Alberta Health Services

Building the Business Case for Cancer Prevention:

The Economic Burden of Occupational Cancer in Alberta

March 23rd 2011
OCRC Research Day

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Why the “Burden” of Occupational Disease?

- Inherent difficulties with latency, awareness and recognition
- Very useful information as dollar figures attract the attention of employers by helping to define the issue
- Provide guidance to decision makers on how to best utilize limited resources by identifying the major conditions that result in the largest burden

The Economic Burden of Occupational Cancer in Alberta Project and Study

Alberta Health Services

Presentation Outline

- Study team and project history
- Study's definition of occupational cancer
- Our model
- Study approach
- Number of occupational cancers
- Costs of occupational cancers
- Recommendations
- Leveraging findings: Building the business case

Study Team

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Alberta Health Services

Acknowledgement

- To the Cancer Surveillance team, Surveillance and Health Status Assessment, Population and Public Health-Alberta Health Services

- Provided the data on aggregate cancer statistics for 2002–2006, obtained from the Alberta Cancer Registry

Project History

- Was an initiative included in a provincial strategy to prevent occupational cancer
- Study commenced in Dec. 2008 with original scheduled completion date of July 2009
- Human and financial resources, along with time available, were considered key factors in study design

Joint Initiative: AHS & AEI

- AHS (Cancer Bureau) and Alberta Employment and Immigration (AEI) were partners in developing an Occupational Cancer Prevention Strategy.
- Other stakeholders include:
    - Alberta Health & Wellness
    - Alberta Environment
    - Employers and Workers
    - Industry, Labour and Professional Associations
    - Educational Institutions

Strategic Goals

- The study's objectives align with the AHS goal of effective and efficient delivery of programs to keep Albertans healthy, in the areas of chronic disease and injury prevention.

- Also supported the Environment Carcinogens Program's 2008-2011 strategic plan of reducing and eliminating exposure to environmental and occupational carcinogens.

Study Objective

- Fill existing information gaps by providing an estimate of the burden of occupational cancers in Alberta, including both the numbers of workplace-related cancers and their associated economic costs.

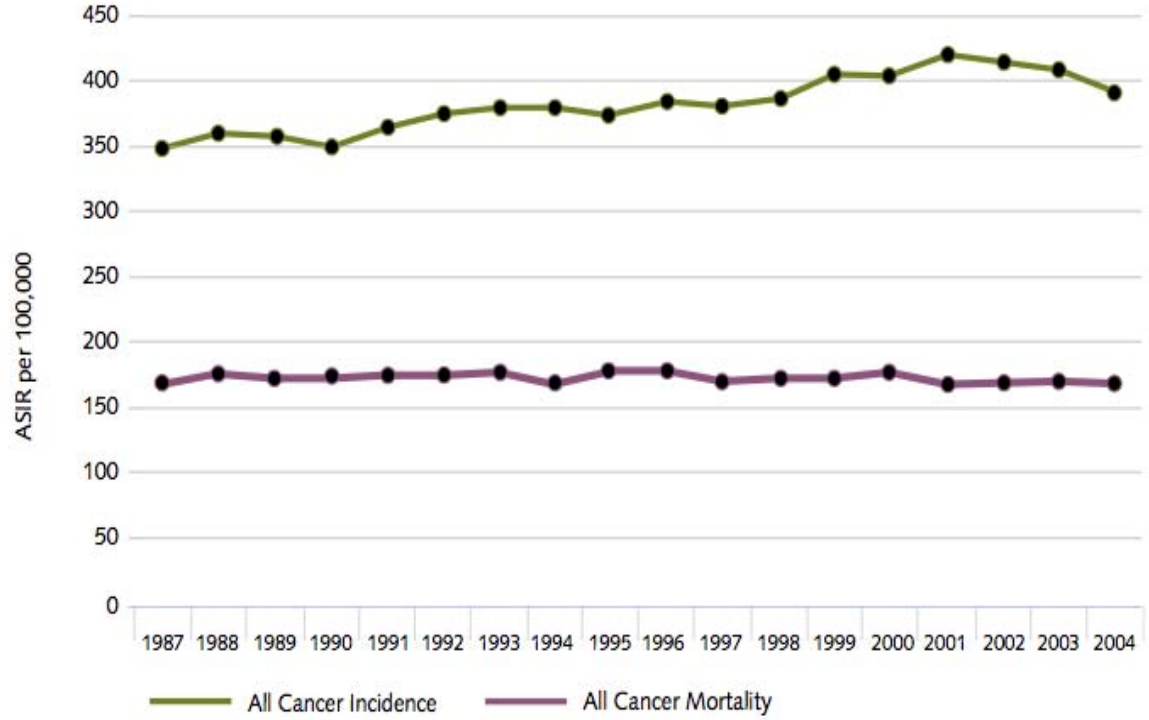
This and similar types of information were consider by the AHS project team as crucial to securing ongoing support of our initiatives

Specific Project Objectives

- To estimate the current number of occupational cancers in Alberta
- To estimate the direct and indirect costs associated with these cancers
- To identify recommendations for the development of a comprehensive occupational cancer prevention strategy for Alberta
- Present a framework that will allow AHS to better understand the business case (costs and benefits) of occupational cancer prevention and leverage findings to assist with implementing future prevention strategies

Cancer in Alberta

Age-Standardized Incidence Rates and Age-Standardized Mortality Rates, Alberta (1987-2004)



Source: Alberta Cancer Board (2007). *Cancer in Alberta: A Regional Picture 2007*.

Quick Occupational Cancer Overview

What is Occupational Cancer?

"Cancer cases that would be eliminated if exposure to carcinogens in the workplace were completely removed"

International Agency for Research on Cancer (IARC) Classification

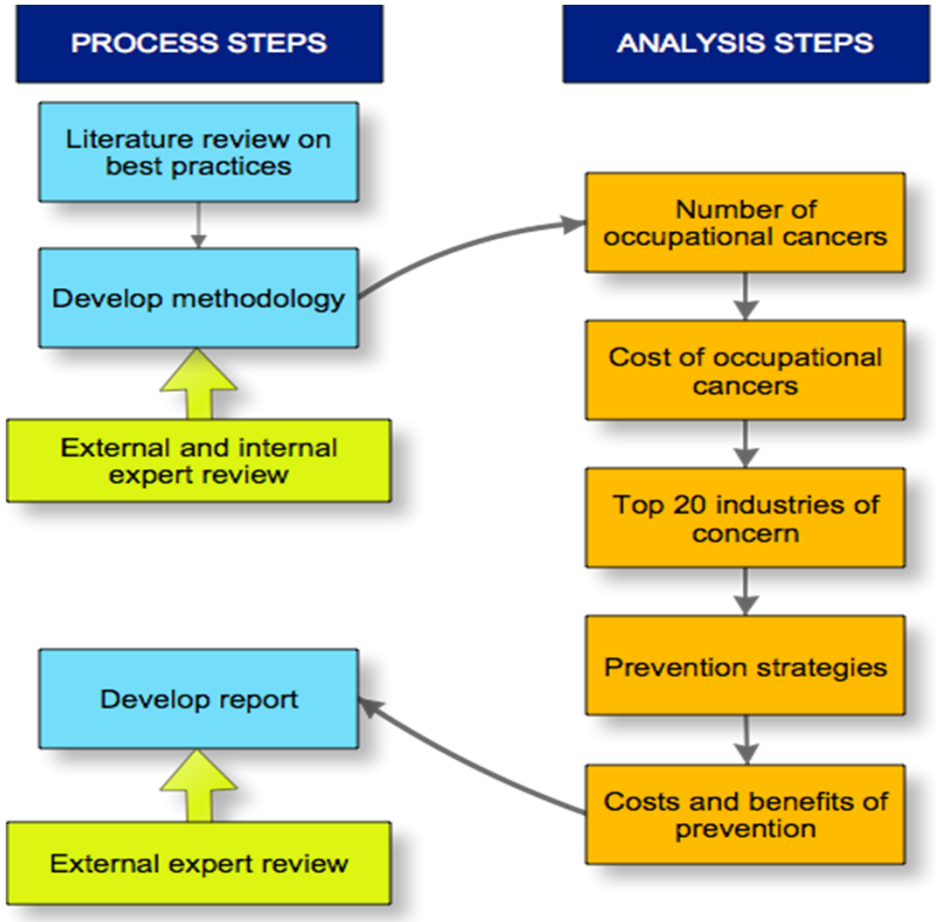
Group	Definition
1	**Carcinogenic** to humans; Sufficient evidence in humans
2A	**Probably carcinogenic** to humans; Limited evidence in humans and sufficient evidence in experimental animals
2B	**Possibly carcinogenic** to humans; Limited evidence in humans and insufficient evidence in animals or inadequate evidence in humans and sufficient evidence in experimental animals
3	**Not classifiable** as to carcinogenicity to humans; Inadequate or unavailable evidence in humans and inadequate or limited evidence in animals
4	**Probably not carcinogenic** to humans

Study Approach

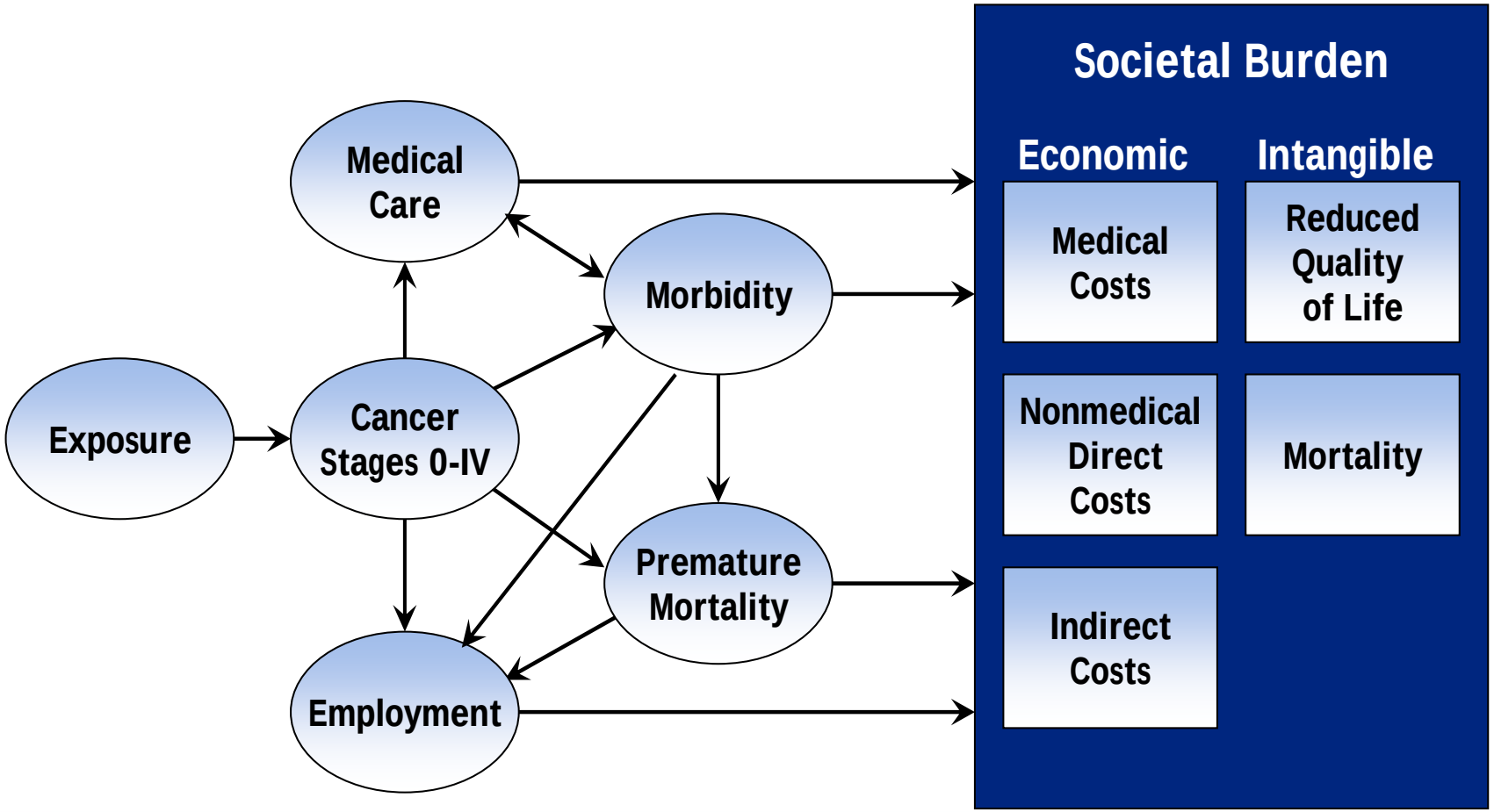
Examples of the “Definite” Occupationally-Linked Cancers?

- Bladder
- Bone
- Larynx
- Leukemia
- Liver
- Lung
- Melanoma
- Mesothelioma
- Nose / nasal sinuses
- Non-melanoma skin

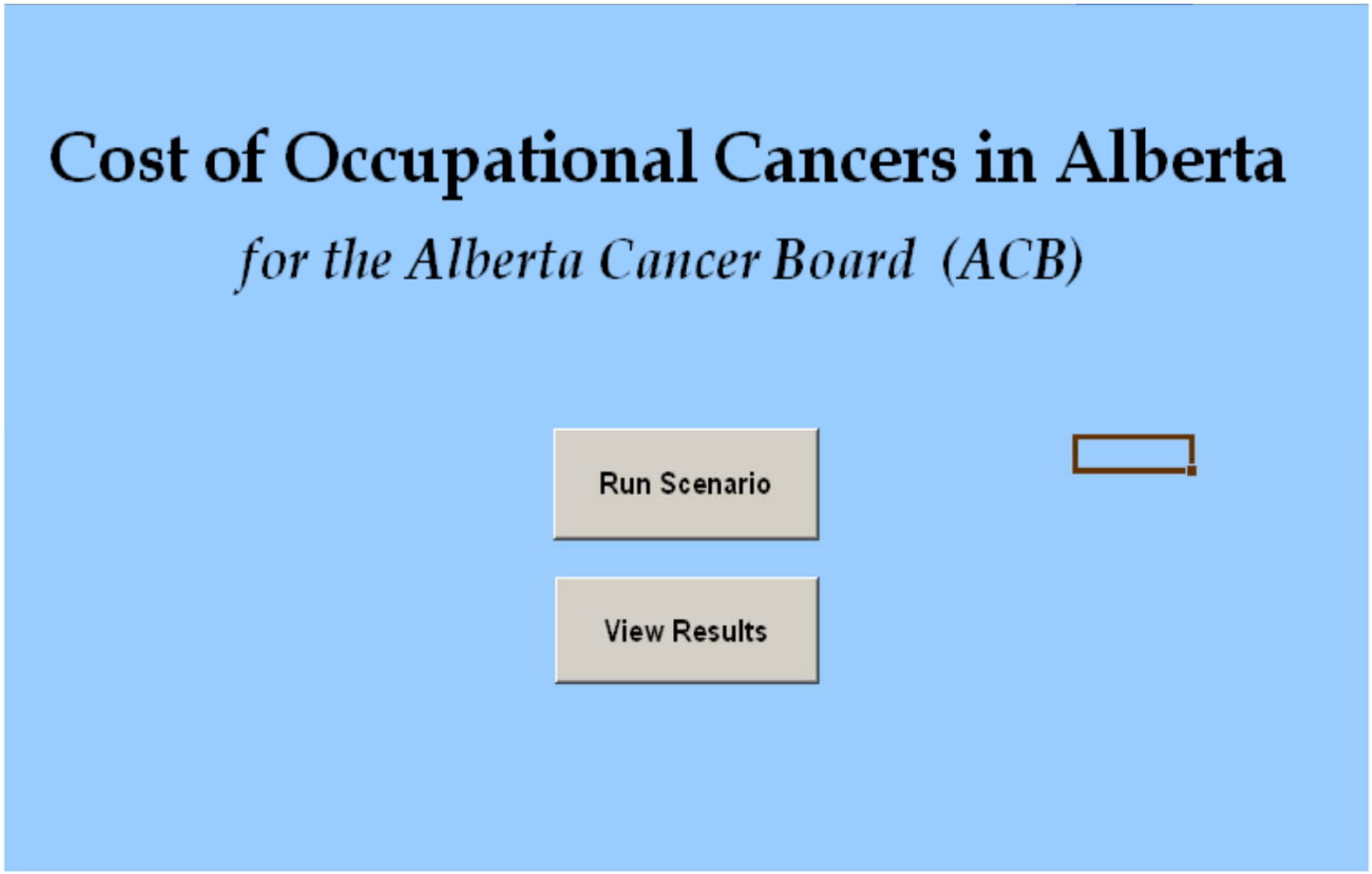
Study Approach



Conceptual Framework



Excel-Based Model



Excel-Based Model

Model purpose

- Repository for data collected from literature/analysis
- Equations and linkages document model logic

Model capabilities

- Estimate current cancer burden
- Easy to update/maintain
- Platform for adding additional cancers
- Platform for developing the business case for intervention

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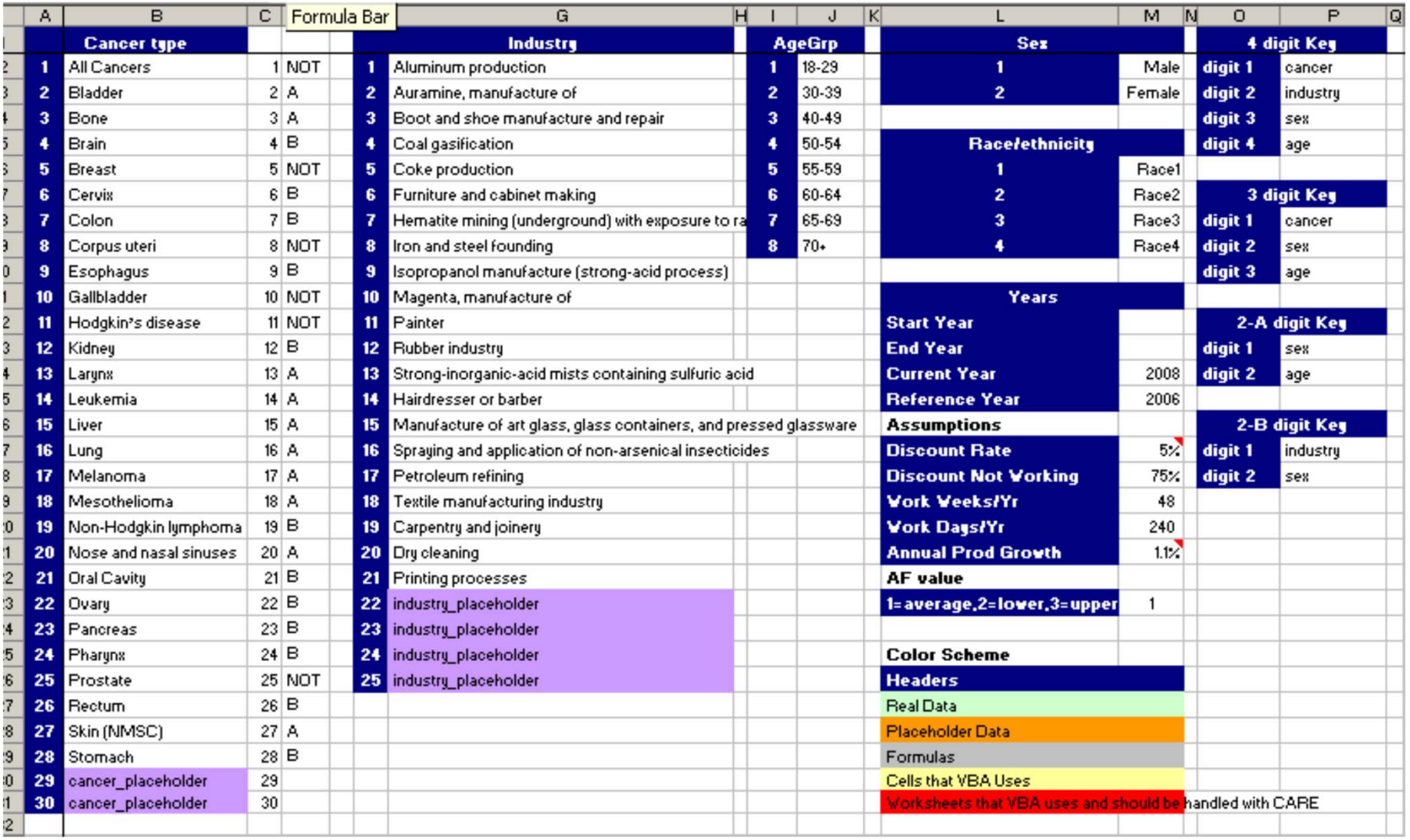

	Cancer type			Industry		AgeGrp		Sex		4 digit Key	
1	All Cancers	1	NOT	1	Aluminum production	1	18-29	1	Male	digit 1	cancer
2	Bladder	2	A	2	Auramine, manufacture of	2	30-39	2	Female	digit 2	industry
3	Bone	3	A	3	Boot and shoe manufacture and repair	3	40-49			digit 3	sex
4	Brain	4	B	4	Coal gasification	4	50-54	Race/ethnicity		digit 4	age
5	Breast	5	NOT	5	Coke production	5	55-59	1	Race1		
6	Cervix	6	B	6	Furniture and cabinet making	6	60-64	2	Race2	3 digit Key	
7	Colon	7	B	7	Hematite mining (underground) with exposure to ra	7	65-69	3	Race3	digit 1	cancer
8	Corpus uteri	8	NOT	8	Iron and steel founding	8	70+	4	Race4	digit 2	sex
9	Esophagus	9	B	9	Isopropanol manufacture (strong-acid process)					digit 3	age
10	Gallbladder	10	NOT	10	Magenta, manufacture of			Years			
11	Hodgkin's disease	11	NOT	11	Painter			Start Year		2-A digit Key	
12	Kidney	12	B	12	Rubber industry			End Year		digit 1	sex
13	Larynx	13	A	13	Strong-inorganic-acid mists containing sulfuric acid			Current Year	2008	digit 2	age
14	Leukemia	14	A	14	Hairdresser or barber			Reference Year	2006		
15	Liver	15	A	15	Manufacture of art glass, glass containers, and pressed glassware			Assumptions		2-B digit Key	
16	Lung	16	A	16	Spraying and application of non-arsenical insecticides			Discount Rate	5%	digit 1	industry
17	Melanoma	17	A	17	Petroleum refining			Discount Not Working	75%	digit 2	sex
18	Mesothelioma	18	A	18	Textile manufacturing industry			Work Weeks/Yr	48		
19	Non-Hodgkin lymphoma	19	B	19	Carpentry and joinery			Work Days/Yr	240		
20	Nose and nasal sinuses	20	A	20	Dry cleaning			Annual Prod Growth	1.1%		
21	Oral Cavity	21	B	21	Printing processes			AF value			
22	Ovary	22	B	22	industry_placeholder			1=average,2=lower,3=upper	1		
23	Pancreas	23	B	23	industry_placeholder						
24	Pharynx	24	B	24	industry_placeholder			Color Scheme			
25	Prostate	25	NOT	25	industry_placeholder			Headers			
26	Rectum	26	B					Real Data			
27	Skin (NMSC)	27	A					Placeholder Data			
28	Stomach	28	B					Formulas			
29	cancer_placeholder	29						Cells that VBA Uses			
30	cancer_placeholder	30						Worksheets that VBA uses and should be handled with CARE			

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TABLE 1.
Cancer cases attributable occupational risks in 2008 by tumor

	Cancer Site	Attributed disability cases	Attributed early mortality cases	Attributed lost work days due to absenteeism per year
	Bone	1	2	73
	Larynx	6	3	339
	Leukemia	18	12	2,410
	Liver	4	8	242
	Lung	99	91	6,713
	Melanoma	10	5	516
	Mesothelioma	5	3	888
	Nose and nasal sinuses	1	0	119
	Skin (NMSC)	53	2	1,455
	SUBTOTAL	**217**	**137**	**14,211**
	Group B - Cancoccupational exposure			
	Brain	6	11	812
	Cervix	14	1	434
	Colon	13	25	1,009
	Esophagus	3	9	276
	Kidney	11	9	389
	Non-Hodgkin lymphoma	62	14	4,529
	Oral Cavity	1	6	157
	Ovary	4	2	279
	Pancreas	8	18	786
	Pharynx	0	3	51
	Rectum	3	11	260

TABLE 2.
Costs attributable occupational risks in 2008 by tumor site

Cancer Site	Total annual attributable cost	Attributed medical cost ($) and its proportion (%) in the toal		Attributed indirect cost ($) and its proportion (%) in the toal	
Bone	$ 989	$ 23	2%	$ 966	98%
Larynx	$ 974	$ 215	22%	$ 758	78%
Leukemia	$ 3,715	$ 496	13%	$ 3,219	87%
Liver	$ 2,447	$ 100	4%	$ 2,347	96%
Lung	$ 21,482	$ 2,971	14%	$ 18,511	86%
Melanoma	$ 2,092	$ 147	7%	$ 1,945	93%
Mesothelioma	$ 848	$ 293	35%	$ 554	65%
Nose and nasal sinuses	$ 88	$ 41	47%	$ 47	53%
Skin (NMSC)	$ 4,629	$ 3,354	72%	$ 1,276	28%
SUBTOTAL	$ 39,815	$ 8,148	20%	$ 31,667	80%
Group B - Cancers with a suspected link to occupational exposure					
Brain	$ 5,706	$ 355	6%	$ 5,351	94%
Cervix	$ 625	$ 195	31%	$ 430	69%
Colon	$ 5,397	$ 414	8%	$ 4,984	92%
Esophagus	$ 2,359	$ 119	5%	$ 2,239	95%
Kidney	$ 2,446	$ 163	7%	$ 2,283	93%
Non-Hodgkin lymphoma	$ 6,989	$ 2,240	32%	$ 4,749	68%
Oral Cavity	$ 1,720	$ 29	2%	$ 1,692	98%
Ovary	$ 480	$ 120	25%	$ 360	75%
Pancreas	$ 4,008	$ 253	6%	$ 3,755	94%
Pharynx	$ 1,037	$ 14	1%	$ 1,024	99%
Rectum	$ 2,261	$ 101	4%	$ 2,160	96%

TABLE 3.
Indirect costs attributa

Cancer Site
Bone
Larynx
Leukemia
Liver
Lung
Melanoma
Mesothelioma
Nose and nasal sinuses
Skin (NMSC)
SUBTOTAL
Group B - Cancers wit
Brain
Cervix
Colon
Esophagus
Kidney
Non-Hodgkin lymphoma
Oral Cavity
Ovary
Pancreas
Pharynx
Rectum

Main | Key | Output_eq | Sensitivity Summary | Sum_cancer | Inc & Prev | Prevalence | Incidence | Pop | ALB top indus | AF0716

Estimating Numbers of Occupational Cancers

Estimating Numbers of Occupational Cancers

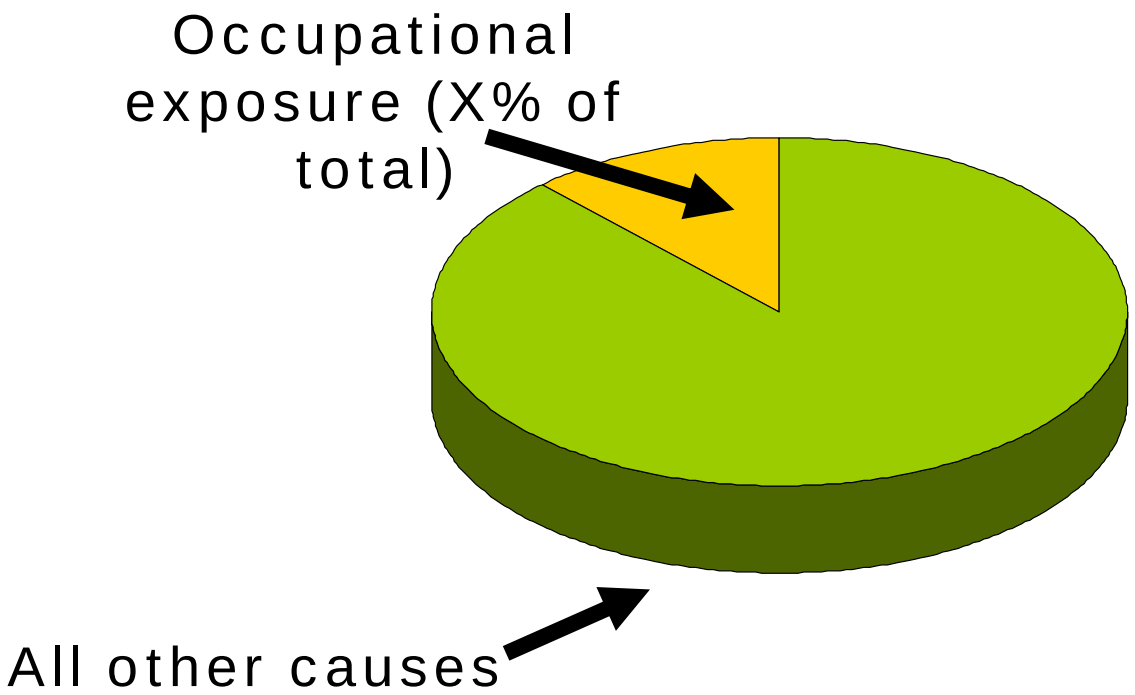
Two possible methodologies

- Measure or estimate exposure in Alberta workers.
- Calculate numbers of occ. cancers based on RR associated with exposure.

Apply existing "attributable fractions" to Alberta cancer estimates.

Attributable Fractions

- The proportion of all cancers attributable to the exposure of interest (in this case, occupational exposure)



Methodology Overview

Calculating the Numbers of Occupational Cancers

1. Systematic review of the literature to identify Attributable Fractions for each cancer site
2. Categorize cancers by strength of evidence
3. Identify “best” values for Alberta
4. Apply AFs to local cancer data

Step # 1 Systematic Review of the Literature

Comprehensively identify original research that provided AFs for occupational cancers, the research team conducted a systematic literature search in April and May of 2009.

The literature search was initially conducted using PubMed and Google Scholar to identify articles (peer-reviewed journal articles, official reports or grey literature) based on the following search strategy. The research team searched for all variants on the following three sets of terms:

1. *cancer* or *neoplasm*
2. *work*, *workplace* or *occupation*
3. *attributable fraction*, *attributable risk*, *PAR* or *etiologic fraction*

Reference lists of relevant publications were hand-searched to identify additional related material. All materials with published information on methods were initially considered for review, and were not restricted by language or location. Studies were limited to those published since 1989 and for reasons described in Step 2 below.

The PubMed search, last repeated on July 12, 2009, turned up an initial 401 articles for consideration.

Step # 2 Occupational Cancer Groupings

- Group A: Cancers with a strong link to occupational exposures
- Group B: Cancers with a suspected link to occupational exposure
- Cancers associated with elevated risk in some occupations

Note: Only Group A & B cancers used for further analysis

Step # 3 Averaged Attributable Fractions

	Average		*Low*		*High*	
	M	W	M	W	M	W
Bladder	11.0%	3.5%	1.2%	0.4%	27.0%	19.0%
Bone	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
Larynx	8.6%	0.5%	1.0%	0.5%	20.0%	0.5%
Leukemia	5.1%	6.3%	1.8%	0.5%	18.5%	3.0%
Liver	2.1%	5.3%	0.0%	5.3%	3.5%	5.3%
Lung	15.9%	3.2%	6.0%	1.0%	33.0%	5.5%
Melanoma	4.3%	0.4%	4.3%	0.4%	4.3%	0.4%
Mesothelioma	89.6%	42.1%	83.0%	1.0%	98.0%	90.0%
Nose / nasal sinuses	43.1%	9.0%	24.0%	2.0%	64.3%	18.4%
Skin (NMSC)	9.5%	3.4%	1.2%	3.0%	13.1%	3.8%
All cancer deaths	9.8%	1.3%	3.3%	0.1%	13.8%	2.2%

Step # 4 Example of how occupational cancer numbers were generated (bladder cancer example)

	Average	Low	High
Number of bladder cancers in men in Alberta per year	206.2	206.2	206.2
x AF for bladder cancer in men	11.0 %	1.2 %	27.0 %
= Subtotal (Men)	22.7	2.5	55.7
Number of bladder cancers in women in Alberta per year	67.8	67.8	67.8
x AF for bladder cancer in women	3.5%	0.4%	19.0%
= Subtotal (women)	2.4	0.3	12.9
Total	25.1	2.7	68.6

Occupational Cancers: Results

	AVERAGE estimate	LOW estimate	HIGH estimate
ANNUAL INCIDENCE			
Cancers with a *strong* link to occupational exposure	626.4	217.1	996.6
Cancers with a *strong* or *suspected* link to occupational exposure	761.0	313.6	1283.0
All cancers	858	351	1,520
All cancer deaths	262.7	81.5	377.6

Occupational Cancers: Results

5-YEAR PREVALENCE	Average	Low	High
Cancers with a *strong* link to occupational exposure	**2358.5**	**786.6**	**3614.0**
Cancers with a *strong* or *suspected* link to occupational exposure	**2733.5**	**1055.1**	**4457.1**
All cancers (including NMSC)	**3045.3**	**1083.6**	**5432.9**
All cancers (not including NMSC)	**1282.3**	**509.7**	**3123.4**

Estimating Costs of Occupational Cancers

Estimating Costs of Occupational Cancers

- Overview
  - Cost per case
    - Methods
    - Results
  - Total costs
    - Methods
    - Results

Cancer Cost Components

Direct Costs	**Medical Costs**	Hospitalizations
		Physician visits
		Home health care
		Hospice
		Pharmaceutical agents
		Chemotherapy
		Radiation
		Equipment and medical devices
	Nonmedical Costs	Transportation to hospital or physician's office
		Housekeeping services
		Costs of moving
		Alterations to property
Indirect Costs		Time spent seeking medical care
		Time lost from work/lost productivity
		Economic productivity lost due to premature death
		Caregiver time or changes in caregivers employment
Intangible Costs /Lost QALYs		Pain
		Suffering
		Grief

Methodology

Calculation of Direct Medical Costs

- Step 1. Obtain previously estimated Alberta-specific direct medical costs per cancer case from existing studies

- Step 2: Obtain and apply estimates of ratios between known Alberta-specific cancer cost per case and other occupational cancers.

Calculation of Direct Medical Costs

- Step 3. Multiply the number of attributable occupational cancer cases and estimated average cost per case to calculate the total medical cost of cancers attributable to workplace exposure.

- Step 4. Validate and benchmark cost estimates.

Annual Medical Cost per Cancer Case

Group	Tumor Site	1st approach for cost ratio: from 2002-06 MEPS	2nd approach for cost ratio: from literature review	Sources for 2nd approach	Cost ratio used in the model	Estimated annual medical cost per case in Alberta
Group A	Bladder	0.46	0.35	AIHW 2005, Bosanquet 2004, Hertz 2005, Kim 2008	0.46	$4,790
	Bone	1.00	0.68	AIHW 2005, Hertz 2005	1.00	$10,520
	Larynx	1.10	0.42	AIHW 2005	1.10	$11,477
	Leukemia	0.85	1.07	AIHW 2005, Bosanquet 2004, Hertz 2005, Kim 2008	0.85	$8,898
	Liver	1.08	0.91	AIHW 2005, Kim 2008	1.08	$11,364
	Lung	1.00	1.00	AIHW 2005, Bosanquet 2004, Chang 2004, Hertz 2005, Kim 2008	1.00	$10,480
	Melanoma	0.30	0.22	AIHW 2005, Bosanquet 2004, Hertz 2005, Kim 2008	0.30	$3,136
	Mesothelioma	N/A	1.23	AIHW 2005, Bosanquet 2004, Chang 2004, Kim 2008	1.23	$12,847
	Nose and nasal sinuses	N/A	0.60	Bosanquet 2004, Hertz 2005	0.60	$6,327

Indirect Costs (Including Reduced Productivity)

- Absenteeism—missed work days
  - Estimates from literature
- Presenteeism—reduced productivity while at work
  - Insufficient data to model this
- Disability
  - Inability to be gainfully employed (estimates from literature)
  - Working part time or under employed (insufficient data to model this)
- Early mortality
  - Modeled using Human Capital Approach
  - Alternative for comparison: Willingness-to-pay Approach

Cancer Site	Per capita total annual attributable cost ($)	Per capita annual attributed medical cost ($)	Per capita annual attributed indirect cost ($)
Group A - cancers with a *strong* link to occupational exposure			
Bladder	$24,110	$4,790	$19,320
Bone	$452,736	$10,520	$442,216
Larynx	$51,918	$11,477	$40,441
Leukemia	$66,679	$8,898	$57,781
Liver	$277,291	$11,364	$265,927
Lung	$75,765	$10,480	$65,285
Melanoma	$44,575	$3,136	$41,439
Mesothelioma	$37,135	$12,847	$24,288
Nose and nasal sinuses	$13,456	$6,327	$7,129
Skin (NMSC)	$2,719	$1,970	$749
Group B - Cancers with a *suspected* link to occupational exposure			
Brain	$221,707	$13,790	$207,917
Cervix	$16,401	$5,119	$11,282
Colon	$93,186	$7,143	$86,043
Esophagus	$284,981	$14,407	$270,574
Kidney	$118,954	$7,943	$111,012
Non-Hodgkin lymphoma	$41,509	$13,303	$28,206
Oral Cavity	$239,555	$3,989	$235,565
Ovary	$43,745	$10,955	$32,790
Pancreas	$202,924	$12,794	$190,130
Pharynx	$497,598	$6,532	$491,066
Rectum	$151,418	$6,746	$144,671
Stomach	$111,972	$8,608	$103,364

The Economic Burden of Occupational Cancer in Alberta

The direct cost to the Alberta medical system is estimated to be approximately $15,682,000 per year.

In addition, indirect costs—resulting from loss of economic resources and reduced productivity—are estimated at approximately $64.1 million per year.

Direct Costs + Indirect Costs: ~ ***$ 80 million per year***

Strategies for Occupational Cancer Prevention

Recommendations

Two areas:

- General recommendations
- Process recommendations

Study Recommendation Highlights

Target level of the workplace rather than the worker

Effectiveness	Prevention Level	Prevention Target	Hierarchy of Controls
Most Effective	Primary	Control at the Source of Hazard	Elimination Substitution Use Reduction
	Primary	Controlling Dispersion	Engineering Controls (e.g., local exhaust ventilation, process enclosure) Exposure Assessment Administrative Controls (e.g., workplace policies and procedures)
	Primary	Control at the Worker	Safe Work Practices Personal Protective Equipment Biological Monitoring for absorption of a toxicant
	Secondary	Control at the Worker	Pre-clinical medical exams/screening Biological monitoring for effects of absorbed toxicants
Least Effective	Tertiary	Control at the Worker	Diagnosis Therapy Rehabilitation

Study Recommendation Highlights

- Need to consider “who” and “how”

- Ascertaining the occupational history of cancer patients is also a key component in understanding workplace exposures

Study Recommendation Highlights

- Data on Alberta workplace exposure is critical but currently very limited
- Increased awareness for all occupational diseases is needed, including cancer
- Treatment/costing data also limited

Costs and Benefits of Prevention Interventions

Economic framework

- Allocate scarce public health resources to interventions with highest expected return on investment

- Optimally, continue allocating resources until benefits of last dollar spent = $1.00

Business case must compare anticipated intervention costs and benefits (both financial and non-monetary)

Business Case

Intervention costs examples:

- Cost to government (budgeted)
- Total cost to society could include:
  - Cost to employers (e.g., to comply with mandate)
  - Cost to workers (e.g., wearing a filter mask can be uncomfortable)

Business Case

Intervention benefits

Three factors needed to estimate potential benefits:

- **Economic burden, or cost of "doing nothing"**
- Potential impact of intervention on exposure
- Potential impact of reduced exposure on cancer incidence
- Economic burden avoided per case prevented (Net present value of future costs)

Utilizing Study Findings

Our team has found study findings provide convincing evidence to justify program and project funding

Examples of Projects to Date:

- Recently completed an internal State of the Evidence report on Occupational Health Surveillance
- Exploratory review and analysis of usage and exposure to pesticides by golf course workers in AB
- Outdoor Workers Skin Cancer prevention strategy

Outdoor Workers
Skin Cancer Prevention Project

Activity to Date

- The ECP has developed a comprehensive strategy targeting outdoor workers to reduce their exposure to solar ultraviolet radiation
- Identified Outdoor Workers as an at risk population and target setting

Developed foundational documents:

- Business Case:
  - Rates and Trends
  - Economic Burden
  - Why Outdoor Workers in Alberta
  - Prevention Best Practices

Why Outdoor Workers in Alberta?

- 27.4% of Albertans have a job that requires them to work outdoors:
  - 82% male, 18% female.
  - 44% are between 16 – 35 years of age; 83% are below 55 years.

- 96% spend ~ 30 minutes in the sun while at work
- 73% spend two hours or more in the sun while at work

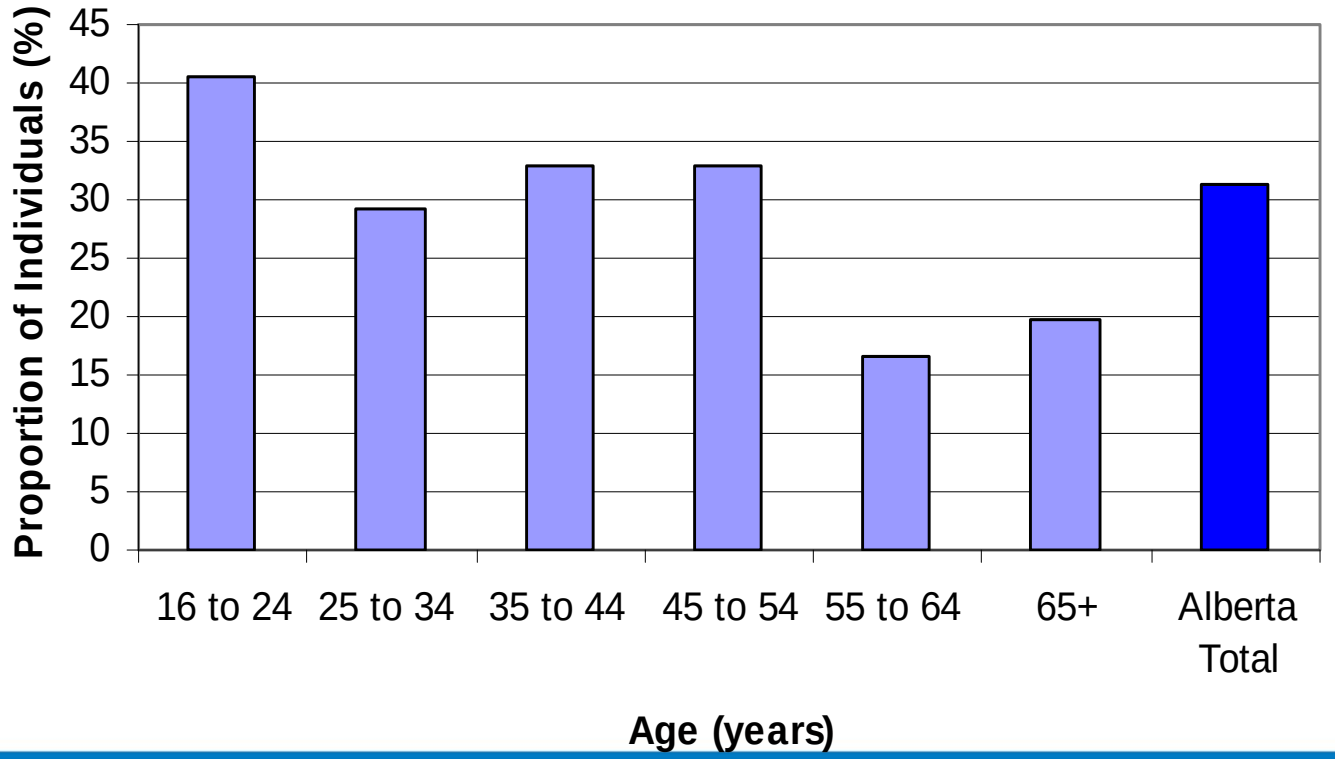
Source: Second National Sun Survey 2006 (NSS2)

Why Outdoor Workers in Alberta?

- CAREX identified solar radiation as the number 1 workplace carcinogen for BC.
- Nature of the work environment for many outdoor occupations is a likely barrier for practicing UVR protective behaviors.
- Studies have shown a substantial number of workers who do not follow recommended UVR protection.

Outdoor Workers in Alberta

- Prevalence of outdoor workers by age reporting they always or often used **SUNSCREEN** on their face when in the sun for 30 minutes or more at work.



Occupational Skin Cancer Business Case

- 1,703 cases of non-melanoma and 47 melanoma, new and prevalent skin cancers attributable to occupation in 2008.
- In 2008, the cost per case $45,393 for melanoma and $3,233 for non-melanoma.
- Assuming a 10% reduction of skin cancer among outdoor workers,
  - $763,927 per year saved and ~ 175 cases of skin cancer averted.

OW Advisory Committee

- Alberta Health Services (ECP, WW, MOH)
- Alberta Employment & Immigration
- Lifesaving Society of AB/NWT
- Alberta Construction Safety Association
- UFA Cooperative Ltd.
- College and Association of Registered Nurses

Conclusions

- Burden of occupational cancer is significant!
- Best estimates: **761** new cancers per year, >**2,700** prevalent cases
- May be as low as **217 / 786** or as high as **1,520 / 5,400**

Conclusions

- Direct medical costs: $**15.7M**/year
- Indirect costs: $**64.1M**/year

Key Points to Remember

- Costs of cancer treatment & drugs are high and sharply rising - will be more expensive in the future
- Occupational cancer is preventable
- Clear need to increase our understanding of carcinogen exposures in Alberta workplaces

Presenter's Contact Information

For more information, including a copy of this presentation, please contact:

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Steps to calculate Alberta-specific prevalence data using bladder cancer as example

Step	Description	M	F
1	2002–2006 new bladder cancer cases from the Alberta Cancer Registry	1,026	304
2	Divide 2002–2006 data by 5 to calculate annual new bladder cancer cases in 2004 and fill data gaps with Annual Reports	206	69
3	To estimate the five-year bladder cancer prevalent cases in 2008, use the average relative survival at five years after diagnosis for bladder cancer patients diagnosed between 2004 and 2008 and the number of incident cases for 2004 to provide a conservative estimate of the number of individuals with bladder cancer expected to be alive by the end of 2008	890	290
4	Convert bladder cancer prevalent cases into prevalent individuals in Alberta	863	283

Population Attributable Risk (PAR) approach

- The PAR is the proportion (often expressed as a percentage) of all cases of a particular condition that is due to a particular exposure (or group of exposures). By applying this proportion to the total number of a particular condition (the number of deaths from that condition due to that exposure can be estimated.
- The PAR is dependent only on the relative risk of developing the condition due to the exposure, and the proportion of the population that has that exposure.

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$$AF = \frac{P(E)(RR - 1)}{1 + P(E)(RR - 1)}$$