Occupational Cancer Research Centre

The Burden of Occupational Cancer: Major Workplace Carcinogens and Prevention of Exposure in Ontario

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Ontario
Cancer Care Ontario
Action Cancer Ontario

Canadian Cancer Society
Société canadienne du cancer

Ontario
Ministry of Labour
Ministère du Travail

Conflict of Interests

- I have no conflicts of interest
- The report was funded by Cancer Care Ontario through the Population Health and Prevention Unit
- The Burden of Cancer Project was funded by the Canadian Cancer Society Research Institute
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- The OCRC is funded by the Ontario Ministry of Labour, Cancer Care Ontario, and the Canadian Cancer Society

Burden of Occupational Cancer in Ontario

Major Workplace Carcinogens and Prevention of Exposure

Occupational Cancer Research Centre

Ontario
Cancer Care Ontario

Objectives of the report

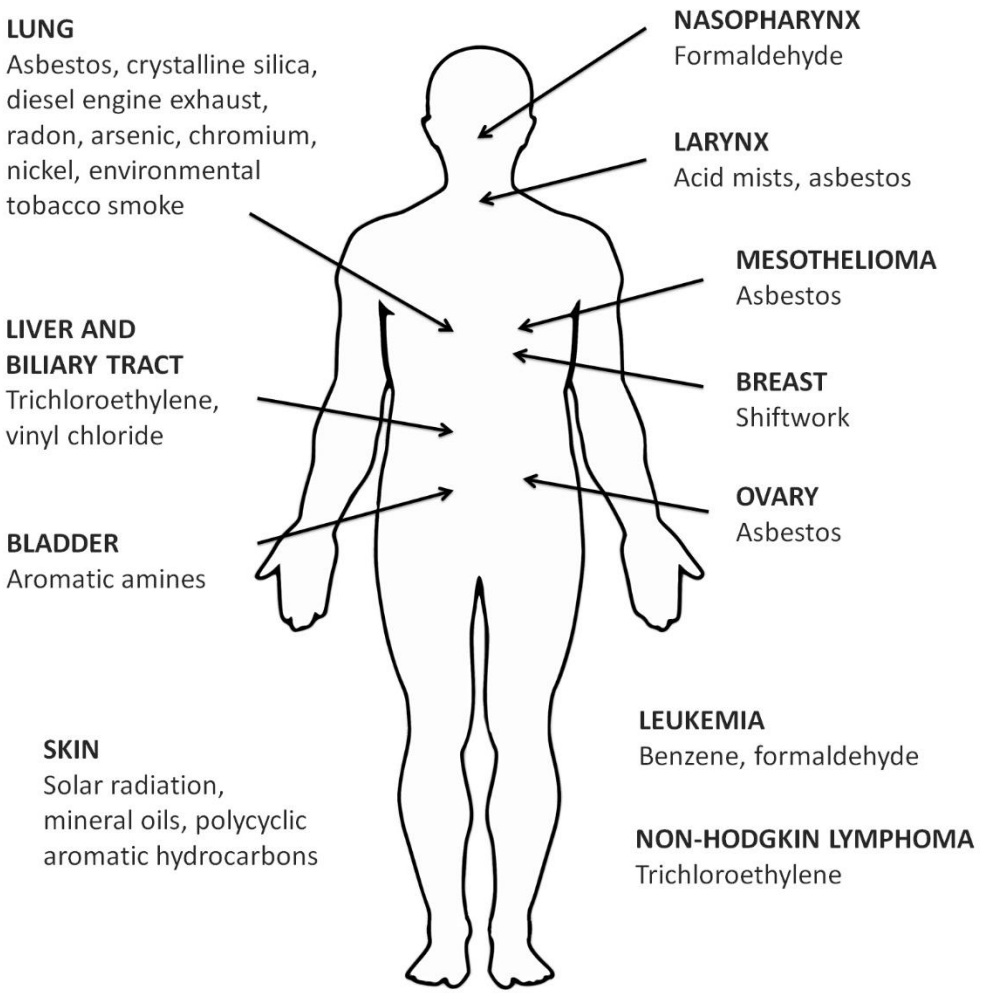
- The primary objectives were to
  - describe & quantify important occupational risk factors for cancer in Ontario
  - present policy recommendations for reducing occupational carcinogen exposure
- The secondary objectives were to
  - propose workplace-based opportunities for reducing exposure
  - discuss emerging issues in occupational cancer research that are relevant to Ontario

Assessing the Burden of Occupational Cancer in Canada

"burden" is the human impact & the economic costs associated with a specific cause of cancer

This project is funded by Canadian Cancer Society Research Institute Multi-Sector Team Grant #701285

Canadian Cancer Society / Société canadienne du cancer



The burden project is a national collaborative effort with:

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Contents of the Report

For the most common, well-established (IARC 1 & 2A) carcinogens in Ontario:

- Number of new cancers diagnosed annually based on the Burden of Occupational Cancer Project
- Number of workers currently exposed and where
- Policy and workplace prevention recommendations

Special thanks to:

- Policy Advisory Committee: Ray Copes, Fe de Leon, Linn Holness, Andy King, Katherine Lippel, Rowena Pinto, Ellen Simmons, William Swanson, Valerie Wolfe
- Reviewers: Jeremy Beach, Paul Bozek, Hugh Davies, Leon Genesove, Tracy Kirkham, Cheryl Peters

International Agency for Research on Cancer

World Health Organization

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans

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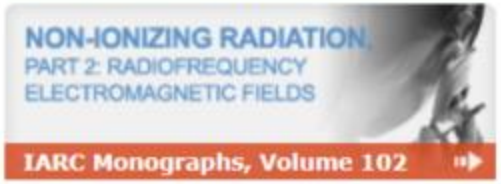
The *IARC Monographs* identify environmental factors that can increase the risk of human cancer. These include chemicals, complex mixtures, occupational exposures, physical agents, biological agents, and lifestyle factors. National health agencies can use this information as scientific support for their actions to prevent exposure to potential carcinogens.

Interdisciplinary working groups of expert scientists review the published studies and evaluate the weight of the evidence that an agent can increase the risk of cancer. The principles, procedures, and scientific criteria that guide the evaluations are described in the Preamble to the *IARC Monographs*.

Since 1971, more than 1000 agents have been evaluated, of which more than 400 have been identified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans.



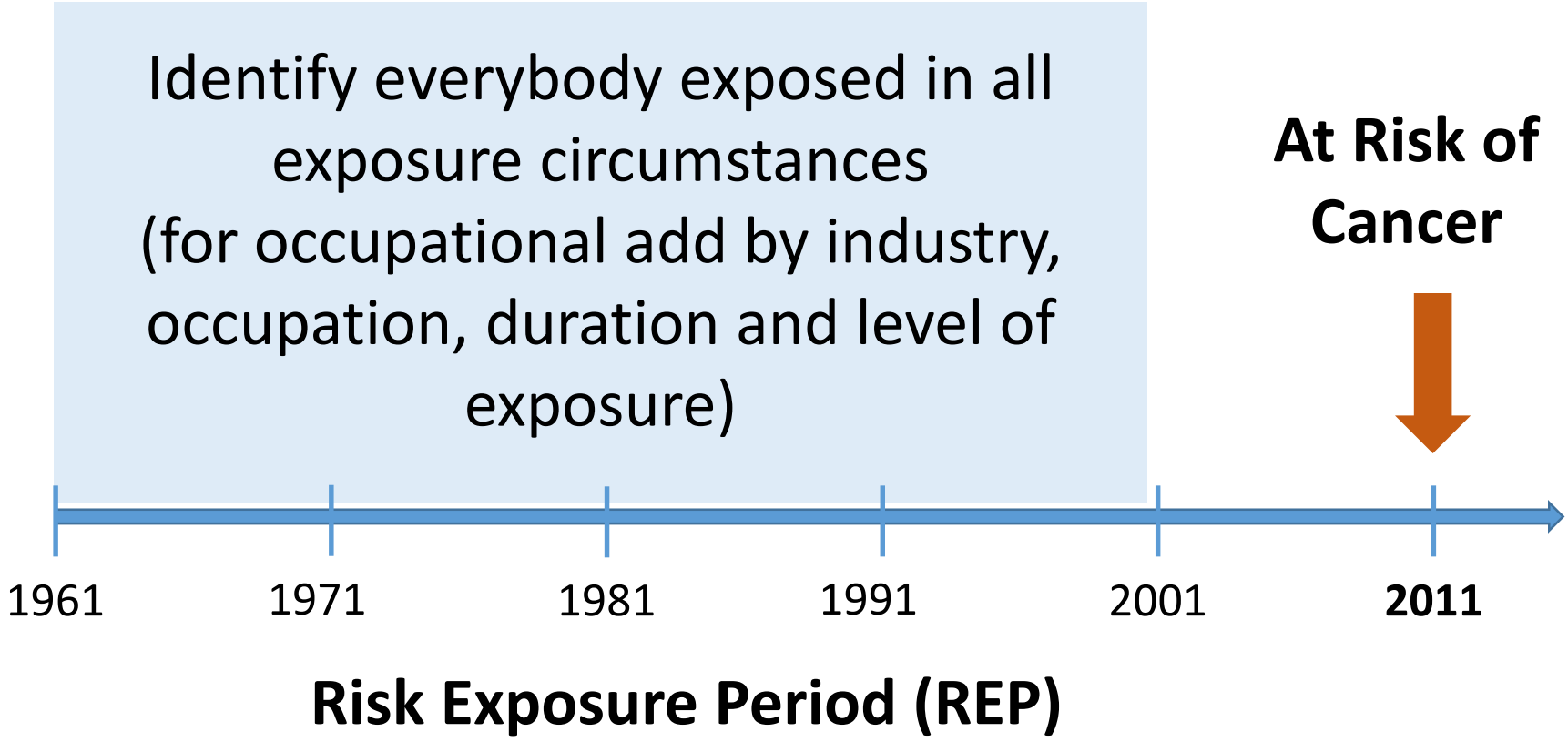
Attributable Risk (AR)

- Burden of disease projects rely on the calculation of AR's (sometimes called etiologic fraction, attributable risk proportion)

- $AR = \frac{Pr(E)(RR-1)}{Pr(E)(RR-1)+1}$

Levin's equation (1953), where Pr(e) is proportion exposed in the target population and RR is the Relative Risk associated with exposure

Challenge: Estimating History of Exposure among the General Population



CAREX CANADA

A National Occupational & Environmental Exposure Surveillance Project

Based at:

1. Faculty of Health Sciences,
   Simon Fraser University, Vancouver
2. School of Population and Public Health,
   University of British Columbia , Vancouver
3. Occupational Cancer Research Centre, Toronto

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

PARTENARIAT CANADIEN CONTRE LE **CANCER**

CAREX Canada: Job-Exposure Matrix

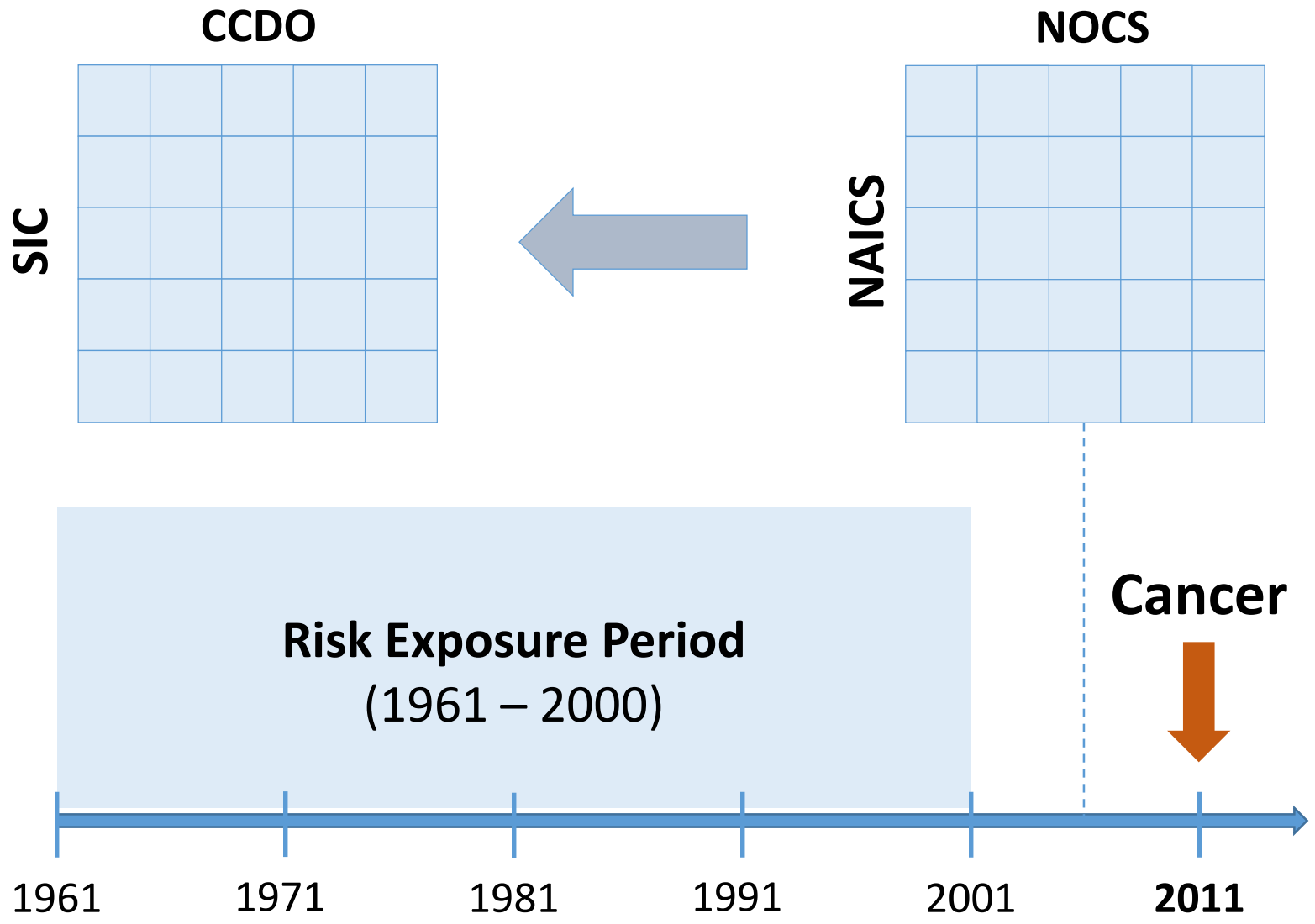
- CAREX Canada: Prevalence and level of exposure
  - 328 industries & 520 occupations

National Occupational Classification System 2006 (NOCS)

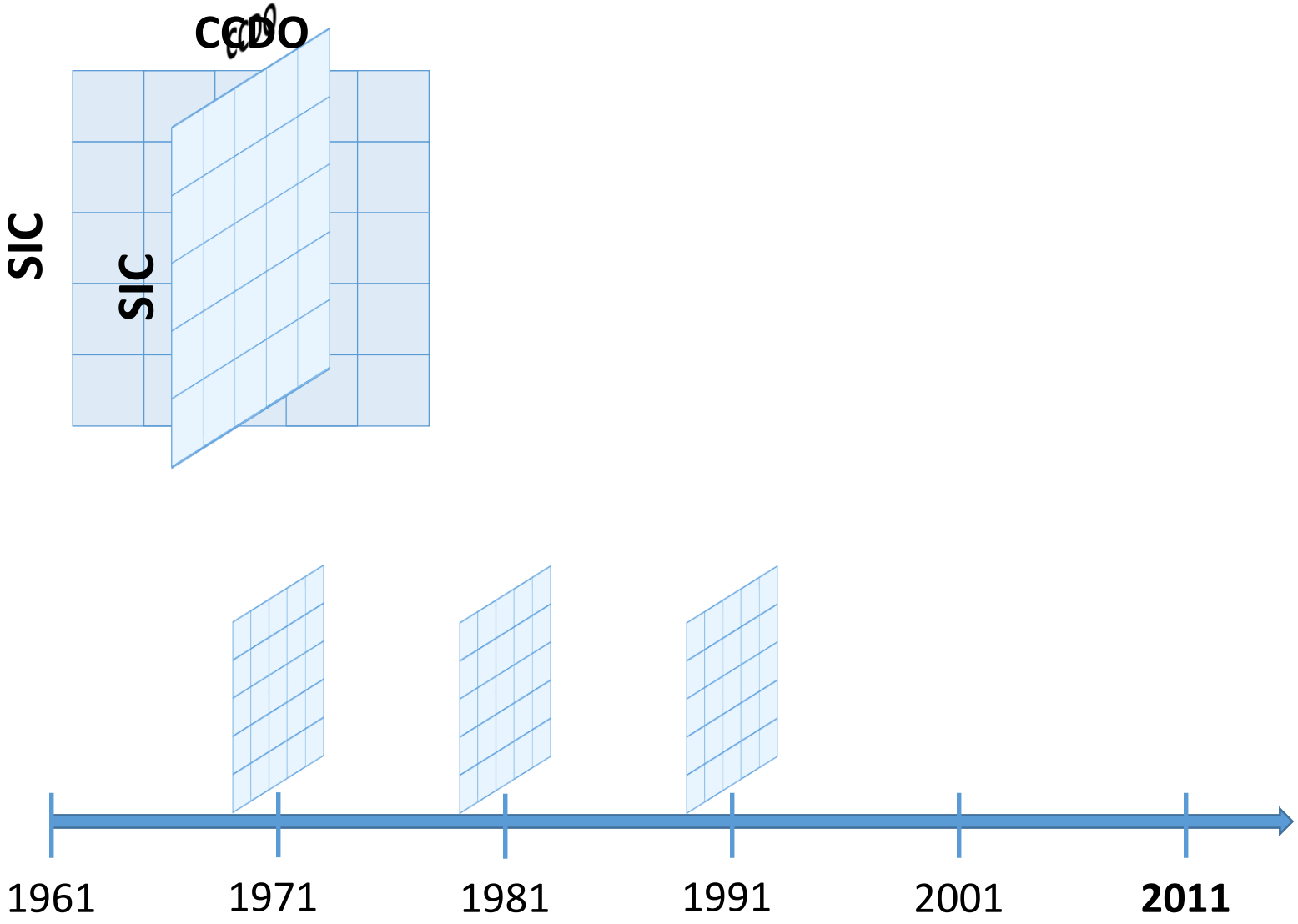
North American Industrial Classification System 2002 (NAICS)

Prevalence / Level	Occ 1	Occ 2	…	Occ 519	Occ 520
Ind 1	0.2/L	1.0/L	…		
Ind 2			…	0.5/H	0.1/M
…	…	…	…	…	…
Ind 327	0.6/M		…	1.0/L	1.0/L
Ind 328	0.5/H	1.0/L	…	0.8/L	

Applying CAREX JEMs to estimate burden



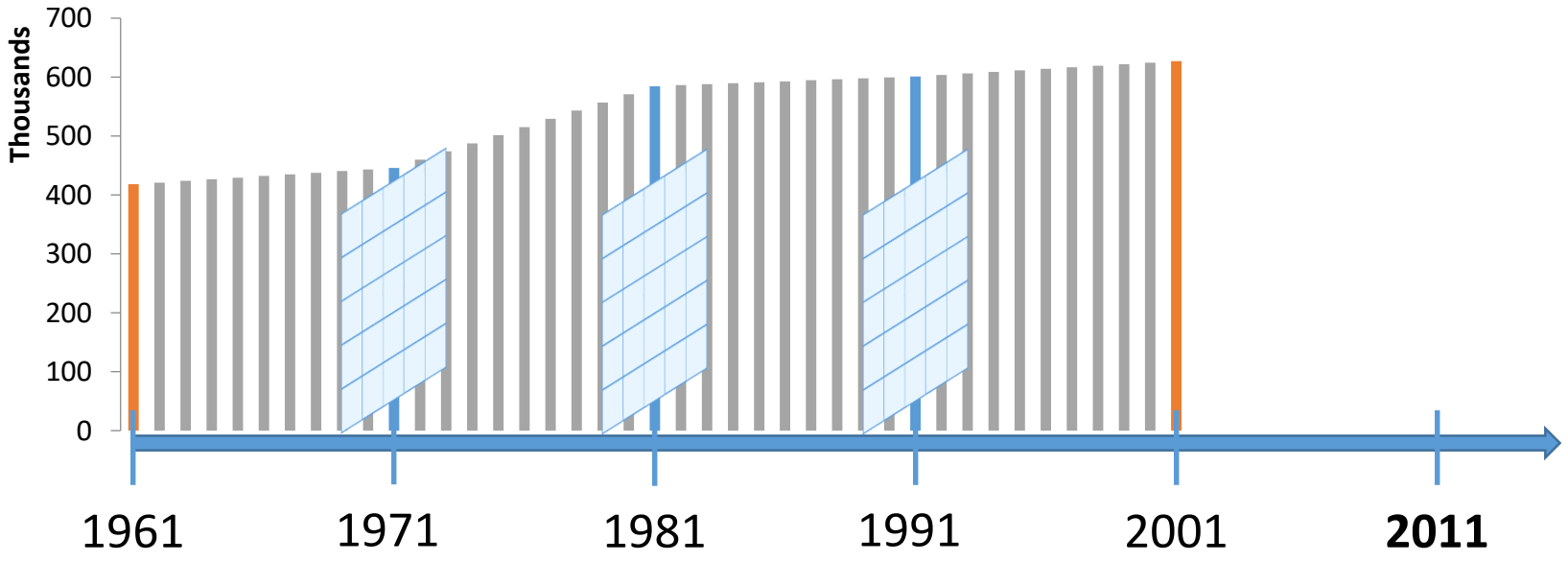
Apply the CAREX JEM to Census Data



Apply the CAREX JEM to Census Data

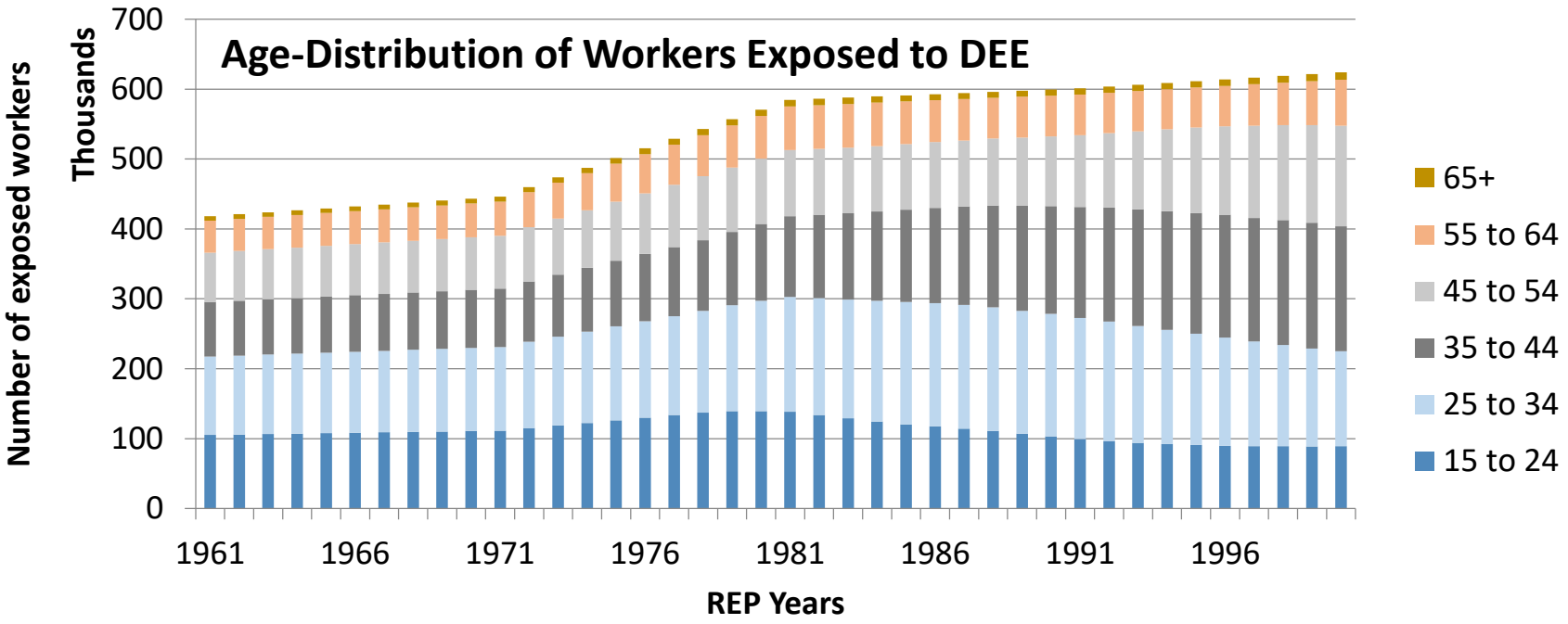
- Census employment data (1971/1981/1991)
- Use 1961 and 2001 census data to anchor time trends
- Add estimates for intermediate years

$\Rightarrow$ Number of exposed workers in each REP year



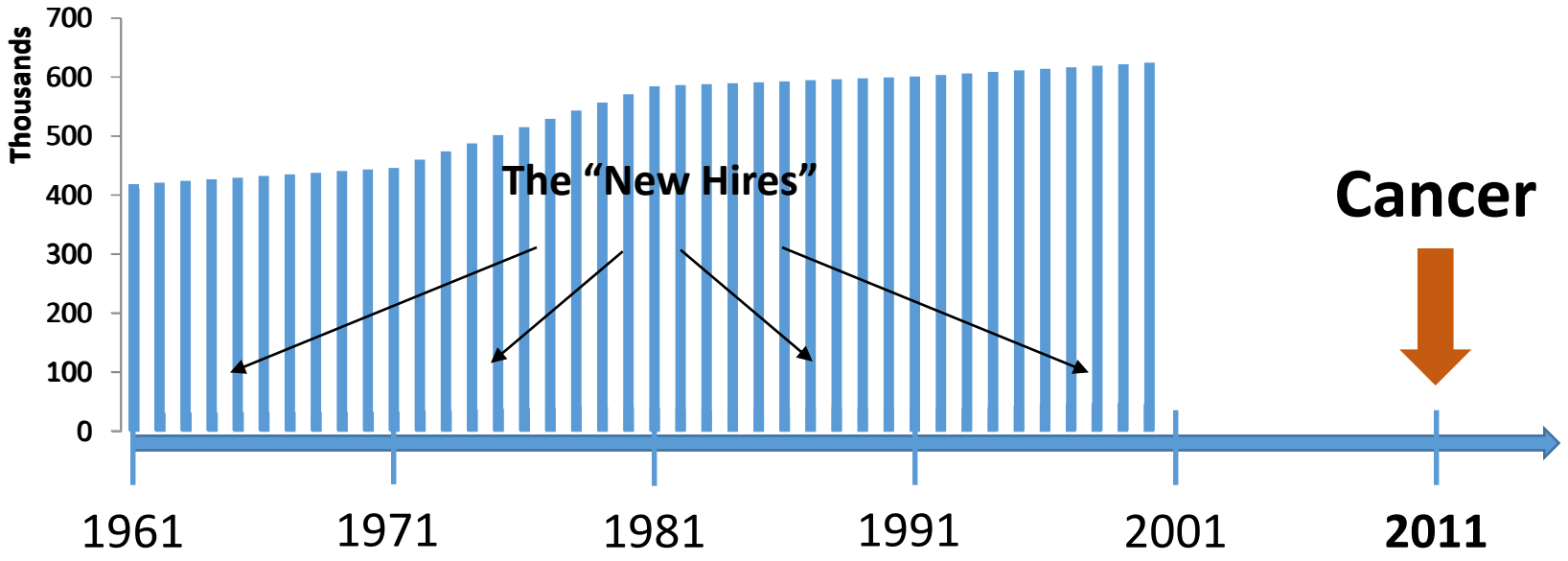
Exposed: Detailed Picture over Time

- CAREX JEM + Census data
  - *Industry, occupation, province, sex, exposure level*
- Labour Force Survey for age distribution
- National Enhanced Cancer Surveillance System for tenure distribution



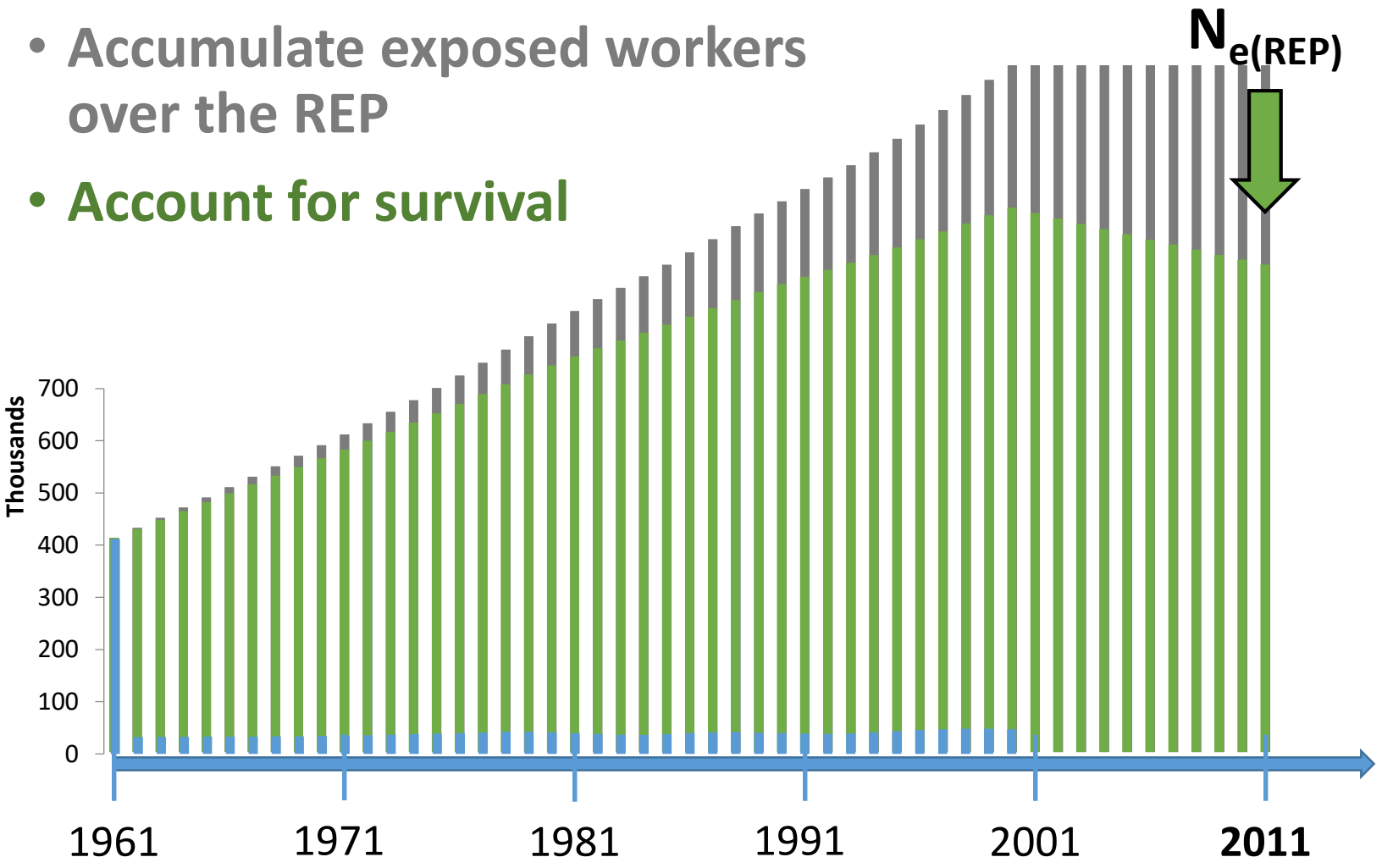
Population Modelling

- How to estimate the number of workers ever exposed ($N_{e(REP)}$)?
  - Count everyone in the initial REP year
  - Add “new hires” from each subsequent year



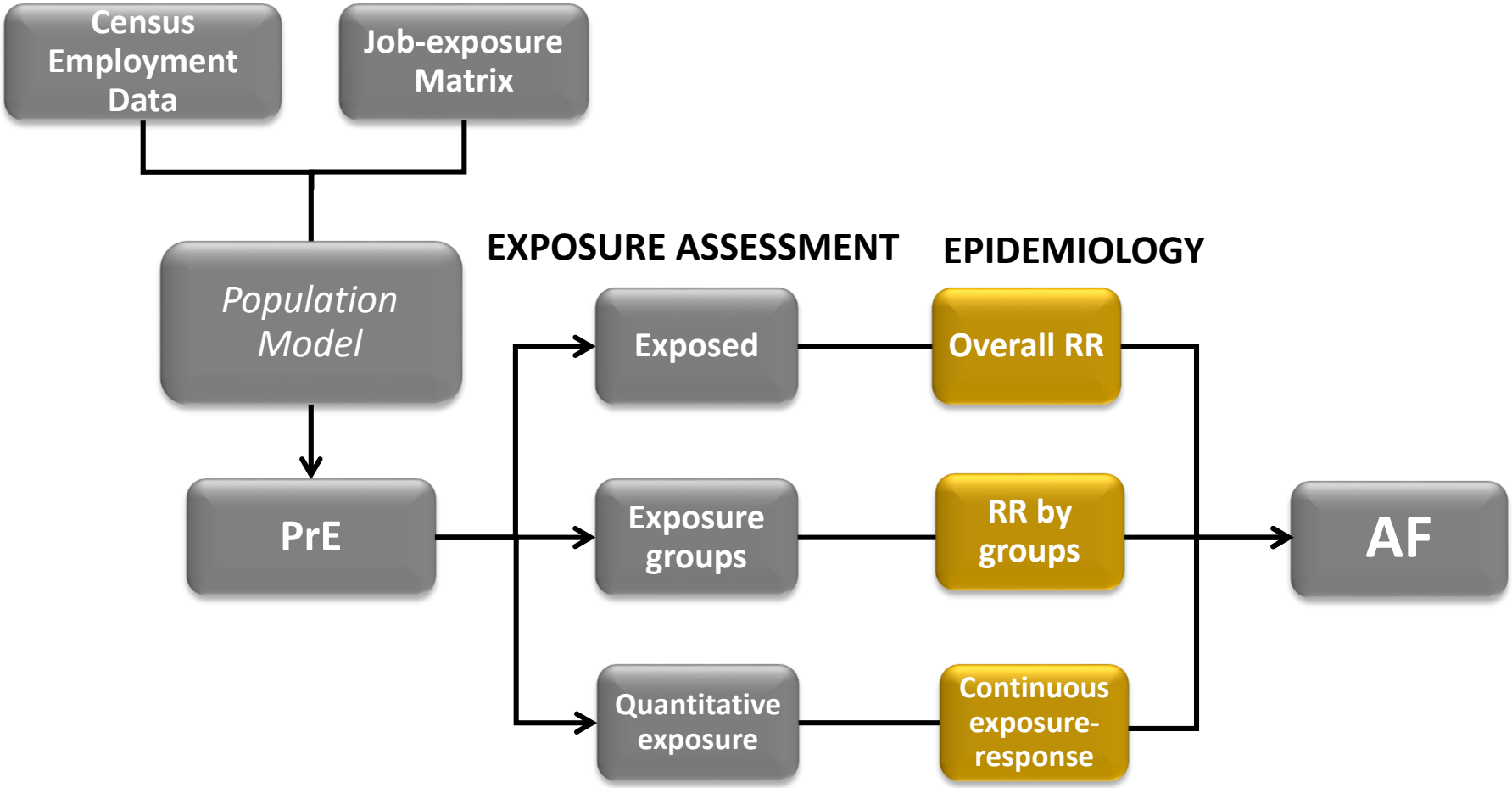
Population Modelling

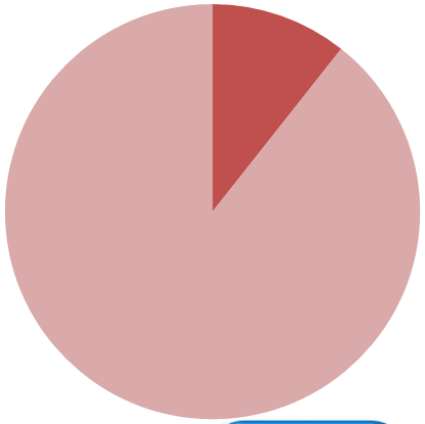
- Accumulate exposed workers over the REP
- Account for survival



*For illustration purposes only, not real results

Conceptual Overview





Transportation and warehousing

400,000 (49%) exposed

Diesel exhaust exposure

Construction

94,000 (9%) exposed

Mining & oil and gas

61,000 (26%) exposed

Agriculture, forestry, and fishing

54,000 (10%) exposed

Public admin

51,000 (5%) exposed

Diesel Exhaust Exposure Distribution

CAREX Level (based on average exposure)	Population in 2011, ever exposed during Relevant Exposure Period	Cumulative Exposure ($\mu g/m^3$- years EC)		
		Mean	Min	Max
Low	1,357,000 (84%)	41	5	99
Moderate	199,000 (12%)	131	17	299
High	56,000 (3%)	1,575	225	2,957

Example: Diesel & Lung Cancer (national)

Proportion in 2011 exposed
(1961 – 2001)

6.8% of the 2011 population, or 1,612,000 current or former workers

Relative Risk and Source

A dose-response curve from a meta-analysis of cohort studies *

Attributable Cancers

560
lung cancers
AF = 2.4%

* Vermeulen R, Silverman DT, Garshick E, Vlaanderen J, Portengen L, Steenland K. 2014. Exposure-response estimates for diesel engine exhaust and lung cancer mortality based on data from three occupational cohorts. Env Health Persp 122:172-77.

Burden of Cancer in Ontario: Results

Carcinogen	Annual Cancers	Current Exposure
Solar UV at Work	1400 non-melanoma skin	449,000
Asbestos	630 lung, 140 mesothelioma, 15 laryngeal, <5 ovarian (? digestive)	52,000
Diesel Exhaust	170 lung, (45 bladder)	301,000
Crystalline Silica	200 lung	142,000
Welding Fumes	100 lung	169,000
Nickel*	80 lung	48,000
Chromium VI*	25 lung	39,000
ETS at work	50 lung, 10 pharynx, 5 larynx**	125,000
Radon	60 lung	34,000
Arsenic	20 lung	8,000
Benzene	10 leukemia, <5 multiple myeloma	147,000
PAH's	(60 lung, 15 skin, 30 bladder)	134,000
Shiftwork	(180-460 breast)	833,000

* Excluding welding ** Among never smokers (probable associations)

Solar Ultraviolet (UV) Radiation

- 450,000 workers exposed
- ~ 1,400 non-melanoma skin cancers annually
- Greatest burden in construction & agricultural. Other groups, such as outdoor parks & recreation workers
- *Policy recommendation:*
  - *Require all workplaces with workers that work outdoors for part or all of the day to develop a comprehensive, multi-component sun safety program*
    - includes a risk assessment, sun protection control measures, and sun protection policies and training (*Sun Safety at Work Canada provides examples)*

Asbestos

- Approximately 52,000 still regularly exposed
- ~630 lung cancers, 140 mesotheliomas, 15 laryngeal cancers & <5 ovarian cancers
- Canadian government committed to ban in 2018. However, much more needed
- *Policy recommendations:*
  - *Create a public registry of all public buildings & workplaces that contain asbestos*
    - Saskatchewan & Federal programs only cover public buildings, we would include workplaces
  - *Establish an inter-ministerial working group to address occupational asbestos exposure & issues such as safe disposal, building renovation/abatement, public health…*
    - An inter-ministerial working group has been established in British Columbia, and could serve as a model

Diesel Engine Exhaust

- 300,000 workers exposed
- ~ 170 lung and possibly, 45 bladder cancers annually
- Greatest burden in transportation, construction & mining
- *Policy recommendations:*
  - *Adopt occupational exposure limits of 20 µg/m³ elemental carbon for the mining industry and 5 µg/m³ elemental carbon for other workplaces*
  - *Upgrade or replace old on-road and off-road trucks and diesel engines*
    - There is a precedent for mandating the transition for on-road vehicles in jurisdictions such as California

Crystalline Silica

- 140,000 workers exposed
- ~ 200 lung cancers annually
- Greatest burden in construction, mining, and mineral products processing
- *Policy recommendation:*
  - *Include construction project employers and workers in the Designated Substances Regulation*
  - *Ontario should follow 7* provinces, the federal govt., and ACGIH (2009) in implementing a more rigorous OEL of 0.025 mg/m^3,respirable for all forms of crystalline silica
    - *Current is 0.10 mg/m3 for quartz, 0.05/mg/m3 cristobalite*

Welding Fumes

- Classified as Group 1 in 2017
- 170,000 workers exposed
- ~ 100 lung cancers annually
- Greatest burden in manufacturing & construction
- *Policy recommendations:*
  - *Introduce ventilation requirements in Ontario Occupational Health and Safety (OHS) legislation for welding activities*
  - *[not from the committee: as a Group 1 carcinogen, a specific OEL for respirable welding fumes is needed]*

Environmental Tobacco Smoke at Work

- Significant progress has been made over the past decades to reduce ETS in workplaces through legislation, supported by increased awareness
- However, an estimated 125,000 workers still exposed
- 50 lung, 10 pharynx, 5 larynx annually among never smokers
- Policy recommendation:
  - Build on successes by strengthening enforcement of smoke-free workplace legislation
    - According to the Canadian Tobacco Use Monitoring Survey many workers still report exposure to ETS at work and a lack of smoke-free policies

Radon

- Approximately 34,000 workers exposed in underground work or poorly ventilated workplaces in high background regions
- Approximately 60 lung cancers annually
- *Policy recommendations:*
  - *Develop explicit and specific regulation of radon in indoor air in Ontario occupational health and safety regulations*
    - Naturally Occuring Radioactive Materials (NORM) Guidelines could be legislated
  - *Implement 100 Bq/m^3 (WHO's guideline) as the exposure standard for remediation in all underground and above-ground work areas*

General policy recommendations to prevent occupational cancer in Ontario

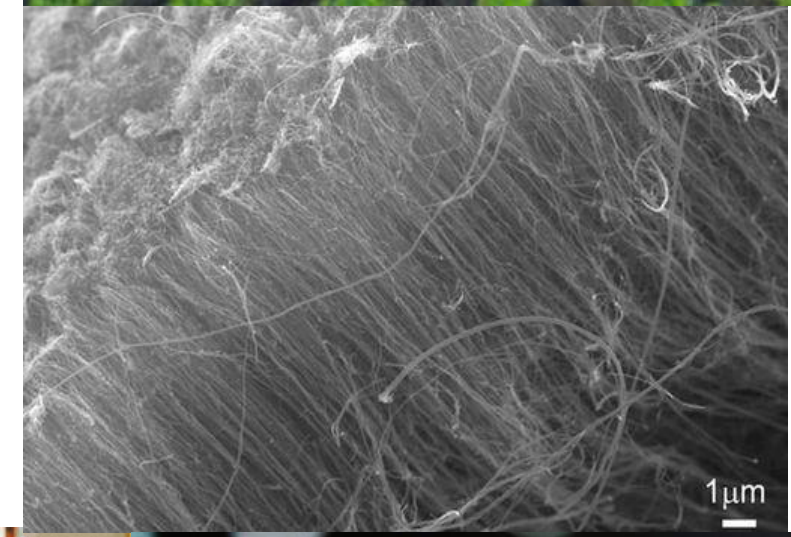
- OELs should be strengthened to align with recent evidence on health effects & be at least as protective as American Conference of Governmental Industrial Hygienists (ACGIH)
  - chromium (VI) compounds: 0.025 mg/m^3(ceiling limit 0.1 mg/m^3) for water soluble compounds in alignment with the BC
  - nickel compounds: 0.05 mg/m^{3}for elemental and insoluble and soluble inorganic nickel compounds; 0.001 ppm for nickel carbonyl; and 0.1 mg/m^{3}for nickel subsulfide; in alignment BC
  - formaldehyde: 0.3 ppm STEL; in alignment with the ACGIH
  - wood dust: 1 mg/m^3 in alignment with ACGIH

General policy recommendations to prevent occupational cancer in Ontario

- Toxics Reduction Act provisions can be amended to more explicitly incorporate worker exposure and Toxics use reduction
    - Ontario in the only province in Canada with this legislation, but it could be strengthened
- Exposure surveillance and exposure registries can help prevent occupational exposure by providing a regular and standardized method of informing workers of potential exposures

Other Carcinogens & Emerging Issues

- They were also other carcinogens with smaller numbers of cancers or less-established cancer associations
- The report focused on well-established carcinogens, but included emerging issues, including pesticides, anti-neoplastic agents, nanomaterials, sedentary work



Thank You!!

This report is available online at

http://www.occupationalcancer.ca/2017/news-occupational-burden-ontario-report