



Occupational
Cancer
Research
Centre

Challenges of Estimating Exposure to Workplace Carcinogens in Canada

Paul Demers, PhD

IWH Plenary

November 2, 2010

Cancer in Canada



- In 2009 in Canada there were:
 - 171,000 new cases of cancer
 - 75,300 deaths
- based on current rates 40% of women & 45% of men will develop cancer in their lifetime
- 24% of women & 29% of men will die of cancer

Scrotal Cancer among Chimney Sweeps

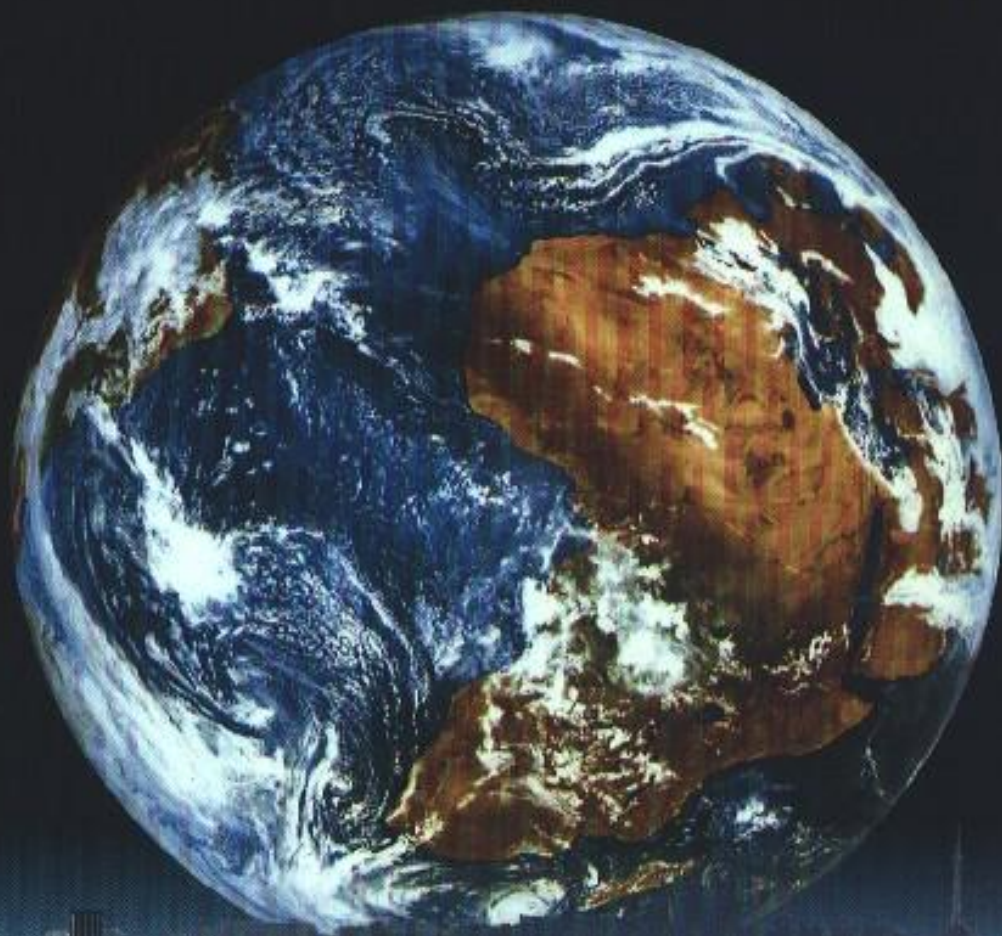


- Percival Pott (1775) linked scrotal cancer in chimney sweeps to the nature of their work and their exposure to cancer causing agents in soot
- He was the first to identify an occupational carcinogen
- Finally in 1840's laws were passed prohibiting young boys from performing the work

**INTERNATIONAL
AGENCY FOR
RESEARCH ON
CANCER**



WORLD
HEALTH
ORGANIZATION



IARC Monograph Evaluations

What we know about occupational carcinogens



- ~ 60 definite or probable common workplace carcinogens
- Over 100 additional workplace exposures are possible carcinogens
- Many other workplace exposures with a suspicion of human carcinogenicity

Occupational Lung Carcinogens

Metals	Arsenic & inorganic arsenic compounds Beryllium & beryllium compounds Cadmium & cadmium compounds Chromium (VI) compounds Nickel compounds
Dusts	Asbestos (all 6 types) Crystalline silica (quartz & chrysothalite)
Radiation (alpha- and beta-particle emitters)	Radon-222 & decay products Plutonium, X-radiation, gamma-radiation
Polycyclic Aromatic Hydrocarbon-related	Soot Coal tar pitches
Other chemicals	Bis(chloromethyl)ether/chloromethyl methylether Sulfur mustard
Suspected, but with more limited evidence	Dioxin (2,3,7,8-TCDD) Diesel exhaust, lead
Exposure circumstances (strong evidence, but unknown exposure)	Coal gasification, coke & aluminum production Iron & steel foundries Rubber manufacturing Welding & Painting

Occupational Sinonasal Carcinogens



Metals	Chromium (VI) compounds Nickel compounds
Dusts	Wood dust Leather dust
Radiation	Radium-226 (dial painters)
Suspected, but with more limited evidence	Chromium (VI) compounds Formaldehyde
Exposure circumstances	Isopropyl alcohol manufacture using strong acids

Occupational Nasopharyngeal Carcinogens

Dusts	Wood dust
Industrial Chemicals	Formaldehyde

Occupational Pleural Carcinogens

Dusts	Asbestos (all 6 types) Erionite
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Occupational Laryngeal Carcinogens

Dusts	Asbestos
Industrial Chemicals	Strong inorganic mists
Suspected, but with more limited evidence	Sulfur Mustard Rubber manufacturing industry

Occupational Bladder Carcinogens



Aromatic Amines	4-Aminobiphenyl Benzidine 2-naphthalamine Ortho-toluidine Auramine and magenta production
PAH-related	Mineral oils Shale oils Aluminum production
Metals	Arsenic & inorganic arsenic compounds
Suspected, but with more limited evidence	Soot Coal tar pitches
Exposure Circumstances	Painting Rubber manufacturing

Occupational Skin Carcinogens



Radiation	Solar Radiation (Basal Cell Carcinoma, Squamous Cell Carcinoma, Melanoma) UV-emitting tanning devices (Melanoma)
PAH-related	Soot Coal tar instillation Mineral and shale oils
Metals	Arsenic & inorganic arsenic compounds
Antineoplastic Drugs	Methoxsalen and ultraviolet light

Occupational Liver Carcinogens

Biological Agent	Aflatoxins
Industrial Chemical	Vinyl chloride
Radiation	Plutonium
Suspected, but with more limited evidence	Arsenic & Inorganic Arsenic Compounds

Occupational Lymphatic/hematopoietic Carcinogens

<p>Leukemia</p>	<p>Benzene (Acute non-lymphocytic, suspected for acute & chronic lymphocytic) 1,3-Butadiene Formaldehyde X-radiation & gamma-radiation (excluding CLL) Ethylene oxide (suspected chronic lymphocytic) Rubber manufacturing industry</p>
<p>Multiple myeloma</p>	<p>Benzene (Suspected, but with limited evidence) Ethylene oxide (Suspected, but with limited evidence)</p>
<p>Non-Hodgkin's lymphoma</p>	<p>Benzene (Suspected, but with limited evidence) Dioxin (Suspected, but with limited evidence) Ethylene oxide (Suspected, but with limited evidence)</p>

Occupational Reproductive Carcinogens



Ovary	Asbestos Talc (Suspected, based on non-occupational exposure)
Breast	X-radiation and gamma radiation Shiftwork resulting in the disruption of circadian rhythms (Suspected, but with limited evidence)
Prostate	Arsenic & inorganic arsenic compounds (limited) Cadmium & cadmium compounds (limited)

Other Occupational Carcinogens

Bone	Plutonium (and other ionizing radiation)
Soft tissue sarcoma	Dioxin (Suspected, but with limited evidence)
Colorectal & Stomach Cancer	Asbestos (Suspected, but with limited evidence)
Kidney	Arsenic & inorganic arsenic compounds (Suspected, but with limited evidence)

Common Sites for Occupational Cancer Mortality



Type of Cancer	Related to Occupational Exposure Estimated % (USA) *
Lung	6.3-13%
Bladder	3-19%
Mesothelioma	85-90% (men); 23-90% (women)
Leukemia	0.8-2.8%
Laryngeal	1-20% (men)
Skin Cancer (non-melanoma)	1.5-6% (men)
Sinonasal and nasopharyngeal	31-43% (men)
Kidney	0-2.3%
Liver	0.4-1.1 (vinyl chloride only; men)

* Steenland, K., et al. Dying for work: the magnitude of US mortality from selected causes of death associated with occupation. Am J Indust Med 2003;43:461-482.

Industry sectors with potential over-exposure to carcinogens in Quebec: 2001-2005



<u>Substance (IARC Category)</u>	<u>Industries</u>
PAHs (1/2A/2B)	70
Crystalline silica (1)	27
Wood Dust (1)	25
Beryllium (1)	12
Styrene (2B)	11
Methylene chloride (2B)	11
Lead (2B)	9
Nickel (1)	7
Cobalt (2B)	4
Asbestos (1)	4

* Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST) Rapport R-485, 2007

CAREX: International Information System on Occupational Exposure to Carcinogens

- Developed by the Finnish Institute for Occupational Health in collaboration with experts from across Europe
- Estimates the number of workers *potentially* exposed to IARC 1 & 2A carcinogens in 55 industry sectors
 - Based on the principle of hazard rather than risk
- Used to estimate the burden of occupational cancer in Europe (by the EU) and the World (by the WHO)



www.carexcanada.ca

Surveillance of environmental & occupational exposures for cancer prevention

Surveillance de l'exposition aux agents cancérogènes en milieu de travail et dans l'environnement pour la prévention du cancer

CANADIAN **PARTNERSHIP**
AGAINST **CANCER**



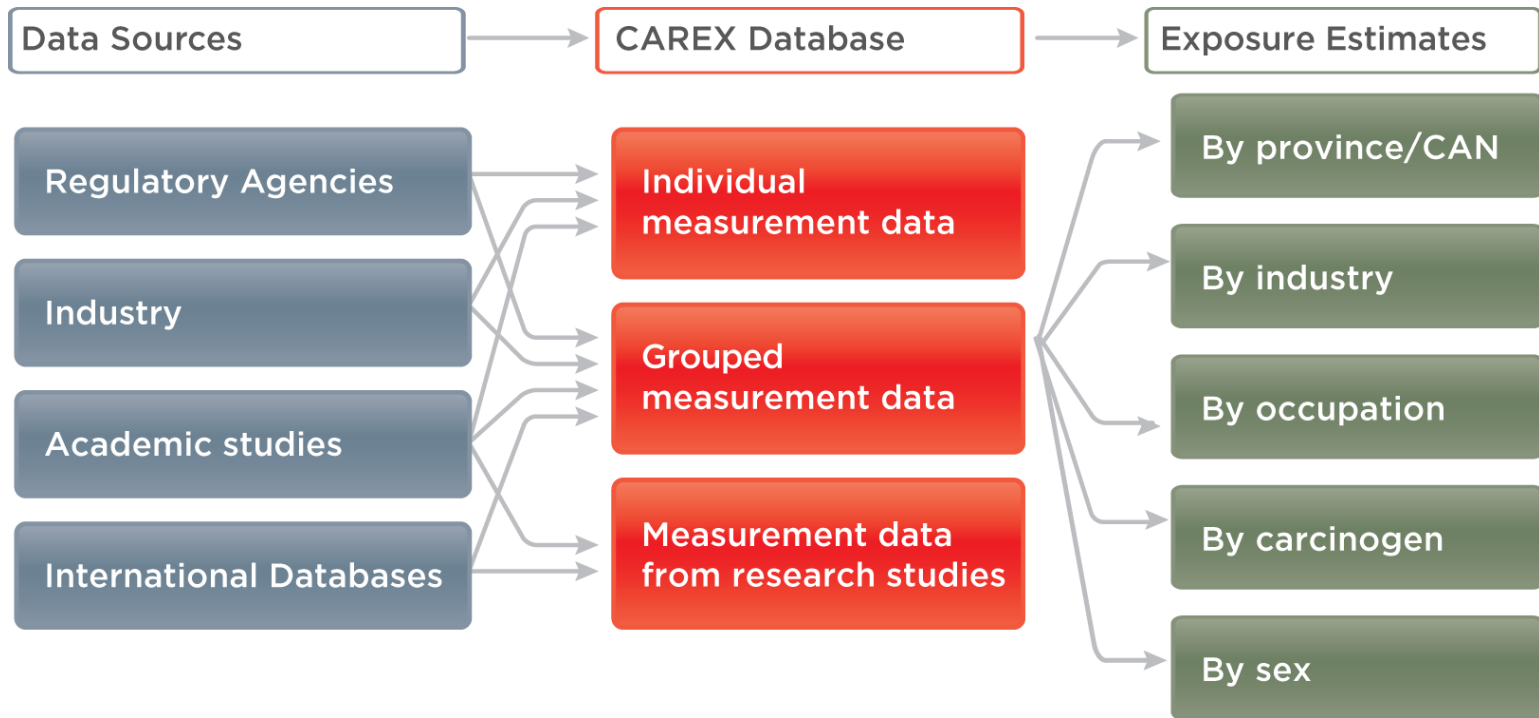
PARTENARIAT CANADIEN
CONTRE LE **CANCER**



CAREX Canada - OVERVIEW

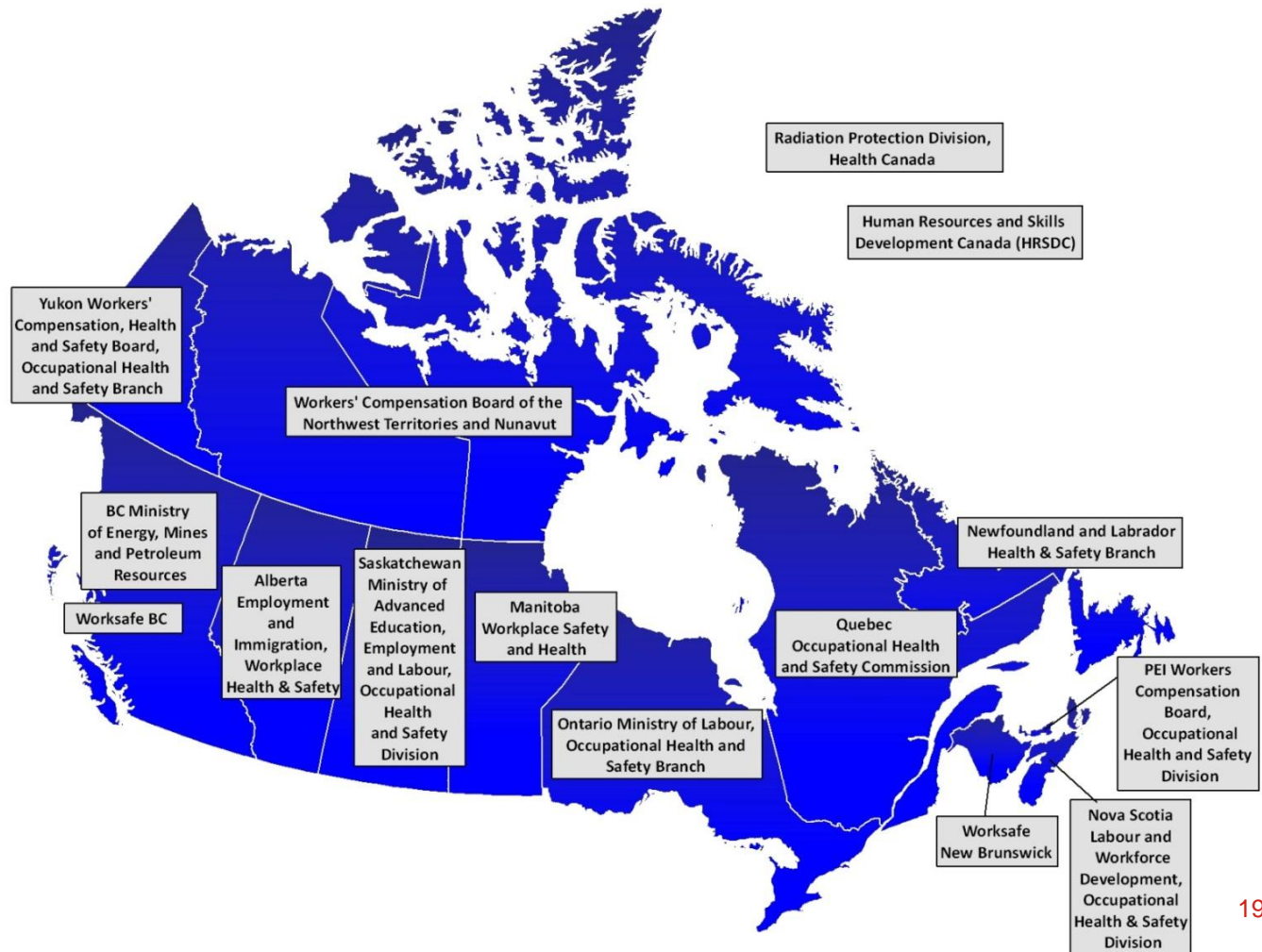
- The objectives of CAREX Canada are to:
 - develop estimates of the **number** of Canadians exposed to IARC carcinogens in their workplace & community environments,
 - identify **how** & **where** people are exposed, and
 - when possible, determine their **level** of exposure.
- Estimates are generated using existing Canadian exposure data, census population data & the best exposure estimation procedures available.

Canadian Workplace Exposure Database (CWED)



Workplace Exposure Data Survey: Public Agencies Contacted

15 regulatory & government agencies across Canada were contacted with an open-ended survey in 2009



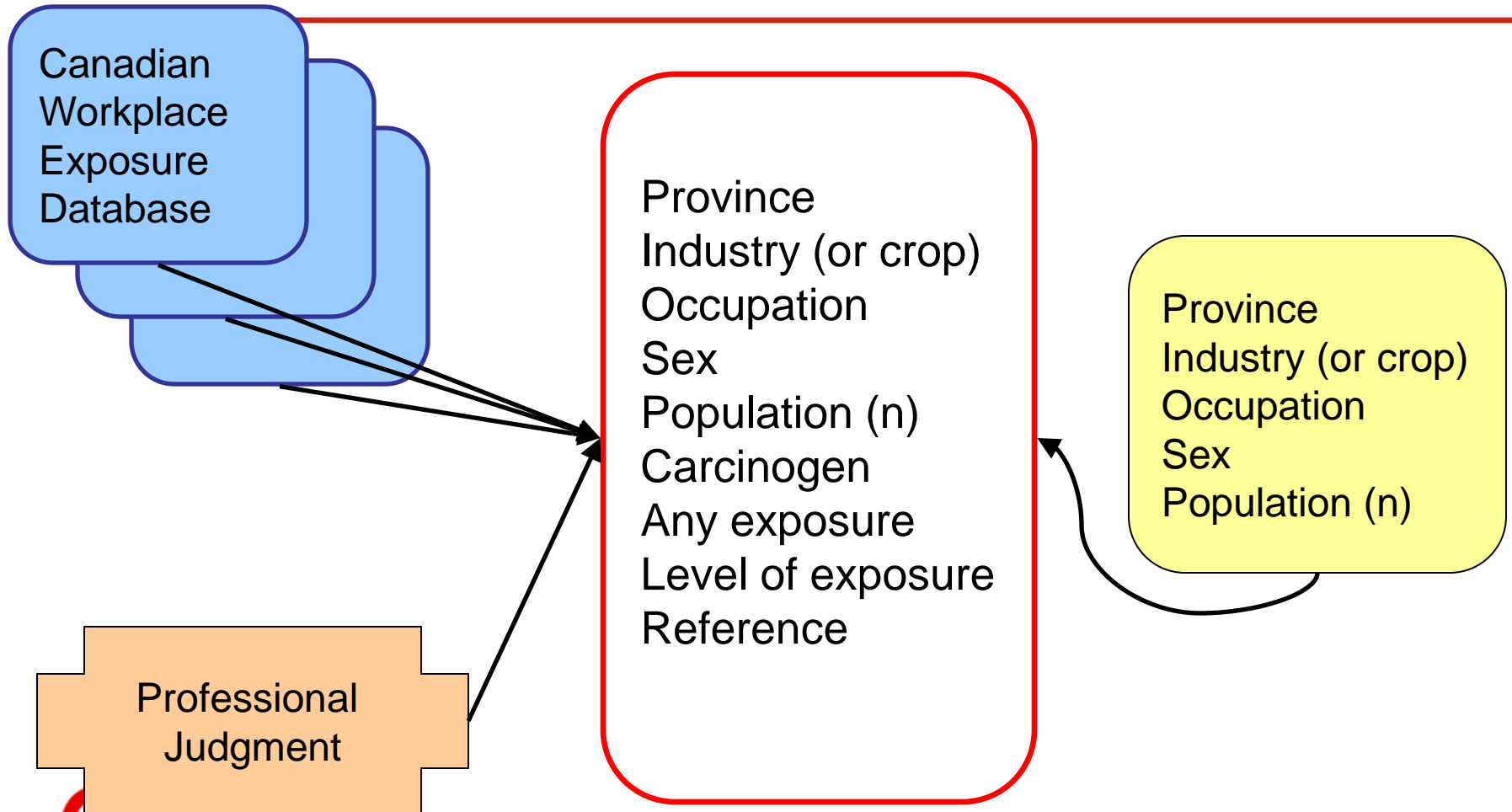
Regulatory and Government Agencies Collaborating

- Ontario Ministry of Labour: MESU Database
- WorkSafe BC: LIMS Database
- National Dose Registry: Radiation Database (aggregated)
- Université du Montréal: SMEST & Hygiene Databases
- Health Canada Radiation Protection: National Dose Registry aggregated data
- Saskatchewan Ministry of Labour, Yukon WCB, BC Mines being computerized
- Ongoing discussions with Alberta Employment, Manitoba Workplace Safety and Health, and HRSDC

Provincial Workplace Measurements

	Ontario (81-96)	BC (81-04)	Quebec (01-05)
Wood dust	3,848	7,194	4,588
Formaldehyde	7,936	2,788	4,629
Lead	7,806	3,060*	3,459
Silica	4,666	1,640	3,373
Perchloroethylene	2,764	2,148	882
Benzene	1,441	658	1,240
Cadmium	1,358	851	662
Asbestos	1,787	4,718	1,385
Beryllium	292	128	17,864

Developing Exposure Estimates



CAREX Canada Electronic Platform

Views | Clipboard | Font | Rich Text | Records | Sort & Filter | Find

fmnuMainMenu | frmExposureEstStage

Staging table to add new Industry/Job code exposure estimates - Add record mode | Pull or Push data ... | Close

Switch - Search by Occupation | Carcinogen: Styrene

Industry search: [All] | Occupation search: [All]

List of related Occupations: Select one or more to add an exposure

JobCodeII	Pop_CA	Occupation
J012	685	Supervisors, petroleum, gas and chemical proce:
J02	10	Supervisors, assembly and fabrication
J023	10	Supervisors, electrical products manufacturing
J026	10	Supervisors, other mechanical and metal produc
J1	5720	Machine operators in manufacturing
J11	5645	Central control and process operators in manufac
J111	25	Central control and process operators, mineral a
J112	5620	Petroleum, gas and chemical process operators
J12	10	Machine operators and related workers in metal i
J121	10	Machine operators, mineral and metal processi
J13	10	Machine operators and related workers in chemi
J134	10	Water and waste plant operators
J14	10	Machine operators and related workers in pulp ar
J144	10	Other wood processing machine operators
J171	10	Process control and machine operators, food anc
J18	20	Printing machine operators and related occupatio
J182	25	Camera, platemaking and other pre-press occup
J19	25	Machining, metalworking, woodworking and relat

Sort by Rollup | Sort by Descr

Current Intersection: [Oil and gas extraction] - [Camera, platemaking and other pre-press occupations]

Exp. Description - 255 Char. | Exp level | 1st Ref: Assessors estimate | RefList... | Add new Estimate

Low Conf | Exposure proportion | 2nd Ref | 3rd Ref

Filter for Ind. | Show all | Refresh Exp. List | Mode of use: Add Records | Edit Records

Exp Estimates for the current carcinogen - edit directly in the lines below. (Note: Some fields have been locked on purpose) | Review Del. Rec | Delete Exp

sysEx	CCod	Expos	Low Conf	ExpDesc	Exp Pro	Pop Exp	Total Pop	Industry
6660	STYR	H	<input type="checkbox"/>	Exposure during styrene monomer production. Occurs	0.1	87	870	Basic chemical manufacturing

Navigation Pane

Form View

Potentially Exposed Workers: Initial Estimates

Known or suspected carcinogen (IARC classification)	Canada	Ontario
Shift work with circadian disruption (2A)	2,800,000	1,150,000
Solar radiation (1)	1,500,000	450,000
Diesel engine exhaust (2A)	804,000	275,000
Silica (crystalline) (1)	349,000	129,200
Polycyclic aromatic hydrocarbons (2A/2B)	307,000	103,400
Benzene (1)	297,000	112,100
Wood dust (1)	293,000	78,000
Lead (2A)	202,000	70,000
UV radiation (artificial sources)(1)	150,000	55,000
Asbestos (1)	152,000	52,000
Chromium (VI) compounds	83,000	31,300
Nickel compounds	53,000	18,000
Formaldehyde	41,600	16,000
Ionizing radiation*	37,110	17,550

Initial CAREX Estimates of Crystalline Silica Exposure by Industry

Industrial Sector	Ontario Workers
Construction	88,740
Mineral products mfg.	7,130
Mining	4,780
Basic metal industries	4,460
Metal products mfg.	2,450
Other manufacturing	5,810
Other industrial sectors	15,780
Total	129,150

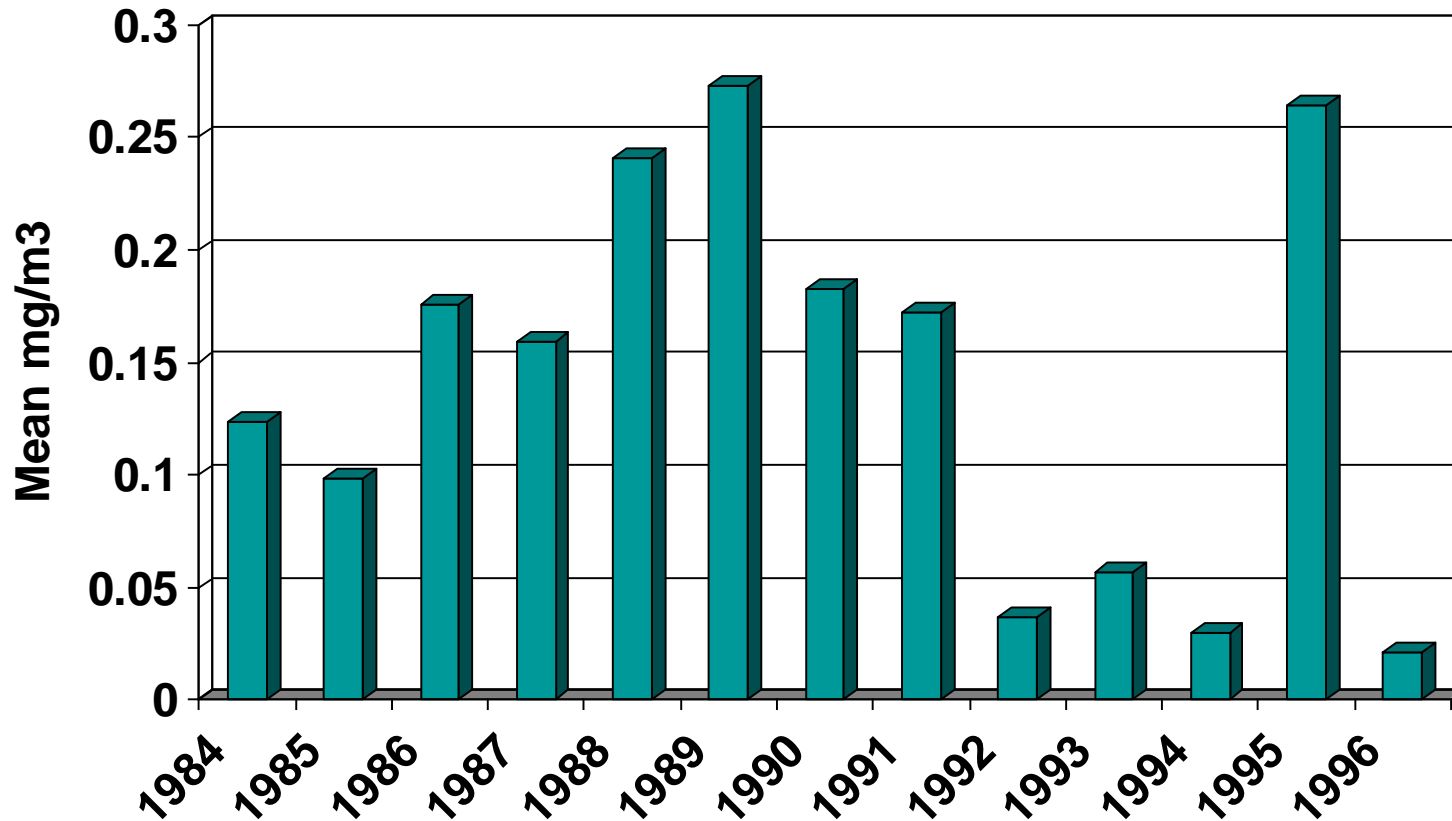
Levels of Exposure to Crystalline Silica by Industry Sector, Ontario 1983-1996

Industrial Sector (# samples)	Mean* (range)
Construction (270)	1.8 (0-52.0)
Mineral products mfg. (1147)	0.2 (0-27.0)
Mining (277)	0.1 (0-2.7)
Basic metal industries (1465)	0.2 (0-22.5)
Metal products mfg. (577)	0.3 (0-66.5)
Other manufacturing (340)	0.2 (0-5.6)
Other industrial sectors (539)	0.2 (0-6.2)

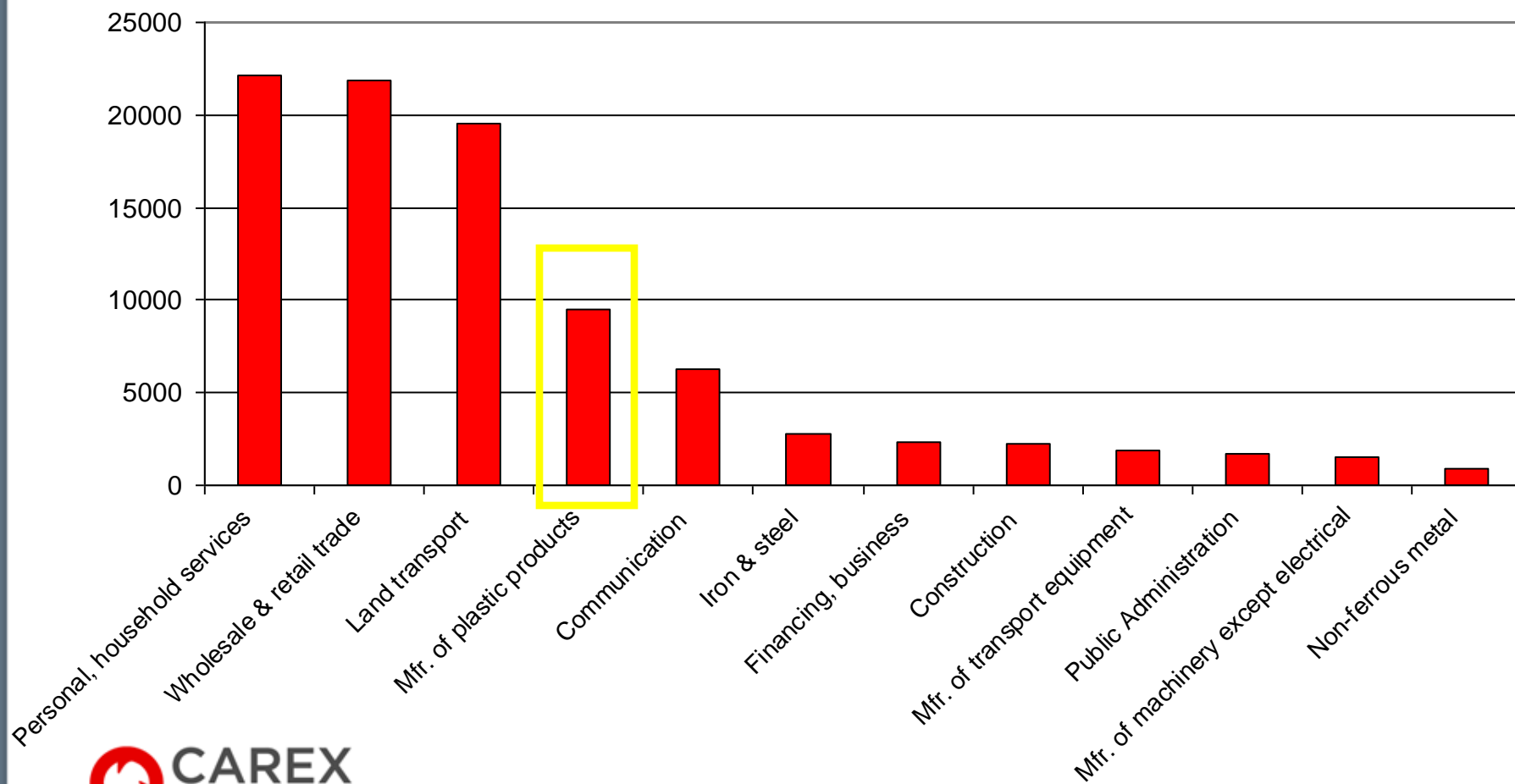


* mg/m³, current ACGIH TLV is 0.05 mg/m³ www.carexcanada.ca

Average Exposure to Crystalline Silica: Ontario Mineral Products Industries



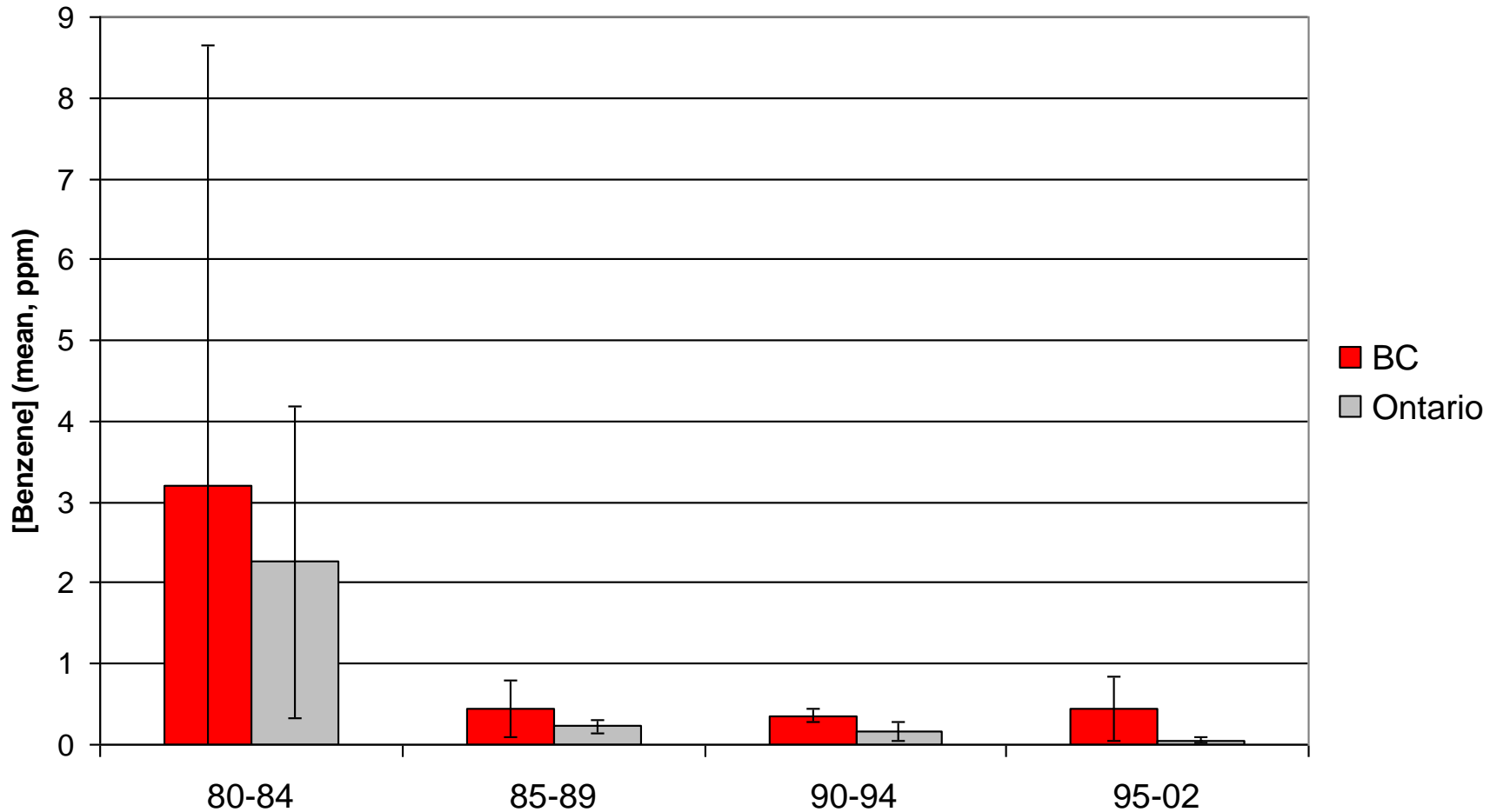
Initial CAREX Estimates of Workers Exposed to Benzene by Industry for Ontario



Benzene exposure in the plastics manufacture industry (Ontario)

Job	Exposure	# exposed
Plastics processing machine operators	10% assumed exposed	1332
Auto service technicians	Car repair (80% assumed exposed)	32
Delivery & courier drivers	Diesel/gasoline (50% assumed exposed)	35
Chemical technologists	50% assumed exposed	63
Foundry workers	Thermal degradation of core resins (100% assumed exposed)	185
Labourers in rubber and plastic mfr.	10% assumed exposed	7222
Plastic products assemblers, finishers, inspectors	10% assumed exposed	631

Mean benzene exposure over time in BC and Ontario workplaces



* current ACGIH TLV is 0.5 ppm, NIOSH PEL is 0.1 ppm

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Levels of Exposure to Benzene by Industry Sector, Ontario 1981-1996

<u>Industry Sector (measurements)</u>	<u>Mean ppm (range)</u>
Gasoline stations (12)	13.0 (0.01-55.8)
Iron and Steel Mills (29)	2.3 (0.01-16.0)
Printing industry (38)	0.9 (0.01-7.8)
Pharm. & Medicine Mfr. (128)	0.7 (0.01-19.5)
Rubber Manufacture (192)	0.1 (0.01-5.2)
Plastics Manufacture (137)	0.05 (0.01-2.5)
Electrical Components Mfr. (21)	0.03 (0.01-0.2)

Benzene exposure to service station attendants: Personal long-term samples

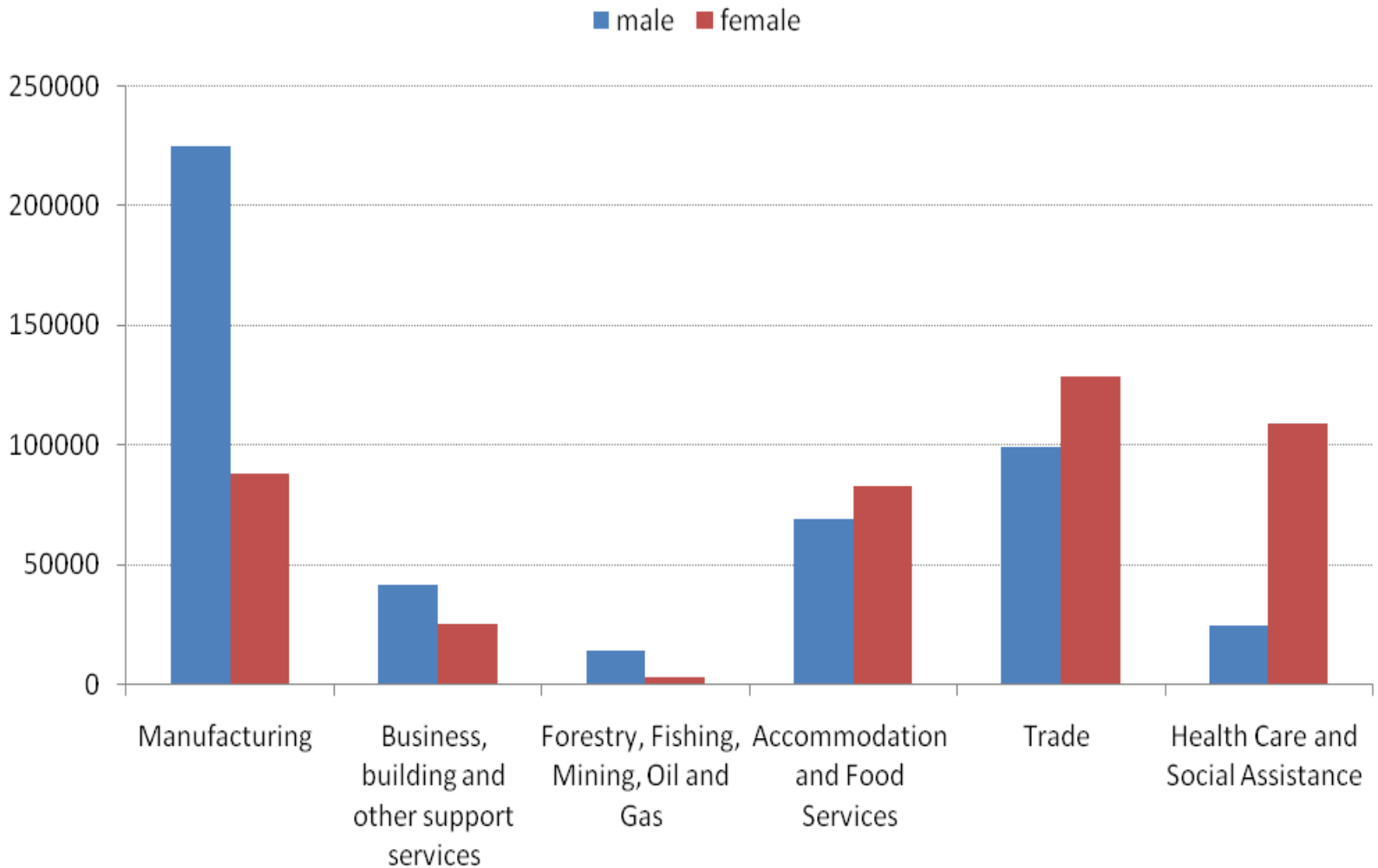
Source	Location	Mean (ppm)	n samples
CPPI-PACE 1996	Canada	0.04	78
CPPI-PACE 1990	Canada	0.38	280
PACE 87-4 Pilot 1987	Canada	0.03	42
Rappaport 1987	USA	0.2	49
Halder 1986	USA	0.3	21
Kearney 1986	USA	0.1	18
Runion 1985	USA	0.06	1478
Weaver 1983	USA	0.06	14
McDermott 1979	USA	0.09	84

Number of People Exposed to Ionizing Radiation by Industry in Ontario

Industrial group	Number of workers monitored by NDR in 2005	Number of workers exposed*
Nuclear power	18,600	7,320
Medicine	27,700	4,280
Professional, scientific services	6,950	2,570
Uranium mining	18	2
Public administration	2,500	475
Other	13,000	2,900

*Exposure is defined as having an annual ionizing radiation dose of >0 mSv

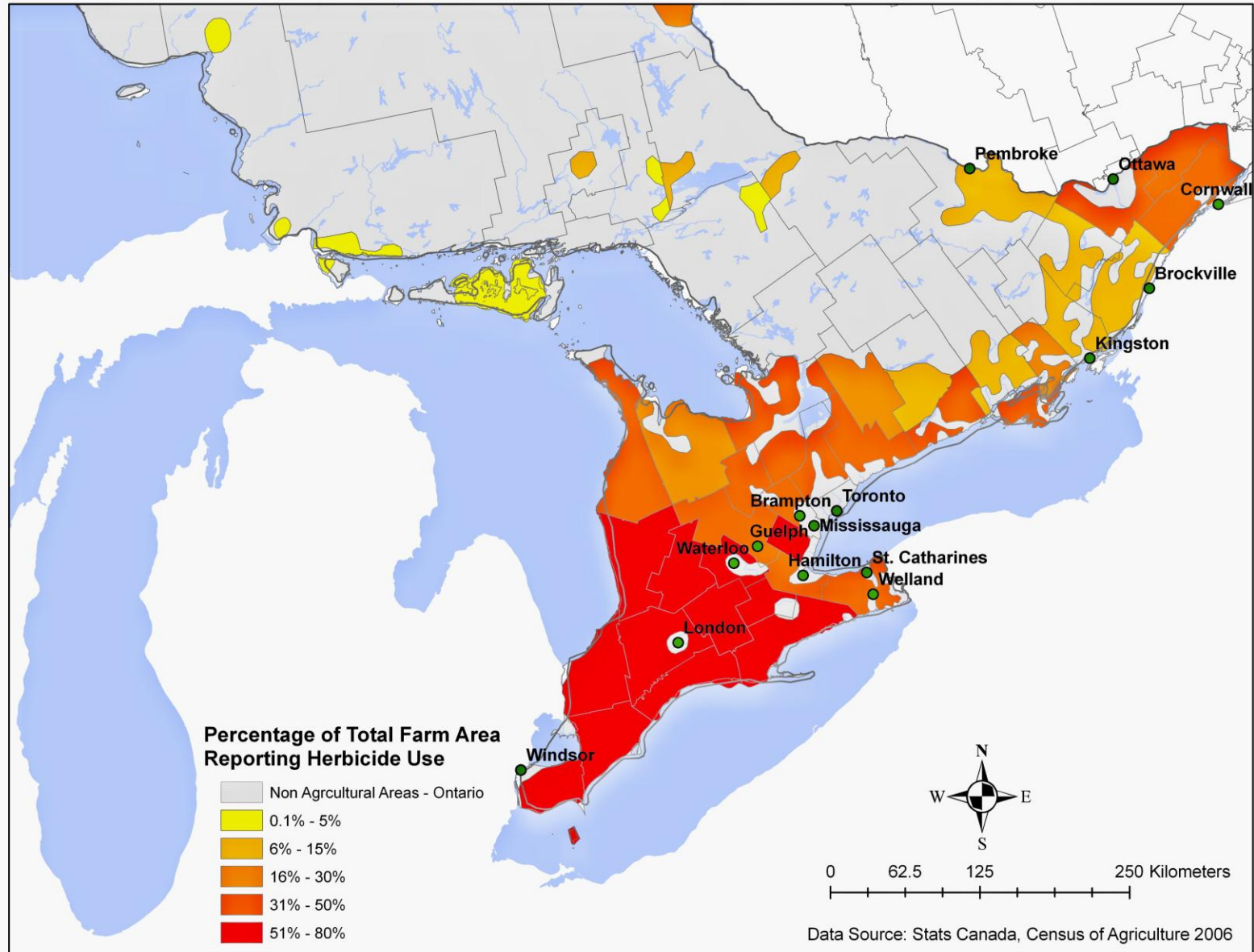
Night, Evening & Rotating Workers in Ontario Industries with the Highest Prevalence



CAREX Priority Agricultural Pesticides

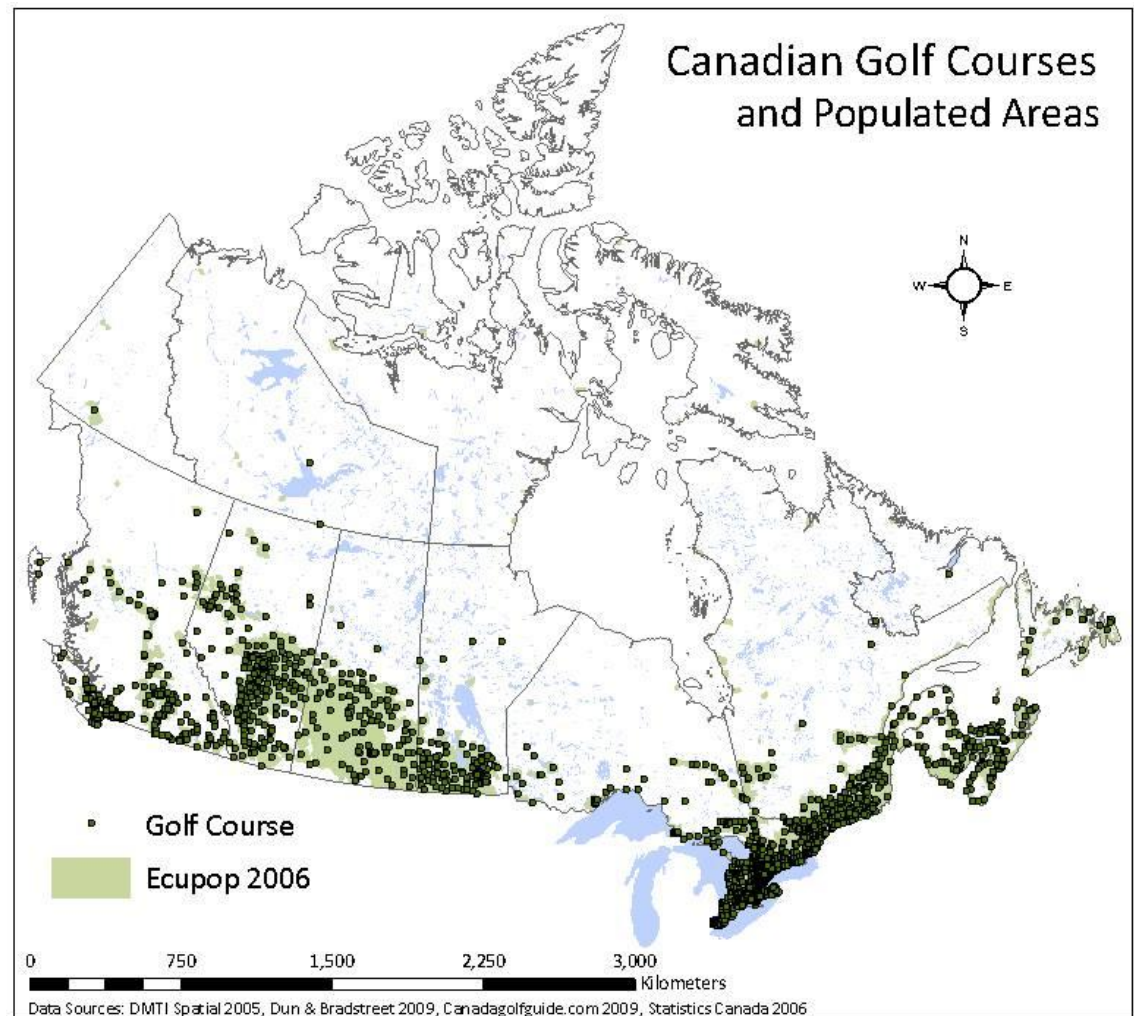
Pesticide Active Ingredient	Type of Pesticide
2,4-Dichlorophenoxy acetic acid (2,4-D)	Herbicides
(4-chloro-2-methylphenoxy) acetic acid (MCPA)	
Mecoprop (MCP)	
Dichlorprop (2,4-DP)	
2,4,5-Trichlorophenoxy acetic acid (2,4,5-T)	
Chlorothalonil	Fungicide
1,1,1-trichloro-2,2-bis(4-chlorophenyl) ethane (DDT)	Insecticides
Hexachlorobenzene (HCB)	
Lindane	
Dichlorvos	
1,3-Dichloropropene (1,3-D)	

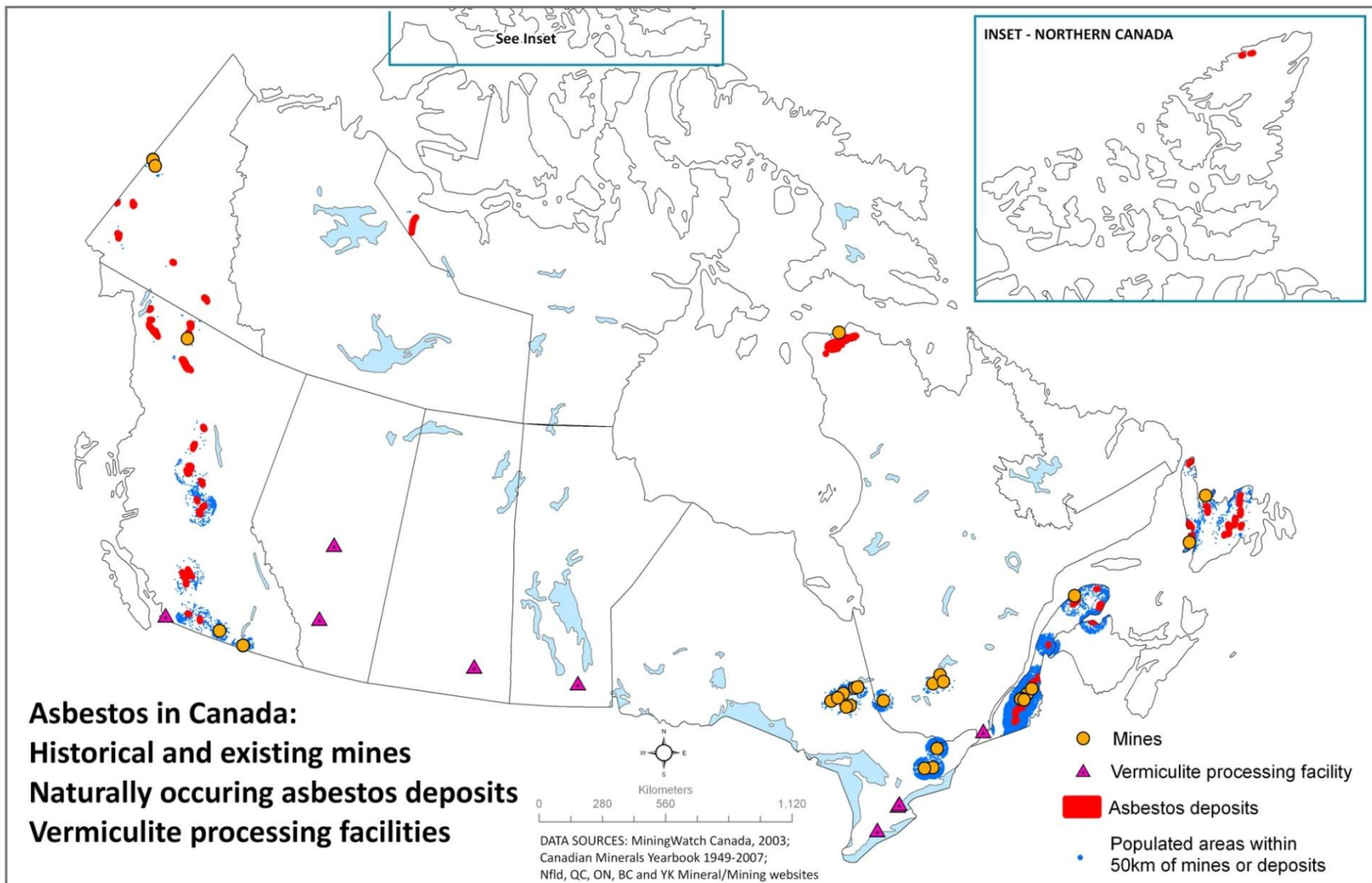
Distribution of Herbicide Use - Ontario - High Agricultural Activity Areas



Golf Course Pesticide Applicators by Province

Province/Region	Total
BC	1056
AB	999
SK	426
MB	399
ON	2493
QC	1083
NFL	66
PEI	84
NB	174
YT	6
NT	3
NU	0
Canada	7017





The CAREX Canada Team

Anne-Marie Nicol (Exec. Director)

Occupational Exposure:

Cheryl Peters, Amy Hall, Yat Chow,
Barb Lang, Calvin Ge, Imelda Wong,
Midori Courtice, Kim McLeod

Environmental Exposure:

Eleanor Setton, Perry Hystad,
Karla Poplawski, Steeve Deschenes,
Niki Garzia, Alejandro Cervantes

Communications:

Christie Hurrell, Barb Karlen,
Kristen Hodgins, Sarah-Nelle
Jackson



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► Carcinogen Profiles
& Estimates

► Resource Center

► About Us

CAREX Canada is developing estimates of the number of Canadians exposed to [known, probable and possible](#) carcinogens in workplace and community environments. These estimates will provide significant support for targeting exposure reduction strategies and cancer prevention programs. By bringing together data from across Canada on sources and levels of exposure, we will identify regional differences and vulnerable populations. CAREX Canada will create a significant new resource for policy makers and researchers to prevent cancer.

[View Carcinogen Profiles & Estimates ►](#)

Occupational Cancer Research Centre

VISION

The prevention of occupational cancer through the identification and elimination of exposures to carcinogens in the workplace

MANDATE

- Conduct research on occupational cancer and carcinogens
- Bridge occupational, environmental, and public health
- Build research capacity

SCOPE

- Ontario-wide focus
- Nationally/internationally networked
- Multi-disciplinary approach
- Applied research





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News & Events

Student Research Prize for Occupational Cancer Research
September 23, 2010

OCRC is accepting applications for its annual Student Research Prize, a competition that recognizes the work of one student who has made a significant...

Students recruited to OCRC
September 23, 2010

OCRC continues to recruit students to work on several occupational cancer research projects. Manisha Pahwa is an occupational/environmental health graduate...

[More News](#)

About OCRC

The Occupational Cancer Research Centre (OCRC), established in 2009, is the first of its kind in Canada. The Centre was established to fill the gaps in our knowledge of occupation-related cancers and to translate these findings into preventive programs to control workplace carcinogenic exposures and improve the health of workers.

The Centre is establishing and leading a program of integrated research that will involve collaborations between researchers, worker organizations and employers.

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Featured Profile



Shelley Harris
Scientist

[Biography](#)

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