below for approaching haematopoeitic cancers, cancer of the brain, and lung cancer in non-smoking fire fighters was described in full before an international audience of approximately 50 peer occupational epidemiologists on 25 February 2003, at the International Congress on Occupational Health (Iguassu Falls, Brazil), where an abstract describing the general problem (but not the specifics of methodology) was peer-reviewed and accepted. No objections were expressed, the general approach was considered sound and a delegate from Germany indicated in open discussion that a similar proposal was under active consideration by the national workers' compensation system, die Berufgenosschaften.

The Rationale of Adjudication

The *Protocol for the Assessment of Medical/Scientific Information* is a carefully constructed and reasonable general guide to evaluating the epidemiological literature for purposes of weighing adjudication. In the sections below on specific cancer type, we generally adhere closely to its provisions. However, there are a few areas that the Protocol does not address that are fundamental to the issue of establishing presumption, for fire fighters or for any other occupation. These are discussed in this section, which assumes familiarity with the *Protocol*. For a more detailed, basic, theoretical and systematic treatment of each topic, readers are referred to our recent book *Science on the Witness Stand: Evaluating Scientific Evidence in Law, Adjudication and Policy* (Guidotti and Rose, eds., 2001).

Logic of Assessing Causation

Strict causation is one of several types of association that are important in workers' compensation but not the only form of association that merits recognition. Aggravation (a form of causation), contribution (where the exposure is necessary but not sufficient), multifactoral disease and confounding (in which a second hazard is associated with both the occupation and the outcome and is therefore work-related but not measured as a primary effect) all represent forms of association that qualify a condition as arising out of work although a strict cause-effect relationship may be lacking. The *Protocol* does not make this clear because it is focussed on a more traditional "strict causation" model more appropriate for epidemiological research.

As a consequence, there is an important component missing from the *Protocol* and that is guidance on how to frame the problem in the first place. For example, the difficult problem of brain cancer is inappropriately framed in several extant discussions of the problem. Unlike bladder cancer (which itself is not strictly homogeneous as a category but can be treated as such to a first approximation), brain cancer is not a sensible aggregation of outcomes: it consists of several ICD-9 codes and several different types of cancers, each with different risk factors. As will be demonstrated below, the problem with brain cancer is not whether the risk for the diagnostic group is elevated but whether there is evidence of an elevation in risk for a biological

relevant tumour within the overall group. This issue will be explored in much greater detail in subsequent sections of this report.

The essential issue in workers' compensation is not whether an attributable risk is strong enough to justify the presumption of a group risk but on the question of whether the group risk applies to the individual and informs the adjudication of the individual claim, since all claims must be adjudicated on their individual merit. For this reason epidemiology is a very valuable guide to identify and to characterize an association, but ultimately the facts of the individual case determine whether the information gained from epidemiological research can be applied and is useful. The *Protocols* are silent on the critical issue of interpreting epidemiological data for the individual case.

The logic of assessing causality in adjudication is also not the same as for concluding causation in a scientific investigation. The near-universal standard of certainty is "more likely than not", rather than the conventional 95% level of certainty (the meaning of the standard alpha probability for Type I error, commonly expressed as $p < 0.05$, for a scientific finding or study). Thus, one obstacle to applying the results of epidemiology to adjudication practice is learning to abandon the conventional notion of certainty one learns as a scientist and which creates a highly conservative, and therefore reassuring, standard of certainty. In evaluating a claim or as an expert for purposes of litigation, one is working within a framework in which individual studies may be so judged but the weight of evidence is evaluated as odds, with greater than equal odds favouring one conclusion over another. The *Protocol* is silent on this.

The relationship between risk and the decision to accept a claim or to adjudicate in favour of a claimant or plaintiff is therefore not simple. Merely demonstrating that there is an elevated risk of a particular outcome among members of an occupational group is not enough. It is also necessary to demonstrate that the individual circumstances of the claimant are consistent with the premise that the condition arose out of work. The weight of the available evidence, which is usually incomplete, must then support a decision that it is more likely than not (with the benefit of the doubt going to the claimant if the odds are even) that the claimant's condition did indeed arise out of work. The factor causing the outcome could be a job-related hazard or circumstances intimately associated with work (such as passive cigarette smoking) but would not normally be a voluntary activity that is not required by the job (such as active cigarette smoking).

It is important to realize that the application of epidemiology "as if" the standard of certainty were 50+% does not represent a distortion of scientific standards. Rather, it represents a legal requirement. Expert witnesses must follow the rules of the court.

Measuring Risk

Critical to assessing the strength of an association is a measure of risk. The magnitude of risk is expressed in epidemiology in one of two general forms. Studies that observe the experience of a population over time (i.e. cohort or prospective studies) use a ratio of the observed number of cases to the expected number of cases or relative risk. This may be expressed as a ratio but in occupational cohort studies is often expressed multiplied by 100, as if a percentage. When referring to the frequency deaths, this ratio times 100 is called the standardized mortality ratio (SMR) and when referring to the fraction of all deaths represented by the particular outcome it is called the proportionate mortality ratio (PMR). (Confusingly, some authors, such as Baris et al (2001) express SMRs as relative risks without the conventional normalization to 100.) The alternative term for describing magnitude of risk is used in study designs that compare how often a risk factor was present in the past among those who have developed the outcome and compares that with those who did not (case-referent or retrospective studies) in the form of a ratio. This is called an odds ratio (OR or, if specifying associations with mortality, sometimes MOR). The odds ratio is closely related to a relative risk mathematically but generally has more uncertainty.

In this paper, the risk estimates will be presented as they were reported in the original paper. SMRs are given to three places, without decimals, or expressed as relative risks as in Baris et al 2001). Relative risks are given as decimals, with no qualification. Odds ratios are given as decimals and identified as such.

Presumption

One situation in which attributable risk can be directly applied to individual claims, rather than treated only as supporting evidence, is in a rebuttable presumption.

Presumption is, simply, the doctrine that claims should be accepted without opposition when, all other things being equal, a claim received from a worker in a certain occupation is demonstrably more likely than not to have arisen out of work, whether or not it is possible to

prove the association in the individual case. An SMR of 200 is equal to an attributable risk of 100% of expected, and represents a high degree of association. It implies that the attributable risk due to work as a fire fighter is equal to the shared risk from other factors in life, including environmental factors associated with living as a member of the community. As a practical matter, in workers' compensation and tort litigation an SMR of 200 implies that, all other things being equal, the risk of a fire fighter developing a cancer (such as bladder) from work-related exposure is approximately equal to that of the risk of the same cancer in everyday life. Therefore, that the cancer arose from work and that it did not are equal odds and it is as or "more likely than not" (giving the benefit of the doubt to the worker) that the condition arose out of work. This constitutes the basis for a "rebuttable presumption" under which such cases would normally be considered work-related unless there is evidence to the contrary (Industrial Disease Standards Panel, 1992; Guidotti, 1995).

A presumption assumes that, all other things being equal, most cases of a certain type are associated with occupational exposure, even though it is not possible to determine which. Presumption is a way of being inclusive in the acceptance of such claims given that it is not possible to distinguish among them. Presumption is usually based on demonstration that the relative risk exceeds two because this statistical measure corresponds to even odds, but in practice, it is impossible to make such a fine distinction. A relative risk of 1.7 or 1.8 (SMR of 170 or 180) is usually indistinguishable statistically from one of 2 (200) with any confidence. Presumption is most appropriate when the condition is rare and there is a pattern or strong suggestion of strong association with an occupation that may be concealed by other factors that complicate interpretation of the risk estimate (Guidotti, 1998).

It would be desirable from a scientific basis to establish the subgroups in which the risk is concentrated, to identify the specific types of cancer in the aggregate categories most likely to be associated with elevated risk and to determine the threshold level associated with significant risk. However, to do so is not feasible, any more than it is now practical to identify the specific carcinogen that is responsible for the risk. To reject all such claims or to apply criteria that are arbitrary, such as restricting compensation to non-smokers, will predictably deny benefits to persons whose disorders did in fact arise from occupation but who cannot demonstrate the association. To accept all such claims will predictably include all such cases in which the disorder did not arise from occupation as well. To apply criteria that are liberal, i.e. that include

almost all workers with a plausible claim and exclude those who do not fit the criteria, inevitably raises issues regarding the adequacy, specificity and validity of the criteria and is likely to exclude some few individuals whose condition did arise out of work but may not have fit the inexact criteria precisely. To avoid this problem, presumption is sometimes applied as a means of ensuring that persons whose disorder did arise from their occupation are compensated, recognizing the expense of accepting some claims in which it did not.

Latency

Duration of employment is difficult to separate from latency. Latency is the elapsed time between first exposure to a carcinogen and the clinical manifestation of the disease. It reflects the time after the genetic constitution of the cell has been altered that the cell is dormant, then becomes cancerous and finally proliferates by dividing until a cancer appears that is visible, detectable on tests or interferes with function and is discovered.

It is generally held as a rule of thumb that the latency period for solid tumours is on the order of twenty years, but this should be understood as the modal latency, the time elapsed before an excess is observed, and not the minimum time required for the tumour to become manifest. Such rules of thumb do not readily apply to individuals. Cancers associated with occupational exposures can and do appear well before an arbitrary latency period, although there is usually a minimum imposed by the biology of the tumour and its rate of proliferation.

The *Protocol* does not discuss latency other than in the context of temporal relationships.

Positive and Negative Findings

An epidemiological approach based on a standard of "more likely than not" accepts the preponderance of evidence for an association even when that evidence does not achieve a scientific standard of certainty. Because of power considerations with uncommon disease outcomes and the tendency for misclassification and ascertainment bias to lower the estimate of risk, it is entirely possible by chance alone to miss a true elevation in an uncommon disease. Statistical "error" and low power predict that many replicate studies are not likely to show a true excess. Evidence for an elevation should rightly, therefore, be weighted more heavily than evidence for a negative finding in a similar study, all other things being equal. When they are

not, the validity of study design and power of the more substantial positive and negative studies are more persuasive than a meta-analysis.

All epidemiological risk estimates are just that – estimates – and represent the experience reflected in the populations being studied. Uncommon events, such as lung cancer, are subject to chance variation. This is precisely why we derive confidence intervals for our estimates. The power of a study is its ability to detect an elevated risk when there actually is one. One likes to have a power of at least 80% but few studies can achieve even 50% for lung cancer, because it is not common enough. This means that a large fraction of studies might well miss the true association. This is not controversial. What to do about negative studies when there are strong positive studies addressing an association is highly controversial. This is the case with lung cancer among fire fighters.

If one believes that power considerations and inherent bias make it more likely that an association will be missed than that one will be revealed, then one places greater weight on positive studies. This uncertainty over power means that studies that do show an excess risk should carry more weight in adjudication than the evidence of studies that have not demonstrated an excess risk. Studies that show no elevation in risk may simply have missed the excess and convey no information. Studies that show an excess risk, especially if they are consistent and show a dose-response relationship (one important criterion of a true association) are likely to be more useful in assessing the probable magnitude of the true excess risk. A meta-analysis, in this view, is not likely to be very helpful because the true risk will merely be diluted by the low risk estimates of studies that failed to detect the elevation.

Meta-analysis is often used to interpret the epidemiological evidence and indeed is a useful tool for doing so, but only one tool. Meta-analysis, even properly conducted under near-ideal conditions, has failed to predict the outcome of larger and more complete studies. For example, in the 1990's, meta-analysis of several small retrospective studies strongly suggested that great benefits could be made in the management of patients following a heart attack by giving them a certain type of drug that reduced demands on the heart muscle. A randomized clinical trial intended to validate this finding had to be stopped early because the results were opposite: patients died more often when they received the drug. Such clinical studies represent a near ideal application for meta-analysis because dosage (exposure) is accurately quantified and consistent and subjects are randomized, leading to similar populations within statistical limits. Studies in occupational epidemiology are

much less standardized and present much greater uncertainty. If meta-analysis was so far off in an ideal application, why should it be given undue weight in a less certain situation? Indeed, the premiere, but now dated meta-analysis conducted on studies of fire fighters (Howe and Burch, 1990) did not successfully predict elevated rates for some cancers, such as colon and genitourinary cancers, in studies over the next decade.

Criteria for Assessing Causation

Much has been made of the traditional Bradford Hill criteria (temporal sequence, exposure-response, strength of association, biological plausibility, consistency, specificity, coherence) applied to adjudication (Bradford Hill, 1995). However, these criteria are not clearly valid for the purpose. The Bradford Hill criteria (commonly called the "Hill criteria") are powerful tools but to prevent their misuse it is important to appreciate their limitations (Guidotti, 1992).

First, they exist to be a guide (and no more than that: Bradford Hill himself took the position that they do not constitute proof) to concluding that an association is causal once an association has been demonstrated. In other words, the criteria are not intended to be applied to the question of whether an association exists but to that of whether an association, once demonstrated, is causal. Thus, where there is a question about the certainty or magnitude of an association in the first place, the criteria do not apply.

Second, when an association exists, its interpretation is different in workers' compensation than in other arenas. An association that coexists with an occupational exposure but does not arise from it may still arise from work. A confounding risk factor, which by definition is associated with the occupation in some way, is equally valid as a causal determinant in relationship to work. For example, if a fire fighter develops asthma after exposure to floor wax polishing the floor of the fire station, it does not matter that the relevant exposure was not to the characteristic exposure of fire fighting - products of combustion. The condition is still work-related. If many fire fighters develop asthma for this reason (unlikely, of course) it would not matter if the Hill criteria applied or not – the condition would still be work-related.

Third, the individual criteria do not fit the problem of adjudication and the Hill criteria, individually or together, were never designed to be applied to adjudication. Several criteria require a complete database that is rarely available (fire fighters are here the exception): exposure-response relationship, consistency, specificity, coherence. Several of the criteria require corollary evidence

that is seldom available or relevant: coherence, biological plausibility. The criterion for strength of association is redundant, since this criterion is taken into account when an association is first identified and, if taken as a doubling or greater for the group as a whole, is overly stringent for individuals who may belong to an identifiable subgroup. Both the criterion for coherence taken alone and the other Hill criteria taken together require a vastly greater standard of certainty than "more likely than not" and are therefore highly prejudicial to individual cases where the database is incomplete or some part of the evidence is equivocal.

Finally, the Hill criteria can never be applied to an individual case, only to a body of evidence.

As useful as the Hill criteria are in epidemiology, they do not replace sound and informed judgement with appreciation of the particulars of the individual case.

The Evidentiary Base

In 1995, we reviewed the current literature on disease risk among fire fighters in order to compare findings and to infer magnitude of risk (Guidotti, 1995). Since 1995, there have been three major studies that have contributed to the world literature on fire fighters. They are summarized below.

Burnett et al (1994), which was actually not available until 1995, conducted a very large proportionate mortality study on fire fighters in 27 American states from 1984 through 1990, using data from the National Occupational Mortality Surveillance system. Limitations of these data are partially overcome by the sheer size of the database, which, with 5744 deaths among white male fire fighters, is beyond what may be achieved in any one cohort study. This system is an example of population surveillance for occupational disease we have advocated elsewhere (Guidotti, 1999).

Deschamp et al (1995) studied the recent experience of relatively small number of fire fighters in Paris from 1977, as a prelude to a longer-term cohort study. An elevated SMR was found for respiratory cancers (1.12), gastrointestinal cancers (1.14) and genitourinary cancers (3.29) among other findings. However, the study is anomalous in several ways, uniquely demonstrating an elevated mortality from stroke (1.19) and a very low overall mortality (0.52), the lowest reported to date among fire fighters. Further experience with this cohort is required to interpret the findings.

Ma et al (1998) conducted a large study using the same database to explore race-specific disparities in cancer mortality. The study was not intended to replicate or overlap with the Burnett et

al., as its purpose was different, but it is much smaller and covers a heavily overlapping population. For this study, the NOMS database was extended by three years to 1993 but lost data from three states that were removed. As expected, the results were similar. Race as coded on the death certificates yielded 1817 deaths of white fire fighters and 66 deaths of black fire fighters. Of greater interest is the pattern of race-specific elevations. If an environmental or occupational factor is the major risk factor for a type of cancer, one would expect elevations in both white and black fire fighters.

Bates et al (2001) reported a study on fire fighters in New Zealand from 1977 to 1996, conducted to investigate the observation of a cluster of testicular cancer. This elevation was confirmed as finding independent of the cluster. This study is unusual in reporting both cancer incidence and mortality. It reports one of the lowest mortality ratios reported for fire fighters (0.58), suggesting a strong healthy worker effect. Bates et al. observed no significant elevation except for testicular cancer. The authors caution that matching to mortality data and cancer registration data may be incomplete prior to 1990 and suggest that they have greater confidence for findings after this date. Among cancers of interest in this paper, they found a marked increase in testicular cancer and nonsignificant elevations in incidence in the 1977 – 1996 cohort of cancers of interest: lung (1.14, 95% 0.7 – 1.8), which showed a modest increase with duration of service, bladder (1.14, 95% CI 0.4 – 2.7), brain (1.27, 95% CI 0.4 – 3.0), and "myeloleukemia" (1.81, 95% 0.5 – 4.6), but not kidney (0.57, 95% CI 0.1 – 2.1). Limiting the analysis to the 1990 – 1996 subcohort, however, they found the increase in testicular cancer and a deficit in the same cancers, except for brain (1.59, 95% CI 0.3 – 4.6), and no kidney or "myeloleukemia" cases. A strikingly different picture is observed in the pattern of deaths, however. Mortality among fire fighters in the 1977 – 1996 cohort is elevated for bladder cancer (2.73, 95% CI 0.3 – 9.8) but less than expected for lung (0.86, 95% CI 0.4 – 1.6), brain (0.68, 95% CI 0.1 – 2.4) and "hematopoietic cancer" (0.72, 95% CI 0.2 – 1.8), and no deaths from testicular cancer. The discrepancy between incidence and mortality in cancers with a high case mortality, such as lung, is an anomaly. However, all numbers are small and the authors are candid in describing limitations of the database outside their control.

Baris et al (2001) conducted an exemplary cohort mortality study. This study should be accorded great weight because among recent studies it has exceptional power, spans most of the 20th century, and has the most complete follow-up. The study therefore merits description in detail.

The cohort consisted of 7789 Philadelphia fire fighters employed from 1925 to 1986 compared to US white male rates, comprising 204,821 person years of follow-up. The men were hired in their late 20s (on average) and worked for approximately 18 years, with an average of 26 years follow up. Baris et al (2001) examined their cohort by age, duration of employment, job assignment and by number of runs to fight fires (enumeration of responses from the firehall) in three broad ordinal categories.

There were 2220 deaths among the members of the cohort. All causes of death and all cancers were approximately equal to the expected rates for all U.S. white males. The authors did observe statistically significant excesses for colon cancer (SMR 1.51; 95% CI =1.18-1.93). Nonsignificant excesses were reported for cancers of the buccal cavity and pharynx (1.36; 95% CI=0.97, 2.14); for non-Hodgkin's lymphoma (1.41; 95% CI=0.91,2.19); for multiple myeloma (1.68; 95% CI=0.90-3.11) and for lung cancer (1.13; 95% CI 0.97-1.32). With >20 years of fire fighting, the following cancer sites showed elevated risks: colon cancer (1.68; 95% CI 1.17-240); kidney cancer (2.20; 95% CI 1.18-4.08); non-Hodgkins lymphoma (1.72; 95% CI 0.90-3.31); multiple myeloma (2.31; 95% CI 1.04-5.16); and benign neoplasms (2.54; 95% CI 1.06-6.11).

Baris et al developed a direct index of exposure by assessing risk by three categories of fire fighting runs, with low exposure being less than 3322 runs; medium exposure being greater than or equal to 3323 and less than 5099 runs; and high exposure being greater than 5099 runs. Cancer of the pancreas showed a clear dose-response with rose from 1.02 for low to 1.17 for medium to 1.61 for high exposure. Although there were no other tumour sites with exposure-response gradient, when comparing low exposure (1.00) to high exposure, several cancer sites demonstrated increasing risk: stomach, 1.20; pancreas, 1.42; leukemia, 1.22; and benign neoplasms, 2.06. The authors also compared lifetime runs with diesel exposures, including a category of nonexposed. Although there were no exposure-response gradients, several sites demonstrated increasing risks in the medium and high categories compared to unexposed: buccal cavity and pharynx, prostate, brain, multiple myeloma, and leukemia.

There is also an apparent dose-response for assessment of low, medium and high exposure related to diesel exhaust for mortality from respiratory diseases (but not for any cancer). The risk rises from 1.00 (nonexposed) to 1.37 for low exposure to 1.45 for medium and finally to 1.49 among those in the high exposure group. Interestingly, there is no such exposure-

response relationship for number of runs over the career of the fire fighter (regardless of diesel exposure).

All of these excesses have relevance to toxicology and inhaled toxic hazards found in the fire fighting profession, except the excesses for benign neoplasms. This is a "wastebasket", or residual category of diagnostic rubrics. Thus, it is not clear whether this represents a true elevation in some unusual class of tumour or (more likely) misclassification.

From the Baris et al study, some tentative conclusions emerge from an overview of the epidemiology data. There were no significantly *reduced* SMRs for any of the a priori tumour sites plausibly linked with fire fighting: brain, bladder, kidney, and lymphatic malignancies. Further, the Baris study adds weight to linkages between fire fighting and cancers of lymphatic system and with kidney, and suggests associations with colon, pancreas and prostate cancers.

Most recently, Stang et al (2003) have published a focused case-control of testicular carcinoma among firefighters in north Germany, showing an odds ratio of 4.5 (0.7 – 30.5). This was interpreted as consistent with the results from New Zealand by Bates et al (2001) described above.

Brain

Cancers of the brain arising from brain tissue (i.e. primary malignancies of the brain, rather than metastatic brain tumours) are relatively rare and may include twenty or more individual types. Epidemiological studies do not distinguish among them because they most are individually rare and subject to miscoding and aggregated coding when reported. In all probability there are different environmental causes for the different types, when and if environmental factors play a role in causation.

The most common type of "brain" tumour is glioma, followed by meningioma, which is not obviously associated with environmental or occupational exposures. A serious nosological problem faced by cancer epidemiologists is that tumour registries continue to record meningiomas, which are usually benign, in overall statistics for brain cancer. This tends to dilute any risk estimate specific for gliomas. Gliomas (astrocytomas) are the primary type of malignancy and these tumours are more likely to be associated with environmental and occupational exposures. Thus, with brain cancer it is probably the case that a true excess in one or more types may be diluted by the inclusion in the category of cancers (and, in the case of most

meningiomas, benign tumours) of all other types. This leads to an inherent bias to underestimate the risk for that subset of cancers that may have a true association with fire fighting. Analysis by specific tumour type might identify which one, if any, is associated with the risk but these cancers are uncommon and such a study would be very difficult and require large populations. Unless more specific studies are conducted on individual types of brain cancer among fire fighters, which is not likely, this problem cannot be resolved and the risk within the class must be inferred from the available data.

Burnett (1994) did not observe an elevation for cancer of the brain. The PMR was 85 for fire fighters dying under the age of 65 and 103 for those dying at or over the age of 65. With 19 and 38 deaths, respectively, this is a large collection of deaths by brain cancer. Ma et al reported that no elevation was observed for brain cancer among white fire fighters but a very large elevation, with a mortality odds ratio (MOR) of 6.9 (95% CI 3.0 – 16.0) was observed for black fire fighters.

Baris observed a relative deficit of brain cancer, with an SMR of 0.61 (95% CI 0.31-1.22). Risk did not appear to be concentrated in any subset of fire fighters by assignment, number of runs or duration, although the highest SMR (1.18) was observed among fire fighters with more than 729 runs in the first five years of duty. Because brain is an uncommon tumour site, statistical power is usually limited in epidemiological studies. This study therefore does not contradict the findings of other studies that suggest an elevation in risk (upper 95% CI was 1.22), but it does not support them either.

Brain cancers, being a heterogeneous category, is not adequately described by a single latency. The excess reported for brain in other studies is not observable in either Baris et al (2001) and was not so analyzed in Guidotti et al (1993) because of small numbers, so that neither study is available for the purpose of establishing the association between risk and occupational activity for this set of cancers. Demers et al (1992) does document a doubling of risk (SMR 257) at less than ten years of employment peaking at over a tripling (353) up to 19 years. Heyer et al (1990) also shows a near-doubling of risk (184) at less than 15 years duration of exposure. On the limited available evidence, therefore, an elapsed period of less than ten years cannot be used to rule out an association in an individual. It is not clear what the minimum latency for a brain cancer might be, especially for rapidly-growing astrocytoma. It would be reasonable to assume

that for aggressive brain cancers, exposure periods plus latencies may be very short, perhaps as short as five years.

Leukemia, Lymphoma, Myeloma

This is not a medically defensible aggregation of disease outcomes. Even so, many studies have aggregated deaths or incident cases in these three broad categories in order to achieve sufficient numbers for statistical analysis. The problem comes when these aggregations are taken at face value, as legitimate disease outcomes. They are not and elevations in one disease or a deficit in another can easily distort the aggregate risk estimate.

Non-Hodgkin's Lymphomas

Lymphatic cancers are generally known as lymphomas. Unfortunately, because they are not common they tend to contribute a small number of deaths in most studies and are difficult for epidemiologists to analyze. In smaller studies they are often aggregated with leukemias and myeloma into a residual category of cancers. This obscures differences among the groups. Because they are a collection of conditions and they tend to manifest themselves in older persons, their relationship to environmental factors is more difficult to determine.

Epidemiological studies generally do not separate the various types, or, if they do, use an old classification system that divides lymphomas into Hodgkin's disease and non-Hodgkins lymphomas. Hodgkins disease is actually a class of apparently closely related lymphomas that tend to peak in young adulthood and again at older age and have not been associated with occupational or environmental exposures or occupational risks. Non-Hodgkins lymphomas are a larger, more heterogeneous category and have been associated, in the aggregate, with many environmental exposures and occupations. Non-Hodgkins lymphoma is further divided in many epidemiological studies into "lymphosarcomas" and "reticulum cell sarcomas". More commonly, all lymphomas are aggregated or lumped together with haematopoietic cancers and multiple myeloma.

This aggregation obscures the level of risk that may exist for certain critical types of lymphoma. There are over 30 types of lymphoma recognized in the current classification system (the WHO and R.E.A.L. system), at least nine of which were commonly observed in, for example, India (Naresh et al, 2000). New types are expected to be identified as immunological

and genomic methods become more sophisticated. Different types of lymphoma are known to be associated with different occupational risk factors, including follicular cell lymphoma with the meatpacking industry and small cell lymphoma with solvent exposure (Tatham et al, 1997). Multiple myeloma most closely resembles the lymphomas and is a tumour of B-lymphocytes, but appears to have different risk factors. Chronic lymphocytic leukemia, which is more accurately considered a lymphoma appearing in blood, was recently separately identified as a probable risk of Vietnam veterans exposed to herbicides on the basis of its characteristics and differences from leukemias in general, which are not so recognized (NAS, 2003).

If, as seems plausible, different environmental exposures may be associated with different cell types of non-Hodgkins lymphoma, a truly elevated risk that may, for example, arise from exposure to some constituent of combustion gases may be diluted by inclusion with all the other types of lymphoma, many of which may have no environmental association. This leads to an inherent bias to underestimate the risk for that subset of lymphomas that may have a true association with fire fighting. Analysis by specific tumour type might identify which one, if any, is associated with the risk but these cancers are uncommon and such a study would be very difficult, likely impossible for one occupation, and require huge populations. Such a study has been attempted with pooled data from North American and European cancer registries and failed to identify a pattern, primarily because of difficulties in reliably and consistently typing the cancers by type of lymphoma. Unless more specific studies are conducted using molecular markers on lymphoma cases arising among fire fighters, pooling data from many fire services, this problem cannot be resolved. Such a study is not likely to occur, and so the risk within the class must be inferred from the available data.

Lymphatic cancers were separately addressed in the Burnett et al (1994) study, which revealed an elevation for non-Hodgkins lymphoma. The PMR was 161 for fire fighters dying under the age of 65 and 130 for those dying at or over the age of 65. With 35 and 66 deaths, respectively, this is a large collection of deaths by lymphoma. These cancers were also separately identified by Ma, who found a statistically significant elevation of lymphatic cancer was observed among white fire fighters, with a MOR of 1.4. Ma found no elevation was observed among black fire fighters, based on a single case.

Baris observed a not-quite significant overall elevation for non-Hodgkins lymphoma, with an SMR of 1.41. While not achieving statistical significance, this rose to 1.72 for fire

fighters with 20 years or more experience and 2.65 for those assigned to ladder companies. The subset hired between 1935 and 1944 did show a statistically significant elevation of SMR 2.19 (95% CI 1.18-4.07). A reverse dose-response relationship was observed by number of runs, with the group experiencing the lowest number showing a significant elevation, with an SMR of 2.36 (95% CI 1.31-4.26), but no relationship was found with runs during the first five years. These data may appear internally inconsistent, however when the associations do achieve statistical significance, their lower bounds are greater than 1.0. This suggests the possibility that these are true elevations in these subgroups. Baris et al found that among those employed more than 20 years, the SMR was 2.20 (95% CI=0.90,3.31).

Leukemias

Haematopoietic cancers (which affect the blood-forming organs, most particularly bone marrow) are generally known as leukemias. There are about a dozen well-recognized forms of leukemia, of which five or six predominate. Acute myeologenous leukemia is known to be associated with benzene exposure. AML is the most common leukemia in adults and this leukemia has been the subject of several specific studies exploring this association. Individually, leukemias are relatively uncommon and in population-based epidemiological studies of occupational risk they are often aggregated with other diseases as "leukemia, lymphoma and multiple myeloma". This obscures the level of risk that may exist for certain critical types of leukemia. Different environmental exposures may be associated with different cell types and particularly AML. Thus, a truly elevated risk of AML that may arise from exposure to benzene in combustion gases, may be diluted by inclusion with all the other types of lymphoma, many of which may have no environmental association. This leads to an inherent bias to underestimate the risk for that subset of lymphomas that may have a true association with fire fighting. Analysis by specific leukemia type might identify an elevated risk confined to one type, such as AML, but leukemias are uncommon and such a study would require large populations. Unless more specific studies are conducted on leukemia among fire fighters, which is not likely to occur, this problem cannot be resolved and the risk within the class must be inferred from the available data.

Haematopoietic cancers were separately addressed in the study by Burnett et al (1994), which revealed an elevation for the class as a whole. The PMR was 171 for fire fighters dying under the

age of 65 and 119 for those dying at or over the age of 65. With 33 and 61 deaths, respectively, this is a large collection of deaths by leukemia. Ma observed no apparent elevation for haematopoietic cancers, with a MOR of 1.1. There were no cases among black fire fighters. This is unusual but probably reflects the small numbers of black fire fighters in the population.

L'Abbé and Tomlinson (1992), in a study of fire fighters in Toronto, uniquely reported risk for general types of leukemia. They observed an excess of "lymphatic" [lymphocytic] leukemia at 190 (42 – 485). This was highly influential in the IDSP report, however the finding is surprising. Acute myelogenous leukemia (AML) is the type to be expected in circumstances in which benzene is a hazard, not lymphocytic, presumably the acute form which is more common than chronic.

Baris found no overall elevation was observed for the leukemias (SMR 83, 95% CI 0.50-1.37), not specified as acute or chronic or by type. A statistically significant elevation in SMR of 275 (95% CI 1.03-7.33) was observed for fire fighters assigned to ladder companies only, but not to those assigned to both ladder and engine companies. A non-significant elevation was observed for those with a high level of runs in the first five years, with an SMR of 2.44 (95% CI 0.70-8.54) and with medium (but not high) levels of runs over a lifetime, with SMR of 2.50 (95% CI 0.56-11.10). These data are not compelling evidence for a true association in this population but do not rule it out. Because of power considerations, this study also does not contradict others that have demonstrated a higher overall risk. However, the study by Baris et al (2001) does not really clarify this issue, either.

The apparent association with "lymphatic cancer" is an anomaly, from these points of view. However, in its totality the evidence suggests (again, at the level of "more likely than not") that one cannot choose among the types of leukemia on the basis of current evidence. It cannot, for example, be convincingly argued that only one form of acute leukemia, either myelogenous or lymphocytic, should be recognized. One is suggested by the empirical data, the other by the known toxicological profile of exposures experienced by fire fighters. Although Ontario now recognizes lymphocyctic leukemia, the evidence presented by L'Abbé and Tomlinson (1992) is not definitive and because of power considerations cannot be used to rule out the possibility of an association with AML. Thus, it is not possible to recommend a selective criterion that only recognizes AML, ALL or, for that matter, only acute and not chronic leukemias.

Leukemias tend to have short latencies, on the order of five years or so. Short latencies and therefore duration of employment for leukemia are reasonable, on the order of four years to ensure that no errors of exclusion are likely.

Myeloma

Myelomas are B-cell lymphomas and malignant plasma cell dyscrasias. Multiple myeloma (ICD-9= 203) is often lumped with lymphatic malignancies, and the results from Baris et al (2001) lend weight to the prior assessment of fire fighting and lymphatic cancers—Non-Hodgkins and leukemia, specifically. These authors found that increased with duration of employment, with 20 + years having a statistically significant SMR of 2.31, and a statistically significant SMR of 2.54 for engine company employment only, with some suggestion of correlation with medium and high diesel exposures (latter based on small numbers of deaths).

Genitourinary Cancers

Bladder cancer

Burnett et al (1994) found no elevation for bladder cancer but the authors imply that they expected a deficit due to the healthy worker effect. The PMR was 101 for fire fighters dying under the age of 65 and 99 for those dying at or over the age of 65. With 9 and 37 deaths, respectively, this is a large collection of deaths by bladder cancer. Applying the IDSP criteria would not have flagged this cause of death as an outcome of concern. Using the same database, Ma (1998) reported a not-quite statistically significant elevation of 1.2 was observed for bladder cancer among white fire fighters and an elevation (but based on a single case) for black fire fighters.

For bladder cancers, latencies tend to be shorter and more variable than for other solid tumours. It is generally held as a rule of thumb that the latency period for solid tumours is on the order of twenty years, but this should be understood as the modal latency, the time elapsed before an excess is observed, and not the minimum time required to elapse. Such rules of thumb do not readily apply to individuals. Cancers associated with occupational exposures can and do appear well before an arbitrary latency period, although there is usually a minimum imposed by the biology of the tumour and its rate of proliferation. For bladder cancer, evidence from aniline

dye workers in the 1940's and 1950's provided strong evidence for a latency as short as seven years. Latency is responsive to dose for many tumours and the high, constant exposure of workers in the chemical industry in the early twentieth century may have compressed the latency period to its absolute minimum in a tissue that is susceptible to malignant degeneration. This is not plausibly the case for fire fighters, where exposure tends to be much less and highly intermittent. The exposure of fire fighters to potential bladder carcinogens is much less than for chemical workers in that era. In data from Alberta (Guidotti, 1993), bladder cancer did not appear before age 60 or before 20 years of service and showed a very long peak latency of 40 years. Baris et al reported a slightly elevated SMR of 1.25 for bladder cancer, with greatest risk being among those hired before 1935 (SMR=1.71 95% CI=0.94,3.08), and among those with greater number of runs during their first 5 years employed (SMR=2.59, 95% CI=0.64,9.84). It would be difficult to accept a latency under 10 years for bladder cancer in a fire fighter but the literature does not rule out latencies under twenty years in other occupations. One might expect that the duration of service associated with risk among fire fighters to be on the order of 15 years.

Kidney cancer

Burnett et al (1994) found a marked elevation for cancer of the kidney. The PMR was 141 for fire fighters dying under the age of 65 and 144 for those dying at or over the age of 65. With 24 and 53 deaths, respectively, this is a large collection of deaths by kidney cancer. Using the same database, Ma (1998) reported a borderline statistically significant elevation of 1.3 was observed for cancer of the kidney among white fire fighters. No cases were observed for black fire fighters.

It is not clear that kidney cancer follows the same pattern as bladder cancer and latency has not been as intensively studied for kidney cancer. On the basis of current understanding and the literature on fire fighters, it might be difficult to accept a latency under 15 years, just on the basis of the time required for a solid tumour to proliferate, but latency periods less than 20 but greater than 15 would not be unreasonable.

The standard cancer epidemiology text Schottenfeld and Fraumeni (1996) cites several studies in which a near doubling of risk is associated with duration of employment less than ten years, among them aluminum workers exposed to polycyclic aromatic hydrocarbons. Fire

fighters are not exposed to the same intensity of exposure but are exposed to the same or similar carcinogens. In data from Alberta (Guidotti, 1993), a marked elevation in risk for kidney cancer was visible in the category 10 – 19 years of employment. Baris and co-workers (2001) reported a doubling of risk with an SMR=2.20, 95% CI=1.18, 4.08 among those employed for 20 or more years.

Testicular Cancer

Bates et al (2001) found a standardized incidence ration of 3.0 (1.3 – 5.90) for firefighters in the New Zealand city of Wellington. The findings of Stang et al (2003) from northern Germany were consistent with this finding, although their odds ratio of 4.3 (0.7 – 30.5) was not statistically significant. Such high risks are unlikely to be confounded by differences in the prevalence of cryptorchism (the major known risk factor), smoking (not known to be associated with testicular carcinoma) or other plausible alternative risk factors. In their community-based study of testicular carcinoma, only four firefighters and three controls were firefighters out of 269 and 797, respectively, making the power of their study very limited. Stang et al (2003) also reported on duration of employment. Of the four cases, two had been employed as firefighters more than 20 years and two for less than 4.

There are five basic tissue types of testicular cancer, the most common by far being seminoma (about 95%). Bates et al (2001) does not specify the histology of the tumour. Stang et al (2003) reports that of the four, two were embryomas, an unusually high frequency, which suggests, but does not prove, and that this type (which is also found in mixed germ cell types) may be associated with occupational risk. The evidence is too weak to rely on, however.

Biological credibility for the association, however, comes from the observation by Olshan et al (1990) that the offspring of male firefighters (the vast majority are male) are at significant and (for atrial septal defects, with an odds ratio of almost 6) substantial elevated risk for birth defects, specifically common cardiac anomalies. Such a finding, implying a congenital birth defect mediated by a male factor, points to an effect mediated by the testes or, less plausibly, seminal fluid.

Given the totality of the evidence, it is reasonable to establish a presumption for testicular carcinoma on the basis of current evidence. However, given the methodological limitations of

Bates et al (2001) and the lack of available evidence on exposure, tissue type of the tumours and latency, no further guidance can be recommended.

Evaluation in Light of Recent Evidence

Overall

When a strong potential exists for misclassification or dilution of risk estimates, or when power considerations make the achievement of statistical significance unlikely because of small numbers, elevated risks take on added significance. In this analysis we have placed greatest weight on the magnitude and consistency of the association for bladder and kidney cancer, which are discreet and separable tumours, and on suggestions of an elevation in various subgroups for brain, lymphatic (non-Hodgkins lymphomas) and haematopoietic cancers.

The weight of evidence to date suggests that the elevation in risk for brain cancer reflects a true risk in certain subgroups, as demonstrated in black fire fighters, but these subgroups cannot be readily identified by usable criteria in adjudication. The inconsistency in the literature cannot be explained by current data but given power considerations, the demonstration of an excess in past studies appears more convincing as evidence of a confounded or obscured association than the inconsistency is convincing as evidence of no association.

The weight of evidence for lymphatic cancer of the non-Hodgkins type and haematopoietic cancer suggests that the elevation in risk reflects a true risk in certain subgroups but these subgroups cannot be readily identified by usable criteria in adjudication. The more recent evidence is consistent with an elevation for lymphoma and does not contradict the finding in other studies of an increased risk for haematopoietic cancers (leukemias). The L'Abbé/Aronson and Tomlinson (1992) and Demers et al (1992) studies, for example, provide strong evidence suggesting an elevated risk notwithstanding the variation in risk estimates in other studies. Baris et al (2001) present a confusing picture for non-Hodgkins because employment for 20 or more years produces an SMR of 1.72, with elevated risk for those hired after 1935, but there was an inverse of risk for cumulative number of runs. Thus, the earlier recommendations from IDSP (1994), for a presumption, and by Guidotti (1995), for an implied presumption but with individual evaluation of each case, are not contradicted by the new evidence.

Lung Cancer

Lung cancer has been the most difficult cancer site to evaluate in epidemiologic studies of fire fighters. Despite the obvious exposure to carcinogens inhaled in smoke, it has been difficult to document an excess in mortality from lung cancer of a magnitude and consistency compatible with occupational exposure. Documentation of an association between lung cancer and occupational exposure as a fire fighter remains elusive; many investigators, including this author, continue to believe that an association exists that is confounded by cigarette smoking. An effect probably does exist but it is likely to be heavily obscured by confounding factors and may not be as strong as would be suggested by the toxicological literature (Guidotti and Clough, 1992).

Without question, cigarette smoking is a confounding exposure that complicates the analysis, but the prevalence of smoking among fire fighters does not appear to be excessive compared to other blue collar occupations. Respiratory protection has probably reduced individual exposure levels since the 1970's, although it was not optimally used for many years in most fire departments. This may be the reason that studies rich in recent person-years of observation, such as Baris et al (2001), do not observe elevations. A major issue is whether the large-scale introduction of synthetic polymers into building materials and furnishings after about 1950 has increased the risk of cancer among fire fighters because of exposure to the combustion products. Studies we conducted in Alberta on fire fighters entering the fire service from 1927 to 1987 show evidence for such an increase in risk (Guidotti, 1993).

What is the Unconfounded Risk Attributable to Fire fighting?

Many studies have shown an excess of lung cancer on the order of 20 to 80% (i.e. SMRs around 120 or 180), a magnitude not uncommon in studies of other blue collar occupations with less plausible exposure levels (Guidotti, 1987). However, the empirical findings on lung cancer from recent, well-designed epidemiological studies have been inconsistent. One study from Denmark in which the comparison population is unusual reported a standardized mortality ratio of 317 for older fire fighters, while studies on cohorts from San Francisco and Buffalo showed no excess and even suggest a deficit. The possibility of an association that is obscured in comparison to the general population by the healthy worker effect is probably less likely for this cause of death than for other chronic diseases; over the long periods of observation typical for these studies the mortality

experience of initially selected workers can be expected to approach that of the general population more closely, especially for noncardiovascular causes of death.

In 1995, we proposed that the true risk for lung cancer associated with fire fighting was probably on the order of 150 (Guidotti, 1995). This figure has been disputed. We suggest that there are contextual reasons for thinking that the true risk has been underestimated in career fire fighters and both diluted and confounded by the effect of cigarette smoking, which is a much greater risk factor. One may examine virtually all extant studies in the literature (Guidotti, 1995, and above) and observe that those studies that are positive, relevant, close to the primary data, large and well done seem to cluster in a band from an excess of 30% (Rosenstock, 1990) to 68% (Petersen and Milham, 1977).

The principal exceptions are Baris et al (2001) and Vena and Fiedler (1987). Baris et al, despite a low overall risk (1.13, 95% 0.97 – 1.32) does report suggestive elevations in certain subgroups, notably fire fighters with less than 9 years of service (1.52, 95% CI 1.16 – 2.01), those assigned to engine companies (1.18, 95% CI 0.93 – 1.51), and those hired before 1935 (1.30, 95% CI 0.97 – 1.73). Vena and Fiedler (1987) present one of the lower overall risks in the fire fighting literature (0.94, 95% CI 0.62 – 1.36) but their data show a possible exposure-response relationship with duration of employment (a near-monotonic increase of 0.14 relative risk for each of five decade of fire service, nonparametric $p < 0.07$) and a statistically significant excess (at $p < 0.01$) for fire fighters with more than 40 years of fire service (1.29). Heyer et al (1990) reported an overall risk of only 97 (95% CI 65-139) but observed an elevated risk among fire fighters aged 65 years or more, an age when the incidence of lung cancer tends to peak. Thus, even in so-called "negative" studies there are hints of a possible association.

Among those studies that appear to be unequivocal in reporting low risk, Beaumont et al (1991), which shows the lowest risk (0.84, 95% CI 0.64 – 1.08), also shows the largest healthy worker effect (i.e. the lowest overall mortality from all causes (0.90) and from cancer (0.95) among the major studies) and is also atypical in age and the high rate of cirrhosis.

At the other extreme is one study in which an overall risk of 163 (95% CI 75 – 310) was accompanied by a tripling of risk (317) for fire fighters aged 60 to 74 (Hansen, 1990). This is an imaginative Danish study that aggregated other occupational groups into a synthetic reference group. The artificiality of this construct makes the study difficult to interpret.

In our study of urban fire fighters in Alberta (Guidotti, 1993), we found trends that we believe suggest a true SMR on the order of 150 in that population. Individually, these trends are not definitive but together they are highly suggestive. The overall SMR for lung cancer was 142 (95% confidence interval 91, 211), statistically not significant, and statistically indistinguishable from 150. However, lung cancer was elevated to an SMR of 167 among fire fighters entering the fire service in the 1960's, the most recent cohort which at the time of the study was surviving as a group beyond the expected latency period. This is not strong evidence, because it is based on only two cases, but the following cohort of fire fighters entering in the 1970's showed an even greater risk, 261 (but based on a single case). The risk of lung cancer also showed an exposure-response relationship in our data, with groups of fire fighters who had higher exposure opportunities and duration showing elevations on the order of 200. By duration of employment, an initially high risk for those with less exposure declined with duration of employment but achieved a doubling for those working 40 or more years (but only two fire fighters were in that group). More persuasively, when duration of employment was corrected for exposure opportunity in job classification, the exposure-response relationship changed to suggest an initially high risk among probationary fire fighters or those unfit for duty, a more or less consistent but low elevation for the middling exposed varying around 150 (range 32 to 258), and a significantly elevated risk (408, $p < 0.05$) for those with more than 35 exposure opportunity-weighted years of employment. Baris et al (2001), although negative overall, appears to show the same effect in the first 9 years. Unfortunately, the data from other studies cannot be disaggregated on the same basis as the Alberta cohort.

An important factor in the Alberta study, which was not appreciated at the time of initial publication, is that cigarette smoking is historically less of a confounding factor in Alberta than it has been in other populations. Subsequent studies of smoking-related lung disease outcomes suggest that smoking rates have been historically low in the province compared to the rest of the country and this is reflected in lower mortality from chronic obstructive pulmonary disease. In recent years mortality rates for smoking-related disorders appear to have converged with the rest of Canada as smoking rates in the rest of the country have gone down and those in Alberta have changed less dramatically (Guidotti, 1995b). Again, this suggests, but does not prove, that the Alberta experience is less confounded by cigarette smoking than elsewhere.

An anomaly of the Alberta data is that the excess was seen in one city (Edmonton) and not another (Calgary). This represents a valuable internal replication because the same study team

collected data from both cities, matched against death certificates concurrently and analyzed both datasets simultaneously. Were Edmonton to have been studied separately, the risk would be 201, the highest overall risk for lung cancer reported.

Taken together, and supported by the methodologically stronger studies in the literature, 150 seems to be a reasonable estimate of the true (unconfounded) risk. The attributable risk fraction would therefore be on the order of 50% for fire fighters. Population attributable risks are used as crude, best estimates in estimating the risks for an individual. For the average fire fighter, therefore, the most likely estimate of the risk of working as a fire fighters would be about half that of the actual risk of lung cancer associated with living in the community, or as a member of the population as a whole.

The Non-Smoking Fire fighter

The findings of epidemiological studies are best estimates for the individual, but they are not necessarily applicable to the circumstances of an individual case. Claims under workers' compensation and other adjudication systems are generally required to be based on individual circumstances, not on broad generalizations, unless there is a relevant presumption. One of the individual factors of greatest practical importance is smoking. When lung cancer occurs in a fire fighter who does not smoke, the relevant comparison is to the risk of other nonsmokers, not the population as a whole, which includes many smokers. For a non-smoking fire fighter, the a priori risk for lung cancer is low. Is the additional risk attributable to fire fighting sufficient to achieve a doubling, the threshold for presumption? There is evidence that it is but some reasonable assumptions are required.

There is no study available that describes the experience of non-smoking fire fighters. This is not unusual: it is difficult to identify or to partition out the risk of non-smokers in most epidemiological studies of occupational risk factors. The smoking effect is so strong that it makes it difficult to isolate other factors in epidemiological studies. Lung cancer in a non-smoker is rare. Although lung cancer is rare in people who do not smoke, when it occurs it is usually adenocarcinoma. However, adenocarcinoma is also increased among smokers, so tissue type does not help as an indicator in the individual case.

In calculating the SMR or relative risk, both the numerator and the denominator include smokers. Smokers among the fire fighters contribute the majority of cases of lung cancer, as they

do in the general population. Although their risk may be increased compared to similar smokers who do not fight fires, the increase is probably small in absolute terms given their already increased risk, which is in the range of 5 to 10 times that of nonsmokers (Schottenfeld and Fraumini). In the 1980's, perhaps 30 to 40% of fire fighters smoked; the data available are sketchy but seem to be more or less in line with the general population (Gerace, 1990). The question therefore is how to attribute risk to nonsmoking fire fighters when most of the cases are already coming from smokers.

One may assume that, within a reasonable range of exposure, the magnitude of increase in risk for lung cancer associated with a given exposure to combustion products, such as polycyclic aromatic hydrocarbons, is the same for smoking and non-smoking fire fighters. For smoking fire fighters, this risk is added onto the existing risk from cigarette smoking, which is associated with at about ten times the risk as for nonsmokers. Thus, if the risk is increased by 50% for smoking fire fighters, the proportionate increase in risk for non-smokers would be much greater, by as much as tenfold, because the same attributable risk is added to a much smaller baseline risk.

One approach to quantifying the risk of nonsmoking fire fighters is to estimate that 40% ($f = 0.4$) of fire fighters smoke and that 60% do not ($1 - f$), that the relative risk of lung cancer for smokers is 10 times that of nonsmokers ($R = 10.0$), and that the relative risk (r) of lung cancer for fire fighters overall is 1.5. If x represents the attributable risk fraction, $0.4(10+x) + 0.6(1+x)/0.4(10) + 0.6(1.0) = 1.5$. Solving for x yields an attributable risk fraction of 2.3. This translates to a relative risk for nonsmoking fire fighters of 3.3, comfortably above a doubling. The exact value is unimportant because of the compounded uncertainties; that it exceeds a doubling is what matters.

Another way to approach the problem is to determine, based on the same assumptions, what the minimum relative risk for the population as a whole would have to be to reflect a true doubling of risk for nonsmoking fire fighters. The calculations are similar and yield $r = 1.22$, which is comfortably supported by the world literature whether or not the true risk is 1.5, as has been argued above. How sensitive is this model to underlying assumptions? Reducing the estimate of the proportion of the fire fighting population that smokes to 30% barely changes the overall relative risk required to support the presumption, to 1.27. Reducing the estimate of the relative risk associated with smoking from 10 to 5, which is a low estimate and intentionally

biases the model against nonsmokers, increases the overall relative risk required to support the presumption to 1.38, still in line with the world literature and below the 1.5 level that probably represents the "true" risk. Again, the exact number is unimportant; what matters is that the overall risks that would be associated with a doubling in the subgroup of nonsmoking fire fighters falls into an area entirely consistent with the literature and therefore best evidence.

Thus, it seems apparent that the available evidence supports the conclusion that the risk for lung cancer among nonsmoking fire fighters is at least doubled compared to the general population.

However, the most relevant comparison of all is to the nonsmoking population. If a nonsmoking fire fighter were compared to a similar population of people who also do not smoke, the expression would be $0.6(1 + x)/0.6(1.0) = 1 + x = 3.3$, which is the relative risk given above. (This is not coincidence, just the result of a mathematical identity. The group risk of people who do not smoke is defined as unity.) In other words, compared to nonsmokers as a group, smoking fire fighters have much more than a doubling of risk. Again, the exact value is unimportant because of the compounded uncertainties; that it clearly exceeds a doubling is what matters most.

Thus, properly framed it is clear that the risk for lung cancer among non-smoking fire fighters more likely than not exceeds a doubling, based on the best available evidence.

Other Sites

Because of the large power in the study of Baris et al (2001), and because there is some past evidence of an association, colon cancer is worth considering to be added to presumption list. Overall, Baris and co-workers found a SMR of 1.51 (95% CI 1.18,1.93), based on 64 deaths; there was no consistent dose-response for duration of employment nor for cumulative number of runs. However the risks were greater than 1.00 for all three levels, 1.93 for low; 2.22 for medium and 1.22 for high number of runs. It is worth noting that an excess of colon cancer risk was reported by Guidotti, 1993; Howe and Burch, 1990; Schwartz and Grady, 1986; and Vena and Fiedler, 1987, who reported a significant SMR of 1.83. Thus, two studies, one in two out of three subgroups and the other in the population as a whole, have demonstrated relative risks close or equal to a doubling. There may now be sufficient evidence to consider colon cancer to be added to the presumption list for claims related to fire fighting.

As well, a similar case to that made above for nonsmoking fire fighters may be made for fire fighters with a low personal risk of colon cancer, such as vegetarians with no family history of polyps. If the risk is assumed to be 1.50 (as suggested in Guidotti, 1995), a similar but simplified calculation could be made depending on the magnitude of risk reduction that is assumed.

Conclusion

The evidence available since 1994 suggests that it is reasonable given the available scientific evidence to adopt a policy of presumption for brain cancer, bladder cancer, kidney cancer, testicular cancer, non-Hodgkins lymphoma (lymphatic cancer) and leukemia (haematopoietic cancer) for claims associated with occupation as a fire fighter, and for lung cancer among fire fighters who do not smoke. Colon cancer among fire fighters is also worth considering for addition to a presumption list. The presumption for brain cancer, bladder cancer, kidney cancer and testicular cancer are based firmly on a strong suggestion of an excess in the literature. The presumption for non-Hodgkins lymphomas and leukemias are based on the inference that within the overall category there are specific disorders for which the evidence suggests an elevated risk but it is not possible to discern which among several are in excess. The presumption for lung cancer among fire fighters who do not smoke is derived from a mathematical restatement of the problem which takes into account robust best estimates of risks for this subgroup.

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BCPFFA Delegate Briefing Notes

Towards a Firefighter/Cancer Occupational Disease Presumption

Highlights
(updated March, 2003)

- Firefighting is one of the most dangerous of all occupations, for obvious reasons – the demands of the job require the firefighter to move into dangerous situations rather than away from them.

- For this reason, in addition to the physical demands and dangers of their occupation, firefighters are continuously exposed in uncontrolled settings to an increasingly complex mix of toxic chemicals including many known and suspected carcinogens and mutagens.

- These include benzene and formaldehyde in wood smoke, PAHs in soots and tars, arsenic in wood preservatives, asbestos in building insulation, diesel engine exhaust, and dioxins.

- Firefighting is a career occupation: firefighters generally start young and remain until retirement. As a result, periodic intense exposures to carcinogens and toxins become prolonged over many years.

- It should not be surprising, then, that cancer is one of the leading causes of death in firefighters, and that there is a growing body of scientific and medical evidence associating an increased incidence of cancer with the occupation of firefighting.

- Recent expert epidemiological review of that evidence discloses that the risk of occurrence of certain types of cancers in firefighters is from one and a half to two times the risk of occurrence in the general population. Those types of cancer include brain cancer, bladder cancer, kidney cancer, testicular cancer, colon cancer, lymphatic cancer (including non-Hodgkin's lymphoma), myeloma and leukemia, and lung cancer in the non-smoker. This means that for every 10 firefighters diagnosed with those types of cancer, it is probable that occupational exposures caused the disease in as few as 3 and as many as 4 or 5.

- Because of the general nature of the epidemiological evidence, it is very difficult to prove which of the 10 cases was caused by occupational exposures.

- In some cases, an expert may be able to render an opinion that a particular firefighter diagnosed with a particular type of cancer, perhaps because of the

absence of certain non-occupational risk factors, had a risk that reached or exceeded double the risk in a member of the general population. In such a case, it can be said that the particular firefighter's cancer was as likely as not caused by occupation. Such an opinion meets the standard of proof required to establish a right to workers' compensation benefits for the firefighter or in a fatal case, the firefighter's surviving dependents. However, pursuing a claim on such a basis is very expensive and very time-consuming.

- As a result, a substantial number of firefighters with cancer are probably not receiving workers' compensation benefits even though the evidence demonstrates that 30% to 50% or more of such cases are occupationally caused.

- The purpose of a legislative or regulatory presumption is to deem a particular type of disease to have been occupationally caused in certain circumstances. This removes the need to produce the voluminous body of scientific and medical literature and expert opinion reports specific to the facts in each individual case. Firefighters are pressing to have certain cancer types deemed caused by their occupation, thereby substantially reducing the costs and delays currently encountered in pursuing such claims in the absence of a presumption.

- The WCB currently has the regulatory power to put such a presumption in place. The WCB's policy, however, is that such a presumption will not be established unless the weight of medical and scientific evidence establishes that the incidence of a particular disease in a particular occupation is double or more the incidence in the general population. Firefighters encountered this threshold difficulty in the WCB's recent repeal of the firefighters' heart presumption, which had been in place for more than 50 years: the WCB's repeal was based on scientific evidence that demonstrated a strong relationship between heart disease and the occupation of firefighting, but which fell short of quantifying the elevation of risk. It is now clear that at least a significant percentage of firefighters now suffering the effects of heart disease or heart attacks caused by their occupational stresses and exposures are not receiving workers' compensation benefits. Firefighters continue to support reinstatement of the firefighter heart presumption.

- Ironically, if the scientific evidence reaches the point of clearly demonstrating a doubling of risk, as required by the current policy of the WCB, a presumption would not be as necessary, as proof of the probability of a causal link would become relatively straightforward, much cheaper, and probably less time-consuming in any individual claim.

- We think that the Provincial Government has the responsibility and authority to rectify this situation, by legislation or regulation requiring a conclusive presumption of occupational cause in the case of a firefighter with brain

cancer, bladder cancer, testicular cancer, kidney cancer, colon cancer, lymphatic cancer (including non-Hodgkin's lymphoma), myeloma or leukemia, or lung cancer in a non-smoker.

- Ontario adopted presumptive firefighter cancer policies after receiving the 1994 IDSP report. Manitoba has recently enacted legislation that requires that a firefighter with brain, bladder, kidney or skin cancer or with blood-related cancers, including non-Hodgkin's lymphoma or leukemia have the benefit of a presumption that his occupation was the dominant cause of that disease. Alberta has very recently moved to enact affirmative presumptive legislation, and Saskatchewan has indicated that it will also do so. A significant number of states have also implemented such legislative presumptions, and more have such measures under consideration.

- The W.C.B. in British Columbia, in the absence of presumptive legislation or regulation, has been moving slowly to acceptance of the causal link between firefighting and the incidence of cancer. Since 1989, the WCB has accepted claims and implemented benefits for firefighters or their surviving dependents in four cases of brain cancer, two cases of kidney cancer, one case of colon cancer, two cases of skin cancer, and three cases of lymphatic cancer or leukemia. The need for presumptive legislation becomes more obvious when we point out that of those 12 firefighter cancer claims now accepted for benefits, 10 required two levels of appeal from initial WCB denials, one required one appeal, and only one was accepted at the initial claims adjudication level. The 11 cases that required appeals were expensive and took years to establish entitlement to compensation benefits.

- The time to enact and implement a firefighter cancer presumption is now. The evidence is strong, and all expectations are that scientific study will provide continuing and fuller support over time. Firefighters support immediate enactment of presumptive legislation.

- We have become aware that the WCB Core Review has recommended that benefits on accepted cancer claims be reduced to reflect non-occupational causes that may have been operating in conjunction with a significant occupational cause ("apportionment"). It is well accepted that the causes of cancer may be multi-factoral, that is, that multiple causes may operate together to cause the disease. In fact, the presence of more than one causative agent may cause a synergistic effect, i.e. the combined effect may be greater than adding together the individual effects. It is really unknown, however, how these combinations work, and for that matter, the mechanics of causation of cancer. However, it has always been one of the basic principles of workers' compensation that if an occupational factor constitutes a significant cause of an occupational disease (even if in combination with other causes), the consequences of the disease are fully compensable. Great injustice may be done to firefighters or their survivors should this proposal be

implemented. Firefighters strongly oppose the introduction of the concept of apportionment.

BCPFFA Delegate Briefing Notes

Towards a Firefighter/Cancer Occupational Disease Presumption

Briefing Paper and Further Information

October, 2002
(updated March 2003)

1. Firefighting is one of the most dangerous of all occupations, for obvious reasons – the demands of the job require the firefighter to move into dangerous situations rather than away from them. One of those dangers is exposure to carcinogens and the resulting increased risk of cancer in firefighters.

Exposure

2. It is well accepted that while detailed quantification of specific exposures may be impossible, firefighters are continuously exposed in uncontrolled settings to an increasingly complex mix of toxic chemicals, including many known and suspected carcinogens and mutagens.

3. These include benzene and formaldehyde in wood smoke, policyclic aromatic hydrocarbons (PAHs) in soots and tars, arsenic in wood preservatives, asbestos in building insulation, diesel engine exhaust, and dioxins, as well as aromatic amines, cadmium, and chlorinated hydrocarbons.

4. For an exhaustive listing of carcinogenic and toxic exposure potentials and sources, see the *Report to the Workers' Compensation Board (Ontario) on Cardiovascular Disease and Cancer Among Firefighters*, IDSP Report No. 13, September 1994, which includes, alphabetically: acroleins, acrylonitrile, asbestos, benzene, carbon monoxide/dioxide, chloroform, diesel exhaust (containing PAHs, benzene, formaldehyde, etc.), formaldehyde, halons, hydrogen chloride, hydrogen cyanide, nitrogen dioxide, organic solvents, PAHs (polycyclic aromatic hydrocarbons), soots, and vinyl chloride (**Appendix A**)[1].

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[1] See also, for example: *An Epidemiological Study of Cancer and Other Causes of Mortality in San Francisco Firefighters*, AJIM 19:357-372, 1991, Beaumont et al, at pp. 357-9; *Evaluation of the Risk of Cancer among Fire Fighters*, June 1999, Michigan Environmental Science Board, attachment 3; *Colon Cancer and Forest Firefightings*, January 1999, WCB of British Columbia, Demers, at pp. 3-7; *Cohort Mortality Study of Philadelphia Firefighters*, AJIM 39:463-476, 2001, Baris et al, at pp.463-4.

5. While the use of asbestos as an insulation material has decreased in recent years, there has been an increase in the use of synthetic building materials which raise additional levels of exposures and risk - the combustion of PVC materials, for instance, releases a range of toxic substances, including cyanide.

6. The exposures are often simultaneous to multiple carcinogens, which raises additional risk given concerns about the synergistic effects of toxic substances (i.e. the combined effect of exposure to more than one carcinogen may be multiplied beyond the combined effect of each separate exposure)[2].

7. The levels of exposures are certainly higher than in the general population, and the use of personal protective equipment is not a full answer to the problem. For instance, while the use of positive pressure SCBA may be effective during knockdown, the masks are often not used during parts of overhaul and cleanup, during which some of the more toxic releases and exposures occur, nor does SCBA protect against non-inhaled exposures.[3]

8. It should be noted that because of the sometimes lengthy latency periods[4] involved in many types of cancer, the decrease in use of a particularly dangerous substance, such as asbestos, does not translate to its lack of involvement in causing cancer for a very long time. Exposures to carcinogens may not result in a diagnosable cancer for as many as 15 to 20 years in some cases.

9. Consequently, we will be dealing with the implications of asbestos exposures for years to come. Similarly, increased use of personal protective equipment in recent years, even if effective to prevent carcinogenic exposures, will not correspond to a decreased incidence of occupational cancers for some time.

10. As an example, the Appeal Division of the WCB recently concluded that an urban fire inspector and investigator had come into contact with a number of

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[2] *An Epidemiological Study of Cancer and Other Causes of Mortality in San Francisco Firefighters*, AJIM 19:357-372, 1991, Beaumont et al,at p.358

[3] See, for example: *Evaluation of the Risk of Cancer among Fire Fighters*, June 1999, Michigan Environmental Science Board

[4] Latency is the elapsed time between first exposure to a carcinogen and the clinical manifestation of the disease caused by that exposure. This latency period can be lengthy because of the time that cells may remain dormant after genetic alteration through the exposure, prior to becoming cancerous, and the additional time that may elapse before the spread of the cancer results in symptoms and diagnosis. The latency period for a range of brain cancers may be from five to twenty years, for bladder cancers from ten to fifteen years, for kidney cancers from fifteen to twenty years. Lymphomas (non-Hodgkin's) have long latencies; leukemias, short latencies (five years or so). These are rough figures, however, arising from variable results of the studies.

carcinogenic substances (such as coal tar products, arsenic compounds and cutting oils) on an intermittent but prolonged basis in the course of his 18-year career both in combing through the remnants of fires and in inspecting freshly installed sprinkler systems, and that his skin cancer was therefore compensable.

11. Firefighting is a career occupation: firefighters generally start young and remain until retirement. As a result, periodic intense exposures to carcinogens and toxins become prolonged over many years. In most instances, officers' exposures at fire and accident scenes are similar to those of regular members.

12. It should not be surprising, then, that cancer is one of the leading causes of death in firefighters, and that there is a growing body of scientific and medical evidence associating an increased incidence of cancer with the occupation of firefighting.

The Scientific and Medical Evidence

13. There is a growing body of medical and scientific evidence of a strong causal association between the occupation of firefighting and a number of specific types of cancers. Tee Guidotti's 1991 study of Alberta firefighters demonstrated increased risks of malignant neoplasms, genito-urinary, renal, and colo-rectal cancers, as well as for leukemias, lymphomas, and myelomas[5].

14. The Ontario Industrial Disease Standards Panel reported to the Ontario WCB on its extensive review of the literature in September, 1994, concluding that presumptive relief should be put in place with respect to firefighters with brain, lymphatic or haematopoietic (leukemias) cancers, on the basis that the evidence showed a probable connection between those cancers and firefighting. The IDSP also concluded that the evidence also demonstrated a probable connection between colon, bladder and kidney cancers and the occupation of firefighting[6].

15. Baris' 2001 study of Philadelphia firefighters demonstrated statistically significant excess risks for colon cancer, and for firefighters with more than 20 years of service, increased risks of mortality for colon cancer, kidney cancer, non-Hodgkin's lymphoma, and multiple myelomas.

16. Guidotti's 2002 report to the Manitoba Workers' Compensation Board concluded that it would be reasonable on the available scientific evidence to

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[5] *Mortality of Urban Firefighters in Alberta*, AmJEp 1990; 123:1039-1050

[6] *Report to the Workers Compensation Board (Ontario) on Cardiovascular Disease and Cancer Among Firefighters*, IDSP Report No. 12, September 1994.

enact presumptive relief for firefighters with brain cancer, bladder cancer, kidney cancer, non-Hodgkin's lymphoma (lymphatic cancer) and leukemia (hematopoietic cancer).

17. Recent expert epidemiological review of that evidence discloses that the risk of occurrence of certain types of cancers in firefighters is from one and a half to two times the risk of occurrence in the general population. Those types of cancer include brain cancer, bladder cancer, kidney cancer, colon cancer, lymphatic cancer, including non-Hodgkin's lymphoma, and leukemia. This means that for every 10 firefighters diagnosed with those types of cancer, it is probable that occupational exposures caused the disease in as few as three and as many as four or five.[7]

18. If anything, these risk estimates are probably low. Because of the phenomenon of dilution of data, studies often underestimate the risk in the firefighter population[8]. There is a further underestimation of risk because firefighters are often healthy when hired and healthy and active when working and therefor at a less than normal risk to begin with (this is known as the "healthy worker effect", or "HWE", in the scientific literature). In addition, because of statistical confidence limits, an increase of risk of 1.7 is really indistinguishable from a risk of 2.0[9].

19. Dr. Guidotti, a leading specialist in occupational medicine and epidemiology, has recently prepared a detailed report for the British Columbia Professional Fire Fighters Association: *"Evaluating the Association Between Selected Cancers and Occupation as a Fire Fighter,"* March 26, 2003 (**Appendix "B"**). On the basis of his review of the historical and current medical and scientific evidence, Dr. Guidotti makes the following conclusions:

    - **"Evidence available since 1994 suggests that it is reasonable given the available scientific evidence to adopt a policy of presumption for brain cancer, bladder cancer, kidney cancer, testicular cancer, non-Hodgkins lymphoma (lymphatic cancer) and leukemia (haematopoietic cancer) for claims associated with occupation as a fire fighter."**

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[7] Epidemiologists often refer to "SMR", or standardized mortality ratio, to express an estimate of the ratio of deaths among an occupational group from a particular disease to the number of deaths expected in the general population from that same disease, in the same time frame. An SMR of 2.0 for a particular disease equates to an estimate of the risk of death from that disease for a member of a particular group of two times that of a member of the general population. For instance, the Baris study found an SMR of 1.51 for colon cancer for Philadelphia firefighters, and for those firefighters with more than 20 years' service, SMRs of 1.68 for colon cancer, 2.20 for kidney cancer, 1.72 for non-Hodgkin's lymphoma, and 2.31 for multiple myeloma.

[8] For instance, see Guidotti, 2002, at pp. 4 – 5.

[9] In discussing SMRs, we have to also acknowledge that uncertainties of scientific evidence (margin of error) mean that "an SMR of 1.7 is usually indistinguishable statistically from one of 2.0" (see Guidotti, 2001, Report to Manitoba WCB, at p. 8).

- **"...it is reasonable to establish a presumption for lung cancer among fire fighters who do not smoke cigarettes."**

- **"Colon cancer among fire fighters is also worth considering for addition to a presumption list."**

The Case for Presumptive Firefighter/Cancer Legislation

20. In the absence of presumptive assistance, because of the general nature of the epidemiological evidence, it remains very difficult to prove which of 10 cases of cancer was caused by occupational exposures, i.e. that any individual firefighter with such a cancer is entitled to workers' compensation.

21. In some cases, an expert may be able to render an opinion that a particular firefighter diagnosed with a particular type of cancer, perhaps because of the absence of certain non-occupational risk factors, had a risk that reached or exceeded double the risk in a member of the general population. In such a case, it can be said that the particular firefighter's cancer was as likely as not caused by occupation. Such an opinion meets the standard of proof required to establish a right to workers' compensation benefits for the firefighter or in a fatal case, the firefighter's surviving dependents. However, pursuing a claim on such a basis is very expensive and very time-consuming.

22. As a result, a substantial number of firefighters with cancer are probably not receiving workers' compensation benefits even though the evidence demonstrates that 30% to 50% or more of such cases are occupationally caused.

23. The purpose of a legislative or regulatory presumption is to deem a particular type of disease to have been occupationally caused in certain circumstances[10]. This removes the need to produce the voluminous body of scientific and medical literature and expert opinion reports specific to the facts in each individual case. **Firefighters are pressing to have certain cancer types deemed caused by their occupation**, thereby substantially reducing the costs and delays currently encountered in pursuing such claims in the

[10] A presumption dictates application of an assumption that a particular disease was caused by occupational exposures, even where the actual evidence indicates that not all incidences of that disease in that occupation are in fact caused by such exposures. We know that while the incidence of certain types of cancer in firefighters is significantly elevated from the incidence of those cancers in the general population, that does not mean that all firefighters diagnosed with those types of cancer had their cancer caused by occupational exposures. However, the basis for the presumption is the elevation of risk coupled with the understanding that we cannot tell which firefighter with that type of cancer had it occupationally caused.

absence of a presumption, and ensuring that all firefighters with occupationally caused cancers (or the surviving members of their families in fatal cases) receive the benefits to which they should be entitled.

24. In British Columbia, the WCB currently has the regulatory power to put such a presumption in place. The WCB's policy, however, is that such a presumption will not be established unless the weight of medical and scientific evidence establishes that the incidence of a particular disease in a particular occupation is double or more the incidence in the general population.

25. Firefighters encountered this threshold difficulty in the WCB's recent repeal of the firefighters' heart presumption, which had been in place for more than 50 years: the WCB's repeal was based on scientific evidence that demonstrated a strong relationship between heart disease and the occupation of firefighting, but which fell short of quantifying the elevation of risk. It is now clear that at least a significant percentage of firefighters now suffering the effects of heart disease or heart attacks caused by their occupational stresses and exposures are not receiving workers' compensation benefits. **Firefighters continue to support reinstatement of the firefighter heart presumption**.

26. Ironically, if the scientific evidence reaches the point of clearly demonstrating a doubling of risk, as required by the current policy of the WCB, a presumption would not be as necessary, as proof of the probability of a causal link would become relatively straightforward, much cheaper, and probably less time-consuming in any individual claim.

27. In a recent decision, a panel of the Appeal Division of the WCB has recognized that quasi-judicial decisions concerning causation require a lower level of technical proof than is sought in matters of science (and that a relative risk of occupational disease of less than 2.0 may nonetheless be persuasive in determination of compensation entitlements in a particular case)[11]. The strict scientific standard imposed by the WCB as a threshold to consideration of presumptive relief is too strict, and is resulting in injustice to firefighters and their dependents.

28. We believe that **the Provincial Government has the political and social responsibility and authority to rectify this situation, by legislation or regulation requiring a conclusive presumption of occupational cause in the case of any firefighter with brain cancer, bladder cancer, kidney cancer, testicular cancer, colon cancer, lymphatic cancer (including non-Hodgkin's lymphoma), myeloma, or leukemia, or lung cancer in a**

[11] Appeal Division Decision No. 2002-2499 (W.C.B. of B.C.)

non-smoker[12]. Strong support lies in Dr. Guidotti's recent report to the BCPFFA.

29. This proposal is not novel. Ontario adopted presumptive firefighter cancer policies after receiving the 1994 IDSP report. As outlined above, the evidence in support of that action has become stronger in the following years.

30. Manitoba has recently enacted legislation that requires that a firefighter with brain, bladder, kidney or skin cancer or with blood-related cancers, including non-Hodgkin's lymphoma or leukemia have the benefit of a presumption that the occupation of firefighting was the dominant cause of that disease (see **Appendix "C"**).

31. A significant number of states have also implemented such legislative presumptions, and more have such measures under consideration. It appears that at least 26 U.S. states apply presumptions in varying forms to firefighter cancer claims. These include Alabama, California, Illinois, Massachusetts, Minnesota, Nebraska, Nevada, New Hampshire, New Jersey, North Dakota, Oklahoma, Rhode Island (with general cancer presumptions), Maryland, Virginia and Arizona (with presumptions covering a broad range of cancer types), as well as Louisiana, Oregon, Pennsylvania, Washington, Missouri, Wisconsin, South Carolina, Michigan, Maine, Hawaii, Iowa and Tennessee (with presumptions apparently limited to lung and respiratory diseases, including lung cancer). In 1999, California relaxed the limited onus of proof on firefighters. Most recently, Arizona enacted presumptive legislation in 2001 specific to brain, bladder, rectal, colon, lymphoma, leukemia and lung cancers. Iowa and Pennsylvania have legislation pending, as does the U.S. federal government (see **Appendix "D"**).

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[12] In other words, there is a political issue beyond the medical and scientific and common sense issues. If the increase in risk for a firefighter is at 2.0 times the risk for the general population, then for every 2 firefighters with the specific disease, we can say with some certainty that one of them resulted from an occupational cause, and the other not. Statistically, we cannot say which is which. This leads to the conclusion that it is at least as likely as not that each of them have a disease caused occupationally, which is the test for workers' compensation coverage. In other words, both will be covered.

If the increase in risk is less, i.e. only 1.5 times the risk for the general population, we can say with some certainty that for every 3 firefighters with the disease, 1 had the disease caused by occupational exposures and 2 did not. Again, we cannot say which one has an occupational disease and which two do not. We do know, however, that over time and on average, 1 out of 3 firefighters with that disease had the disease caused by occupation. Nonetheless, on the basis of the WCB Policy Bureau's view, none of those 3 firefighters should receive compensation.

Politically, it is quite arguable that a fair workers' compensation system should compensate all 3 firefighters, even knowing that this amounts to over-compensation, i.e. 2 out of 3 did not have their disease caused by their occupation. Is this over-compensation politically justifiable on the grounds that 1 out of the 3 did? It is considered to be so where 1 out of 2 did – there is no particular reason why this is not so for a somewhat lower risk.

32. In February, 2003, the Government of Alberta moved to enact legislation similar to Manitoba's, providing for a statutory presumption in favour of occupational cause in the case of firefighters with brain cancer, bladder cancer, kidney cancer, non-Hodgkin's lymphoma, and leukemia, and made that legislation retroactive to cases arising since 1993 (see **Appendix "E"**).

33. On March 18, 2003, the Throne Speech opening the current session of the Saskatchewan Legislature contained the following paragraph, in reference to occupational cancers in firefighters:

> **"A number of studies have documented that professional firefighters can experience higher rates of particular diseases as an occupational hazard. The government agrees with the Saskatchewan Professional Fire Fighters Association that an amendment to *The Workers' Compensation Act* is warranted to ensure such diseases are covered under the Act."**[13]

34. The W.C.B. in British Columbia, in the absence of presumptive legislation or regulation, has been moving slowly to acceptance of the causal link between firefighting and the incidence of cancer. Since 1989, the WCB has accepted claims and implemented benefits for firefighters or their surviving dependents in four cases of brain cancer, two cases of kidney cancer, one case of colon cancer, two cases of skin cancer, and three cases of lymphatic cancer or leukemia.

35. The need for presumptive legislation becomes more obvious when we point out that of those 12 firefighter cancer claims now accepted for benefits, 10 required two levels of appeal from initial WCB denials, one required one appeal, and only one was accepted at the initial claims adjudication level. The 11 cases that required appeals were expensive and took years to establish entitlement to compensation benefits.

36. The time to enact and implement a firefighter cancer presumption is now. The evidence is strong, and all expectations are that scientific study will provide continuing and fuller support over time. **Firefighters urge immediate enactment of presumptive firefighter/cancer legislation, with retroactive effect**.

"Apportionment"

37. On a related issue, we have become aware that the WCB Core Review has recommended that benefits on accepted cancer claims be reduced to reflect

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[13] *Speech from the Throne, 2003, Delivered on the Occasion of the Opening of the Fourth Session of the Twenty-Fourth Legislature Province of Saskatchewan*, Tuesday, March 18, 2003, Hon. Lynda Haverstock, Lt. Gov. of Saskatchewan: (http://www.executive.gov.sk.ca/pdf_documents/throne_speeches/Mar03TSEng.pdf)

non-occupational causes that may have been operating in conjunction with a significant occupational cause ("apportionment").

38. It is well accepted that the causes of cancer may be multi-factoral, that is, that multiple causes may operate together to cause the disease. In fact, the presence of more than one causative agent may cause a synergistic effect, i.e. the combined effect may be greater than adding together the individual effects.

39. It is really unknown, however, how these combinations work, and for that matter, the mechanics of causation of cancer. However, it has always been one of the basic principles of workers' compensation that if an occupational factor constitutes a significant cause of an occupational disease (even if in combination with other causes), the consequences of the disease are fully compensable.

40. Great injustice may be done to firefighters or their survivors should this proposal for apportionment and reduction of benefits be implemented. **Firefighters strongly oppose the introduction of the concept of apportionment**.

APPENDIX "A"

Extracts from:

REPORT TO THE WORKERS' COMPENSATION BOARD ON CARDIOVASCULAR DISEASE AND CANCER AMONG FIREFIGHTERS

SEPTEMBER, 1994

Industrial Disease Standards Panel
IDSP Report No. 13
Toronto, Ontario

CHAPTER 3.
THE EVIDENCE

a) About firefighting

Fire protection in Ontario is a municipal responsibility. As of 1986 (when the most recent figures were available to the Panel), 706 of the approximately 800 municipalities in Ontario operated 656 fire departments. Those Departments employed 9,127 full-time and 16,994 part-time (volunteer) firefighters, for a total of 26,121.

Table 1 shows the number of fires, other calls, firefighter injuries and line-of-duty deaths from 1983 to 1989 in each municipality included in the IDSP study. ***It is important to note that firefighters' illnesses and deaths which were caused by diseases are not included in Table 1.*** It is clear, however, that some municipalities responded to many more actual fires than others [135, 136].

There are two main phases of firefighting. The process of extinguishing the main fire is called the "knockdown" phase. The "overhaul" phase involves searching for and extinguishing hidden fires.

Self-contained breathing apparatus (SCBA) were introduced in the last 20 years or so [60]. SCBA includes a pressurized bottle of air carried on the firefighter's back. A hose leading from the air tank feeds clean air into a mask covering the face. Because of its "positive pressure", any leaks flow *out* from the mask, rather than allowing contaminated outside air to enter the mask. When used properly, SCBA provides very effective, but not complete, protection from carbon monoxide and other chemical exposures [101, 94].

Most SCBA provides oxygen for thirty minutes [61]. Since firefighters must allow about ten minutes to get out of a burning building in order to change air tanks, and since the air supply is consumed more quickly during heavy exertion, each tank effectively provides only 15 minutes' breathing protection. The firefighters' representatives explained that there is often an inadequate number of air tanks available to them at fire sites. They said that, in recent years, Toronto fire departments have been equipped with compressors which produce air for refilling used tanks, but that these are rarely if ever available to firefighters who work outside Metropolitan Toronto.

SCBA were as generally under-utilized or used inconsistently in many fire departments until the 1980's [59]. The firefighters' representatives advised the

Panel that in recent years most of them use SCBA during the knockdown phase. Once the main fire has been extinguished, it *appears* that the danger has been reduced and firefighters often remove their SCBA because it is heavy, hot and cumbersome [19]. Its use actually *interferes* with breathing, particularly during strenuous work [102] and even moreso when the tank's air supply has been reduced to 30% of capacity [110]. Regular use of SCBA is particularly difficult under extreme weather conditions [59].

Firefighters who remove their SCBA during overhaul work could suffer the most dangerous exposures [60]. Researchers who have measured carbon monoxide levels in blood (carboxyhemoglobin) report that intermittent use of SCBA offers as little protection as no use at all [94, 95, 60].

It is estimated that 80% of firefighters' injuries are due to smoke inhalation or oxygen deficiency and that over 50% of line-of-duty deaths are due to smoke exposures [60].

Smoke is a suspension of carbon particles in air and in other gases [166]. *All* smoke is hazardous and is potentially lethal at high enough concentrations. The degree of hazard depends on the chemistry and quantity of gases, concentrations reached, size of particulate, solubility of gases and duration of exposure [60].

Particulates become adsorbed (coated) with chemicals in smoke and carry those chemicals deeper into the lungs during active firefighting than they would during normal, less strenuous activities. The heavy exertion demanded by fighting a fire causes more rapid and deeper breathing which increases delivery of toxins to deep within the lungs [60].

Carbon monoxide is a by-product of *all* fire and is one of the most hazardous chemical exposures encountered by firefighters. Since carbon monoxide is odourless, colourless and tasteless, the amount present at a fire site cannot be judged by the firefighter. There is no correlation between the apparent intensity of smoke and the amount of carbon monoxide in the air [60, 94, 95].

Other dangerous products of combustion also continue to be chemically reactive after the main fire has been extinguished and they continue to form additional chemical substances [60, 30]. For example, one of the fuel components of upholstery, wire, pipe coating and wall, floor and furniture coverings is polyvinyl chloride. When these materials are burned, Hydrogen chloride and phosgene are produced as decomposition products [60].

Synthetic materials, such as polyethylene and polyvinyl chloride, have been widely used since the 1950's in furniture and building construction [60].

These substances are often more dangerous when they are smouldering than in high heat. In addition to carbon monoxide [41], synthetic materials cause large numbers of other hazardous chemicals, such as hydrogen cyanide and hydrochloric acid, to be present at fire sites [60, 40, 83, 210]. Moreover, concrete retains heat and gasses, acting like a sponge, then releases toxic fumes as cooling takes place and for long after the fire has been extinguished [60, 40].

- **Chemical hazards of firefighting**

Fire smoke has so far not been well characterized [119]. The chemicals present at fire sites are extremely variable depending upon the type of fire and local physical conditions [60]. As their representatives told the Panel, firefighters can be exposed to a myriad of substances in unknown quantities, which are heated and mixed together [114]. The synergistic effects of these substances are unknown.

In this Report, the Panel has focused on those chemicals which have been identified at fire sites and for which there is evidence of a potential link with cardiovascular disease or cancers. The chemicals discussed below,

- were measured in studies of actual fires as reviewed by McDiarmid and colleagues [112];
- were reported to be present in a subsequent survey of the fire environment by Jankovic et al. [82]; or
- were included in two toxicological reviews prepared for the Panel [20, 199].

The following discussion summarizes the reported levels of these chemicals at fire sites and includes, for comparison purposes, a brief description of their current Ontario exposure limits. (In some cases the exposure limits are too detailed to be included in the text of this report and the reader should consult the appropriate Regulation.) The Ontario Ministry of Labour's bipartite Occupational Exposure Limits Task Force conducted a review of the current exposure limits and has recommended lowering all of the current limits listed below [137].

Most of the limits given below are Short-Term Exposure Values (STEV) or Ceiling Exposure Values (CEV). The STEV is a 15-minute time-weighted average concentration which may not be exceeded at any time during a workday, while a CEV is the maximum airborne concentration of a chemical to which a worker may be exposed at any time during a workday.

It should be noted that an STEV is set on the basis of preventing the acute adverse effects which have been observed in humans or animals after high

short-term exposures. Thus, comparisons between firefighters' exposures and STEVs or CEVs may have little significance in estimating the risk of long-term health effects such as cancers and chronic cardiovascular diseases.

Where an STEV or CEV is not available, a Time-Weighted Average Exposure Value (TWAEV) may be mentioned instead. A TWAEV is the average airborne concentration of a chemical agent to which a worker may be exposed in a workday or work week.

In most cases, a comparison between airborne contaminant measurements at a fire site and a TWAEV is inappropriate because of firefighters' relatively short period of exposure to airborne contaminants at most fires.

Several of the chemicals mentioned below (i.e. acrylonitrile, benzene, asbestos and vinyl chloride) are also regulated as designated substances in Ontario. This means that permissible exposure levels, methods of use and control in the workplace are specifically prescribed by Regulation.

The Panel's work has been aided by critical reviews and evaluations conducted by the International Agency for Research on Cancer. IARC has used its unique international position to develop a system for classification that has been praised for the elegant scientific criteria used for selecting and evaluating published evidence on cancer. IARC is widely recognized as an authoritative source of information on the carcinogenicity of chemicals and complex exposures. For a detailed description of the IARC criteria, please see Appendix A.

IARC's programme, initiated in 1971, relies on international working groups of scientists expert in the particular area under investigation. Information is analyzed from animal studies, other relevant biological data, and case reports and epidemiologic studies in humans. The working group then makes an overall evaluation of the carcinogenicity of the particular agent to humans and the substance is designated as falling within one of four main IARC groupings as listed below.

Group 1	*The agent is carcinogenic to humans.* There is **sufficient evidence** of carcinogenicity in humans. A causal relationship has been established between exposure to the agent and human cancer.
Group 2A	*The agent is probably carcinogenic to humans.* This category is used when there is **limited evidence** of carcinogenicity in humans and **sufficient evidence** in experimental animals.
Group 2B	*The agent is possibly carcinogenic to humans.* This category is generally used when there is **limited evidence** in humans in the absence of **sufficient evidence** in experimental animals.
Group 3	*The agent is not classifiable as to its carcinogenicity to humans.* This category is used for agents that do not fall into any other group.
Group 4	*The agent is probably not carcinogenic to humans.* This category is used for agents for which there is evidence suggesting lack of carcinogenicity in humans together with evidence suggesting lack of carcinogenicity in experimental animals.

The Panel wishes to emphasize that the following alphabetical list is far from being an exhaustive list of firefighters' potential exposures.

Acrolein

Acrolein is present in most fires as a combustion product of wood, cotton, carpeting and upholstery [60]. Its vapour may also be found at fire sites where acrolein is stored and used for the manufacturing of products such as metals, plastics, perfumes and methyl chloride refrigerants [20].

In a study of various building fires, 56% of the measurements reported for airborne acrolein were above 3 ppm (ranging from below detection to 98 ppm) [198]. These measurements exceed the STEV of 0.7 ppm (0.3 mg/m3) for airborne acrolein by at least four times [143].

A later study of various types of fires reported lower levels during different phases of firefighting, ranging from not detectable to 3.2 ppm in the knockdown phase and 0.2 ppm in the overhaul phase [82]. The study also showed that significant exposure to acrolein could occur amongst firefighters even with the use of self-contained breathing apparatus since levels as high as 0.9 ppm were measured in air samples collected from inside the masks of these devices worn by firefighters at fire sites.

Acrolein is a severe eye and respiratory tract irritant. It has also been shown to interfere with lung function in animals [20]. The carcinogenicity of acrolein has not been well investigated and, according to IARC, the evidence in both humans and animals is inadequate (Group 3). One of its metabolites, glycidaldehyde, is considered to be carcinogenic [79].

Acrylonitrile

Acrylonitrile is a flammable liquid used in the manufacture of acrylic fibres and various rubber products. At fire sites, firefighters can be exposed to vapours from heated acrylonitrile or from the combustion of products in which acrylonitrile is an ingredient [12].

Acrylonitrile is irritating to the skin, eyes and respiratory tract. It is metabolized to form cyanide which inhibits respiratory enzymes and can cause death [154].

Systemic effects are non-specific but may include the central nervous system (headache and nausea) and hepatic (liver dysfunction), renal, cardiovascular and gastrointestinal (diarrhoea and vomiting) systems [154].

particularly in lung and prostate cancers [176]. IARC classifies acrylonitrile as Group 2A, probably carcinogenic in various cancers such as lung, prostate, stomach, colon, brain, lymphatic and haematopoietic system [79].

Acrylonitrile is a "designated substance" in Ontario. The conditions under which most workers may be exposed to it are set out in Ontario Regulation 733/84 under the *Occupational Health and Safety Act* [145].

Asbestos

Because of its insulating qualities, asbestos has been widely used in building materials for residential, commercial and industrial settings [160]. Therefore, asbestos fibres are likely to be present in a wide variety of fires.

In a 1990 study of 226 metropolitan New York firefighters, almost all of whom had worked as firefighters for at least twenty years, forty-nine percent had abnormalities on chest x-ray that are characteristically caused by prior exposure to asbestos. It was concluded that firefighters are at risk for scarring of the lungs and pleura due to occupational asbestos exposure. It was thought that much of that exposure occurred during the overhaul phase of firefighting [107].

It is clearly established that asbestos causes mesothelioma and lung cancer in humans [160, 76]. IARC has classified asbestos as a Group 1 carcinogen for which the evidence is sufficient [79]. The Panel has previously reported that it can also cause laryngeal and gastrointestinal cancers [77, 160]. It is also carcinogenic to animals [79].

Asbestos is a designated substance in Ontario. Regulations limit most workers' exposure to asbestos in workplaces, construction projects and in buildings and repair operations [142, 143].

Benzene

Benzene may be present at fire sites where it is being used as an ingredient for the manufacture of various products (e.g. medicinal chemicals, dyes, artificial leather, linoleum, oil cloth, varnishes and lacquers) and as a solvent for waxes, resins and oils [20]. It is also a common decomposition product of many organic materials.

After carbon monoxide, benzene is generally the second most commonly found organic constituent of fire smoke, typically present in high concentrations in the fire environment [19]. Mean airborne concentrations ranging from 28-63 ppm of benzene were measured from grab samples collected at various content/building or car fires. These concentrations were two to four times Ontario's current maximum allowable concentration of 15 ppm at any time [144]. The measurements from individual air samples were

as high as 16 times this maximum allowable concentration (ranging from not detectable to 250 ppm). These findings are similar to previous reports of benzene measurements at fire sites which reached levels greater than 150 ppm [198].

A more recent study showed that firefighters could be highly exposed to benzene even with the use of self-contained breathing apparatus. Levels as high as 21 ppm were measured from air samples collected from inside SCBA masks worn at fire sites [82].

In addition to its irritative and narcotic effects, benzene damages the bone marrow resulting in reduced red and white blood cells and platelets. This can lead to anemia, susceptibility to infection and clotting disorders [20]. It is also known to produce both non-malignant tumours and leukaemia in rats and cause mutation and DNA damage in rodent cell cultures [79].

IARC has classified benzene as Group 1, for which there is sufficient evidence of carcinogenicity to humans (causing several types of leukaemia) and to animals (causing cancer of multiple sites). It has also produced both non-malignant tumours and leukaemia in rats and caused mutation and DNA damage in rodent cell cultures. Lymphoid cancer has been induced in mice by inhalation of benzene [79].

Benzene is a designated substance in Ontario [144].

Carbon monoxide/dioxide

Carbon monoxide and carbon dioxide are common occupational exposures of firefighters because they are natural products of combustion and are necessarily present at every fire. There are very different health effects associated with exposure to these chemicals either separately or combined..

Mean carbon monoxide concentrations measured from grab samples ranged from 22.7 ppm (auto fire), 235 ppm (content fires) to 272 ppm (building fires) [19], all of which were well below the current Ontario STEV of 400 ppm; however, a much higher mean of 500 ppm was reported in another study [5]. The difference may be due to the nature and intensity of the fires studied, as well as the sampling duration and location selected.

Studies using rats exposed to varying concentration ratios of carbon monoxide and carbon dioxide showed that carbon monoxide in the presence of 5% carbon dioxide is twice as toxic as carbon monoxide alone. Apparently, carbon dioxide increases the absorption of carbon monoxide and prolongs its effects [30].

Unlike carbon monoxide, carbon dioxide is a simple asphyxiant. It is also considered a potent stimulus to respiration, as well as being both a depressant and an excitant of the central nervous system [154].

No mean concentration was reported for carbon dioxide in any of the available studies. Grab sample measurements reported in several studies ranged from below 1,000 ppm to 60,000 ppm (a difference of at least 60 times), the latter being twice the STEV of 30,000 ppm for carbon dioxide. However, such levels may be uncommonly high for carbon dioxide at most fires. A recent study of various fires reported carbon dioxide levels to be 300-5410 ppm during the knockdown phase and 130-1420 ppm in the overhaul phase [82].

When inhaled, carbon monoxide is quickly absorbed into the blood stream and binds with red blood cells to form carboxyhemoglobin. This complex displaces oxygen on red blood cells by a factor of 200 times and interferes with the transfer of essential oxygen to body tissues [60, 205, 222]. Carbon monoxide is directly toxic to the heart [20] and may be involved in the development of atherosclerosis [222]. Atherosclerosis may predispose an individual to aortic aneurysm [158].

Mean carboxyhemoglobin levels of about 4% were measured in non-smoking firefighters exposed to carbon monoxide concentrations as low as 200-1000 ppm [55]. These levels approach those in smokers (5-7%) who consume an average of 1.5 packs of cigarettes per day [180].

The maximum concentration of carbon monoxide in samples measured typically exceeded 1,000 ppm [19, 53, 82] and sometimes reached potentially lethal levels of 3,000 ppm [5] to 5,000 ppm [198]. Levels measured during the knockdown phase (up to 1900 ppm) were substantially higher than during the overhaul phase (up to 82 ppm) [82].

Carbon monoxide may also worsen the damage to hearing caused by noise [46, 223]. Occupational hearing loss among firefighters will be discussed in detail in a subsequent Panel Report.

Chloroform (trichloromethane)

Chloroform may be found as a constituent of solvents and as a decomposition product of organic materials in fires.

Chloroform has been quantified in the fire environment, but at relatively low concentrations [112].

It is known as a skin and eye irritant [20], a central nervous system depressant and a cause of liver and kidney damage [149]. Cardiovascular and carcinogenic effects in humans are generally not known. However, IARC did report sufficient evidence that chloroform is carcinogenic to animals (Group

2B), causing cancers of the liver and kidney [79]. This substance can also cause genetic damage and is a reproductive toxin in rodents [20].

Diesel exhaust

Diesel exhaust is a complex mixture which includes polycyclic aromatic hydrocarbons (PAHs), benzene, formaldehyde, etc. There is to date no single exposure standard or guideline available for diesel exhaust exposure. The combined particulate fraction of diesel exhaust is usually determined as total particulates and as methylene chloride extract of the total particulate fraction. The latter is used as an indicator of the content of PAHs.

A survey of 23 Ontario fire stations concluded that firefighters may be significantly exposed intermittently to diesel exhaust in the fire station from the operation of diesel-powered vehicles. Carbon monoxide levels were used as a marker for diesel exhaust concentration. For purposes of comparison, carbon monoxide concentration was measured directly from the vehicle exhaust and averaged about 200 ppm (ranging from 60 to 750 ppm). Carbon monoxide levels were found to be less than 5 ppm (background level) in the fire stations but were higher than 50 ppm (up to 120 ppm) on the apparatus floor when vehicles were started or returned to the station. Levels as high as 33 ppm were measured in the living quarters of the fire station during these two periods [97].

In most cases, carbon monoxide measured on the apparatus floor decreased to levels below 10 ppm within ten minutes after reaching peak concentration. This was largely attributed to the different types of control measures used in fire stations, such as mechanical tailpipe exhaust, structural barriers, natural and mechanical ventilation, and pole hole location [97].

A union representative of firefighters advised the Panel that in some fire stations, it is common practice to regularly start the vehicle engines while they are inside the station to ensure that they are in working order. Diesel exhaust exposure could also be significant when, for example, only one vehicle in a multi-vehicle station responds to a call. In such a circumstance, the vehicle is started indoors and those firefighters who remain in the station are exposed. The Panel was advised that the walls and floors in most fire stations are washed every year, but in some cases the walls become "black" with diesel exhaust particulate within about six months. Most but not all urban stations have adequate separation between living quarters and the apparatus floor [28].

IARC has classified diesel engine exhaust as probably carcinogenic to humans, particularly in the cases of lung and bladder cancers (Group 2A). It reports sufficient evidence that diesel exhaust causes lung cancer in animals [80].

Formaldehyde

Formaldehyde is used in the manufacture of resins, textiles, embalming fluids, fungicides, air fresheners [20], plastics, adhesives, wood products, insulation, paints, leather and rubber [164]. It may therefore be present as a decomposition product in fires involving such materials.

Brandt-Rauf (1988) studied different types of fires and reported mean (grab sample) formaldehyde concentrations of 0.8 ppm and 0.5 ppm in the air at content fires and building fires, respectively. Airborne formaldehyde was not detected in the automobile fires observed. These means are two to four times below Ontario's STEV of 2 ppm for formaldehyde in workplace air, although levels as high as 3.3 ppm and 8.3 ppm were measured in content fires and building fires, respectively [19]. Thus, formaldehyde levels which could cause acute health effects in humans may be present in certain areas or during certain phases of a fire.

In another study, formaldehyde levels as high as 8 ppm were measured during the knockdown phase of the fires, as well as a maximum level during the overhaul phase of 0.4 ppm [82].

Formaldehyde is a primary irritant to the mucous membranes of the eyes, nose and respiratory system and can cause headaches, cough, difficulty sleeping, diarrhoea, nausea, phlegm, weakness, vomiting, dizziness, wheezing, chest pain and tightness, breathlessness, rash, bronchitis and pneumonia [196]. Acute respiratory tract irritation can lead to pulmonary edema and pneumonitis [131].

According to IARC, formaldehyde is probably carcinogenic (Group 2A) [79]. Excess cancer rates occurred in more than one study for the following cases: Hodgkin's disease, leukaemia, and cancers of the buccal cavity and pharynx (particularly nasopharynx), lung, nose, prostate, bladder, brain, colon, skin and kidney [79].

An excess of deaths from lymphopoietic cancer was found among formaldehyde-exposed workers by Levine et al. (1984).

Thomas and Waxweiler report an association between occupational exposure to formaldehyde and brain cancer [191]. The incidence of brain cancer was consistently elevated among professional groups (embalmers, pathologist, anatomists) but not among industrial workers exposed to formaldehyde. There was correlation between these professionals' years of exposure and brain cancer [14]. For the pathologists studied, chronic exposure to other substances such as organic solvents, tuberculosis infection and drugs have also been implicated [64].

Halons

Halons are fire extinguishing agents. Halon fire extinguishers are present in offices, factories, public buildings, etc. [20].

As a rule, Halon gases are not lung irritants except at high concentrations. The most important toxicological effects of Halons are on the central nervous system (CNS) and on the cardiovascular (CV) system. Clinically important CNS effects almost always appear at lower levels of exposure than do CV effects. CNS effects resulting from Halon overexposure are: alterations in perception, increase in reaction time, and reduced ability to concentrate on complex intellectual tasks [197].

The cardiovascular effects of Halons are the most significant hazard of their use. They can cause decreased blood pressure and cardiac arrhythmias. Halons appear to interact with endogenous catecholamines (chemical messengers in the body) such as adrenalin. It is thought that Halons sensitize the heart to the arrhythmogenic action of adrenalin. This assumption is based on the supposed release of adrenalin from the adrenal medulla during excitement, fear or other stressful stimuli such as that experienced by firefighters. Exposure to other toxicants such as chloroform in fires which can also cause similar effects would potentiate the cardiac effects of Halons [20].

Hydrogen chloride

Hydrogen chloride is used in the manufacture of pharmaceuticals, chlorine, vinyl chloride and alkyl chlorides, and in the chlorination of rubber [20]. Hydrogen chloride gas is one of at least 75 identifiable potentially toxic compounds produced by the combustion of polyvinyl chloride [40]. Since polyvinyl chloride is widely used in home construction, furnishings, electric wire, telephone cables, office equipment [40] and wallcoverings [30], hydrogen chloride is likely to be present in most fires [2, 112].

In a study of different fires, mean hydrogen chloride concentrations of 0.1 ppm and 3.3 ppm (grab samples) were measured in the air of building and content fires, respectively [19]. These concentrations are below Ontario's CEV of 5 ppm [143]. However, levels that exceeded twice that CEV (ranging from not detectable to 13.3 ppm), were measured in some samples collected from content fires. Other studies reported similar and even higher findings, with levels as high as 40 ppm [103], 150 ppm [43] and 200 ppm [198] of hydrogen chloride at sites of "non-specified mixed" fires.

Acute effects of hydrogen chloride exposure include eye, skin and throat irritation [106], as well as impairment to respiratory functions [30]. It has also been found to have cardiotoxic effects in rats [138].

Hydrogen cyanide

Hydrogen cyanide is commonly used in the production of chemicals such as resin monomers, cyanide salts, nitriles (e.g. acrylonitrile) [22] as well as rodenticides and insecticides [20]. It is produced by the incomplete combustion of both natural fibres (such as wool and silk) and synthetic polymers (such as polyurethane, polyacrylonitrile, nylon and melamine) widely used in building materials and furnishings [175].

While one study reported hydrogen cyanide in only 10-15% of the fires surveyed [103], others have detected it in as many as 47% of the fires studied [112]. Since polyvinyl chloride is a pyrolysis product of polyvinyl chloride, which is a very widely used polymer, hydrogen cyanide is likely to be involved in most fires [2].

Mean or average concentrations of hydrogen cyanide reported in different studies ranged from 0.04 [53] to 3.7 ppm [103] and from 2.9 to 15 ppm [19]. The highest level was reported for content fires and exceeded the CEV of 10 ppm [143]. The measurements from such fires ranged from below detection to 75 ppm [19], a level five times the CEV.

Hydrogen cyanide is much more potent and faster acting than carbon monoxide [2] and can be rapidly fatal [30]. Both hydrogen cyanide and carbon monoxide are chemical asphyxiants that render the body incapable of using an adequate supply of oxygen. While carbon monoxide interferes with the transport of oxygen to the tissues by its affinity to haemoglobin, cyanide alters the cellular use of oxygen in energy production [30]. Carbon monoxide and cyanide are additive in producing changes in blood flow within the brain but may act synergistically on cerebral metabolism, so that their combined effects are greater than that expected by either substance alone [153].

Nitrogen dioxide

Nitrogen dioxide is a common decomposition product of fires. It may also be present in fires which occur where it is being used as an ingredient in the manufacture of chemicals [20], nitric and sulphuric acids, and explosives.

A mean concentration of 0.47 ppm was reported for nitrogen dioxide in 8-minute air samples collected at non-specified mixed fires [53]. This concentration is well below the STEV of 5 ppm set for nitrogen dioxide in Ontario workplaces [143]. In another study, nitrogen dioxide levels as high as 10 ppm [198] were observed in some of the samples, although no mean values were reported.

Nitrogen dioxide is a strong lung irritant and can cause pulmonary edema [20]. NIOSH considers it a suspected carcinogen based upon animal studies and limited epidemiologic evidence [149].

Organic solvents

Organic solvents are widely used in various workplaces to dissolve other organic materials and are classified into several broad categories[5].

Firefighters may be exposed to a complex mixture of organic solvents present in fire stations, at fire sites, and from decomposition products of materials involved in the fires.

After carbon monoxide, benzene is generally the second most commonly found organic constituent of fire smoke [19]. In a review of various studies, grab sampling measurements of other solvents such as chloroform, dichlorofluoromethane, methylene chloride, perchloroethylene, toluene and trichloroethylene were well below the respective exposure limits used for comparison by the authors. These limits are comparable to the STEVs or TWAEVs prescribed for the individual chemical agents mentioned.

All organic solvents affect the central nervous system to some extent, acting as depressants and anaesthetics. They also cause dermatitis and other health effects depending on the solvent and the route and extent of exposure. These effects range from narcosis to death from respiratory arrest. While some (e.g. n-hexane and methyl n-butyl ketone) cause peripheral neuropathy when chronically exposed, others (e.g. carbon tetrachloride) are recognized more for their acute injuries to the liver, kidneys and gastrointestinal tract [81]. Exposure to trichloroethylene, a commonly used solvent, has been found to cause liver cancer in mice [154]. Benzene causes considerable adverse effects on the blood-forming tissues and bone marrow (see "Benzene", above). Carbon disulphide has been linked to cardiovascular disease [84]. There is evidence to suggest that solvent exposure can also exacerbate the damage to hearing caused by excessive noise [168].

Polycyclic aromatic hydrocarbons (PAHs)

PAHs are multi-ring aromatic compounds found widely dispersed in nature. They are formed during the combustion of many organic materials (for example, diesel fuel) and high-temperature processing of crude oil, coal and coke. They also occur in tobacco smoke and grilled, smoked and fried foods [81].

5 They are: aliphatic hydrocarbons (hexane, benzine, mineral spirits); cyclic hydrocarbons (cyclohexane, turpentine and kerosene); nitro-hydrocarbons (nitroethane); aromatic hydrocarbons (benzene, toluene and xylene); alcohols (methanol and ethanol); glycols (ethylene glycol); esters (ethyl acetate); ketones (acetone); aldehydes (acetaldehyde); ethers (ethyl ether) and halogenated hydrocarbons (trichloroethylene and carbon tetrachloride).

Only one study reported concentration of airborne PAHs in fire smoke. The measurements ranged from below detection to 0.5 mg/m^3 during knockdown and below detection to 0.02 mg/m^3 during overhaul. Personal samples from firefighters showed no measurable exposure to PAHs when the SCBA was worn [82].

No short-term exposure limit has been prescribed in Ontario for PAHs *per se*, although a TWAEV of 0.2 mg/m^3 has been set for coal tar pitch volatiles (total benzene-solubles). As already mentioned, a comparison of the aforementioned measurements with a TWAEV may not be meaningful because of the short-term or intermittent exposure profile of firefighters to contaminants in fire smoke.

In the human body, PAHs are metabolized to more water soluble compounds which are excreted through urine or bile. While many PAHs, such as naphthacene and anthracene, are not known to be carcinogenic, others (eg. benzo(a)pyrene, benzo(a)anthracene and pyrene) and their metabolites have shown to be slight to potent carcinogens. These PAHs, particularly benzo(a)pyrene, may be linked to increased risk of cancer of the lungs, colon, pancreas, stomach, pharynx and bladder reported in petroleum refinery workers and in workers exposed to coke, coal tar pitch and asphalt. Tar and pitch exposure is associated with benign and malignant skin tumours [81, 79].

A detailed review of the epidemiological literature by Thomas and Waxweiler identified an association between PAHs and brain cancer (1986). Other authors have suggested a link between exposure to PAHs and leukaemia [62] and cancers of the bladder, kidney and ureter [59].

Soots

Since all fires create soots, it is likely that firefighters are also significantly exposed during firefighting. Soots contain polycyclic aromatic hydrocarbons (PAHs), many of which are known carcinogens in humans. These particulates have been measured in detectable amounts in the smoke of building fires [82].

IARC reports that there is sufficient evidence to establish soots as carcinogenic to humans (Group 1) in the cases of skin, scrotal and lung cancer. Statistically significant excesses in mortality from esophageal and liver cancer and leukaemia were also found among chimney-sweeps exposed to soots [79].

Vinyl chloride

Vinyl chloride is used primarily to manufacture plastic articles (from polyvinyl chloride) such as building and construction materials (pipes, ducts,

floor tiles, electrical wire and cable), packaging (films, sheets, bags and bottles), clothing, insulation, automobile upholstery and mats, records, toys and a variety of consumer goods [21]. When sufficiently heated, these articles can release vinyl chloride and other products of decomposition which are health hazards. In all, at least 75 potentially toxic products have been identified in the thermal degradation of polyvinyl chloride [40].

The Panel is aware of only one study by Markowitz et al (1989), which reported measurements of vinyl chloride in fire smoke. Only a small amount of vinyl chloride was detected in the smoke from the decomposition of plastics. Measurements from a fire involving polyvinyl chloride showed that the products of pyrolysis consisted mostly of nitrogen, hydrogen, carbon monoxide and hydrogen chloride [106]. Also identified in lesser amounts were carbon dioxide, hydrogen cyanide, benzene and methane. The concentration of vinyl chloride itself, however, was below the limit of detection (less than 0.2 ppm) in that study.

Short-term exposures to high concentrations of vinyl chloride have resulted in euphoria, dizziness, respiratory irritation, headache, nausea, irritability, poor memory and tingling sensations [20]. A high incidence of Raynaud's syndrome, hypertension and coronary deficiencies had also been reported in workers exposed for at least 5 years [90].

According to IARC, there is sufficient evidence (Group 1) that vinyl chloride is carcinogenic, causing cancers of the liver, brain, lung and haematolymphopoietic system in humans. IARC also noted findings of excessive melanoma, gastric and gastrointestinal cancers in exposed individuals [79]. Several authors also reported an association between vinyl chloride and brain tumours, particularly gliomas [191, 93]. It has also shown to be carcinogenic, mutagenic and genotoxic in studies on rodents and cell cultures [79].

Vinyl chloride is a designated substance in Ontario [141].

Other

Methylene chloride and sulphur dioxide have also been identified at fire sites. They cause eye and skin irritation but are not known to lead to the major health outcomes upon which the Panel has decided to focus in this Report.

SUMMARY

There is evidence that many of the chemical substances to which firefighters may be exposed are carcinogenic to humans and animals. Some of these substances cause cardiovascular, respiratory and central nervous system effects. In addition, carbon monoxide and solvent exposure may worsen the damage to hearing caused by excessive noise exposure.

- **Other hazards of firefighting**

The physical activities demanded by their work may also affect firefighters' cardiovascular health.

In 1992, a York University research team published a detailed study of the activities involved in firefighting [51]. Based upon that information, they developed a fitness screening protocol for firefighter applicants [52] which has recently been adopted by several fire departments.

This research identified the following physical tasks which are commonly required during active firefighting:

- carrying equipment up stairs in high-rise buildings while wearing breathing apparatus and turnout gear, which together weigh 48.4 pounds dry and are heavier when wet;
- advancing charged hoses, sometimes from a distant hydrant, outdoors around obstacles or in icy conditions and indoors through hallways or stairs;
- carrying heavy equipment long distances from the truck to a fire site, particularly when garbage and furniture interfere with access to the fire site;
- breaking down doors, walls, ceilings and roofs; forcible entry through walls or steel security doors using hand tools;
- raising ladders, sometimes with an insufficient number of firefighters; using an axe while on a ladder;
- working overhead with a pike pole or other equipment; for example, breaking through a roof while on a ladder;
- rescuing victims from a roof or window using a ladder, or from confined areas using hand and power tools; moving victims from damaged cars or collapsed buildings;
- raising and lowering equipment or victims from high-rise windows using ropes;
- fighting fires for extended periods of time; conducting lengthy extrication and rescue operations, for example, in multi-vehicle accidents, industrial fires, train derailments, etc.; and working overhead or in awkward positions for extended periods of time [51].

A firefighter's endurance is reduced by self-contained breathing apparatus and other protective clothing which is hot, cumbersome and heavy [179]. The extra weight and effort causes more rapid breathing which is made even more difficult by using the respirator [51]. As mentioned above, the heavy exertion demanded by fighting a fire causes more rapid and deeper breathing which increases delivery of toxins to deep within the lungs [60].

In older buildings composed of heavier construction materials, fires reach higher temperatures and spread more rapidly. Firefighters must work more quickly, encumbered by these physical constraints and in even higher heat [51].

Fighting high-rise building fires requires climbing several flights of stairs carrying the weight of protective gear, tools and hoses, and removing heavy windows or opening concrete walls. Newer buildings often involve concrete construction and toxic materials [51]. Concrete absorbs heat and toxins, then releases them gradually as it cools [51, 60].

Obviously, firefighters are exposed to very high temperatures. Heat stress is compounded by the insulating properties of the protective clothing and by physical exertion, which results in endogenous heat production [60]. Research indicates that heat stress contributes to ischemia [6] and to the risk of a myocardial infarction in a predisposed individual [126].

In addition to burns, radiant heat may cause skin injuries such as erythema and telangiectasia [60].

Firefighting in winter conditions can pose special problems as water freezes and firefighters undergo large fluctuations in body temperature when they repeatedly enter and exit the fire site [51].

Darkness and smoke decrease visibility, impede search and firefighting procedures and may lead to accidents and traumatic injuries [51].

High noise levels make firefighting more difficult and dangerous. Noise interferes with speech and hazard communications and drowns out warning signals, which can eliminate firefighters' ability to prevent traumatic injuries. Loud noise can also cause stress reactions which are measurable in increased heart rate and elevated blood pressure [110] and some studies have documented noise-induced hearing loss among firefighters [159].

Firefighters routinely face unknown personal danger and, unlike most other workers in Ontario, they have no legal right to refuse work which is unsafe[6]. They are often responsible for the safety of other people. These

[6] Section 23(2), *Occupational Health and Safety Act*, R.S.O. 1980, chapter 321 as amended.

responsibilities, quite understandably, cause high levels of psychological stress [60, 16].

Finally, there is some evidence that shiftwork has a negative effect on subjective, and to a lesser extent, objective measures of health. Normal 24-hour (circadian) rhythms are disturbed by shiftwork, which can interfere with sleep patterns. Family and social activities may also suffer [50].

APPENDIX "B"

Report to the British Columbia Professional Fire Fighters Association

Evaluating the Association Between Selected Cancers

And

Occupation as a Fire fighter

Tee L. Guidotti, MD, MPH, FRCPC, CCBOM, FFOM, DABT

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26 March 2003

APPENDIX "C"

News Release,
Government of Manitoba,
May 1, 2002

And

Bill 5,
3rd Session, 37th Legislature,
Legislative Assembly of Manitoba

Manitoba Government
NEWS RELEASE
Manitoba

Information Services, Room 29, Legislative Building, Winnipeg, Manitoba R3C 0V8
Telephone: (204) 945-3746
Fax: (204) 945-3988

FRANCAIS

May 01, 2002

PROPOSAL TO AMEND WORKERS COMPENSATION ACT

Labour and Immigration Minister Becky Barrett today introduced proposed amendments to the Workers Compensation Act recognizing the link between the exposure to hazards faced by full-time firefighters and certain diseases.

The proposed changes reflect the findings of recent medical and scientific studies which show a strong association between the working conditions experienced by full-time firefighters over time and the occurrence of certain diseases.

"This new amendment recognizes that there are health risks faced by Manitoba's full-time firefighters in the course of their duties each day," said Barrett. "There is now enough data to support a link between hazards encountered on duty by these firefighters and their susceptibility to certain illnesses in later years."

Bill 5 would make Manitoba the only Canadian jurisdiction to have a law presuming that certain diseases are caused by firefighting. The amendments would require that the firefighters' exposure to the hazardous conditions take place over a number of years which would be specified in regulation. The amendment would apply to full-time firefighters who contract primary site brain, bladder or kidney cancer, non-Hodgkin's lymphoma or leukemia.

The proposed changes would not apply to part-time or forest firefighters. Studies show that full-time firefighters are exposed to different carcinogens and toxins and for longer periods than other responders.

"This action is based on the most up-to-date evidence and acknowledges the risks faced by these professionals in their service to Manitobans every day," said Barrett. "It will facilitate evaluation of potential compensation claims in this profession."

The new provisions will assist full-time firefighters in making disease claims with the Workers Compensation Board (WBC).

The WCB is a not-for-profit accident and disability insurance agency established in 1917. Workers compensation is funded by employer premiums.

There are about 1,000 full-time and 500 retired full-time firefighters in Manitoba.

- 30 -

RETURN

Third Session,
Thirty-seventh
Legislature

List of Bills Status of Bills

Bill 5

THE WORKERS COMPENSATION AMENDMENT ACT

Explanatory Note Français

(Assented to)

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of Manitoba, enacts as follows:

C.C.S.M. c. W200 amended

1 ***The Workers Compensation Act** is amended by this Act.*

2 *The following is added after subsection 4(5):*

Presumption re firefighters

4(5.1) If a worker who is or has been a firefighter suffers an injury that is

(a) a primary site brain cancer;

(b) a primary site bladder cancer;

(c) a primary site kidney cancer;

(d) a primary non-Hodgkins lymphoma; or

(e) a primary leukemia;

the injury shall be presumed to be an occupational disease the dominant cause of which is the employment as a firefighter, unless the contrary is proven.

Application

4(5.2) The presumption in subsection (5.1) applies only to a worker who has been a full-time member of a fire fighting department for a minimum period prescribed by the Lieutenant Governor in Council by regulation and who has been regularly exposed to the hazards of a fire scene, other than a forest-fire scene, throughout that period.

Regulations

4(5.3) The Lieutenant Governor in Council may make regulations prescribing periods of employment for the purpose of subsection (5.2), which may be different for different diseases referred to in subsection (5.1).

Effective date of presumption

4(5.4) The presumption in subsection (5.1) applies only to accidents that happen on or after the day that subsection comes into force.

Coming into force

3 *This Act comes into force on the day it receives royal assent.*

Explanatory Note

This Bill creates a rebuttable presumption that if a full-time firefighter employed for a minimum period gets a certain type of cancer, the dominant cause of the disease is the employment.

[top of document]

APPENDIX "E"

Canadian Press,
February 20, 2003

And

Workers' Compensation (Firefighters) Amendment Act, 2003
Bill 202,
3rd Session, 25th Legislature,
Legislative Assembly of Alberta

Passed April 11/03 Thank you
Jo Laura

canada.com News

Friday » February 21 » 2003

Alberta firefighters appear to have won battle for WCB coverage

Canadian Press

Thursday, February 20, 2003

EDMONTON (CP) - Alberta firefighters sat in the legislature gallery Thursday to support a private member's bill seeking automatic coverage for their cancer-related illnesses, but their battle was won behind closed doors hours earlier.

The governing Conservative caucus told Human Resources Minister Clint Dunford earlier that day that they wanted firefighters to have that protection from the Workers Compensation Board. Dunford, who had opposed the legislation, admitted as he walked into the legislature chamber that his caucus supported the firefighters.

Premier Ralph Klein publicly offered his support later in the day.

"I think public opinion goes with the firefighters," Klein said after the bill passed first reading. "In defence of Clint, he's playing by the book, but politics is not always playing by the book."

"I think there should be some legislation to protect them and provide them with some assurances."

Manitoba already has similar legislation. New Democrats in Nova Scotia said Thursday they will introduce a similar private member's bill in the spring session of the Nova Scotia legislature.

Calgary Tory MLA Richard Magnus, who introduced the bill in Alberta, said 23 American states have also recognized that firefighters are exposed almost daily to cancer-causing substances as they do their jobs.

Statistics indicate firefighters are up to three times more likely to develop cancers of the brain, bladder and kidney, as well as leukemia and non-Hodgson's lymphoma, from breathing toxic fumes.

Dunford couldn't say Thursday if the private bill introduced will be amended or if some compromise will be sought by his department. But all Magnus needs is 50 per cent of the support of the 83-member legislature to have the bill pass.

"We're going to have a look if there's some way to work with Richard and the firefighters on this," Dunford said. "I still don't like the idea of shifting the burden of proof, but we follow caucus guidelines on this so we will look at it."

Edmonton firefighter Paul Wyndham, who suffers from leukemia, said his doctors believe there is a high probability his illness was caused by exposure to carcinogens on the job.

"I am here to support the bill," he said. "I feel it is important that the onus is more on the WCB to prove the cancer was not related to the job," he said.

Magnus agreed, saying it's the right thing to do and only fair to firefighters.

"In this case these people are getting cancer. The link statistically and every other way has never been an argument. We know they get cancer from fighting fires."

Alex Forrest, president of the United Firefighters of Winnipeg, said Thursday that Manitoba's ground-breaking legislation was having a ripple effect across the country.

Forrest is helping union members in several other provinces who want their governments to follow Manitoba's lead. Manitoba has all the studies and scientific research needed to back their claims, he said.

"Basically, we didn't have to reinvent the wheel."

2003 Bill 202

Third Session, 25th Legislature, 52 Elizabeth II

THE LEGISLATIVE ASSEMBLY OF ALBERTA

BILL 202

WORKERS' COMPENSATION (FIREFIGHTERS) AMENDMENT ACT, 2003

MR. MAGNUS

First Reading . . . . . .

Second Reading . . . . . .

Committee of the Whole . . . . . .

Third Reading . . . . . .

Royal Assent . . . . . .

Bill 202
Mr. Magnus

BILL 202

2003

WORKERS' COMPENSATION (FIREFIGHTERS) AMENDMENT ACT, 2003

(Assented to , 2003)

HER MAJESTY, by and with the advice and consent of the Legislative Assembly of Alberta, enacts as follows:

Amends RSA 2000 cW-15

1 The *Workers' Compensation Act* is amended by this Act.

2 The following is added after section 24:

Presumption re firefighters

24.1(1) In this section,

(a) "firefighter" means an employee, including officers and technicians, employed by a municipality or Metis settlement and assigned exclusively to fire protection and fire prevention duties notwithstanding that those duties may include the performance of ambulance or rescue services;

(b) "municipality" means a municipality as defined in the *Municipal Government Act.*

(2) If a worker who is or has been a firefighter suffers an injury that is

(a) a primary site brain cancer,

(b) a primary site bladder cancer,

(c) a primary site kidney cancer,

(d) a primary site colon cancer,

(e) a primary non-Hodgkin's lymphoma, or

(f) a primary leukemia,

the injury shall be presumed to be an occupational disease, the dominant cause of which is the employment as a firefighter, unless the contrary is proven.

(3) The presumption in subsection (2) applies only to a worker who has been a full-time member of a fire protection service of a municipality or Metis settlement for a minimum period prescribed by the Lieutenant Governor in Council by regulation and who has been regularly exposed to the hazards of a fire scene, other than a forest-fire scene, throughout that period.

(4) The Lieutenant Governor in Council may make regulations prescribing periods of employment for the purpose of subsection (3), which may be different for different diseases referred to in subsection (2).

(5) The presumption in subsection (2) applies only to accidents that happen on or after January 1, 1993.

(6) The Board must

(a) conduct research to determine if the injuries referred to in subsection (2) are occupational diseases, the dominant cause of which is the employment as a casual or part-time member of a fire protection service of a municipality or Metis settlement, and

(b) prepare a report on the status of the research and submit it to the Minister no later than 3 years after the coming into force of this section, and the Minister shall lay a copy of the report before the Legislative Assembly within 15 days after receiving it if the Assembly is sitting or, if it is not, within 15 days after the beginning of the next sitting.

Explanatory Notes

1 Amends chapter W-15 of the Revised Statutes of Alberta 2000.

2 New section regarding presumption of certain diseases for firefighters.

SPEECH FROM THE THRONE 2003

Delivered on the Occasion of the Opening of

The Fourth Session of The Twenty-Fourth Legislature Province of Saskatchewan

Tuesday, March 18, 2003

The Honourable Lynda Haverstock
Lieutenant Governor of Saskatchewan

A VISION. A PLAN. A FUTURE WIDE OPEN.

MR. SPEAKER, MEMBERS OF THE LEGISLATIVE ASSEMBLY, CITIZENS OF SASKATCHEWAN

It is my pleasure to welcome you to the fourth session of the twenty-fourth Legislature of the Province of Saskatchewan.

It is with sadness that I note the passing of two Members of this Legislative Assembly since the last session was convened on March 14 last year. I recognize the contribution of the former Member for Battleford-Cutknife, Rudi Peters and the former Member for Carrot River Valley, Carl Kwiatkowski. I also acknowledge the loss of one of our province's most distinguished citizens, former Governor-General Ramon Hnatyshyn who passed away in December.

As we begin this new legislative session, changes will be proposed to the roles and responsibilities of the standing committees of the Legislature. These changes were unanimously recommended by the Assembly's Special Committee on Rules and Procedures. They will strengthen the role of the Members and provide increased public input into the legislative process. They will help make the operations of the Legislature more open, accountable and responsive to our citizens.

In two years, Saskatchewan will celebrate its 100th anniversary.

However, many of our communities are older than the province itself. More than 20 communities were incorporated as municipalities in 1903, when Saskatchewan was still part of the North-West Territories. Many of those towns and cities are celebrating their own centennials this year.

We can look forward to participating in community centennial celebrations during the months ahead.

We can also look forward to a visit to Saskatchewan by the Earl and the Countess of Wessex. The royal couple will participate in events marking the centennials of Regina, Moose Jaw and Lloydminster. As well, they will visit Prince Albert to unveil the wall of recognition in that city's impressive new Visual and Performing Arts Centre. When in Regina, they will participate in the opening of the magnificent Saskatchewan Indian Federated College building at the University of Regina.

DEDICATION

We have much to celebrate in our past. But, even more, we have much to celebrate as we look to our future.

I am pleased to acknowledge several groups present in the gallery today who are representative of the future strength of our province.

The Dakota Cree Drummers and Singers are a drum group from the Piapot First Nation.

The Swift Current Comp Chamber Singers, directed by Marcia McLean, is an award-winning choir from the Swift Current Comprehensive High School.

Also in the gallery are a number of Team Saskatchewan members who represented our province so well at the recent Canada Winter Games in New Brunswick. More than 300 Team Saskatchewan athletes, coaches and officials attended the Games. Our team won 38 medals – double the number won at the last Winter Games four years ago.

I would like to acknowledge two other groups of Saskatchewan athletes. The 2003 national Junior Women's Team, skipped by Marliese Miller, and the national Junior Men's Team, led by Steve Layton, are both from Saskatoon. Today they are traveling to Switzerland to represent Canada in the World Junior Curling Championships. We wish them well.

These groups of young people are the personification of Saskatchewan's future.

It is to that future that I dedicate the plans of the government.

The essence of our government's agenda is contained in eight words:

A vision. A plan. A future wide open.

VISION

Our government's vision is a province of opportunity, where the future is wide open to those prepared to dream big, plan well and work hard.

It is a vision of an expanding economy from which no one is excluded.

It is a vision of a province where all children will have the opportunity to grow up healthy, in safe, secure communities, receive the very best in education and training, and be encouraged, in turn, to build successful families and careers here at home.

It is a vision of a *green* Saskatchewan, where exciting new breakthroughs in renewable energy, environmental technology and energy conservation support a growing economy in harmony with our natural environment.

This vision is being realized through comprehensive planning in key spheres of activity.

EXPANSION OF OUR ECONOMY

Our vision of the future depends upon expanding our economy today.

Saskatchewan's economy is strong. It is expanding and diversifying.

Our government's economic plan is achieving results.

Employment in Saskatchewan has grown for ten consecutive months. Employment records have been set in six of those months.

Retail sales and business incorporations both increased by more than seven per cent last year. Growth occurred in potash sales, in the value of manufactured goods, in the value of residential building permits, and in average weekly earnings.

Capital investment in our province continues to grow.

However, we are all aware that much of Saskatchewan has faced severe drought during the past two years.

Crop insurance programs have been critical to the survival of many producers. Insurance payments resulting from reduced agricultural yields will exceed $1 billion dollars for 2002. This record payment has eliminated reserves accumulated in past years and necessitated additional debt in support of our farm communities.

Nevertheless, we have every reason to be confident about the future of our rural economy. That confidence is reflected in the Rural Development Strategy, adopted last year in response to the Action Committee on the Rural Economy – ACRE. The Committee's mandate has been expanded to monitor implementation of the Rural Strategy and to recommend new initiatives during the next two years.

The Strategy defines rural diversification as a key element of Saskatchewan's overall economic growth. Results can already be seen across the province.

One hundred and twenty-six plants now process Saskatchewan crops here at home. They add value to our commodity exports and provide employment for more than 1,200 people.

Another 1,200 people earned $34 million last year as part of our hog production industry. That industry has doubled in the last five years.

Since 1997, $433 million has been invested in construction as part of our expanding livestock industry.

We have become one of the world's largest producers and exporters of lentils, dry peas and canola.

Organic agriculture production and processing is increasing by 20 per cent annually. Saskatchewan now has about 1,000 certified commercial organic producers.

Saskatchewan is home to 25 per cent of Canada's beef cow herd. This year our government will release a 10-year beef production strategy.

Saskatchewan is poised to become Canada's leading producer of ethanol. Ethanol will help diversify our rural economy, contribute to the health of our environment and provide by-products that will support an expanded cattle feedlot sector.

Our government has worked long and hard to convince Ottawa that a more realistic national agricultural policy must be developed - to counter international subsidies and to ensure that adequate risk management programs are in place.

Although the national Agriculture Policy Framework falls short of meeting our long-term trade injury expectations, Saskatchewan's participation in the Framework will give our producers access to a larger share of national safety net funding.

The Framework will also help brand Canada as a world leader in marketing quality food products. Our province will actively participate in setting and meeting national standards for environmental sustainability and food safety. We will also be part of national initiatives to encourage innovation – innovation that will contribute to the future success of our agriculture industry.

Saskatchewan's participation in the national Agriculture Policy Framework will necessitate changes to *The Crop Insurance Act* and *The Agricultural Safety Net Act.*

The government's legislative agenda also includes amendments to *The Farm Stability Act* and *The Agricultural Implements Act.*

Beyond the rich resource of our farmland, economic expansion in our province will be based on our abundant natural and human resources.

Saskatchewan's largest economic sector, measured by the value of production, is now energy.

The government has sparked increased oil and gas exploration and development by reducing royalties and taxes on new production. Initial reports for 2003 indicate an immediate response by industry. To the end of February, drilling had increased by 68 per cent over the same period last year.

These changes are predicted to generate more than $4 billion in additional investment over the next 10 years – potentially providing 40,000 person years of new employment.

By balancing reduced royalties with increased production, it is estimated the oil and gas industry will contribute an additional $650 million to the provincial treasury during the next 10 years.

Mining and mineral exploration already support the jobs of 17,000 Saskatchewan people.

Saskatchewan has an abundant supply of coal. Our province is the world's largest producer of potash and uranium. Saskatchewan also has significant potential in gold, base metals and diamonds.

Last year, as part of our government's plan, a package of initiatives was introduced to stimulate new mineral exploration and production, particularly in the North. The package includes exploration grants, royalty and tax changes, and the provision of more geophysical data – all of which will support increased activity by prospectors and exploration companies.

Under our government's comprehensive forestry plan, Saskatchewan's forestry sector has attracted almost $1 billion in investment since 1998.

During this session, the government will present plans to improve inventories of our wood supply. These inventories will increase investment in the short term and ensure sustainable management of our forests for the long term. This four-year project will be undertaken in partnership with northern communities and the new Forestry Development Centre being established in Prince Albert.

Small and medium-sized businesses are major contributors to the expansion of Saskatchewan's economy. They provide goods and services, foster growth in tourism, manufacture value-added products from primary production, apply new technologies, and ensure expression of our cultures. They are contractors and sub-contractors. They employ thousands of Saskatchewan people.

Each year Saskatchewan companies provide more than $1 billion in goods and services to provincial government agencies and Crown corporations. Our government will implement an *Action Plan on Procurement* to assist those companies to provide an even larger percentage of goods and services to the public sector.

The government has recently amended regulations governing Labour-Sponsored Venture Capital Corporations, adding flexibility to their investment parameters. Private investment corporations represent an increasingly important source of capital for small and medium-sized Saskatchewan-based businesses.

Our government's economic plan is increasing the involvement of Métis and First Nations peoples in our growing economy.

In northern Saskatchewan, this objective is being supported through the Northern Development Fund, the involvement of Aboriginal communities in forestry development, and the recently signed federal-provincial Northern Development Accord.

Gaming profits contribute to the economic development objectives of the Métis Development Fund and the First Nations Fund. Legislative proposals during this session will include conversion of the First Nations Fund to the First Nations Trust, increasing First Nations' authority while clarifying accountability obligations.

To date, forty Saskatchewan agencies and companies have become partners in the Aboriginal Employment Development Program. This program has assisted more than 1,500 Métis and First Nations people to obtain employment.

Saskatchewan continues to work with First Nations and Canada in meeting Treaty Land Entitlement obligations. The government has facilitated the transfer of more than 470,000 acres of land to Saskatchewan First Nations since 1992. This land base is the core of long-term economic development opportunities for Saskatchewan First Nations.

Tourism is one of Saskatchewan's fastest growing industries. Building upon our province's natural beauty, history, cultures, and traditional hospitality, our government's plan is on target to increase tourism revenue by 25 per cent to $1.5 billion by 2005.

Our government believes that one of the public sector's key roles in facilitating expansion of our provincial economy is investment in infrastructure.

Saskatchewan's massive highway improvement program will continue as part of a three-year, $900 million commitment. In consultation with Area Transportation Planning Councils, plans have been developed for paving and reconstructing 750 kilometres of provincial roads this year. This includes acceleration of the twinning of Highways 1 and 16.

Infrastructure improvements will occur on many fronts. Our government will announce a multi-year *Building for the Future* capital committment as part of its 2003-04 provincial budget.

The government's plan to build for the future includes new investments in sewer and water systems and other municipal facilities. This will be done through the Canada-Saskatchewan Infrastructure Fund, the Northern Water and Sewer Program, and the Centenary Fund. During the past two years, these programs have resulted in more than $38 million being expended specifically for new and enhanced sewer and water facilities in 145 communities.

Saskatchewan is a world leader in providing telecommunications infrastructure to rural, urban and northern regions.

In 2003, our government, through SaskTel, will complete the conversion of its entire cellular phone network to digital service and reach 94 per cent of Saskatchewan's population.

In 2003, high speed Internet will reach 366 Saskatchewan communities, covering 74 per cent of our population. A second phase of high speed Internet expansion will extend service to at least 95 per cent of our residents over the next five years.

In 2003, Saskatchewan's Crown corporations will invest a total of $650 million to extend and renew utility infrastructure in our province. This investment enables industries to expand and improves the quality of community services. It also contributes to jobs and business opportunities for Saskatchewan people and Saskatchewan companies.

Since 1905, Saskatchewan governments have recognized the value of public enterprise, contributing to a mixed economy together with the private and co-operative sectors.

During the past eight years, Saskatchewan's Crown sector has returned $1.6 billion in dividends and equity repayments to the people of Saskatchewan - the shareholders of our Crown enterprises.

Our government remains committed to a strong, responsive and evolving Crown sector.

Equally, our province has become increasingly competitive in attracting private sector investment for business development:

- We offer high quality telecommunications, energy and transportation infrastructure.
- We have no payroll taxes and no health care premiums.
- Business taxes have been reduced.
- Operating and living costs are lower in Saskatchewan than elsewhere in western Canada.
- We have a well-trained workforce with low staff turnover.

Our government's plan to expand and diversify our economy includes increasing investor awareness of the opportunities for business and industry development in Saskatchewan.

The province's *Wide Open Future* investment attraction campaign has caught the imagination and attention of people across Canada.

Two additional initiatives associated with the campaign will be undertaken later this year.

Increased support will be provided to attract immigration to our province – contributing to our economic growth. And this fall, the Premier will lead teams of business, community and government leaders to visit key Canadian centres to promote the advantages of our province.

Team Saskatchewan will increase awareness of our expanding economy, our tourism destinations, our Centennial and our investment opportunities. *Team Saskatchewan* will demonstrate that our future is *truly* wide open.

The ultimate goal of our government is to build an economic foundation in Saskatchewan to achieve the status of a 'have' province within the Canadian confederation.

OPENING DOORS TO THE FUTURE: EDUCATION AND TRAINING

To achieve our vision, our government's plan includes a major investment in education and training.

The formative years of childhood are crucial to achieving our potential as adults.

Child care is an important part of life for many families. Provincial programs support almost 8000 children in 450 licensed child care facilities. Child care subsidies are provided directly to 2,700 families.

Our government is encouraged that the federal government has announced support for national child care initiatives. Saskatchewan has started to work with Ottawa to address this need.

In the meantime, this Assembly will receive proposals to increase child care subsidies and the number of licensed child care spaces this year.

As our children reach school age, our government responds by supporting programs for Kindergarten to Grade 12. Additional support is provided for at-risk and special needs students.

Funding has been steadily increased for community schools, for developing the School PLUS model, for implementing the *Kids First* program, and for introducing pre-Kindergarten programs.

During 2003, a further 120 at-risk children will receive early childhood development support through *Kids First*. Pre-kindergarten will be expanded to 100 programs in 42 communities.

I note with pride that our government's annual investment per student, from Kindergarten to Grade 12, has risen by 42 per cent during the past five years.

Students are responding well to our education initiatives. Saskatchewan has the lowest high school dropout rate in all of Canada. A greater percentage of Saskatchewan young people are enrolled full time in university than in any other western province.

Saskatchewan's expanding economy, and the growing number of post-war "baby boomers" approaching retirement, will significantly increase the demand for skilled workers during the next fifteen years. As a result, the provision of post-secondary training and education will become increasingly important.

The number of Saskatchewan people participating in post-secondary education is impressive.

More than 30,000 full-time and part-time students attend university. More than 40,000 students participate in various programs offered by the Saskatchewan Institute of Applied Science and Technology. There are more than 30,000 enrolments in regional college classes.

Apprenticeship programs, private vocational training and work-based training also create post-secondary opportunities in our province.

A new innovation in education is *Campus Saskatchewan*, a recently formed partnership of provincial post-secondary agencies. *Campus Saskatchewan* now offers more than 150 on-line courses for adult learners.

Our government is committed to advancing the full citizenship of people with disabilities. To this end, employment support programs will be extended to an additional 680 persons to assist them in achieving greater independence through participation in our provincial labour force.

Enhancements are also planned to Saskatchewan's student loan program. These will raise income exemptions, thereby increasing funds available to individual students. Other changes will recognize the higher costs faced by medical students compared to other courses.

This year, the provincial government, including Saskatchewan's Crown corporations, will provide funding for scholarships, bursaries and grants to more than 11,000 post-secondary students. A further 5,500 students qualify for provincial training and apprenticeship allowances.

Saskatchewan's student employment programs also contribute to the skill development of our young people. During 2002 more than 2,400 students were given work experience and income opportunities through provincial departments and Crown corporations.

Quality education in Saskatchewan is supported by research and development. The provincial government's direct investment in research will exceed $50 million this year, in addition to core funding provided to our universities.

Research undertaken in our province will be further enriched early next year with the opening of the Canadian Light Source Synchrotron in Saskatoon.

In conjunction with the province's post-secondary institutions, the government will step up actions for student recruitment and retention. Greater profile will be given to the variety of courses and student services available in our province, the lower living costs experienced by our students, and the growing range of employment possibilities within Saskatchewan.

Our government's plan recognizes that a comprehensive approach to education creates opportunities for Saskatchewan's young people and supports expansion of our economy.

A SUSTAINABLE FUTURE - ENVIRONMENT PROTECTION

Our government's vision of a strong economy and a secure future requires a healthy environment.

The province's biennial "State of the Environment" report will be tabled during this sitting of the Legislature. It will focus on the health of Saskatchewan's natural environment and the sustainable use of our resources.

Saskatchewan Environment is working closely with others to address environmental hazards. More than 70 orphaned service station sites have been cleaned up. More than 80 landfills have been closed, replaced by regional waste management facilities. SaskPower has undertaken $70 million in modifications to curtail more than 99 per cent of fly-ash emissions at its coal-burning power station at Boundary Dam.

Implementation of Saskatchewan's long-term safe drinking water strategy includes watershed management that protects the source of our water supplies, on-going inspections of water systems in the province, and related education programs.

This year our government will release its first annual State of Drinking Water Quality report. As well, the public will soon be able to access water quality reports for individual communities by way of the Internet.

Last year's drought affected more than agriculture in Saskatchewan. Our province overcame one of the most severe forest fire seasons on record, thanks to the long hours and hard work of our fire fighting crews. Human activity contributed to more than half of all fires.

Our government will propose an enhanced fire prevention information and education campaign to help protect our forestry resource.

Forests are an important commercial resource. They also contribute to the health of our environment, our enjoyment of nature, and the beauty of our urban, regional and provincial parks. Capital improvements for our parks and the planning of several new cottage subdivisions are within the government's plan for the coming year.

Recycling is an important element of environmental management in the province. Increased funding for SARCAN will be provided.

Climate change is a major concern for the health of our entire planet.

Together with other provinces and territories, Saskatchewan agreed to 12 principles as the basis for a national climate change plan to reduce greenhouse gas emissions.

Saskatchewan is prepared to work with the Government of Canada to undertake research and implement measures that will reduce greenhouse gases, while ensuring our economy is not disadvantaged.

Our province is already taking action to address climate change.

- Saskatchewan is participating in two wind turbine projects that are generating electrical power in the Gull Lake region.
- We are contributing to a three-year, $5 million study investigating *clean coal* technologies.

- The International Test Centre for Carbon Dioxide Capture at the University of Regina and the Weyburn Carbon Dioxide Monitoring Project are examples of industry and government co-operation to reduce emissions from the use of fossil fuels.

- SaskPower and Saskatchewan Environment are creating a Forest Carbon Reserve, planting five million trees. This is the first forest carbon-sequestration project in Canada to be nationally certified.

I am delighted to inform Members and the public that our government, through its power utility SaskPower, will soon begin implementation of a new *Green Power* portfolio of initiatives.

SaskPower will partner with the private sector to undertake a major expansion of wind power generation. The plan will mean a nine-fold increase in wind power generation in Saskatchewan and will be implemented over three years.

SaskPower will also welcome small-scale renewable energy proposals that generate Environmentally Preferred Power. Beginning this year, proponents will be invited to develop projects that can be fed into the provincial power grid. The first of these projects is expected to come on line in 2005.

A further SaskPower initiative will extend the Crown corporation's *Energy Solutions* program to encourage retrofits to municipal, First Nation and health care facilities – retrofits financed from energy consumption savings.

Beginning in 2003, the Office of Energy Conservation will help municipalities prepare proposals and applications to take advantage of existing energy conservation programs. The Office will also help increase industry awareness of new building techniques for energy-efficient construction and retrofitting.

Saskatchewan farmers are innovators in environmentally beneficial tillage practices that contribute to the reduction of Canada's greenhouse gas emissions, creating agricultural *sinks.* Many farmers also participate in the province's Conservation Cover Program, which converts marginal agricultural land to permanent cover, helping to sequester carbon in the soil.

Our government is disappointed that the Government of Canada has refused to recognize and credit farmers for these agricultural sinks. The federal government has apparently decided these credits will be applied to national targets rather than to the farmers and province where the sinks have been created.

Saskatchewan will insist that this unilateral federal action be a point of negotiation with the federal government.

Our government is also taking action to ensure that a number of abandoned uranium mine sites in northern Saskatchewan are properly decommissioned.

In the 1950s and 1960s, the federal government regulated all uranium mines. In contrast with today's practices, at that time the federal authority imposed no decommissioning requirements when companies ceased their operations.

Discussions have resumed with Ottawa to stress the importance of proceeding as quickly as possible to reclaim these contaminated sites. The Office of Northern Affairs will ensure that northern communities are kept informed of negotiations and will become full partners in implementing the decommissioning projects.

Our government's plan is ensuring that sustainable economic growth is accompanied by environmental stewardship – protecting our natural environment for future generations.

SECURING MEDICARE INTO THE FUTURE

Saskatchewan people have told our government that sustaining medicare, and improving our access to health services, is a high priority.

Our government's plan for strengthening health services was detailed in the *Action Plan for Saskatchewan Health Care*, made public just over a year ago. The direction and priorities of that plan were supported by the findings of the national review of health care led by Roy Romanow.

Implementation of Saskatchewan's Action Plan is proceeding in many areas:

- The transition to twelve Regional Health Authorities is complete.
- A surgical registry is being implemented to manage waiting lists province-wide.
- The contract has been let to establish a 24-hour telephone advice line.

- Increased funding is available for diabetes education, prevention and care.
- A new Northern Health Strategy is in development.
- Ambulance dispatch coordination is improved.
- Saskatchewan is taking on the giant tobacco companies and leading efforts to help de-normalize smoking among young people.
- Canada's first Health Quality Council is in place.

Last month, Canada's First Ministers agreed to several national health care priorities. These priorities will be reflected within the spending plans of our government.

The arrival of West Nile virus in Saskatchewan last year is of concern. Assistance will be provided to municipalities to increase mosquito control in regions where spread of the virus is predicted to occur.

The province will continue to work with Regional Health Authorities, training institutions and professional organizations to support the training, retention and recruitment of health care professionals. To that end, Saskatchewan Health provided more than 400 health professional training bursaries last year.

Three thousand people will be participating in health professional training in Saskatchewan this year. In addition, more than 1,700 persons will receive home care and special care training.

I am particularly pleased to report that northern residents are taking advantage of a new northern health sciences and nurses training program. Forty additional seats were recently announced as part of the northern program, based in Prince Albert. This increases the number of first-year nurse training positions in Saskatchewan to 300.

During this session of the Legislature, the interests of health professionals will be addressed through several legislative proposals. These will pertain to the status of Podiatrists, Occupational Therapists, Pharmacists and Registered Nurses.

Saskatchewan pioneered both publicly administered hospitalization and medicare in North America. Our government's plan will ensure that quality health care is available to all.

SECURE FAMILIES AND VIBRANT COMMUNITIES – FOUNDATIONS OF OUR FUTURE

Within our vision of a wide open future for Saskatchewan, our government believes that secure families and vibrant communities are fundamental to the well being of our people and our province.

Our government's plan to protect and enhance Saskatchewan's quality of life includes support for families and communities.

Saskatchewan's *Building Independence* program continues to reduce the number of families reliant on social assistance. The Saskatchewan Employment Supplement, Child Benefit, Family Health Benefit and a strong economy have assisted thousands of people to enter the labour force – building their sense of independence and self-worth.

More than 6,000 families have left the social assistance caseload since these programs were introduced.

All Saskatchewan families have benefited from reductions in provincial income tax rates and increases in tax credits.

Affordable housing also contributes to secure families and vibrant communities.

The province's Centenary Affordable Housing Program was launched last year with construction of 124 units for seniors and northern families. Plans are now in place for almost 1,400 additional housing units to be built during the next four years.

Saskatchewan citizens living in condominium homes have identified a significant property tax issue. Legislation to provide for the assessment of individual units will be presented to the Assembly.

Safety and security are of importance to all.

This month, extension of Saskatchewan's 9-1-1 emergency service will reach 95 per cent of the phone lines in the province. During 2003, further extensions will occur in the North and the Lloydminster area.

Internationally, security concerns have been heightened since the events of September 11, 2001. Legislation will be introduced in this Assembly to ensure Saskatchewan authorities are able to respond quickly should any threat to public safety confront our communities.

The federal government's *Youth Criminal Justice Act* will come into effect this April, replacing *The Young Offenders Act*. New legislation will be necessary to facilitate administration of the Act.

The federal legislation places greater emphasis on rehabilitation and community re-integration. But it also targets interventions for the most serious offenders.

Our government, working with Regina's City Police, has had significant success with this approach as part of the Regina auto theft strategy. Targeted crime-reduction strategies are now being developed with the cities of Saskatoon and North Battleford.

These initiatives, together with plans to increase resources for our police services, will help ensure greater family and community security.

A number of studies have documented that professional firefighters can experience higher rates of particular diseases as an occupational hazard. The government agrees with the Saskatchewan Professional Fire Fighters Association that an amendment to *The Workers' Compensation Act* is warranted to ensure such diseases are covered under the Act.

Occupational hazards are a primary reason why Saskatchewan and Canada continue to experience unacceptable levels of workplace injuries and illness. During 2003, Saskatchewan will expand its education program to prevent workplace accidents.

Occupational Health and Safety officers will undertake detailed reviews of at least 300 high-risk work places and conduct 3,000 on-site inspections to ensure awareness and enforcement of occupational health and safety regulations.

This year, our government will publish an *Action Plan for Saskatchewan Women*. The plan will guide government departments in facilitating improvements in the social, economic and cultural status of Saskatchewan women and their families.

Governments must be responsive when intervention is necessary to support children and families. Changes to *The Child and Family Services Act* will be proposed to recognize the importance of kinship care as a first option in these circumstances.

During the past several years, the social services system in Saskatchewan has changed its emphasis from that of a traditional welfare agency to one that promotes independence through a variety of supports for families and individuals. To recognize that change, the department of Social Services will be renamed the department of Community Resources and Employment.

Members will be asked to consider additional revisions to legislation governing municipalities. These legislative changes will further strengthen municipal authority for municipal affairs, while addressing a number of administrative requirements.

Members will also be asked to continue provincial initiatives that provide support for municipalities:

- Revenue-sharing grants, which help communities avoid or limit property tax increases.
- Grants in lieu of taxes for provincial government properties located in municipalities.
- Cost-shared programs that assist in meeting infrastructure needs.
- Capital grants to provide transportation services to persons with disabilities.
- Grants and contracts that enable community-based organizations to deliver front line programs – from women's shelters to small business loan associations, from child care services to mental health groups.

The new fiscal year will mark the completion of the government's four-year Centenary Fund program. The Fund will have provided more than $100 million for new school and university construction, highway and road projects, park and heritage property improvements, municipal infrastructure, social housing and environmental clean-up projects.

Support for families and communities is also the purpose of the Saskatchewan Lotteries Agreement, which directs lottery proceeds to more than 12,000 sports, recreation, cultural and community groups across the province.

The Community Initiatives Fund distributes a portion of casino proceeds to groups providing services to families and children. Our government will significantly increase allocations from the Fund this year to support communities preparing to mark the province's centennial in 2005.

The Fund will support community-based projects and events that:

- Celebrate the centennial;
- Improve community cultural and recreational facilities;
- Increase physical activity as a means to better health; and
- Assist Métis and First Nations youth and families to access cultural, sport and recreation activities throughout the province.

Details about these new grant programs and current planning for our centennial year will be announced in the near future.

The government recognizes that volunteer work is key to our quality of life in communities large and small. Saskatchewan people continue to lead the nation in volunteer activity.

Last year, the *Premier's Voluntary Sector Initiative* developed a framework for partnership between the Government of Saskatchewan and the voluntary sector.

During this session, the government will act on recommendations in the framework, including the introduction of legislation to address liability issues for directors of voluntary boards and committees.

Secure families and vibrant communities ... the essence of our quality of life in Saskatchewan.

Events in our world today remind us of the precious peace and security we enjoy in Saskatchewan and Canada. Today we are mindful of our own citizens who are called to serve with our country's armed forces. Today we join with the hopes and prayers of those who seek peace, justice and security for all nations and peoples of our world.

MR. SPEAKER, MEMBERS, CITIZENS:

Our government has a vision and a plan that meets our shared aspirations. The plan is balanced. It is sustainable. It is a plan that works – generating results for our economy, enhancing education and training, protecting our environment, improving health care, and supporting our families and communities.

Our government is implementing its plan by working with, and responding to, the people of Saskatchewan – industries and the business community, professional associations and organized labour, municipalities, First Nations, northern and Métis communities, and volunteer organizations.

It is a vision and a plan that ensures a future of opportunity – a future wide open.

I want to thank our guests for joining us today for the start of the new session.

I want to thank Mr. Speaker and the Members of this Assembly for assuming duties and responsibilities on behalf of the people of Saskatchewan. I trust that Divine Providence will guide your deliberations and decisions in the best interests of all our citizens.

God bless Saskatchewan. God bless Canada. God Save the Queen.

APPENDIX "D"

U.S. legislation concerning firefighter/cancer presumptions (as of 7/10/02)

Oklahoma	cancer	1981	
Illinois	cancer	1983/8	
Maryland	types[1]	1985	
Rhode Island	cancer	1986	
Nevada	cancer	1987	
Minnesota	cancer	1988	
New Hampshire	cancer	1989	
Massachusetts	cancer[2]	1990	
New Jersey	cancer	1990	
Alabama	cancer	1990	
North Dakota	cancer		
California	cancer		onus of proof relaxed 1999
Virginia	types[3]	1994	
Nebraska	cancer	1996	
Arizona	types[4]	2001	
Louisiana	lung		
Oregon	lung		
Washington	lung		
Missouri	lung		
Wisconsin	lung		
South Carolina	lung		
Michigan	lung		
Maine	lung		
Hawaii	lung		
Iowa	lung[5]		
Tennessee	lung		
Pennsylvania	lung[6]		

nb. According to a 13/5/02 Arizona report, Arizona is the 18th state to provide presumptive firefighter/cancer benefits. In the same report, there is a note that 20 states have firefighter/cancer presumptions, 38 have heart and lung legislation, and 8 have infectious disease presumptions.[7]

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[1] throat, prostate, rectal, pancreatic, leukemia
[2] skin, cns, lymphatic, digestive, hematological, urinary, skeletal, oral, prostate, lung & resp.
[3] as of 1994, leukemia, pancreatic, prostate, rectal, and throat cancers; as of 2000, ovarian and breast cancers added
[4] brain, bladder, rectal, colon, lymphoma, leukemia, lung
[5] legislation to include cancer was introduced in 2002
[6] legislation adding cancer passed House 1/5/02 and referred to Senate
[7] Federal legislation was introduced in 2001 in the U.S. House to provide for cancer presumptions, among others