Occupational Cancer Research Centre

Occupational Carcinogens: Current Knowledge, Gaps, and Stakeholder Perspectives

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CARWH Conference: Worker Health in a Changing world of work

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What we know about occupational carcinogens

- ~ 60 definite or probable workplace carcinogens
- Over 100 additional workplace exposures are possible carcinogens
- Many other workplace exposures with a suspicion of human carcinogenicity
- Even greater number of workplace substances with little formal evaluation
- Established carcinogens are still exacting a toll, i.e., the number of Ontarians diagnosed each year with mesothelioma continues to rise

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.

Well Established Human Carcinogens: Number exposed in Ontario[1] & Cancers Sites[2]

	Exposed	Confirmed	Suspected
Asbestos	52,000	Lung, Mesothelioma, Larynx, Ovary	Pharynx, Colon, Rectum, Stomach
Silica (chrystalline)	129,000	Lung	others?
Wood Dust	78,000	Sinonasal, Nasopharynx	
Leather Dust	?	Sinonasal	
Arsenic	8,100	Lung, Skin, Bladder	Kidney, Liver, Prostate
Beryllium	1,600	Lung	
Cadmium	17,000	Lung	Kidney, Prostate
Chromium (Cr6)	31,000	Lung	Sinonasal
Nickel	18,000	Lung, Sinonasal	
Benzene	112,000	Acute non-lymphatic Leukemia	ALL, Multiple Myeloma, NHL
1,3-butadiene	?	Lymphatic & Haematopoietic	

1. Preliminary CAREX Canada estimates (2010), 2. IARC Monograph 100 evaluations (2009)

Well Established Human Carcinogens: Number exposed in Ontario[1] & Cancers Sites[2]

	Exposed	Confirmed	Suspected
Polycyclic aromatic hydrocarbons	103,000	Lung, Skin, Bladder	
Formaldehyde	16,000	Nasopharynx, Leukemia	Sinonasal
Ethylene oxide	900	(no consistent sites)	MM, NHL, CLL, Breast
Dioxins	?	All cancer	Lung, STS, NHL
Ionizing Radiation	17,500?	Many	
Radon	?	Lung	
Solar radiation	449,000	Skin	
Artificial UV radiation	73,000	Skin, Eye	
Vinyl Chloride	?	Liver	
Antineoplastic drugs	6,000?	Leukemia, Skin	

1. Preliminary CAREX Canada estimates (2010), 2. IARC Monograph 100 evaluations (2009)

Probable Human Carcinogens: Number exposed in Ontario[1] & Cancers Sites[2]

	Exposed	Suspected Cancers
Acrylamide	3,200	(based on animals only)
Polychlorinated biphenyls (PCBs)	2,900	(no consistent sites)
Tetrachloroethylene	5,600	Esophagus, Cervix , NHL, others
Trichloroethylene	5,500	Liver, Kidney, NHL, others
Lead	70,000	Lung, Stomach
Creosotes	340	Skin
Diesel engine exhaust	275,000	Lung
Shift work	745,000-1,051,000	Breast, Prostate?

1. Preliminary CAREX Canada estimates (2010), 2. U.S. National Toxicology Program (2009)

Possible Human Carcinogens: Number exposed in Ontario[1] & Cancers Sites[2]

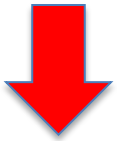
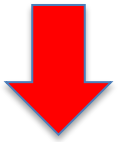
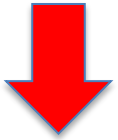
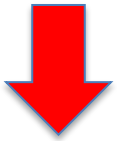
	Exposed	Suspected Cancers
Acrylonitrile	3,700	Lung?, Prostate?
Naphthalene	1,900	Lung?
Styrene	19,000	Lymphatic/hematopoietic?
Toluene diisocyanates (TDI)	12,000	(based on animals only)
Antimony trioxide	3,900	(based on animals only)
Cobalt	11,800	Lung?
Vanadium pentoxide	2,200	(based on animals only)
Refractory ceramic fibers (RCF)	1,700	(based on animals only)
Dichloromethane	9,100	(inconsistent evidence)
Pentachlorophenol	1,100	NHL, Soft Tissue Sarcoma?
Chlorophenoxy herbicides	40,000+?	(inconsistent evidence)
Chlorothalonil	?	(based on animals only)

1. Preliminary CAREX Canada estimates (2010), 2. U.S. National Toxicology Program (2009)

IARC Evaluation Priorities 2010-2014

High Priorities	Medium priorities
Asphalt & bitumen	Atrazine
Carbon-based nanoparticles	Metalworking fluids & lubricants
Crystalline fibres other than asbestos	N-Nitroso compounds with widespread occupational & environmental exposure
Iron & iron oxides	Polybrominated biphenyls (PBBs)
Motor vehicle exhaust emissions	Polybrominated diphenyl ethers (PBDEs)
Perfluorinated compounds (including PFOA)	Polychlorinated biphenyls (PCBs)
Radiofrequency electric & magnetic fields	Some phthalates (e.g. bis(2-ethylhexyl) phthalate, diisononyl phthalate)
Sedentary work	Styrene
Stress	Trichloroethylene & other chlorinated solvents
Ultrafine particles	Ultraviolet radiation, broad-spectrum UV radiation, sunlamps & sunbeds
Welding fumes	

How is occupational cancer research faring around the world?

- Funding? 
- Number of occupational research projects? 
- Number of occupational cancer sessions at scientific meetings? 
- Number of published papers? Probably 

Why the reduction in occupational cancer research?

Perceptions:

- Not an important contributor to the cancer burden

  Contributes as much as any factor, except diet and tobacco use

- No new leads

  Many, many leads from epidemiology and experimental studies

- Occupational exposures are well controlled

  Some are, most are not

- Not scientifically important

  Provided much of what we know about carcinogenesis. Can be even more important in the “omics” era

- Political decisions

  The major impediment

Occupational Cancer Research Centre – A unique effort

- Launched in 2009 to address these needs and re-vitalize occupational cancer research in Canada
- Devoted to the identification, prevention, and ultimate elimination of exposure to carcinogens in the workplace
- **Objectives of the Centre:**

1. Surveillance of occupational cancers and workplace exposures
2. Research into the causes of cancer in the workplace
3. Intervention research to develop and test prevention and exposure reduction strategies
4. Building research capacity
5. Knowledge transfer and exchange

OCRC partners

- Workplace Safety & Insurance Board (WSIB)
- Canadian Cancer Society, Ontario Division (CCS)
- Cancer Care Ontario (CCO)
- United Steelworkers

- To date a total of nearly $1,000,000 annually for 5 years has been pledged jointly by the WSIB, CCS and CCO

Setting occupational cancer research priorities: Results of the OCRC stakeholder survey

Purpose

- To gain advice and insight from stakeholder community on priority setting to assist in developing a research agenda

Methods

- Online survey along with follow-up interviews with several respondents
- Distributed through the OCRC stakeholder database
  - Contacts of OCRC partners
  - Attendees of OCRC launch
  - Scan of funded research in occupational cancer

Results: Respondent characteristics

Total Respondents = 177

Occupational role*	n	%
Researcher/scientist	52	29.38
Health and safety specialist	47	26.55
Industrial hygienist	25	14.21
Interested citizen/advocate	21	11.86
Health practitioner	14	7.91
Policy analyst	13	7.34
Knowledge translation specialist	12	6.78
Worker	12	6.78
Employer	5	2.82

*Participants were able to select more than one role and affiliation

Results: Respondent characteristics

Occupational affiliation*	n	%
Academic institution	45	25.42
Government	24	13.56
Labour union	23	12.99
Non-government organization	21	11.86
Industry	18	10.17
Health and safety organization	15	8.47
Health care organization	14	7.91
Unaffiliated	6	3.39

*Participants were able to select more than one role and affiliation

Results: Most frequently identified exposures

Exposure category	Examples of commonly listed exposures	Frequency
Chemicals	Chlorine, formaldehyde, amines, ammonia, formalin, methamphetamine, PCB, PHC, sulphuric acid mist	30
Respirable dusts and fibres	Asbestos, fibreglass, silica, wood dust, brake dust, carbon black	27
Radiation	Electromagnetic fields, nuclear, cell phone, computer, sun, ionizing radiation, radiofrequency radiation, WIFI, X-ray	24
Lifestyle factors	Smoking, physical activity, stress, diet, alcohol	18
Shiftwork	--	16
Pesticides	--	15
Nanomaterials	--	14
Exhaust	Diesel, gas	14
Metals and metal compounds	Uranium, chromium, cobalt, gold, nickel, smelter fumes, tungsten, welding fumes, lead	13
Work environment	Indoor air, environmental tobacco smoke, mould	12
Solvents	Solvents (general), benzene, TCE, xylene	9
Wood, fossil fuels and oils	Metal working fluid, oil mists, coal tar, fuel, asphalt	7
Pharmaceuticals	Antineoplastic drugs, cytotoxic drugs	4
Plastic and rubber	--	4
Food preparation exposures	Food combustion, high temperature frying	2

Results: Barriers

Barrier	Frequency	Percent
Lack of funding	62	35.0
Lack of data	51	28.8
Difficulty applying results	42	23.7
Lack of awareness	35	19.8
Employer/industry resistance	27	15.3
Exposure relationships hard to disentangle	24	13.6
Not a government priority	17	9.6
Insufficient human resources	17	9.6
Not a public priority	15	8.5
Need for collaboration	11	6.2
Implications for insurance/compensation	10	5.7
Small population to study	9	5.1
Long latency period	9	5.1
Privacy issues	5	2.8
Methodological issues	5	2.8

Results: Solutions

Potential solution	Frequency	Percent
Collaboration	27	20.5
Training, awareness, education	24	18.2
Policies and regulation	10	7.6
Additional funding	9	6.8
Registry or exposure database creation	8	6.1
Government prioritization	7	5.3
OCRC itself	5	3.8
Higher quality exposure information	4	3.0
More causal information	3	2.3
Increased data access	3	2.3
Seek opportunities for data linkage	3	2.3
Focus elsewhere	2	1.5
Other	20	15.2

Priorities identified in follow-up interviews

- Exposures not traditionally thought of as carcinogens
- Information on the health effects of nanotechnology
- Focus on knowledge transfer and exchange
- Public visibility and transparency

Current research activity

- Mesothelioma patterns and projections in Ontario and Canada
- Ontario uranium miner cohort: linkage with national mortality and cancer incidence files
- Cross-Canada study of pesticides and select cancers: A re-analysis
- Systematic review of occupational cancer prevention efforts
- Women and minorities in occupational cancer research: An update

Occupational Cancer Research Centre

Towards a cancer free workplace

http://www.cancercare.on.ca/OCRC