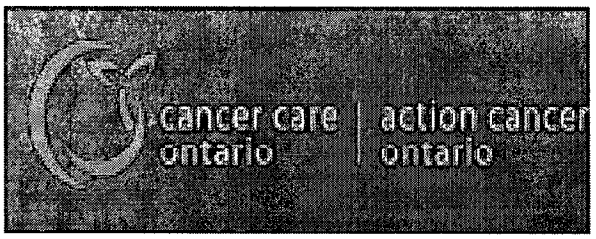
Final report of

The Occupational Cancer Research and Surveillance Project

A joint venture of:



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June 2002 – December 2005

(Revised January 24, 2006)

THE OCCUPATIONAL CANCER RESEARCH AND SURVEILLANCE PROJECT

Based at Cancer Care Ontario, 620 University Ave, Toronto, ON M5G 2L7

December, 2005

This Report was written by:

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Occupational Cancer Research and Surveillance Project: Steering and Advisory Committees

Steering Committee Members

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Dr Loraine Marrett, Senior Scientist and Director, Surveillance	Cancer Care Ontario
Dr Terry Sullivan, CEO and President	Cancer Care Ontario
Dr Eric Holowaty, Senior Scientist and Director, Informatics Research & Development	Cancer Care Ontario
Dr Nancy Kreiger, Senior Scientist and Director, Research	Cancer Care Ontario
Ms Claire Marie Fortin, Director, MODP (Medical & Occupational Disease Policy)	Ontario Workplace Safety and Insurance Board
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Advisory Committee Members*

Dr Anthony Miller (Chair), Professor Emeritus, Department of Public Health Sciences	University of Toronto
Mr Roland Hosein, VP Environmental Health and Safety	General Electric Canada
Mr Reinhard Dumschat, Senior Industrial Hygienist	Imperial Oil Limited
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*Drs Payne, Marrett and Sullivan (Cancer Care Ontario) provided Project Liaison Support to the Advisory Committee.

Executive summary

THE OCCUPATIONAL CANCER RESEARCH AND SURVEILLANCE PROJECT

At present there is no integrated information in Ontario on the burden of occupational exposures and occupational cancer. As a response to this gap in knowledge of even the scope of the problem, the provincial cancer agency, Cancer Care Ontario (CCO), and the Ontario Workplace Safety & Insurance Board (WSIB), partnered to sponsor the '**Occupational Cancer Research and Surveillance Project' (OCP)**, a demonstration/pilot project running from June 2002 to December 2005.

The OCP focused heavily on surveillance measures, deemed more fitting to maximize output and lay the groundwork for future research work in the short life of the pilot project. Staff members were overseen by a CCO senior scientist, a six-member steering committee, and a nine-member advisory committee. Project work centered around six key objectives, and a summary of these plus recommendations and future directions are found in the following table.

Summary Table of Projects and Recommendations by Objective, and Future Directions/Vision

Objective	Projects	Recommendations
1. To evaluate occupational cancer surveillance opportunities via the Ontario Cancer Registry (OCR) and other sources	Surveillance options discussion and paper Workshop: occupational cancer surveillance	Options to facilitate occupational cancer surveillance: ▪ Use of census data ▪ Use of population surveys ▪ Cohort follow-up of Ontario study groups Workshop Outcomes/Recommendations: ▪ Focus on a few well-known carcinogen exposures ▪ Use data sources already available (WHMIS, MSDS, DSR) ▪ Recognize the importance of funding both surveillance and research ▪ Linkage and cohort studies valuable ▪ Learn from other jurisdictions with track records in this area ▪ Define overall strategy to set priorities for both surveillance and research
2. To design, develop and implement new surveillance systems for occupational cancers and carcinogens	CAREX as an occupational carcinogen exposure surveillance tool Occupational exposure among youth	Continued development of CAREX as a tool for occupational carcinogen exposure surveillance in Ontario, using improvement tools: ▪ Ministry of Labour workplace carcinogen exposure data ▪ Detailed Census information (occupation distribution within industry)

Objective	Projects	Recommendations
3. To profile types of cancers by communities/regions to identify areas of potential concern to the WSIB. 4. To collect cases related to mesothelioma and angiosarcoma, two cancers known to be caused by exposure to certain occupational carcinogens.	The burden of mesothelioma in Canada related to asbestos use The burden of occupational cancer/burden of mesothelioma in Ontario Evaluation of the Ontario Cancer Registry (OCR) as a mesothelioma surveillance tool	▪ Develop a notification system to increase the likelihood that newly diagnosed mesothelioma patients with a legitimate claim to compensation will receive such compensation ▪ Prioritize ongoing surveillance of asbestos use and mesothelioma ▪ Focus on improving awareness of mesothelioma as a potentially compensable cancer ▪ Study OCR source record adequacy to determine utility of the OCR as a mesothelioma surveillance tool
5. To develop risk assessment and risk communication programs (outreach)	Increasing interest, visibility and communicating information Risk assessment (ties in with Objective #2) Production of Cancer Facts	▪ Continue to develop stakeholder relationships and network for knowledge exchange among experts ▪ Continue community outreach to increase awareness of the importance of the field
6. To establish/maintain a comprehensive occupational cancer research program	Risk of cancer among Ontario uranium miners Firefighters and cancer risk Expert panel report on screening guidelines for asbestos-related lung diseases	▪ Develop a research focus in the area of occupational cancer at CCO

Future Plans and Vision	Complete manuscripts-in-preparation Complete ongoing projects as noted above: ▪ Further development of CAREX ▪ Burden of mesothelioma in Ontario and evaluation of the OCR as a mesothelioma surveillance tool ▪ Burden of occupational cancer in Ontario Mesothelioma, asbestos exposure and workers' compensation: ▪ Development/implementation of a mesothelioma physician notification system ▪ Periodic re-linkage of OCR-WSIB databases ▪ Review of mesothelioma cases (chart review) ▪ Projections of future mesothelioma burden Systematic approaches to occupational cancer surveillance in Ontario: ▪ Use of CAREX for occupational carcinogen exposure surveillance ▪ Linkage of census and cancer mortality/incidence data ▪ Inclusion of workplace exposure questions on the Canadian Community Health Survey ▪ Follow-up of selected Ontario cohorts (i.e. uranium miners) Development of a research agenda: ▪ Recruitment and training of researchers to provide leadership in the field including: ▪ Recruit a scientist (In process at CCO) ▪ Secure infrastructure support for the scientist ▪ Network with research community for funding/collaboration opportunities ▪ Secure research project funding
Conclusions	There is a strong need for continued support for occupational cancer work at Cancer Care Ontario. The organization is ideally suited for this due to its dedication evidenced by stakeholder relations, commitment to funding a scientist, the placement of occupational cancer on its target agenda, links to occupational disease research groups, committee memberships, housing of the Ontario Cancer Registry, and many other factors demonstrating commitment and leadership in the field.

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1. Background

Occupational exposure to carcinogens is an important and preventable cause of cancer. A carcinogen can be defined as a substance that causes cancer under certain circumstances, or raises the risk of developing a cancer. Such exposure may initiate the occurrence of cancer or make it happen faster than without the exposure. (Siemiatycki, 1991) Only two specific types of cancer are almost always linked to occupational exposure: mesothelioma (asbestos) and liver angiosarcoma (vinyl chloride). (Shaw, 1981)

Although some have tried to estimate the burden of cancer that may be due to occupational exposure to carcinogens, there is no consensus about what the actual burden is. Reasons for this include the lack of definitive research, the long latency between exposure and cancer development, the mixed nature of both workplace exposure and cancer causation (multiple exposures in the workplace and multiple causes of cancer), the variation in specific workplace exposures over time and place, and the poor validity and reliability of the methodology used to assess exposures, resulting disease processes and estimates of burden. (Mannetje et al, 2003; Kauppinen, 1994)

There are also wide variations in published estimates of the general disease burden attributable to occupational agents, largely for the same reasons as noted above. (Sun et al, 2003; Mannetje et al, 2003; Siemtiatycki, 1991) An estimate produced by Leigh et al (1999) predicts 10.7 million new cases of occupational disease worldwide each year, about 190,000 of which would be cancer. However, it is likely that illness and death from occupational disease – including cancer - are significantly underestimated by available data sources in Canada. Inadequate primary care physician training, reporting, collection and publication of data contribute to this underestimation, as does the influence of liability factors including industry and workers' reluctance to disclose/take action regarding potential risk. (Kraut, 1994) It appears likely that fewer than 10% of occupational cancers are compensated, due mainly to the lack of compensation claims being submitted as opposed to claims being rejected. (Teschke & Barroetavena, 1992)

At present there is no integrated information in Ontario on the burden of occupational carcinogen exposures or occupational cancer or about the proportion of cancer cases attributable to occupational exposures.

Ontario has no routine systematic means of linking cancer incidence, employment, industry and occupation, with workplace exposures.
This information is needed:

- **To estimate the burden of occupational cancer in the province**
- **To promote early recognition and elimination of work-related illness and death**
- **To set research and prevention priorities**
- **To inform program and policy development**

As a response to the obviously pressing need to better document the scope of the occupational cancer burden in Ontario, the provincial cancer agency, Cancer Care Ontario (CCO), and the Ontario Workplace Safety & Insurance Board (WSIB), partnered to sponsor the '**Occupational Cancer Research and Surveillance Project' (OCP)**, a three-year demonstration/pilot project running from June 2002 to May 2005 (subsequently extended to December 31 2005).

This report describes the development of the OCP, including infrastructure and workscope, the main projects undertaken and the outputs produced. The latter will be detailed within the framework of the project objectives as established by WSIB and CCO at the outset. The report concludes with recommendations for ongoing work in the field of occupational cancer research and surveillance in Ontario.

2. Infrastructure

The Division of Preventive Oncology at CCO provided a physical home for the project, and **Dr Loraine Marrett**, Senior Scientist and Director of the Surveillance Unit, provided general oversight throughout. Other scientists (Drs. Nancy Kreiger, Eric Holowaty and Terry Sullivan) served on the OCP Steering Committee. Being based at CCO, the project staff benefited from interactions with other staff in Preventive Oncology, particularly in the Surveillance and Research Units, with whom they were able to exchange knowledge and expertise. Establishing links with external stakeholders (i.e. unions, Health and Safety committees, etc) and building capacity were important components of the OCP. These are described in more detail below.

2.1 Financial resources

Each sponsoring agency contributed $150,000 annually for three years, for a total project funding of $900,000. The financial statement is located at the end of this report.

The OCP was also successful in securing external funding: the scientists were awarded a Doctoral training fellowship from the Program of Research on Environmental and Occupational Etiology of Cancer (PREECAN), funded by the National Cancer Institute of Canada to support the program of a PhD student (Mr. Do). A grant application submitted in the project's third year yielded funding for Mr. Do's PhD research through the Canadian Institute for Health Research (CIHR), with co-funding from the WSIB separate from the OCP budget. Additionally, funding was awarded to scientists affiliated with the OCP to conduct a meta-analysis of cancer and the occupation of firefighting for the BC Workers' Compensation Board. This work was undertaken in part because it meshed so well with the intent of the OCP and the expertise of OCP staff. It was partly conducted within the OCP (i.e., with some resources purchased from OCP)

2.2 Human resources

The OCP consisted of the following staff members:

STAFF OF THE OCCUPATIONAL CANCER RESEARCH AND SURVEILLANCE PROJECT	
Dr Jennifer Payne, PhD	Scientist and OCP Manager (June 2002 – June 2005, 0.8 FTE; on maternity leave January – July 2004)
Ms Ruhee Chaudhry, MSc	Senior Research Associate (June 2003 – November 2004 1.0 FTE)
Ms Bronwen Waller, MHSc	Research Associate (December 2002 – ongoing; ~1/2 @ 0.4 FTE, 1/2 @ 1.0 FTE)
Ms Erin Pichora, MSc	Research Associate (September 2004 – ongoing, 1.0 FTE)
Ms Anisha Abreo, BSc	Junior Research Associate (October 2004 – June 2005, 1.0 FTE)
Mr Minh Do	Research Associate and PhD candidate (September 2002- ongoing, variable time)
Ms Ahalya Mahendra, MHSc	Practicum student (May 2003 – August 2003); Junior Research Associate (May 2004 – June 2004)
Ms Tanya Cecic/Ms Yen Borrego	OCP Administrative Support Staff

Dr Paul Demers, a trained hygienist and epidemiologist affiliated with the School of Occupational and Environmental Hygiene at the University of British Columbia (UBC), joined the Program as a Visiting Scientist, a first for the Division of Preventive Oncology at CCO. He spent a total of 5 weeks in Toronto during the winter of the project's second year. Dr Demers acted as mentor to staff, provided leadership in the development of a collaborative British Columbia-Ontario project (CAREX, see description under new surveillance systems) and provided advice regarding other aspects of project work. The partnership with Dr Demers of UBC has allowed sharing of expertise between occupational epidemiologists at both UBC and CCO. He is now an adjunct scientist for CCO, to recognize his ongoing role in the OCP.

The OCP supported and/or supervised several trainees: Minh Do, a PhD student working primarily on the Ontario Uranium Miners' project (see later); Ahalya Mahendra, an MHSc candidate who joined the OCP for a practicum placement; and Joy Angeles, an MSc candidate whose external thesis advisor is Dr Loraine Marrett, an OCP-associated scientist.

Regular liaison between project staff and WSIB was assured through the formal involvement of Ms Alice Peter and Ms Claire-Marie Fortin as members of the OCP Steering Committee; they additionally were available to give advice or other forms of support as required. Other WSIB staff supported specific project components – e.g., Ms Carol Luce and Mr Glen Farr in the area of data access and management.

Important connections with other scientists working in the field were made throughout the project's span, including the potential for partnering with the Center for Research Expertise in Occupational Disease (CREOD), the Ontario Ministry of Labour

through the use of some sampling data from their occupational carcinogen exposure database, and contracts with Ms Martha Fair, formerly of Statistics Canada, and the Workers' Compensation Board of British Columbia. These interactions are expanded on further when specific projects are discussed.

2.3 Steering and Advisory Committees

The project team's work was overseen by a six-member Steering Committee representing both sponsoring agencies. An Advisory Committee was composed of individuals representing various stakeholder communities, and provided both advice and a forum for wider dissemination of project findings.

2.3.1 OCP Steering Committee

The OCP Steering Committee was formed prior to the project's beginning for the purpose of providing support and direction to the project team. Members consisted of representatives from CCO and WSIB, and the committee was chaired by the Provincial Vice-President, Prevention & Research. Primary purposes of the committee included assisting the team in the development of project goals and associated timelines, as well as problem solving, overcoming barriers, and allowing the two sponsoring agencies a forum for discussing priorities and dissemination of project output. The full steering committee met four times a year, and members were available for consultation at any time. The full terms of reference and membership can be found in Appendix A.

2.3.2 OCP Advisory Committee

The Advisory Committee was formed during the project's first year. Its composition was established to provide the project with linkages into key stakeholder communities. Such linkages are important to facilitate two way communication on an ongoing basis: the project needed a mechanism for disseminating information to stakeholders, in terms of both findings and identified priority areas, and for getting input from knowledgeable stakeholders to ensure the relevance of its work. The committee was chaired by Dr. Tony Miller, an eminent cancer researcher and Emeritus Professor at the University of Toronto. The membership had equal representation of labour, employer, researcher and other stakeholder groups. Meetings were held approximately twice a year, and members were available for consultation at any time. The full terms of reference and membership can be found in Appendix B.

3. Project objectives and scope

3.1 Objectives

Upon establishment of the OCP, the two funding bodies established a set of broad objectives for the project:

1. To evaluate occupational cancer surveillance opportunities via the Ontario Cancer Registry (OCR) and other sources

2. To design, develop and implement new surveillance systems for occupational cancers and carcinogens

3. To profile types of cancers by communities/regions to identify areas of potential concern to the WSIB

4. To collect cases related to mesothelioma and angiosarcoma, two cancers known to be caused by exposure to specific occupational carcinogens

5. To develop risk assessment and risk communication programs (outreach)

6. To establish/maintain a comprehensive occupational cancer research program

3.2 Development of project scope and foci of work

There were three underlying principles guiding development of the scope and foci of OCP work within these broad objectives. First, because of the limitations inherent in a demonstration pilot of fixed and fairly short (three-year) duration, and the need to maximize output to demonstrate 'proof of principle' and value, the decision was made to focus on development of ***surveillance*** initiatives and exploration of how these could inform research priorities, rather than development of in-depth research endeavors. This decision recognizes the longer time frame and greater resources required to initiate and complete research, compared to surveillance, projects. It also takes advantage of the facts that CCO is custodian of the Ontario Cancer Registry (OCR), and that CCO staff are very knowledgeable about the content, strengths and limitations of the OCR. The OCR is a passive population-based registry including information on all cancers diagnosed in Ontario residents since 1964. It therefore comprises a logical base for conducting occupational cancer surveillance. This is why exploration of various ways to use the OCR for occupational cancer surveillance was in fact identified as the first OCP objective (section 3.1).

Project work focused on two main substantive/methodological surveillance areas that were particularly relevant and important to Ontario workers: description of the burden of mesothelioma, and development of a carcinogen exposure surveillance tool (CAREX).

Second, the OCP placed a major emphasis on capacity-building and outreach, recognizing the general lack of surveillance and research activity in the area of occupation and cancer, and of knowledge about the importance and role of workplace exposures in the development of cancer. This is a recurring theme through project work and this report.

Products and outputs are identified for each project and are included in Appendices attached to this report.

Third, flexibility was a key instrument allowing the project to be shaped or redirected in response to priorities of stakeholders and the funding organizations or on the basis of demonstration of feasibility, and to capitalize on opportunities that arose unexpectedly during the project. Due to its existence and profile, the project was requested to assist the Workers' Compensation Board of British Columbia (via a contract) with a review, and the Ontario Ministries of Health and Long Term Care and Labour as part of an Expert Panel. Work resulting from these external projects is described briefly in the report.

3.3 Occupational cancer surveillance

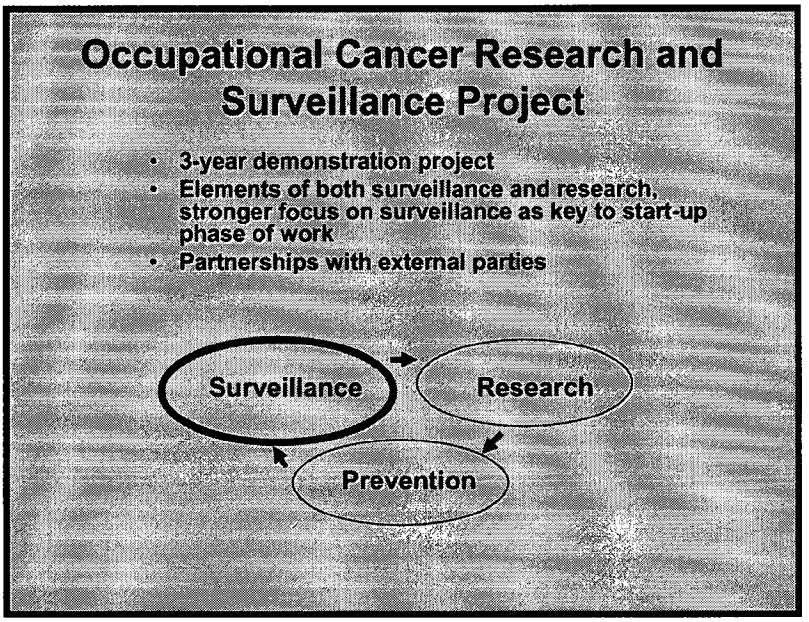
The purpose of surveillance is to describe, for illnesses/injuries:

- Where are they occurring
- How frequently
- Are they increasing or decreasing in frequency
- Are prevention efforts working?

The goal of surveillance is to collect, analyze and interpret the above information to monitor and reduce health problems, aiming to promote health. (Health Canada, 2003)

Occupational cancer surveillance specifically can be defined as "The systematic collection, evaluation and dissemination of data relating workplace exposures to disease or mortality, with the ultimate aim of reducing or preventing excess risk." (Baker et al, 1989)

Surveillance is a key component of an iterative process that includes research and prevention: surveillance can identify a potential problem and quantify it (e.g., monitoring of asbestos workers can estimate the incidence of mesothelioma and suggest that it is a possible concern); research can then be undertaken to confirm the link (e.g., between asbestos exposure and mesothelioma) and to quantify the magnitude of the association; prevention can then be undertaken to reduce or remove the exposure and thereby reduce the burden of disease.



4. OCP projects

The specific projects undertaken by the OCP will be described within each of the objectives noted above.

4.1 Objective 1: Evaluation of occupational cancer surveillance opportunities through the OCR and other sources

To address the issue of cancer surveillance as a whole, two main activities were undertaken.

4.1.1 Review of surveillance options

First, CCO members of the OCP Steering Committee and selected outside experts, including some members of the advisory committee, developed a list of some general surveillance options warranting further investigation. (Several of these will be explored in detail in this report.) The OCP then contracted Ms. Martha Fair, recently retired Head of Statistics Canada's Occupational and Environmental Health Research Unit, to prepare a report reviewing five of the most promising options (in its entirety: Appendix C).

Ms Fair, in her review, recommended some options for systematic occupational cancer surveillance as worthy of further investigation. Brief descriptions of the three deemed most feasible and valuable for future work follow. The other two options that she reviewed are then discussed briefly, with reasons they are not recommended.

4.1.1.1 Use of census data: linkage of census and cancer mortality/incidence data

Statistics Canada, in collaboration with researchers in Ontario (including Loraine Marrett, Cancer Care Ontario), have conducted pilot studies utilizing census data for occupational health surveillance. This option builds on this earlier work, and a currently funded and approved mortality-census linkage project (R Wilkins, J-M Berthelot, C Mustard, et al., Principal Investigators). Mortality follow-up of three out of four long form questionnaires from the 1991 Census and the 1991 post-census Health and Activity Limitation Survey, for the population aged 25 and over, is being carried out by Statistics Canada. These data can be used for surveillance and monitoring of cancer causes of death in relation to occupation and industry through producing a set of baseline indicators (e.g. age-specific and age-standardized rates of cancer by occupation and industry groups).

It is further recommended that the possibility of linking the census cohort with cancer incidence data for Ontario (i.e., from the OCR) be evaluated. If deemed feasible (in terms of sample size, budget, etc.), this would require that a new application-to-link be prepared and submitted Statistics Canada, and that funding be secured.

4.1.1.2 Use of population surveys: Collection and use of health survey data

There are two aspects to this option: one would link cancer incidence/mortality data to survey data that are available for Ontario and/or nationally, such as the 1990 Ontario Health Survey, the National Population Health survey, including provincial supplements, the Canadian Community Health Survey, the proposed Canadian Health Measures Survey, smoking surveys, and related business surveys; the other would involve collection of new data as part of routine surveys.

With respect to the first aspect, of particular interest is the potential for following up the individuals in 1990 Ontario Health Survey (OHS) and the second large 1996/97 Ontario Health Survey that was part of the 1996/97 National Population Health Survey (NPHS) by linkage with the Ontario Cancer Registry and Ontario mortality data. Provided that the identifying information are of sufficient quality and quantity for the linkages, and that sample sizes are deemed adequate, Ms Fair recommended that further work be carried out to review the possibility (legal and feasibility) of conducting the linkages.

With respect to the second aspect, Statistics Canada is currently consulting widely about content for the ongoing Canadian Community Health Survey. The Canadian Association for Research in Work and Health (CARWH) is encouraging members to recommend inclusion of a module about workplace exposures. Data would be by self-report.

4.1.1.3 Follow-up of Ontario cohorts: documentation of occupational cohort files

Ms Fair recommended cataloguing cohorts of Ontario workers, along with detailed descriptions of available variables, and building guidelines for development of future cohorts (outlining which variables are required and what good epidemiological practice would be recommended to ensure the timeliness, availability, and quality of cohort data for future studies). These guidelines would facilitate the capacity of Ontario industry, health departments and other agencies to conduct occupational cancer cohort studies by linking with the OCR. It could also strengthen surveillance of potential high risk industries (e.g. construction workers, miners, firefighters, radiation workers) and occupations, including within special populations (e.g. women, immigrants).

Cohorts of particular interest are those that have been used in linkages in the past (e.g., nickel workers, radiation workers, Ontario miners, asbestos workers), those with exposure and physical measurements available, and long follow-up periods.

4.1.1.4 Other options

The two other options reviewed by Ms Fair (use of administrative death records and follow-up on the sample of 10% of the labour force) are not recommended for future work. Collection and use of occupation and industry data on administrative death (or cancer registry records) is expensive. Even if such data are routinely collected, such as is the case on Ontario death certificates, computerizing and coding are labour-intensive. Furthermore, there is evidence that such data are of poor quality. Finally, job title and industry alone are insufficient to determine workplace exposures. Thus, additional data must be collected (or exposure assumptions made).

Further follow-up of the 10% labour force sample is not recommended because these data represent workers and jobs in the late 1960s and 1970s. Workplaces and workplace exposures have changed considerably since that time.

Five Options to Facilitate Occupational Cancer Surveillance (M Fair, 2004):

1. **Use of census data***
2. **Use of population surveys***
3. **Use of administrative death records**
4. **Cohort follow-up of Ontario study groups***
5. **Follow-up on sample of 10% labour force**

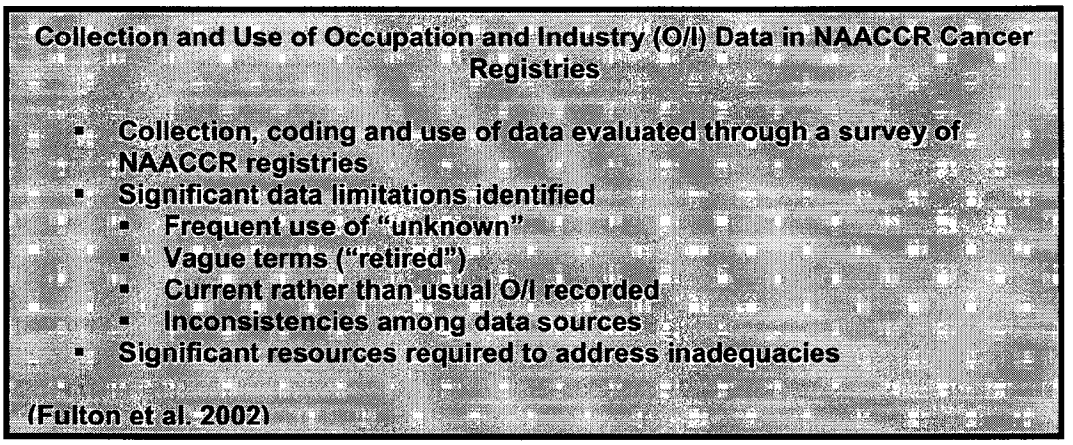
*** Most feasible options**

4.1.2 Occupational Cancer Surveillance Workshop

As a second surveillance-focused venture, the OCP hosted a workshop in Toronto on February 1-2, 2005 to provide an opportunity for stakeholders to learn about and discuss occupational cancer surveillance options. The workshop included speakers with experience in both research and surveillance in the area of occupational cancer from across Canada. Objectives were:

- To assemble interested stakeholders representing a broad range of both institutional affiliations and disciplinary backgrounds;
- To provide participants with information on occupational cancer surveillance work accomplished to-date in Canada; and
- To provide opportunities for participants to engage in small-group interactions in the process of developing surveillance priorities.

One of the workshop presentations addressed the feasibility of the frequently recommended surveillance option of collecting occupational history of patients in the Ontario Cancer Registry (OCR). Specifically, results of a survey of its member registries conducted by the North American Association of Central Cancer Registries (NAACCR) in 2001, concluded that even when industry and/or occupational information was collected for new cancer cases, data quality was very poor, suggesting that significant resources would be required to address these deficiencies.



Workshop participants agreed that surveillance priorities should be developed as a function of what data are currently available on a few carcinogens, what is already known about exposures in relation to certain cancers, what is already known about the prevalence of certain exposures in Ontario workplaces, and what has been shown to be feasible in other jurisdictions in Canada. Data sources might include Workplace Hazardous Materials Information documentation (WHMIS; MSDS), or Designated Substances Regulations (DSR). Some key concepts arising from a discussion of priorities for surveillance vs. research included: not funding one at the expense of the other; using a common strategy to define priorities for both; and not neglecting the utility of linkage or cohort studies. The workshop provided a tool for development of priorities beyond the three-year OCP.

Occupational Cancer Surveillance Workshop: Major Recommendations

- **Focus on exposures to a few well-known carcinogens**
- **Use data sources that are already available (WHMIS, MSDS, DSR)**
- **Ensure funding for both surveillance and research**
- **Recognize value of linkage and cohort studies**
- **Learn from other jurisdictions with track records in this area**
- **Define overall strategy to set priorities for both surveillance and research**

Appendix C includes a brief report on the workshop published in Chronic Diseases in Canada (CDIC), as well as selected detailed workshop materials (agenda, list of participants and a more extensive report with results of workshop evaluation by participants).

4.2 Objective 2: Design, develop and implement new surveillance systems for occupational cancers and carcinogens

A key objective for the OCP was the initial exploration and development of a template or tool, for the purpose of occupational carcinogen exposure surveillance.

4.2.1 CAREX as an occupational carcinogen exposure surveillance tool

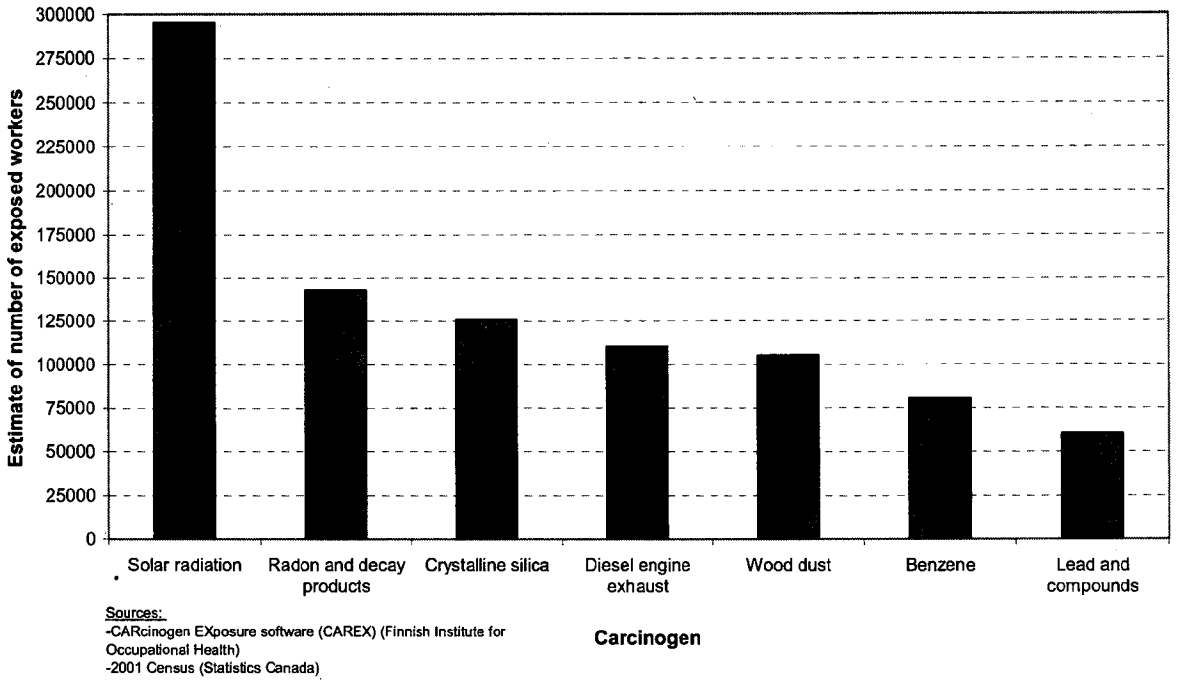
Development and evaluation of CAREX (CARcinogen EXposure) software as a tool for identifying important occupational carcinogen exposures in Ontario was the main project undertaken as part of this objective. CAREX is an Access database developed by the Finnish Institute for Occupational Health (FIOH, Kauppinen et al, 1998). It contains estimates of the numbers of workers exposed to 139 known, suspected and probable carcinogens, using labour force and exposure data from national (US and Finland) hygiene experts. By applying the exposure data from CAREX to Ontario data on the numbers of workers by industry (from the Census), crude estimates of the numbers of Ontario workers exposed to each carcinogen, by industry category, can be produced.

Findings based on these crude estimates include (Figure 1):

- The top workplace carcinogen exposures are solar radiation, radon and its decay products, silica, and diesel engine exhaust.

Figure 1

Crude estimates of numbers of workers exposed to common workplace carcinogens, Ontario 2001



Sources:
-CARcinogen EXposure software (CAREX) (Finnish Institute for Occupational Health)
-2001 Census (Statistics Canada)

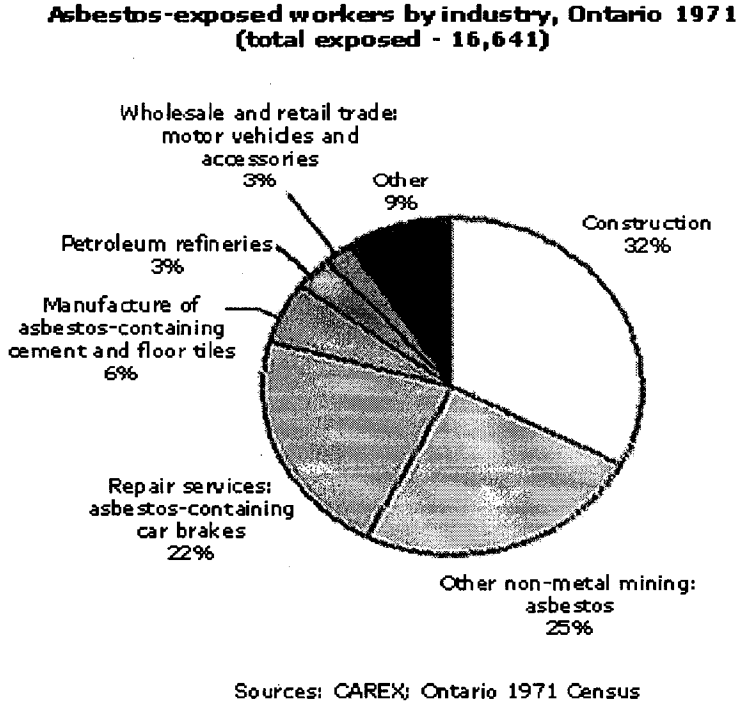
There are some major caveats associated with using these initial estimates as indicators of the current situation in Ontario: the estimates assume similar exposure circumstances and worker-within-industry distributions in Ontario now and Finland/US at the time the hygiene data were collected, approximately 15-25 years ago. Since these assumptions are unlikely to be totally correct, there is a need to "Ontario-ize" and update CAREX. To do this, the OCP joined forces with occupational carcinogen exposure expertise in British Columbia by appointing Dr Paul Demers as a visiting, and later an adjunct, scientist at CCO. Use of provincial exposure data and more detailed census information will result in the ability to produce more accurate estimates of exposure prevalences for both provinces (Ontario and BC). Specifically, two major resources that have been acquired for Ontario (with analogous data for BC) are:

1) Exposure data from the Ministry of Labour, up to the year 1996, for many of the most frequently occurring carcinogens, and
2) Detailed Ontario labour force data from Statistics Canada, of the numbers of people employed in occupations by industry, at the most precise available level.

These resources are being built into CAREX with the explicit approval of its creators, resulting in "CAREX Canada".

Development of CAREX and the collaboration with Dr. Demers is ongoing. Continued development, evaluation and implementation of CAREX is one of our central recommendations for post-OCP activities, discussed in detail later in this report. More accurate workplace carcinogen exposure surveillance is important because it can aid in the identification of priority areas for more in-depth surveillance for, ultimately, exposure reduction.

Figure 2



Sources: CAREX; Ontario 1971 Census

Appendix D includes all of the output produced to-date using CAREX: posters and presentations made at conferences, a Cancer Fact, from which Figure 2 is produced (Cancer Facts being a monthly product of CCO's Surveillance Unit which briefly profiles an aspect of cancer focusing on a specific cancer type, risk factor, exposure, etc), and a paper submitted to Chronic Diseases in Canada.

4.2.2 Occupational exposure among youth

A second much smaller venture in the area of exposure surveillance dealt with youth. Difficulties in ascertaining the burden of occupational exposures are magnified within a young (~16-24 year old) population due to several factors: the often short-term and transient nature of employment (e.g., summer jobs), increased risk/susceptibility due to psychological and behavioral factors, and incomplete physical maturation. Another potential factor is firm size, as the probability of adherence to Occupational Health and Safety regulations varies directly with the size of the firm, and youth tend to primarily work in sectors comprised of

small firms. Currently little is known of the burden of occupational exposure to harmful agents in the workplace among youth.

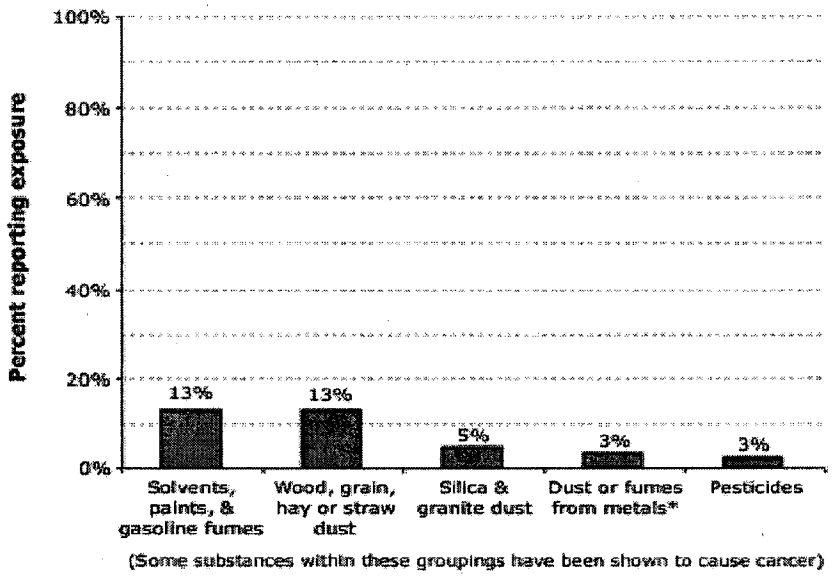
An analysis of the 1990 Ontario Health Survey (OHS) data was conducted. The OHS collected data on workplace exposure to five groups of substances through self-report. Each of these groups includes a mix of non-carcinogens and known human carcinogens.

Findings from youth occupational exposure work include:

- **The two exposures with the highest reported prevalence over 16-24 year olds were: fumes from solvents, paints or gasoline and dust from wood, grain, hay or straw (Figure 2)**
- **Youth exposed to any of these groups of occupational agents consistently reported working for the agricultural, construction or manufacturing industries**
- **Each of the groups of agents contains at least one known human carcinogen**

Figure 3

Youth 16-24 reporting harmful workplace exposures, Ontario, 1990



*Metals include lead, mercury, chromium, nickel and cadmium
Source: Ontario Health Survey, 1990

The Cancer Fact, released in November 2003 and shown in part as Figure 3, was based on this analysis, and is included in its entirety in Appendix D, along with a report detailing the analysis and findings in greater depth.

4.3 Objective 3: Regular profiles of cancers and types by communities/regions to identify areas of potential concern; and

Objective 4: Collection of cases related to mesothelioma and angiosarcoma, two cancers known to be caused by exposure to certain occupational carcinogens

Several projects arose from the OCP's endeavor to focus on a few specific work-related cancers and their profiles/characteristics. Objectives (3) and (4) are considered together because the OCP's approaches to them were so integrated.

It became clear as the OCP unfolded that exposure to asbestos and cancers related to this exposure – in particular pleural mesothelioma, which is almost a sentinel marker of asbestos exposure – constitute an important concern within Ontario occupational cancer stakeholder communities.

Mesothelioma is a cancer of the mesothelial cell, a specialized type of cell that lines the sacs containing the body's internal organs. The most common site of mesothelioma is the pleura, which lines the chest cavity and surrounds the lungs, but it can also occur in the peritoneum which encloses the abdominal organs, the pericardium which encloses the heart, or (rarely) within the ovaries and testes. It takes many years (20-40 usually) for this

cancer to develop, but it is highly fatal: half of patients die within one year of being diagnosed, with a median survival found in one study of 9 months. (Attanoos & Gibbs, 2000; Ruffie, 1989). Exposure to asbestos is the most important and well-documented cause of mesothelioma.

Mesothelioma:

- **A cancer of cells that line body cavities, most commonly found in the lining surrounding the lungs (pleura) and abdomen (peritoneum)**
- **Highly fatal; half of patients die within one year of diagnosis**
- **This cancer is strongly associated with asbestos exposure, primarily through work (e.g., construction, foundry work, petroleum industry, brake repair)**
- **Time from exposure to diagnosis is in the order of 20-40 years**

Because of the perceived importance of this topic, the OCP developed it as a major focus and undertook a number of separate but related projects.

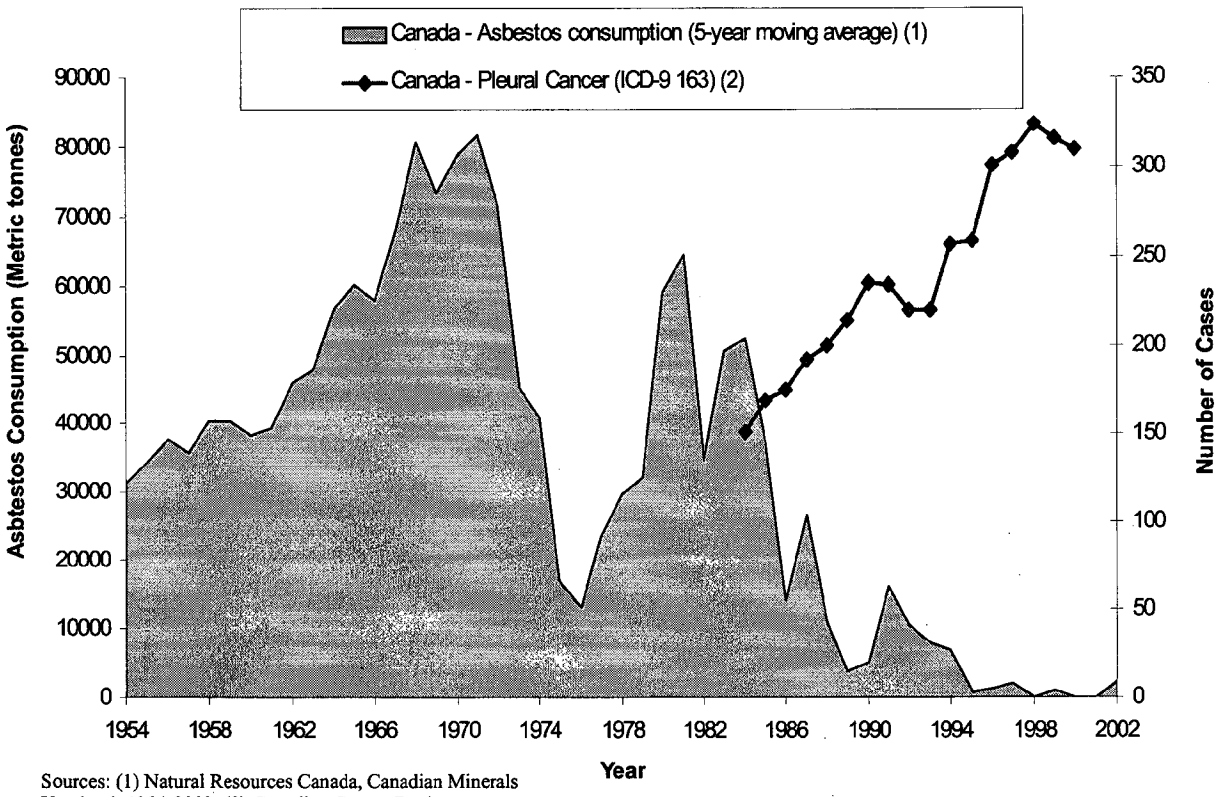
4.3.1 Burden of mesothelioma in Canada in relation to apparent use of asbestos

The objective of the first project was to describe the mesothelioma burden in relation to apparent asbestos exposure. Since there were no historical data on the amount of asbestos in use (and therefore available for human exposure) in Ontario, we used those for Canada as a whole. Asbestos was at one time mined extensively in Canada, and was also used widely in a number of industries (construction, brake linings, foundries etc) due to its heat-resistance and other valuable properties. Asbestos 'consumption' in Canada rose to a peak in the late 1960s and early 1970s and has fallen off precipitously since then (Figure 4). (The dip in 'consumption' in the mid-1970s was due to a strike in the asbestos mines in Quebec.) The number of newly diagnosed pleural cancers (most of which are mesotheliomas) has been rising since 1984, paralleling the earlier increase in asbestos 'consumption'. In 1984, there were 151 new cases of pleural cancer reported in Canada, and by 2000, the annual number had increased to 310. There is no clear indication that the peak in pleural cancers has yet been reached.

A descriptive paper on this work has been submitted to Chronic Diseases in Canada, and several conference presentations have also been made based on this material, all found in Appendix E.

Figure 4

Annual estimated apparent consumption of asbestos, 1954-2002, and number of newly diagnosed cases of pleural cancer (ICD-9 163), 1984-2000, Canada.



Sources: (1) Natural Resources Canada, Canadian Minerals Yearbook 1954-2002; (2) Canadian Cancer Registry

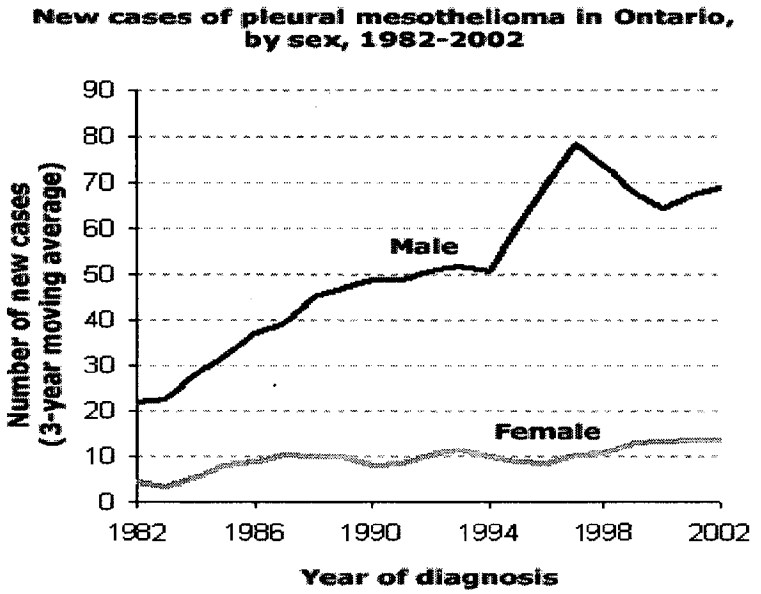
Notes to accompany Figure 4:
ICD = International Classification of Disease coding system, National Center for Health Statistics, Centers for Disease Control.
A "moving average" has smoothed out the variability which might obscure a trend.

4.3.2 Burden of mesothelioma in Ontario: a descriptive analysis based on the OCR

Ontario Cancer Registry (OCR) data have been analyzed to describe the extent, trend over time and geographic distribution of mesothelioma in Ontario.

In Figure 5, we see that the number of new cases of pleural mesothelioma in Ontario males rose from about 20 in 1982 to 72 in 2002. In females, new cases rose from fewer than 5 in 1982 to 14 in 2002. Because of the long time between exposure and disease development, we do not yet know the full extent of the effect of asbestos on the burden of mesothelioma. Surveillance of this cancer and of asbestos use must be ongoing priorities.

Figure 5



Source: Cancer Care Ontario (Ontario Cancer Registry, 2004)

Notes to accompany Figure 5:
Source: Cancer Care Ontario Cancer Fact, November 2004.
Pleural mesothelioma defined as: ICD-9 = 163 AND ICD-O = 905.
A moving average has smoothed out variability which might obscure a trend.

The Cancer Fact, released in November 2004 and shown in part as Figure 5, was based on this analysis, and is included in its entirety in Appendix E.

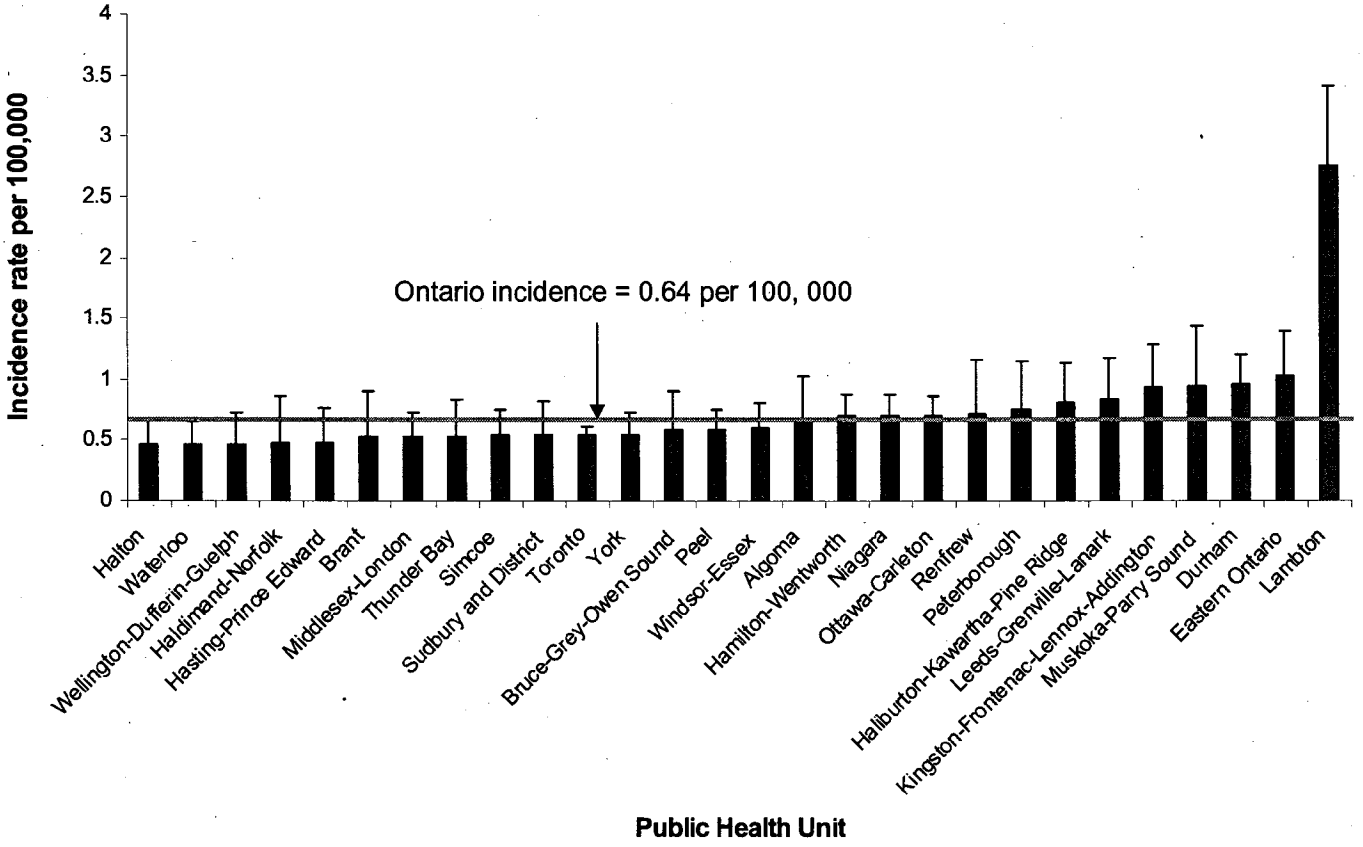
Analysis of mesothelioma incidence rates by Ontario public health unit indicate that there is an apparent clustering of mesothelioma cases in the area of Lambton County (Figure 6), which has significantly higher incidence than any other part of the province. This is not surprising, since this region was home to a number of industries involving exposure to asbestos.

These data, along with relevant documentation and "Q&As", will shortly be sent to all Ontario Medical Officers of Health (MOHs) to assist them in responding to media or other

queries when this information is publicly released (soon thereafter), and to improve awareness that those with mesothelioma may be eligible for workers' compensation.

Figure 6

Mesothelioma* age-adjusted incidence rates by Ontario Public Health Units, 1980-2002**



Notes to accompany Figure 6:
**Mesothelioma defined as: (ICD-9 163 (pleural cancer) OR 158 (peritoneal cancer)) AND morphology of mesothelioma (ICD-0 905); ICD = International Classification of Disease coding system, National Center for Health Statistics, Centers for Disease Control.*
***Age-adjusted incidence rate = number of new cases per 100,000 people, where the effects of population age differences are statistically minimized.*

Mesothelioma in Ontario:

- **Rates of mesothelioma continue to climb, primarily among males**
- **There is no evidence as yet that the peak has been reached**
- **Analysis of rates by public health unit area indicates that there is a high concentration of mesothelioma in Lambton**

4.3.3 Evaluation of the OCR as a surveillance tool to monitor the burden of mesothelioma in Ontario

There are different ways to identify mesothelioma in the OCR, and by choosing various combinations of source records and disease codes, the estimate of mesothelioma burden will differ. Within the Registry, misclassification of mesothelioma cases can occur because of either incompleteness and/or inaccuracy of the source records, as well as the decision rules that are used to resolve conflicting information. Between 1980 and 2002, a total of 1,824 cases with a mesothelioma histology were registered in Ontario. This analysis will determine what proportion of source records indicating mesothelioma histology are in fact finally resolved as mesothelioma cases. Also, the primary site distribution and validity of source records will be evaluated to investigate the quality of cases resolved as mesothelioma. The OCR needs to be evaluated as a surveillance tool based on adequacy of source records, and, if warranted, guidelines put in place to inform coding of mesothelioma cases so that they are appropriately counted as such, or discounted as such.

Preliminary exploration of this area has begun, and Appendix E contains a submitted abstract proposing a poster presentation to be displayed at the 2006 Annual Meeting of the North American Association of Central Cancer Registries.

4.3.4 The burden of occupational cancer in Ontario: Claims for workers' compensation

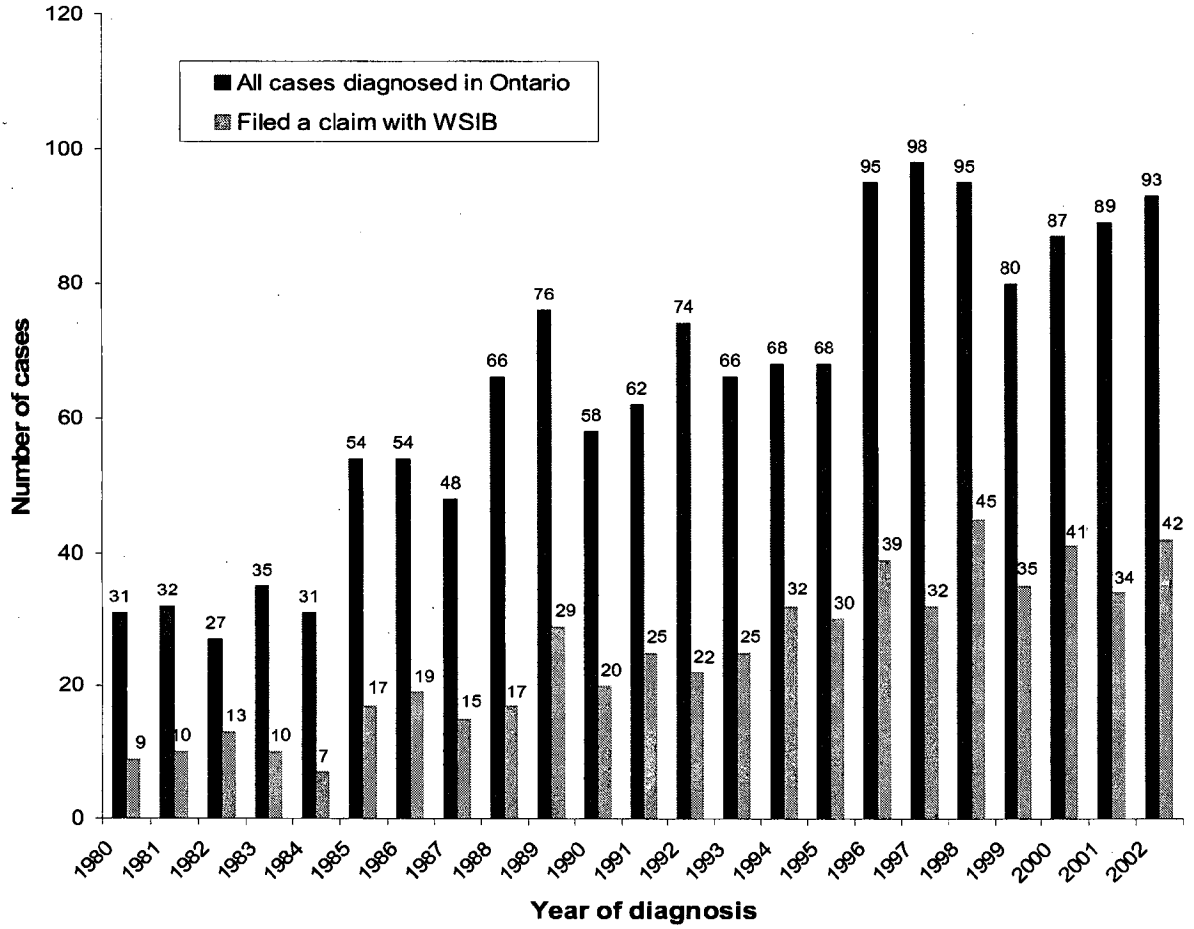
Approximately 75% of the Ontario labour force is covered by the WSIB. Occupational disease claims filed with WSIB are described in the Occupational Disease Information Surveillance System (ODISS) database, in terms of demographics, claim administration, disease, and work history. In an attempt to describe the extent of compensated occupational cancer in Ontario, data were requested from WSIB on all claims, filed through 31Mar2004, where a neoplasm (malignant or benign) was listed in at least one diagnostic field. These were linked at the person level with malignant neoplasms recorded in the OCR.

A major objective of this work is to estimate, over time, the proportion of patients with mesothelioma who have filed a workers' compensation claim. This proportion appears to have increased over time, but is still well under 50% (Figure 7) – despite the fact that the vast majority of mesotheliomas are likely due to workplace exposures to asbestos and that documentation of such exposure would usually result in a compensable claim.

These results provided, in part, the impetus for a proposed notification system for mesothelioma patients and their physicians (described in Future Directions), to increase awareness of potential eligibility for workers' compensation benefits.

Figure 7

Mesothelioma* Cases diagnosed and filed for compensation, 1980-2002



Notes to accompany Figure 7:
**Mesothelioma defined as: (ICD-9 163 OR 158) AND morphology of mesothelioma (ICD-0 905).*
Sources: Ontario Cancer Registry and WSIB's Occupational Disease Information Surveillance System (ODISS).

This project also provides the opportunity to describe trends and patterns in claims awarded compensation for other malignant neoplasms by the WSIB, as well as demographics and work exposure measures for claims filed in 1990-2003. Filing trends over time show a steady increase in the number of cancer claims awarded compensation since 1970, with lung cancer being the most common overall. More recently, mesothelioma and other cancers such as non-Hodgkin lymphoma, leukemia, and cancers of the brain, kidney and colon/rectum are starting to make up a larger proportion of compensated cancers.

Products from this section of work, including several conference poster presentations and an abstract accepted the Canadian Association for Research on Work and Health for their 2006 conference, can be found in Appendix E.

4.4 Objective 5: Development of risk communication and risk assessment programs

4.4.1 Information and risk communication

Because the project placed considerable importance on outreach and capacity-building, much effort went into building relationships with stakeholders and research colleagues (for example, union members, Health and Safety organizations, etc), making them aware of project activities and disseminating information generated by the project. Staff attended many conferences and meetings to display project work, and to generate discussion and interest. Appendix F contains presentations made based on an overview of the OCP and its projects.

As the project progressed, relatively more effort went into providing information about occupation and cancer. Multiple information dissemination vehicles were employed to promote awareness, education and interest in the field of occupational cancer. These included giving invited presentations, hosting the workshop (see section 4.1.2), producing and disseminating Cancer Facts, and preparing papers to submit for publication.

Staff also liaised with various specific organizations to gather and share information. For example, staff worked closely with the Construction Safety Association of Ontario in the development of a Cancer Fact on asbestos exposure (Appendix D) and with the Ontario Ministry of Health and Long Term Care and Medical Officers of Health on the development of an information package concerning the geographic distribution of mesothelioma incidence in Ontario (see section 4.3.2)

The Cancer Care Ontario website contains an overview of the OCP (http://www.cancercare.on.ca/documents/occupationpresentation.pdf), also found in Appendix F.

4.4.2 Risk assessment

As well as formulating a surveillance system for occupational carcinogen exposures, the CAREX work can be seen as a risk assessment venture, an attempt to quantify the risk of exposure to occupational carcinogens based on what industry someone works for, or at what occupation.

4.5 Objective 6: Establish/maintain a comprehensive occupational cancer research program

As noted earlier, the research activities of the OCP were deliberately less developed than the surveillance ones. However, a research application was prepared by project staff early in 2005 and funding was awarded. This work could be considered "surveillance research" as it proposes to estimate the relative burden of cancer in a particular occupational group in Ontario: uranium miners.

4.5.1 Risk of cancer among Ontario Uranium miners

In some areas of Ontario, uranium mining was very prevalent throughout the 1950s. Uranium was since discovered to be a human carcinogen, and the population of miners has been followed in order to observe health effects of mining. Breakdown products produced when uranium is mined (ex: ionizing radiation) can cause lung cancer. Whether these products can cause other types of cancer is less well-known, and this project will build on and extend previous work conducted on Ontario uranium miners. It will examine the effects of exposure to ionizing radiation on a number of cancer sites with a focus on sites other than the lung. The Mining Master File (MMF) is a database containing work history information about workers employed in Ontario mines between 1954 and 1986. This information will be combined with employee-specific ionizing radiation exposure from Health Canada's National Dose Register (NDR) and cancer incidence and mortality data from the OCR to investigate the long-term relationship between ionizing radiation exposure and various forms of cancer. CCO has the MMF and NDR data files for uranium miners for other projects and has developed some expertise in using these files.

Development of this project was jointly supported by the OCP and a PhD fellowship for Mr Minh Do, as noted earlier. A grant application submitted for the February/March 2005 competitions of WSIB and CIHR, respectively, was funded by both agencies. Because CIHR awarded only partial funding (all approved projects' budgets were cut by nearly 20%), funding will be provided jointly by the two agencies. Project work will be conducted in 2006 and 2007, and part of it will constitute the PhD project of Mr Do. The abstract describing this work and accepted for CIHR funding can be found in Appendix G.

4.5.2 Expert contributions resulting from external requests

The existence of the OCP, with its concentration of expertise in occupational cancer, resulted in some external requests for expert assistance. Where it was felt that these were important and/or would benefit the field, the OCP agreed. This resulted in participation in two additional projects.

4.5.2.1 Firefighters and cancer risk

Until recently, firefighters in British Columbia who contracted cancer were required to collect scientific and personal data themselves to prove a link between their occupation and their cancer, in contrast to five other provinces already recognizing the increased cancer risks firefighters face. CCO was awarded a contract from the Policy and Regulation Development Bureau of the Workers' Compensation Board (WCB) of BC to assess the association between the occupation of firefighting and a number of specific types of cancer, with a comprehensive review of the available literature and an analysis of the relationship between each cancer and firefighting. An OCP staff person was assigned to this project on a cost-recovery basis (see financial statement for revenue generated by this purchase of services).

Conclusions included limited evidence of an association between the occupation of firefighting and brain/nervous system and colorectal cancers, no evidence of such association for kidney and lung cancers, and insufficient evidence for a number of other cancers.

Cancer Type	CCO Conclusion of Evidence of Association with Firefighting
Bladder	Insufficient
Brain/nervous system	Limited
Colorectal	Limited
Colon	Inconclusive
Rectum	Inconclusive
Kidney	None
Leukemia	Insufficient
Lung	None
Multiple myeloma	Insufficient
Non-Hodgkin lymphoma	Insufficient
Testicular	Insufficient

A final report was submitted to the contractor in June 2004. It was reviewed independently by two scientists, and CCO responded to their comments in November 2004. The BC WCB then developed a discussion paper for stakeholder consideration.

The result of this entire process (review, report, subsequent discussion) was amendment of the Workers' Compensation Act to recognize a number of cancers as diseases that could arise where a worker has been employed full-time as a firefighter (includes volunteer firefighters) and has been regularly exposed to the hazards of a fire scene, other than a forest fire, over certain periods of time. The cancers so recognized are primary brain, bladder, kidney, ureter and colorectal cancers, along with leukemia and non-Hodgkin lymphoma.

4.5.2.2 Expert Panel on screening guidelines for asbestos-related lung diseases

As a result of recent health concerns regarding potential past exposures to asbestos in Ontario workplaces, the Ontario Chief Medical Officer of Health, on behalf of the Ontario Ministries of Labour (MOL) and Health and Long-Term Care (MOHLTC) established an Expert Panel (Drs Linn Holness (Director, Center for Research Expertise in Occupational Disease (CREOD)) and Loraine Marrett (Senior Scientist, CCO, and overseer of the OCP)) to recommend medically sound and scientifically rigorous protocols to screen individuals for asbestos-related lung diseases. This was considered an appropriate endeavour because of the OCP's asbestos focus, and because it involved partnering with WSIB's Center for Research Expertise in Occupational Disease (CREOD), based at Toronto's St Michael's Hospital.

The report was submitted to the Ontario Chief Medical Officer of Health in December 2005. A companion report on screening for beryllium-related lung diseases will follow in 2006.

5. Current status as at December 31 2005

5.1 Financial resources

The project financial statement for the final period (June 1 2004 to December 31 2005) is located at the end of this report, along with a summary statement for the entire project period (June 1 2002 through December 31 2005). Because we do not yet have final financial statements for December 2005, expenses for that month have been estimated.

Not all project funds have been expended. This is largely due to the early departure of the project manager, Dr Jennifer Payne, in June and to other staffing shortfalls throughout the project.

5.2 Human resources

Two of the research associates employed by the OCP (Ms Pichora and Ms Waller) are still working for the OCP, as is Mr Do (on a casual basis) and Ms Borrego (provision of administrative support). While it has been challenging to recruit staff familiar with the areas of workplace exposures and cancer, and learning curves are therefore steep, one of the successes of the project has been training research associates and thereby building of capacity in these areas.

5.3 Projects

5.3.1 Papers under review

Two papers have been submitted for publication and are still under review:

Do MT, Chaudhry R, Demers PA, Holmes P, Marrett LD. Asbestos and pleural cancer in Canada. Manuscript submitted to Chronic Diseases in Canada, May 2005. Awaiting review.

Waller BJ, Demers PA, Payne JI, Marrett LD, Kauppinen T. CAREX as a tool for occupational carcinogen exposure surveillance in Ontario and British Columbia. Manuscript submitted to Chronic Diseases in Canada, August 2005. Awaiting review.

5.3.2 Manuscripts in preparation for completed projects

A manuscript summarizing findings of the firefighter meta-analysis, expanded to include additional cancers not within the scope of the contracted review is in preparation:

Chaudhry R, Marrett LD, Kreiger N, Klar N, Sullivan T. Systematic review of the occupation of firefighting and cancer risk. Prepared for submission to the British Medical Journal.

5.4 Current status of work in progress

As noted in earlier sections, a number of projects remain in progress. With their current status, these are:

5.4.1 CAREX as an occupational carcinogen exposure surveillance tool

As detailed in section 4.2.1, Ontario/BC exposure data are now included in CAREX for many of the most frequently occurring carcinogens (e.g. radon, silica, benzene, lead, etc) as are detailed 2001 labour force data and aggregate sampling data for the two provinces. A functional "Canadianized" version of CAREX therefore exists for these exposures. Dr Paul Demers will be providing an end-of-year report to the BC Workers' Compensation Board describing the relative success with different methods to estimate exposure, suggestions for further work, and how the data can be used to further develop and refine this tool for occupational carcinogen exposure surveillance.

5.4.2 Burden of mesothelioma in Ontario: a descriptive analysis based on the OCR

Continuing from activities described in section 4.3.2, previous work describing the burden of mesothelioma in Ontario focused on the most common mesothelioma primary site: the pleura. In an effort to better understand rarer mesothelioma primary sites such as the pericardium and tunica vaginalis testes, and their association with occupational exposure to asbestos, an extensive literature review was conducted.

Using the latest release of the OCR master file (November 2005), which contains a substantial amount of previously unregistered Regional Cancer Centre data, updated descriptive statistics are now being generated for mesothelioma cases overall diagnosed 1980-2002. When possible, site-specific statistics are also being generated and compared to published mesothelioma reports from other jurisdictions.

These results will be presented and interpreted in conjunction with the evaluation of the OCR as a surveillance tool to monitor the burden of mesothelioma in Ontario in a manuscript to be submitted for publication.

5.4.3 Evaluation of the OCR as a surveillance tool to monitor the burden of mesothelioma in Ontario

As discussed in section 4.3.3, preliminary data quality investigations using source record information have been generated and an outline of final investigations to be carried out has been drafted. These final investigations will be carried out using the latest release of the OCR data file, and are expected to differ slightly from preliminary results. Discussions regarding methodological issues and interpretation of results are ongoing.

5.4.4 The burden of occupational cancer in Ontario: Claims for workers' compensation:

As detailed in section 4.3.4, additional data required to complete this work was only recently provided by WSIB. As a result, linkage has only just been finalized and data is being provided to the analyst who will then finalize both descriptive and analytic components of this project. Preliminary results of this work have been presented in poster presentations at the SER-CSEB conference. Final results will be further interpreted in the context of current literature and presented in two manuscripts to be submitted publication.

A strategy for advancing and/or completing these projects is described in section 6.

6. Completing project work with current funds

We propose to expend remaining funds over the next 6 months to either complete or advance the projects noted in 5.4. A budget indicating proposed expenditures for January 1-June 30 2006 is located at the end of this report.

Staff who are currently with the OCP will continue until June 30 2006 as follows:

- Ms Pichora will continue to work on two projects: "Burden of mesothelioma in Ontario", Evaluation of the OCR as a mesothelioma surveillance tool", and "Burden of occupational cancer in Ontario";
- Ms Waller will continue to advance the other project: "CAREX as an occupational carcinogen exposure surveillance tool" (she has been the main staff person working on CAREX throughout the OCP);
- Ms Borrego will provide administrative support (10% time) to monitor the account, manage expenditures, purchase supplies, etc.;
- Mr Do will continue on a casual basis (about 10 hours per month) assisting as required.

A few hours of specialized human resources may also need to be purchased to support residual linkage issues and provide expert advice about the OCR.

6.1 Work to be completed/advanced

6.1.1 Further development of CAREX

Although much work has been done to develop Ontario- and BC-specific versions reflecting current or recent working environments, there is much that remains to be done. Additional sources of exposure data for common workplace carcinogens need to be identified, evaluated and incorporated into CAREX. CAREX output needs to be validated with actual workplaces. A protocol is needed for determining appropriate "next steps" for further examining types of workplaces for which CAREX indicates a particular problem and for developing exposure reduction priorities and strategies. Further development of CAREX will be ongoing well into the future, once its validity and utility have been demonstrated.

Using remaining project funds, we will continue to identify, secure, evaluate and integrate additional exposure data, collaborating with BC investigators to gather and validate province-specific sampling data and current occupation/industry distribution.

A more detailed protocol for future CAREX work is found in Appendix H. One planned output is a second manuscript focusing on one or two specific carcinogens and their workplace exposure circumstances in depth, in a province-appropriate context, for submission to a journal specializing in occupational and environmental exposure issues. Authors include Bronwen Waller and Paul Demers.

6.1.2 Burden of mesothelioma in Ontario and evaluation of the OCR as a mesothelioma surveillance tool (combination of 4.3.2 and 4.3.3)

Using the latest release of the OCR data, the burden of mesothelioma (all sites included) will be described for 1980-2002, and an evaluation of the OCR as a mesothelioma surveillance tool will be carried out. Specifically, age-adjusted and age-specific incidence rates and survival rates will be generated by sex, and site-specific statistics will be generated when possible. Data quality investigations to evaluate the OCR as a surveillance tool for mesothelioma will also be completed and will be interpreted in conjunction with these descriptive statistics. It is anticipated that this project will generate a detailed report focusing on data quality investigations for internal use, as well as a manuscript describing the burden of mesothelioma and the results of the evaluation of the OCR as a surveillance tool for cases diagnosed Ontario 1980-2002. This manuscript is currently being drafted for publication in Chronic Diseases in Canada. The working title is "The Burden of Mesothelioma in Ontario, 1980-2002" and authors include: Jennifer Payne, Erin Pichora, Minh Do and Diane Nishri. It is expected to be ready for submission for publication by March 2006.

6.1.3 Burden of occupational cancer in Ontario

Additional data required to complete this work was only recently provided to CCO by WSIB. As a result, the linked dataset has only just been finalized and work is currently underway to generate final results for both describing the proportion of mesothelioma patients diagnosed 1980-2002 that filed for compensation and for describing trends and patterns in claims awarded compensation for all malignant neoplasms. Results of this work will be interpreted in the context of current literature and presented in two manuscripts. Filing rates for

mesothelioma will be drafted for publication in Canadian Medical Association Journal (CMAJ) under the working title of "The Burden of Occupational Cancer in Ontario: Focus on Mesothelioma" by Jennifer Payne and Erin Pichora, and the description of cancer claims awarded compensation will be drafted for Chronic Diseases in Canada under the working title of "Compensated Occupational Cancer in Ontario, Canada, 1937-2003" by Erin Pichora and Jennifer Payne. These manuscripts are expected to be submitted for publication by June 2006.

7. Recommendations for future work

The accomplishments of the Occupational Cancer Research and Surveillance Project have resulted in the identification of a number of feasible and fruitful future avenues of work, particularly in the area of surveillance, which was the focus of the OCP. Such work should be supported at least in part through infrastructure, or in some cases by project-specific funding. Infrastructure support would provide leverage for securing external research grant funding. Indeed, continued growth in the area of occupational cancer research and surveillance may be able to capitalize on some opportunities that are timely in addition to the momentum generated by the OCP. These include:

- **Cancer Care Ontario has committed to funding a permanent scientist position with a focus in occupational cancer research. Recruitment for this position is currently underway;**
- **Cancer Care Ontario has identified occupational carcinogen exposures as one of its target areas for cancer prevention by the year 2020. A number of the specific activities noted call for surveillance;**
- **The recent announcement of some funding for the Canadian Strategy on Cancer Control (CSCC) (through the Public Health Agency of Canada). The CSCC's Primary Prevention Action Group includes a National Committee on Environmental & Occupational Exposures, which has developed a series of recommendations for action (found in Appendix H). This funding may result in some resources for occupational work;**
- **The WSIB's Research Advisory Committee has expressed interest in supporting a Centre of Research Expertise with a cancer focus or in exploring other ways of stimulating occupational cancer research;**
- **The Ontario government recently announced funding for an Ontario Institute for Cancer Research. Scientists recruited to this Institute could be encouraged to develop a focus of research in occupational cancer.**

There is a high level of enthusiasm among members of the OCP Advisory Committee to see a continuation and expansion in occupational cancer research and surveillance. They are eager to continue to serve in an advisory capacity and to give more support, where possible. For example, the Ontario Division of the Canadian Cancer Society is keen to identify a specific role for itself, perhaps in promoting awareness of occupational cancer and workplace carcinogens as well as advocacy and sharing of knowledge.

There is no doubt that CCO is the right organization for developing a focus in workplace cancer surveillance and research. A number of factors support this:

- **CCO's commitments to recruiting a scientist and to reduce exposure to workplace carcinogens, as noted above;**
- **CCO's leadership in housing and nurturing the OCP for the past 3.5 years;**
- **CCO's commitment to evidence development and an evidence base for action;**
- **CCO is well-placed within the Canadian Strategy for Cancer Control, with membership on many Action Groups and Committees (including the environmental and occupational exposure committee noted above);**
- **CCO is custodian of the Ontario Cancer Registry, and has extensive expertise in using the OCR for surveillance, service and research;**
- **CCO scientists have strong links to occupational disease researchers at the University of Toronto as represented in CREOD (the Centre for Research Expertise in Occupational Disease).**

8. Additional recommended surveillance or service projects

Several worthwhile and feasible projects were identified in the course of OCP work.

8.1 Mesothelioma, asbestos exposure and workers' compensation

This has been identified as a priority area, since mesothelioma can be considered a sentinel for workplace asbestos exposure. There are a number of additional projects that should be undertaken within this area:

- **Development, evaluation and implementation of a mesothelioma physician notification system to increase rates of compensation claim-filing for asbestos-exposed workers. This would be a service project that CCO could carry out for WSIB. A brief protocol for a pilot study was developed and submitted to WSIB in October 2005 (along with a budget). This is found in Appendix H.**
- **Periodic repeat of the linkage of the OCR-WSIB claims databases to assess changes in compensation filing patterns and rates, particularly for mesothelioma but also for other asbestos-related cancers and others cancers more generally. This would be useful to WSIB for ongoing evaluation and planning.**
- **In-depth evaluation of the quality of mesothelioma data in the OCR and of their adequacy for surveillance purposes. This could involve chart reabstractions, slide reviews, etc. The results would allow for better surveillance of mesothelioma and more accurate prediction of the future burden.**
- **Determination of sources of asbestos exposure for recently diagnosed mesothelioma cases. This could be done as part of the physician notification system (see protocol, Appendix H). The resulting data would be useful to anticipate likely sources of future compensation claims.**
- **Projection of future burden of mesothelioma, involving sophisticated modeling. The results would be useful to the WSIB in terms of planning for future compensation claims.**

8.2 Development of systematic approaches to occupational cancer and carcinogen surveillance in Ontario

A number of different approaches have been explored, some in more depth than others. Additional work is recommended for some of these where 'proof of concept' or value has been demonstrated:

- **CAREX:** Development, validation and the use of CAREX for workplace carcinogen exposure surveillance in Canada, and particularly in Ontario, should be continued. The OCP and Dr. Demers have made considerable investment already in this work, and the results can only now start to be realized. However, as previously mentioned, more work is needed to include additional carcinogens, to validate results and to put CAREX into use to actually begin to reduce workplace carcinogen exposure. CAREX is being used by many European countries to identify workplace hazards.

- **Linkage of census and cancer mortality/incidence data:** Linkage of 1991 census data (including occupation/industry) with post-1991 mortality for Canada as a whole is essentially complete. Discussions with the principal investigators of this project have identified Cancer Care Ontario's interest in analyzing the Ontario occupation-cancer mortality part of linkage results. If funds were available, this could be pursued during late 2006. The feasibility of linking census occupation/industry data with the OCR could be evaluated. Linkage of census occupation/industry information to cancer incidence as an approach to systematic occupational cancer surveillance has been successfully used in other countries, most notably Sweden, for several decades.

- **Collection of workplace exposure data on the Canadian Community Health Survey (CCHS):** Cancer Care Ontario is developing a recommendation for questions to be included in a module for an upcoming wave of the CCHS. Content will focus specifically on carcinogens in the workplace and knowledge/awareness of workplace exposures. Despite the limitations of self-report, such information, in conjunction with CAREX and other sources, would help round out the picture of workplace exposure.

- **Follow-up of Ontario cohorts:** CCO has recently secured grant funding to link the cohort of Ontario uranium miners with the Ontario Cancer Registry. This is the largest cohort of uranium miners in the world. Because there is currently little information about long-term risks for cancers other than that of the lung, results will be valuable internationally. Although this represents just one cohort with very specific exposure, the same approach could be used for other Ontario cohorts if resources were available. Certainly, the identification of existing cohorts in need of information on cancer risks would be a valuable step.

A recommendation from the OCP Workshop (Section 4.1.2) was to explore the use of MSDS (Material Safety Data Sheets) and WHMIS (the Workplace Hazardous Materials Information System) to identify and promote action on workplace carcinogen exposures. Exploration of this approach has also been recommended by the National Committee on Environmental & Occupational Exposures of the Canadian Strategy for Cancer Control. This is a more investigative activity than those described above.

8.3 Development of a research agenda

There is currently a dearth of research, and of researchers, in occupational cancer; there are a few who spend part of their research time working in this area, but few to none who are dedicated to it. Yet there are many opportunities for high quality research which could directly affect workers, either by:

- Enhancing their opportunities to secure compensation where it is due;
- Reviewing or producing evidence that will help develop compensation policy; or
- Identifying carcinogens in the workplace so that exposure can be reduced, thereby decreasing the future burden of occupational cancer.

Infrastructure support to establish a research centre is urgently required in Ontario. CCO is hiring a scientist; this person could provide leadership; s/he could network other researchers having an interest in occupational cancer; develop a research agenda; and secure project funding. However, in order to do this, infrastructure support is required if s/he is to do this effectively.

9. Closing remarks

The Occupational Cancer Research and Surveillance Project (OCP) had to be built from scratch – staff found where there were none; expertise developed where it did not exist; and stakeholder liaisons built and nurtured where none had been. Much has been learned and accomplished in its 3 years, creating both excitement and expectation for future benefits among stakeholders and funding bodies. The OCP has succeeded in raising awareness of associations between workplace exposures and cancer, and has developed a reputation as a centre of expertise in occupation and cancer. The core staff (research associates and students) have gained expertise in the area and may, if the opportunity were presented, choose to dedicate additional years to work in occupational cancer. It would be a shame if this were to be lost, particularly given the identified opportunities for continued development and feasible projects just waiting to be done.

There are considerable benefits to both of the OCP's funding organizations, of a continued partnership to further develop occupational cancer surveillance and research beyond June 30, 2006. Momentum, excitement, expertise and a solid body of work have been created. The OCP has hopefully clearly demonstrated the effectiveness and the potential benefits to workers of a partnership between an organization concerned with workers' health and safety, and one with concerned with cancer control.

CCO has demonstrated ongoing commitment by creating a scientist position; supervising a graduate student working in occupation and cancer; securing research funding to quantify long-term cancer risks among uranium miners; and developing a protocol to assist WSIB in enhancing compensation filing for workplace asbestos-related cancer.

The project team, OCP advisory and steering committees, and CCO scientists and management hope that there will be continued support from WSIB for both surveillance and research.

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