



# **The Economic Burden of Lung Cancer & Mesothelioma in Canada Due to Occupational Asbestos Exposure**

Emile Tompa, Christina Kalcevich, Chris McLeod, Martin Lebeau, Daniel Fong, Kim McLeod, Joanne Kim, Paul Demers

Advisory Committee Meeting of the EU-OSHA project on Estimation of the Costs of Work-related Injuries, Illnesses and Deaths at European Level

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Funding provided by the Canadian Cancer Society



## Overview of Larger Study on the Burden of Occupational Cancer in Canada

- 4 year study funded by the Canadian Cancer Society (2013-2016)
- 4 modules within the study:
  1. Estimation of Past Prevalence and Levels of Exposure (Lead: H. Davies)
  2. Estimation of Attributable Fraction and Human Burden (Lead: P. Demers)
  3. Estimation of Economic Burden (Lead: E. Tompa)
  4. Knowledge, Translation, and Exchange (Lead: D. Kramer)
- Held a daylong stakeholder symposium in November 2015



## Estimating the Attributable Fraction and Human Burden

- Epidemiology team in the research project considered 44 recognized workplace carcinogens and 27 different types of cancers
- Labour force size (by province, sex, age, and industry) identified from 1961 through to 2001 to estimate level and duration of exposures as well as survival probability through to 2011
- Based estimates of attributable fractions and relative risk on extensive literature synthesis
- Developed estimates of numbers of cancer cases in 2011 attributable to occupational exposure or para-occupational exposure by province, sex, age, and industry

## Exposure Assessment

Employment Data

CAREX Canada  
JEM

## Population Modelling

Exposed  
Population

Age Distribution

Tenure  
Distribution

Survival  
Probabilities

$N_{e(REP)}$

÷

$N_{p(REP)}$

$$\Pr(E) = \frac{N_{e(REP)}}{N_{p(REP)}}$$

where,

$\Pr(E)$  is the proportion ever exposed during the REP, and

$N_{e(REP)}$  is the number ever exposed during the REP, and

$N_{p(REP)}$  is the number ever of working age during the REP

PrE

AF

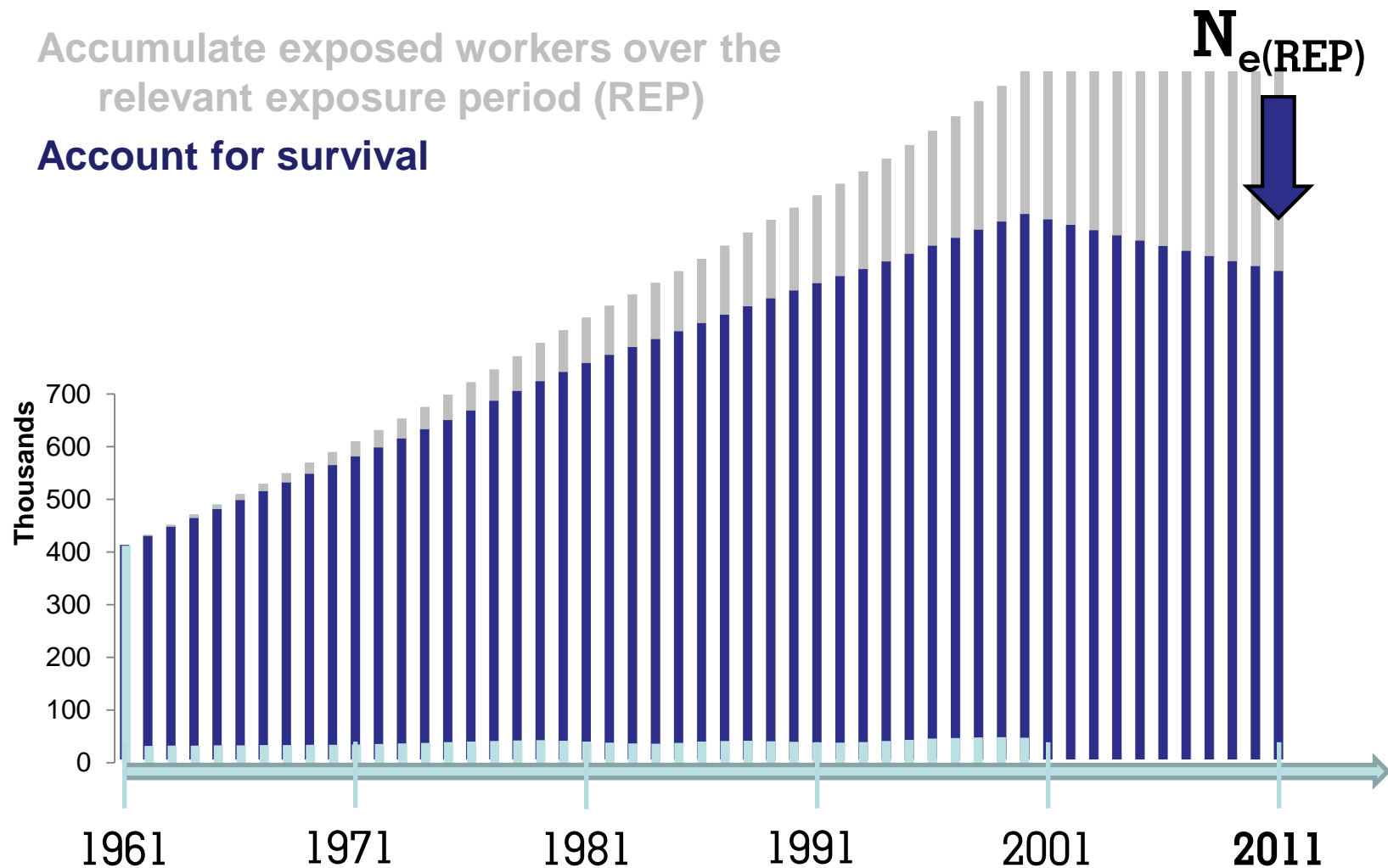
## Epidemiological Review

[www.iwh.on.ca](http://www.iwh.on.ca)

Literature  
Review

Selection process

RR





# Human Burden of Lung Cancer and Mesothelioma from Occupational Asbestos Exposure

## Mesothelioma

- In 2011, there were 427 newly diagnosed cases of mesothelioma attributable to occupational and para-occupational exposure
  - 370 in men, and 57 in women
- 85% of cases for men are occupational and 40% for women
- 15% of cases for men are para-occupational and 60% for women

## Lung Cancer

- In 2011, there were 1,904 newly diagnosed cases of lung cancer attributable to occupational exposure
  - 1,727 in men, and 177 in women



## Summary of Findings from Occupational and Para-Occupational Asbestos Exposure

- **Total cost of mesothelioma and lung cancer from asbestos related occupational exposure for new cases in 2011 was \$1.9 billion**
- The per case average lifetime cost was \$816K
- Health-related quality of life costs were the highest proportion of the costs at 80%
- The next highest proportion was direct costs, including health care, out of pocket, family care giving and WCB administration at 11%
- Indirect costs, including friction and output & productivity costs, were 9% of total costs
- Substantial economic burden from 2,331 newly diagnosed cases in 2011



## Methodological Overview

### Type of economic burden study undertaken

- Incidence costing study
- Considers only newly diagnosed cases in a particular year
- Includes lifetime costs associated with each new case incurred by all stakeholders

### Key question addressed by this economic analysis

- What would be the saving to society if we did not have any cases of cancer attributable to occupational asbestos exposures in a particular year?
- Economic burden = counterfactual scenario – current scenario
- Counterfactual scenario is the road not taken, the alternative world without the occupational cancer under considered in the study





## Methodological Overview (cont'd)

### Key cost components considered

1. Direct costs (health care products & services)
2. Indirect costs (output & productivity in paid work)
3. Quality of life costs (social role engagement & intrinsic value of health)

### Study Framing

- Newly diagnosed cases in 2011
- Estimate total lifetime costs of these cases incurred by all stakeholders (societal level economic burden)
- Discounted all (future) costs to 2011 calendar year



## Impacts & Related Costs by Stakeholder

### 1. Direct

Individual	Family & Community	Employer	System, public sector & society
<ul style="list-style-type: none"><li>• out-of-pocket expenses for health care products &amp; services</li></ul>	<ul style="list-style-type: none"><li>• care giving of family &amp; community members</li></ul>	<ul style="list-style-type: none"><li>• insurance programs costs for health care products &amp; services</li><li>• insurance admin</li></ul>	<ul style="list-style-type: none"><li>• health care products &amp; services</li><li>• insurance admin</li></ul>



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2. Indirect	<ul style="list-style-type: none"><li>• labour-market earnings</li><li>• payroll benefits associated with labour-market earnings</li><li>• wage replacement benefits</li></ul>	<ul style="list-style-type: none"><li>• family income and savings</li></ul>	<ul style="list-style-type: none"><li>• productivity &amp; output</li><li>• replacement worker recruitment &amp; training costs (friction costs)</li><li>• insurance program costs for wage replacement benefit</li></ul>	<ul style="list-style-type: none"><li>• productivity &amp; output</li><li>• friction costs</li></ul>



## Impacts & Related Costs by Stakeholder

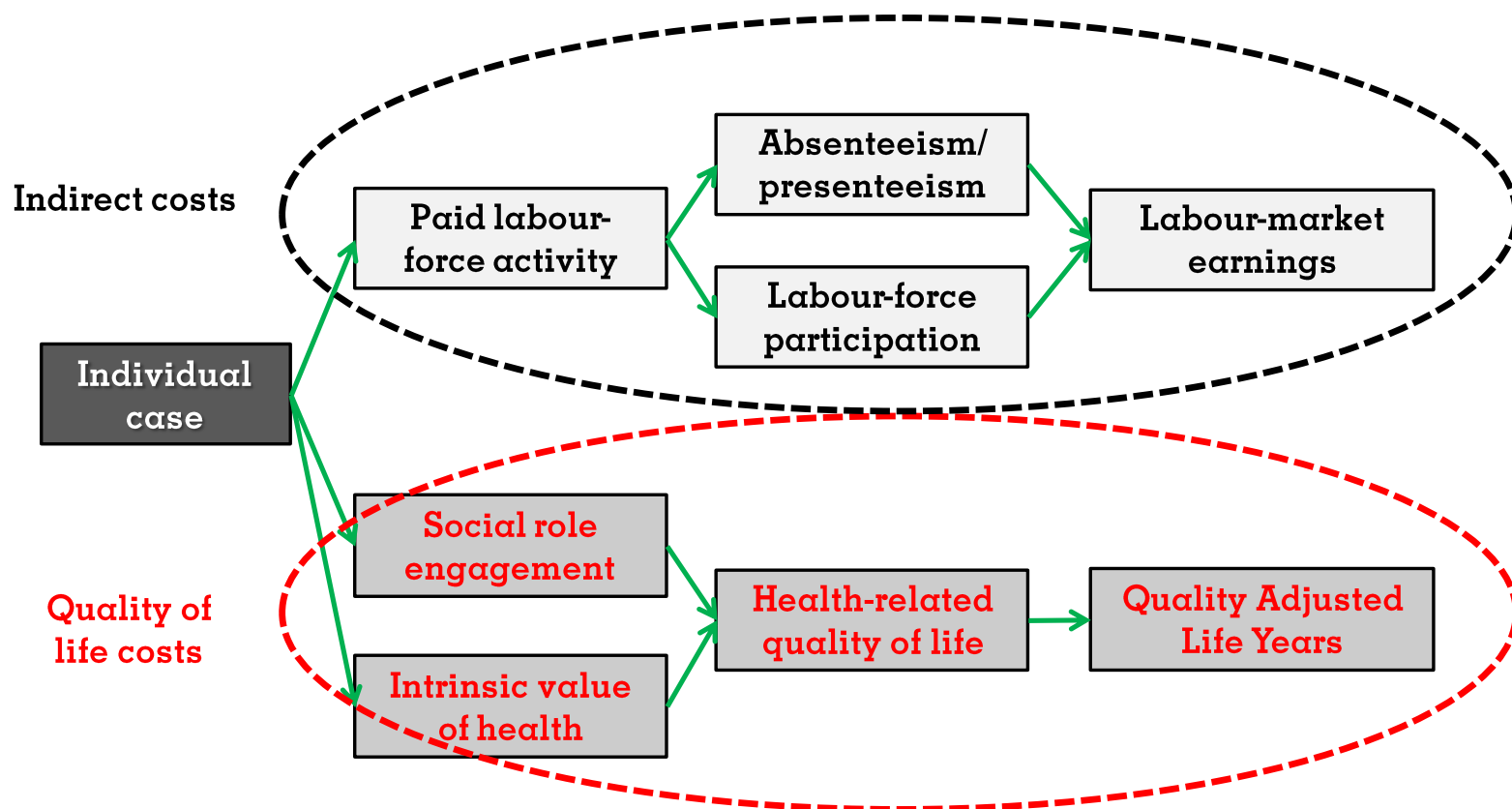
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## Schema of Health Valuation at the Individual Level





## Assumptions and Details of in the Estimates

- All figures in 2011 Dollars
- Discount Rate: 3% for health and earnings
- Productivity Growth Element: 1% for earnings
- Wage Supplements/Fringe Benefits: 14% for earnings
- Survival by 5 year age groups and sex for counterfactuals from Canadian life tables 2009-2011, using endpoint of five year bands
- Lung cancer survival rate from CRMM model
- Counterfactual employment rate and annual earnings from 2011 LFS, matched by age and sex, in 5 year groups
- Employment rates for those aged 70+ adjusted by rates from 2007 SLID
- Reduced employment for lung cancer patients estimated from Earle (2010)
- Productivity losses adjusted by annual likelihood of survival, from CRMM model
- New cases do not work in the year of diagnosis, on average six months
- Productivity losses after year of diagnosis incurred by surveillance schedule in years 1-10 and end of life care 4.5 months before death, from CRMM model
- Lung cancer HUI from CRMM model, weighted by stage
- Counterfactual HUI from 2010 CCHS, matched by age and sex
- Cases surviving beyond 10 years (8.6% of diagnosed cases) are cured and do not accrue any additional indirect or intangible costs



## Direct Costs of Health Care

- Starting point was health care costs of lung cancer by type and stage identified by **Canadian Cancer Risk Management Model (CRMM)**
- CRMM also provided data on survival probabilities
- For mesothelioma survival used **US Surveillance, Epidemiology, and End Results (SEER) Registry**
- Added health care administration costs of 16.7% (Woolhandler 2003)
- Fraction of cases appearing in WCB system– 54% for mesothelioma and 10% for lung cancer (Del Bianco 2013)
- Higher health care costs for WCB accepted claims (WSIB 2007, CRMM)





## Other Direct Costs

### Family & Community Time in Care Giving

- Assumed 16 hours of care giving time per week (Van Houtven 2010)
- Care giving time valued at weighted average provincial minimum wage
- Weighted average increased by 2% per year after 2015

### Out of Pocket Costs

- Assumed to be \$548/month—includes travel, parking, drugs, home health care, vitamins, accommodation (Longo 2011)
- Assumed to increase by 2% per year
- Cost assumed to be incurred for 10 years and were adjusted for survival rates over this period

### Administration

- Added WCB administrative costs of 27% of incurred expenses & transfer payments for proportion of cases that are administered in this program (AWCBC 2011)



## Indirect Costs of Output & Productivity

### Human Capital Approach (HCA)

- **Used to estimate lost labour-market productivity & output**
- Considered the wage of individual & the amount of work time lost due to poor health or premature death (CRMM, Earle 2010, SEER Registry)
- For counterfactual, used average labour-market earnings in Canada adjusted for age & sex (LFS 2011, SLID 2010)
- Included payroll costs (14%) and productivity growth (1%) in estimates (Canadian National Accounts)

### Friction Cost Approach (FCA)

- **Used to reflect cost to employer to replace absent worker if sickness absence endured for a period of time**
- Losses assumed to be 6 months of annual wage in year of diagnosis



## Quality of Life Costs

- Captured through Quality Adjusted Life Years (QALYs)
- Preference-based measure of health-related quality of life
- **Morbidity & time are combined using a weight that is between 0 (death) & 1 (one year in perfect health)**
- QALY does not include productivity & output from market activity
- Future QALYs were discounted using a 3% rate



## Quality of Life Costs (cont'd)

- QALY weights and conditional life expectancies associated with each cancer case were identified (CRMM, SEER, Arnold 2015)
- For counterfactual, used population average QALY adjusted for age & sex (CCHS 2010)
- For counterfactual, used population conditional life-expectancy (Canada Life Tables 2009-2011)
- Literature offers range of values for a QALY from \$US20K to US\$161K
- **We used CAN\$100K for value of a QALY**



## Economic Burden of Mesothelioma

### Based on 427 cases in 2011

	All cases	Per case
Health care costs:	\$ 19,542,452	\$ 45,794
Informal care giving:	\$ 5,665,353	\$ 13,276
Out of pocket:	\$ 6,052,921	\$ 14,184
Workers' comp administration:	\$ 32,731,536	\$ 76,700
Productivity and output:	\$ 30,212,135	\$ 70,796
Friction:	\$ 2,324,633	\$ 5,447
Health-related quality of life:	\$296,303,160	\$694,325
<b>Total:</b>	<b>\$392,832,191</b>	<b>\$920,521</b>

\* 2011 Canadian dollars



## Economic Burden of Asbestos-related Lung Cancer

**Based on 1,904 cases in 2011**

	<b>All cases</b>	<b>Per case</b>
Health care costs:	\$ 53,993,826	\$ 28,355
Informal care giving:	\$ 32,713,179	\$ 17,180
Out of pocket:	\$ 35,539,487	\$ 18,664
Workers' Comp administration:	\$ 26,134,338	\$ 13,725
Productivity and output:	\$ 126,275,066	\$ 66,314
Friction:	\$ 10,394,631	\$ 5,495
Health-related quality of life:	\$1,224,370,103	\$642,986
<b>Total:</b>	<b>\$1,509,420,630</b>	<b>\$792,682</b>

\* 2011 Canadian dollars



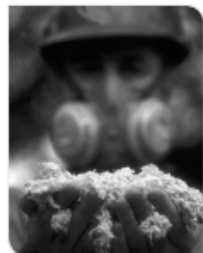
## Summary of Findings

- **Total cost of mesothelioma and lung cancer from asbestos related occupational exposure for new cases in 2011 was \$1.9 billion**
- The per case average lifetime cost was \$816K
- Health-related quality of life costs were the highest proportion of the costs at 80%
- The next highest proportion was direct costs, including health care, out of pocket, family care giving and WCB administration at 11%
- Indirect costs, including friction and output & productivity costs, were 9% of total costs
- Substantial economic burden from 2,331 newly diagnosed cases in 2011
- This yearly burden is likely to increase in future, given number of new cases is projected to continue to increase over next few years



# Asbestos

## Burden of Occupational Cancer Fact Sheet



### WHAT IS ASBESTOS?

Asbestos is a group of naturally occurring, fibrous silicate minerals. The manufacturing and use of asbestos-containing products is severely restricted in most western countries, including Canada, and in some countries it is banned.

Asbestos has historically been useful for many commercial applications because of its heat resistance, tensile strength, and insulating and friction characteristics. It is found primarily in roofing, thermal and electrical insulation, cement pipe and sheets, flooring, gaskets, friction materials, coatings, plastics, textiles, and other products.

The International Agency for Research on Cancer classifies asbestos as a **known carcinogen** (IARC 1).

### WHAT ARE ITS HEALTH EFFECTS?

- Mesothelioma (a cancer of the protective lining of many internal organs)
- Lung, laryngeal, and ovarian cancer
- Asbestosis (scar tissue in the lungs)

### THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO ASBESTOS IN CANADA

The term 'burden' refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

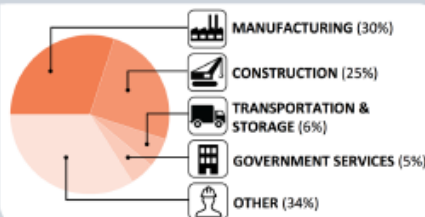
**1900**

Lung cancers caused by  
workplace asbestos exposure

Preliminary results show that approximately **1900 lung cancers** and **430 mesotheliomas** are attributed to occupational asbestos exposure each year, based on 2011 cancer statistics. This amounts to **8% of all lung cancers** and **81% of all mesotheliomas** diagnosed annually (almost all of the remaining mesotheliomas are likely due to environmental asbestos exposure).

### WHAT WORKERS ARE MOST AFFECTED?

Most asbestos-related cancers occur among workers in the **manufacturing and construction sectors** (see pie chart on right). These cancers also occur among workers in the transportation and storage sector and government services. Some of the other sectors affected include communication and other utilities, educational services, and wholesale trade.



### WHAT IS THE ECONOMIC IMPACT?

Preliminary results show that work-related asbestos exposure resulted in approximately \$1.9 billion in costs for newly diagnosed lung cancer and mesothelioma cases in 2011.

This includes approximately:

- 4% (lung cancer) and 3% (mesothelioma) in health care expenses and administrative costs
- 3% (lung cancer) and 1% (mesothelioma) in informal caregiver and out-of-pocket costs
- 7% (lung cancer) and 2% (mesothelioma) in output and productivity losses
- 65% (lung cancer) and 15% (mesothelioma) in health-related quality of life losses

**\$1.9 billion**

Estimated yearly cost of lung cancer and mesothelioma caused by asbestos exposure

### CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO ASBESTOS

Inhalation is the most important route of occupational exposure to asbestos.

Approximately 152,000 Canadians are exposed to asbestos at work.

Industries with the largest number of exposed workers in Canada include:

- **Specialty trade contractors** (82,000 people exposed)
- **Building construction** (52,000 exposed)
- **Automotive repair and maintenance** (4,300 exposed)

Occupations with the largest number of exposed workers include:

- **Carpenters** (34,000 exposed)
- **Construction trades helpers and labourers** (28,000 exposed)
- **Electricians** (16,000 exposed)

### Exposure level

Occupational exposure to asbestos has changed over the past 40 years in Canada, making it challenging to assess exposure levels using historical data. Research on current exposure levels is ongoing.

### HOW CAN EXPOSURE BE REDUCED?

Asbestos-related cancers can be prevented by reducing the number of workers exposed and ensuring that the levels of exposures are as low as reasonably achievable (ALARA). Organizations should evaluate the risk of exposure in the workplace and implement the hierarchy of controls to address the safety needs of workers.

### ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study aims to quantify the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It is a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health, University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.



For more information, please visit OCRC at [www.occupationalcancer.ca](http://www.occupationalcancer.ca) or CAREX Canada at [www.carexcanada.ca](http://www.carexcanada.ca).

This fact sheet was produced by OCRC and CAREX Canada. The Burden of Occupational Cancer Study is led by the OCRC and is supported by the Canadian Cancer Society. CAREX Canada is hosted at Simon Fraser University and supported by the Canadian Partnership Against Cancer. Acknowledgments for header photos: KOMUnews, Chris RubberDragon.



Canadian Cancer Society  
Société canadienne du cancer



CANADIAN PARTNERSHIP  
AGAINST CANCER  
PARTENARIAT CANADIEN  
CONTRE LE CANCER

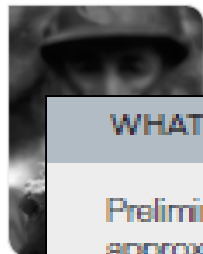






## Asbestos

### Burden of Occupational Cancer Fact Sheet



#### WHAT IS ASBESTOS?

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#### WHAT IS THE ECONOMIC IMPACT?

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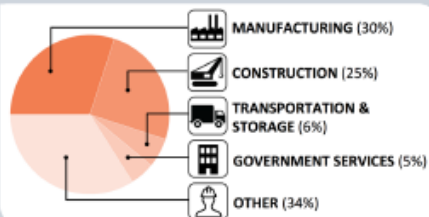
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#### Exposure level

Occupational exposure to asbestos has changed over the past

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[www.iwh.on.ca](http://www.iwh.on.ca)

Emile Tompa  
Senior Scientist  
[etompa@iwh.on.ca](mailto:etompa@iwh.on.ca)  
416-927-2027 ext 2113