NZ-CAREX

OCCUPATIONAL EXPOSURE TO CARCINOGENS IN NEW ZEALAND

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Occupational cancer in new Zealand

- The National Occupational Health and Safety Committee (NOHSAC) estimates that **237-425** people die each year from occupational cancer in New Zealand.
- This represents **3-6%** of all cancer deaths in New Zealand.
- Within blue collar workers may be as high as **25%.**
- All of these work-related cancers are **preventable** in principle.

Many questions remain

- **How many** workers are potentially exposed to carcinogens in New Zealand?
- **Which industries** are the most exposed in New Zealand?
- **What carcinogens** are the most common in New Zealand work places?
- **What interventions** would have the biggest impact on reducing the number of occupational cancer cases in New Zealand?

NZ-CAREX

A NEW ZEALAND SPECIFIC INFORMATION SYSTEM ON OCCUPATIONAL EXPOSURE TO CARCINOGENS

PART OF A PROJECT FUNDED BY THE HRC AND DOL ENTITLED

“WORKPLACE EXPOSURE TO CARCINOGENS IN NEW ZEALAND”

CAREX in the European Union

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Occupational exposure to carcinogens in the European Union

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Abstract

Objectives—To construct a computer assisted information system for the estimation of the numbers of workers exposed to established and suspected human carcinogens in the member states of the European Union (EU).

Methods—A database called CAREX (carcinogen exposure) was designed to provide selected exposure data and documented estimates of the number of workers exposed to carcinogens by country, carcinogen, and industry. CAREX includes data on agents evaluated by the International Agency for Research on Cancer (IARC) (all agents in groups 1 and 2A as of February 1995, and selected agents in group 2B) and on ionising radiation, displayed across the 55 industrial classes. The 1990–3 occupational exposure was estimated in two phases. Firstly, estimates were generated by the CAREX system on the basis of national labour force data and exposure prevalence estimates from two reference countries (Finland and the United States) which had the most comprehensive data available on exposures to these agents. For selected countries, these estimates were then refined by national experts in view of the perceived exposure patterns in their own countries compared with those of the reference countries.

Results—About 32 million workers (23% of those employed) in the EU were exposed to agents covered by CAREX. At least 22 million workers were exposed to IARC group 1 carcinogens. The exposed workers had altogether 42 million exposures (1.3 mean exposures for each exposed worker). The most common exposures were solar radiation (9.1 million workers exposed at least 75% of working time), environmental tobacco smoke (7.5 million workers exposed at least 75% of working time), crystalline silica (3.2 million exposed), diesel exhaust (3.0 million), radon (2.7 million), and wood dust (2.6 million).

Conclusion—These preliminary estimates indicate that in the early 1990s, a substantial proportion of workers in the EU were exposed to carcinogens.

(*Occup Environ Med* 2000;57:10–18)

NZ-CAREX

- ✓ A LITERATURE REVIEW
- ✓ A COMPUTERIZED INFORMATION SYSTEM

NZ-CAREX list of carcinogens

- **82 Group 1**: carcinogenic to humans

e.g.: asbestos; benzene; silica; wood dust

- **56 Group 2A**: probably carcinogenic to humans

e.g.: diesel engine exhaust, inorganic lead; shiftwork

- **118 Group 2B**: possibly carcinogenic to humans

e.g.: carbon tertrachloride; DDT; Mirex; carbon black

<group 1> 1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitros
<group 1> 1,3-Butadiene
<group 1> 1,4-Butanediol dimethanesulfonate (Myleran)
<group 1> 8-Methoxypsoralen (Methoxsalen) plus ultraviole
<group 1> Aflatoxins (naturally occurring mixtures of)
<group 1> Aluminium production
<group 1> Arsenic and arsenic compounds
<group 1> Asbestos
<group 1> Azathioprine
<group 1> Benzene
<group 1> Benzidine
<group 1> Beryllium and beryllium compounds
<group 1> Boot and shoe manufacture and repair
<group 1> Cadmium and cadmium compounds
<group 1> Chimney sweeping
<group 1> Chlorambucil
<group 1> Chromium VI compounds
<group 1> Ciclosporin (=cyclosporine?)
<group 1> Coal gasification (see PAH)
<group 1> Coal-tar destillation
<group 1> Coal-tar pitches (see PAHs)
<group 1> Coal-tars (see PAHs)
<group 1> Cyclophosphamide
<group 1> Diethylstilboestrol
<group 1> Dyes metabolized to benzidine
<group 1> Epstein-Barr virus
<group 1> Ethylene oxide
<group 1> Etoposide
<group 1> Formaldehyde
<group 1> Furniture and cabinet making
<group 1> Helicobacter pylori (infection with)
<group 1> Hepatitis B virus (chronic infection with)
<group 1> Hepatitis C virus (chronic infection with)
<group 1> Involuntary smoking (exposure to second hand
<group 1> Iron and steel founding
<group 1> Melphalan
<group 1> MOPP and other combined chemotherapy includ
<group 1> N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlorna
<group 1> Nickel compounds
<group 1> Oestrogens, nonsteroidal
<group 1> Oestrogens, steroidal
<group 1> Ortho-toluidine
<group 1> Painter (occupational exposure as a)
<group 1> Paving and roofing with coal-tar pitch
<group 1> Phenacetin
<group 1> Phenacetin, analgesic mixtures containing (see
<group 1> Phosphorus-32, as phosphate
<group 1> Rubber industry
<group 1> Silica, crystalline
<group 1> Solar radiation
<group 1> Soots (see PAHs)
<group 1> Strong-inorganic-acid mists containing sulfuric
<group 1> Thiotepa
<group 1> Treosulfan
<group 1> Vinyl chloride
<group 1> Wood dust
<group 1> X and gamma-radiation
<group 2A> 1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (C
<group 2A> 1,2,3-Trichloropropane
<group 2A> 1,2-dimethylhydrazine
<group 2A> 4-chloro-ortho-toluidine
<group 2A> Acrylamide
<group 2A> Adriamycin
<group 2A> Alpha-chlorinated toluenes (benzal chloride,
<group 2A> Androgenic (anabolic) steroids
<group 2A> Art glass, glass containers and pressed ware (
<group 2A> Azacitidine
<group 2A> Bischloroethyl nitrosourea (BCNU)
<group 2A> Captafol
<group 2A> Chloramphenicol
<group 2A> Chlorozotocin
<group 2A> Cisplatin
<group 2A> Cobalt metal with tungsten carbide
<group 2A> Creosotes (see PAHs)
<group 2A> Diesel engine exhaust
<group 2A> Diethyl sulfate
<group 2A> Dimethyl sulfate
<group 2A> Dimethylcarbamoyl chloride
<group 2A> Epichlorohydrin
<group 2A> Ethyl carbamate (urethane)
<group 2A> Ethylene dibromide
<group 2A> Glycidol
<group 2A> Hairdresser and barber (occupational exposure
<group 2A> High-temperature frying, emission from
<group 2A> Lead compounds, inorganic
<group 2A> Nitrogen mustard
<group 2A> N-Nitrosodiethylamine
<group 2A> N-Nitrosodimethylamine
<group 2A> Non-arsenical insecticides (occup. exp. in spra
<group 2A> Petroleum refining (occupational exposures in)
<group 2A> Polychlorinated biphenyls (PCB)
<group 2A> Procarbazine hydrochloride
<group 2A> Shiftwork that involves circadian disruption
<group 2A> Styrene-7,8-oxide
<group 2A> Sunlamps and sunbeds (use of)
<group 2A> Tetrachloroethylene
<group 2A> Trichloroethylene
<group 2A> Ultraviolet radiation, artificial
<group 2A> Vinyl bromide
<group 2A> Vinyl fluoride
<group 2B> 1,1-dimethylhydrazine
<group 2B> 1,4-dioxane
<group 2B> 2-Methylaziridine (Propyleneimine)
<group 2B> 3,3`-Dimethoxybenzidine (ortho-dianisidine)
<group 2B> 3,3`-Dimethylbenzidine (o-tolidine)
<group 2B> 3,3'-Dichlorobenzidine
<group 2B> 4,4-methylene dianiline
<group 2B> Acetaldehyde
<group 2B> Acrylonitrile
<group 2B> Antimony trioxide
<group 2B> Bitumens
<group 2B> Carbon black
<group 2B> Carbon tetrachloride
<group 2B> Carpentry and joinery
<group 2B> Catechol
<group 2B> Ceramic fibers
<group 2B> Chlordane
<group 2B> Chlordecone (Kepone)
<group 2B> Chloroform
<group 2B> Chlorophenoxy herbicides
<group 2B> Chlorothalonil
<group 2B> Cobalt and its compounds
<group 2B> Diesel fuel, marine
<group 2B> Dry cleaning (occupational exposures in)
<group 2B> Engine exhaust, gasoline
<group 2B> Ethylbenzene
<group 2B> Firefighter (occupational exposure as a)
<group 2B> Fuel oils, residual (heavy)
<group 2B> Gasoline
<group 2B> Gasoline engine exhaust
<group 2B> Heptachlor
<group 2B> Hexachloroethane
<group 2B> Hydrazine
<group 2B> Magnetic fields, extremely low frequency
<group 2B> Methylene chloride (dichloromethane)
<group 2B> Mirex
<group 2B> Nitrobenzene
<group 2B> Nitromethane
<group 2B> Ochratoxin B
<group 2B> Ortho-anisidine
<group 2B> Para-dichlorobenzene
<group 2B> Printing processes (occupational exposures in
<group 2B> Propylene oxide
<group 2B> Styrene
<group 2B> Tetranitromethane
<group 2B> Textile manufacturing industry (work in)
<group 2B> Toxaphene (polychloronated camphenes)
<group 2B> Vinyl acetate
<group 2B> Welding fumes

NZ-CAREX background for each carcinogen

Arsenic and arsenic compounds

IARC evaluation	1	>>	vol. 23, suppl. 7; 1987	**CAS** >>	7440-38-2
exposure category	metals				
uses	Historically used as pesticides and in medicine for treatment of leukemia, psoriasis, and asthma. Currently used in the wood treatment chromated copper arsenate (CCA), in glass, and nonferrous alloys and in a variety of semiconductor applications.				
exposure standard	TWA: 0.05mg/m3.				
CAREX definition	Inhalatory exposure at work to arsenic or arsenic compounds (eg, arsenic trioxide, arsenic pentoxide, arsenates, arsine) likely to exceed significantly the nonoccupational background level due to air pollution (usually below 0.1 ug/m3).				

Asbestos

IARC evaluation	1	>>	vol. 14, suppl. 7; 1987	**CAS** >>	1332-21-4
exposure category	fibres and dust				
uses	Asbestos has been used in roofing, thermal and electrical insulation, cement pipe and sheets, flooring, gaskets, friction materials, coatings, plastics, textiles, paper, and other products				
exposure standard	Chrysotile: TWA(4hr): 1fibre/ml; TWA(10min): 6fibres/ml. Amosite/Crocidolite: TWA(4hr): 0.1 fibre/ml. Fibrous actinolite/anthophyllite/tremolite: TWA(10min): 0.6fibre/ml.				
CAREX definition	Inhalatory exposure at work to any form of asbestos (eg, chrysotile, crocidolite, tremolite, anthophyllite, actinolite, amosite) likely to exceed significantly the nonoccupational background level in dwellings or urban air (usually below 0.001 f/cm3).				

NZ-CAREX list of industries

ANZSIC 3-digit industry subdivision		total
A01	Agriculture	23,784
A02	Services to Agriculture; Hunting and Trapping	18,909
A03	Forestry and Logging	7,974
A04	Commercial Fishing	2,862
B11	Coal Mining	771
B12	Oil and Gas Extraction	297
B13	Metal Ore Mining	438
B14	Other Mining	1,719
B15	Services to Mining	927
C21	Food, Beverage and Tobacco	54,789
C22	Textile, Clothing, Footwear and Leather Manufacturing	17763
C23	Wood and Paper Product Manufacturing	22,980
C24	Printing, Publishing and Recorded Media	22,242
C25	Petroleum, Coal, Chemical and Associated Product Manuf.	17,955
C26	Non-Metallic Mineral Product Manufacturing	6,822
C27	Metal Product Manufacturing	26,745
C28	Machinery and Equipment Manufacturing	42,654
C29	Other Manufacturing	14,193
D36	Electricity and Gas Supply	4,401
D37	Water Supply, Sewerage and Drainage Services	1,695
E41	General Construction	64,908
E42	Construction Trade Services	82,644
F45	Basic Material Wholesaling	28,566
F46	Machinery and Motor Vehicle Wholesaling	35,577
F47	Personal and Household Good Wholesaling	43,530
G51	Food Retailing	81,024
G52	Personal and Household Good Retailing	106,596
G53	Motor Vehicle Retailing and Services	50,490
H57	Accommodation, Cafes and Restaurants	94,590
I61	Road Transport	33,432
I62	Rail Transport	1,857
I63	Water Transport	2,151
I64	Air and Space Transport	8,949
I65	Other Transport	1,419
I66	Services to Transport	22,272
I67	Storage	5,172
J71	Communication Services	24,333
K73	Finance	38,415
K74	Insurance	9,039
K75	Services to Finance and Insurance	16,686
L77	Property Services	52,329
L78	Business Services	201,414
M81	Government Administration	57,267
M82	Defence	9,834
N84	Education	139,134
O86	Health Services	106,305
O87	Community Services	54,834
P91	Motion Picture, Radio and Television Services	11,151
P92	Libraries, Museums and the Arts	15,801
P93	Sport and Recreation	24,717
Q95	Personal Services	34,299
Q96	Other Services	41,739
Q97	Private Households Employing Staff	33

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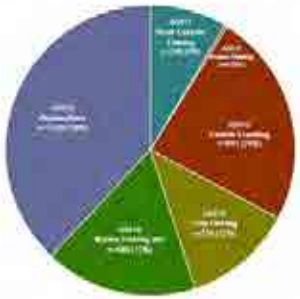
LITERATURE REVIEW

Subdivision A04: Commercial Fishing

1. Description of the industry

A total of 2,865 of the New Zealand working population (0.14% of total), work in commercial fishing. More men (78%) than women (22%) work in this sector. A majority is employed in ocean or coastal water fishing, including finfish trawling, line fishing, rock lobster fishing and marine fishing not otherwise classified. Over one-third (38%) is employed in aquaculture, which covers the farming of fish, crustaceans and molluscs and also includes units mainly engaged in commercial inland or freshwater fishing[1]. The most common occupations within commercial fishing include fisherpersons, deck ratings, and fish farm workers.

Industry sectors within Commercial Fishing (n workers) | The main occupations within Commercial Fishing



Total	2,865
61411 Fishing Skipper, Fisherperson	921
61421 Fish Farmer, Worker	192
83411 Deck Rating	180
61422 Mussel and Oyster Farmer, worker	129
91514 General Labourer	120
12111 General Manager	117
82719 Fish Processing Worker	90
41443 General Clerk	69
82715 Oyster Opener and Canner	54
31411 Ships' Engineer	51
All other occupations in this industry	942

Census 2006

2. Potential for work-related carcinogen exposure

Skippers and deck ratings on commercial fishing boats can be exposed to known or suspected carcinogens associated with the fishing vessel. Most fishing boats are diesel powered and workers on the boat can thus be exposed to diesel fuel, diesel engine exhaust and polycyclic aromatic hydrocarbons from exhaust fumes and soot. Because fire safety on fishing vessels is very important, asbestos was a commonly used material in ship construction in the decades before the dangers of asbestos became well known (e.g. for insulation of ships' boilers, incinerators, ventilation, flooring and pipes). Engine room personnel in particular can be exposed to asbestos that is used as insulation material in the engine room, as well as PAHs, soot and used engine oil. Workers can also be exposed to asbestos, solvents, glues, polyester resins, wood preservatives, paints, and heavy metals, while doing maintenance tasks on the vessel. Welding and cutting maintenance work is regularly required on board which can result in exposure to welding fumes and metal fumes. Coatings based on coal tar epoxy have also been used to coat wooden vessels. Different preservatives including tar have also been used to preserve fishing nets. Skippers and deck ratings as well as fish farmers can be exposed to UV radiation from the sun, due to the often outside nature of their work. Marine communication antennas and radars on the fishing vessel can also result in exposure to electromagnetic radiation. Shift and night work that could disrupt circadian rhythm is also common in commercial fishing. Fishermen can also be exposed involuntary to environmental tobacco smoke[2], due to confined spaces on the fishing vessel shared with smoking colleagues.

Although not directly related to occupation, work in commercial fishing can be related to an elevated dietary intake of fish and fish products that can be contaminated with persistent organic compounds and heavy metals. The extent of

contamination varies widely from region to region and between fish species[1]. Fishermen have also been found to have a diet particularly lacking in fruit and vegetables [2], and long hours at sea has been associated with higher smoking rates [3].

Known and suspected carcinogens (group 1, 2A and 2B) potentially present in commercial fishing

carcinogen	IARC evaluation	Exposure source
Asbestos	1 (1987)	Insulation material strips' boilers, incinerators, ventilation, flooring and pipes.
Coal tar soots	1 (1987)	Coating wooden vessels
Involuntary smoking	1 (2004)	Smoking colleagues in confined space of ship
Solar radiation	1 (1992)	Working outside
Soots	1 (1987)	engine
Diesel engine exhaust	2A (1989)	Vessel engine
Shift work involving circadian disruption	2A (2007)	Long work shifts, including night shifts
Marine diesel fuel	2B (1989)	Fishing vessel engine fuel
Welding fumes	2B (1990)	Repair on vessel
Benzo(a) pyrene (and other PAHs)	1 (2005)	Marine diesel engine exhaust and in motor oil

Other exposures that may potentially involve carcinogens: used engine oil; solvents; glues; polyester resins; wood preservatives; paints; welding fumes; metal fumes; heavy metals; electromagnetic radiation.

3. Exposure studies

Most occupational health and safety studies in the fishing industry have focussed on accidents and injury, which is a major problem in commercial fishing. The worldwide commercial fishing fatality rate is 80 per 100,000 workers. In New Zealand, the fatality rate for commercial fishing over the 15-year period to 2000

was 167 per 100,000. (ACC: http://www.acc.co.nz/injury-prevention/safer-industries/Fishing/index.htm). To our knowledge, there are no occupational exposure studies available within the fishing industry that have particularly focussed on exposure to carcinogens.

One study reported on asbestos exposure of maritime seamen or sailors [1]. Historical industrial hygiene data quantifying airborne asbestos concentrations onboard US maritime shipping vessels between 1978 and 1992 were assembled, indicating that historic airborne asbestos concentrations on maritime shipping vessels, when insulation-handling activities were *not* actively being performed, were consistently below contemporaneous US occupational standards from 1978 until 1992, and nearly always below the current permissible exposure limit of 0.1 f cc(-1).

4.1. Cancer risk, general

The International Agency for Research on Cancer has not included fishing or fish-processing industry among those industrial branches showing clear signs of cancer risk[1]. However, several studies have shown increased risks for cancer for fishermen of the fishing industry, particularly for cancer of the lip, lung and stomach.

Cancer of the lip

Fishing has been associated with an increased risk of lip cancer [4,5]. Previously this was thought to be related to tars used to preserve the nets, since the workers had used their mouths as "third hands" when handling the nets. Currently the aetiology of lip cancer among fishermen is considered to be the joint effect of exposure to ultraviolet radiation during outdoor work and smoking.

Cancer of the lung

Some studies have observed an increased lung cancer risk among fishermen [4,10-12]. Without information on smoking habits it has been difficult to evaluate the role of smoking versus the occupational factors in possible cases [4].

Cancer of the stomach

Many studies have found elevated stomach cancer risk in fishermen [10-13](refs). At present it is uncertain what role dietary, lifestyle and occupational factors play in the association of stomach cancer with fishing. Inadequate intake of fresh fruit and vegetables is associated with an increased stomach cancer risk and fishermen have been found to not eat sufficient fruits and vegetables in an overseas study. A Swedish study found that fishermen who were high consumers of fatty fish, contaminated with organochlorine compounds, had an increased risk for stomach cancer compared to low consuming fishermen [14].

4.2. Cancer risk, studies from New Zealand

To our knowledge no studies on cancer incidence or mortality have been conducted in the New Zealand fishing industry. However, there are several general population studies that looked at occupation in association with cancer mortality and incidence, and some have reported risks for fishing related occupations.

In a mortality study among New Zealand males covering the period 1974 to 1978[15], the occupational group of fishermen and hunters had a statistically significant increased risk for mortality from all neoplasms (RR 1.73, 95%CI 1.11-2.57) and lung cancer [16] in particular (RR 2.06, 95%CI 0.99-3.79). In a male cancer mortality study covering 1973-1986 [17], lung cancer risk was again statistically significantly increased (SMR 1.59, 95%CI 1.02-2.37) for fisherman and hunters. Brain cancer risk was elevated in male ships' engineers (OR 4.2,

95%CI 1.0-17.1) in New Zealand over the period 1972-1988 [18], while in another study brain cancer risk was not elevated in New Zealand fishermen (OR 0.48, 95%CI 0.07-3.04) [17]. In a study on testicular cancer incidence [19], fishermen and hunters did not have an increased risk (OR 1.03, 95%CI 0.26-4.13).

While interpreting these studies, it should be noted that workers involved in fishing often represent a very small fraction of a general population study, making it less likely for an association to be detected, and if an association is detected this generally based on small numbers. For the same reason, fishermen were sometimes grouped together with other occupations. These results were generally not adjusted for potential confounders such as smoking and other lifestyle factors.

5. Gaps in knowledge

There is little known about the presence and levels of occupational carcinogens within the fishing industry, although there is some evidence that fishermen have an increased risk of some cancers. However, to what extent this increased risk is due to lifestyle factors such as smoking and diet is not known.

6. Prevention strategies

Because there are no studies that have particularly focussed on exposure to carcinogens in commercial fishing, there are no prevention strategies available that have particularly focussed on carcinogen exposure prevention or cancer prevention in commercial fishing. FishSafe published Guidelines for Health and Safety on Board Small Fishing Boats (available online http:// www.fishsafe.org.nz/

guidelines/ docs/ guidelines.pdf). It includes strategies for preventing accidents of fishing vessels, but does not cover prevention strategies particularly relevant for carcinogens.

7. References

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NZ-CAREX

A04 Commercial Fishing — 2,862 workers — 78% men 22% women — occupations in this industry — industries in this industry — link to classification occupation — link to classification industry

<IARC eveluation> Carcinogen	% exposed	source of exposure:
<group 1> Asbestos	3	insulation material ship's boilers; incinerators; ventilation; flooring and pipes
<group 1> Coal-tar pitches (see PAHs)	10	coating wooden vessels
<group 1> Involuntary smoking (exposure to second hand smoke or 'environmente	30	smoking colleagues in confined space of ship
<group 1> Solar radiation	50	working outside
<group 1> Soots (see PAHs)	3	engine
<group 2A> Diesel engine exhaust	30	vessel engine
<group 2A> Shiftwork that involves circadian disruption	30	long shifts including night shifts
<group 2B> Diesel fuel, marine	30	fishing vessel engine fuel
<group 2B> Welding fumes	2	repair on vessel
Polycyclic aromatic hydrocarbons (excl. environmental tobacco smoke)	30	marine diesel engine exhaust and in motor oil
	0	

NZ-CAREX

THE DATABASE

CARCINOGENS BY INDUSTRY

REPORT: CARCINOGENS BY INDUSTRY

		n employed	% exposed	n men exposed	n women exposed	n exposed
	<group 1> Formaldehyde		1 %	71	87	158
	<group 1> Silica, crystalline		1 %	71	87	158
	<group 1> Wood dust		1 %	71	87	158
	<group 2A> Creosotes (see PAHs)		1 %	71	87	158
	<group 2A> Lead compounds, inorganic		1 %	71	87	158
	<group 2A> Tetrachloroethylene		1 %	71	87	158
	<group 2A> Trichloroethylene		1 %	71	87	158
	<group 2B> Carbon tetrachloride		1 %	71	87	158
	<group 2B> Chloroform		1 %	71	87	158
	<group 2B> Chlorophenoxy herbicides		1 %	71	87	158
	<group 2B> Gasoline		1 %	71	87	158
	<group 2B> Methylene chloride (dichloromethane)		1 %	71	87	158
P93	**Sport and Recreation**	24717		603	633	1,236
	<group 1> Involuntary smoking (exposure to second hand smoke or		1 %	121	127	247
	<group 1> Solar radiation		1 %	121	127	247
	<group 2A> Androgenic (anabolic) steroids		1 %	121	127	247
	<group 2B> Chlorophenoxy herbicides		1 %	121	127	247
	<group 2B> Styrene		1 %	121	127	247
Q95	**Personal Services**	34290		2,349	3,825	6,174
	<group 1> Arsenic and arsenic compounds		1 %	131	213	343
	<group 1> Benzene		1 %	131	213	343
	<group 1> Formaldehyde		1 %	131	213	343
	<group 1> Solar radiation		1 %	131	213	343
	<group 2A> Hairdresser and barber (occupational exposure as a)		1 %	131	213	343
	<group 2A> Lead compounds, inorganic		1 %	131	213	343
	<group 2A> Shiftwork that involves circadian disruption		1 %	131	213	343
	<group 2A> Sunlamps and sunbeds (use of)		1 %	131	213	343
	<group 2A> Tetrachloroethylene		1 %	131	213	343
	<group 2A> Trichloroethylene		1 %	131	213	343
	<group 2A> Ultraviolet radiation, artificial		1 %	131	213	343
	<group 2B> 1,1-dimethylhydrazine		1 %	131	213	343
	<group 2B> Carbon tetrachloride		1 %	131	213	343
	<group 2B> Catechol		1 %	131	213	343
	<group 2B> Chloroform		1 %	131	213	343
	<group 2B> Chlorophenoxy herbicides		1 %	131	213	343
	<group 2B> Dry cleaning (occupational exposures in)		1 %	131	213	343
	<group 2B> Hydrazine		1 %	131	213	343
Q96	**Other Services**	41728		2,091	2,435	5,426
	<group 1> 1,3-Butadiene		1 %	230	187	417
	<group 1> Asbestos		1 %	230	187	417
	<group 1> Benzene		1 %	230	187	417
	<group 1> Cadmium and cadmium compounds		1 %	230	187	417
	<group 1> Formaldehyde		1 %	230	187	417
	<group 1> Solar radiation		1 %	230	187	417
	<group 1> Soots (see PAHs)		1 %	230	187	417
	<group 2A> Diesel engine exhaust		1 %	230	187	417
	<group 2A> Lead compounds, inorganic		1 %	230	187	417

NZ-CAREX

THE DATABASE

OVERVIEW NUMBER EXPOSED BY CARCINOGEN

REPORT: CARCINOGENS

	men exposed		women exposed		total exposed	
<group 2B> 1,1-dimethylhydrazine	1,127	0.107%	755	0.081%	1,882	0.095%
<group 2B> 1,4-dioxane	126	0.012%	54	0.006%	180	0.009%
<group 2B> 2-Methylaziridine (Propyleneimine)	126	0.012%	54	0.006%	180	0.009%
<group 2B> 3,3`-Dimethoxybenzidine (ortho-dianisidine)	71	0.007%	106	0.011%	178	0.009%
<group 2B> 3,3`-Dimethylbenzidine (o-tolidine)	71	0.007%	106	0.011%	178	0.009%
<group 2B> 3,3`-Dichlorobenzidine	71	0.007%	106	0.011%	178	0.009%
<group 2B> 4,4-methylene dianiline	126	0.012%	54	0.006%	180	0.009%
<group 2B> Acetaldehyde	121	0.012%	101	0.011%	222	0.011%
<group 2B> Acrylonitrile	197	0.019%	160	0.017%	357	0.018%
<group 2B> Antimony trioxide	182	0.017%	66	0.007%	248	0.012%
<group 2B> Bitumens	1,282	0.122%	193	0.021%	1,476	0.074%
<group 2B> Carbon black	247	0.024%	155	0.017%	402	0.020%
<group 2B> Carbon tetrachloride	1,861	0.177%	1,544	0.165%	3,405	0.171%
<group 2B> Carpentry and joinery	2,903	0.277%	1,482	0.158%	4,385	0.221%
<group 2B> Catechol	257	0.024%	266	0.028%	523	0.026%
<group 2B> Ceramic fibers	606	0.058%	228	0.024%	834	0.042%
<group 2B> Chlordane	883	0.084%	467	0.050%	1,349	0.068%
<group 2B> Chlordecone (Kepone)	815	0.078%	454	0.049%	1,270	0.064%
<group 2B> Chloroform	575	0.055%	1,220	0.130%	1,795	0.090%
<group 2B> Chlorophenoxy herbicides	1,204	0.115%	893	0.095%	2,098	0.106%
<group 2B> Chlorothalonil	815	0.078%	454	0.049%	1,270	0.064%
<group 2B> Cobalt and its compounds	344	0.033%	83	0.009%	427	0.021%
<group 2B> Diesel fuel, marine	173	0.017%	71	0.008%	244	0.012%
<group 2B> Dry cleaning (occupational exposures in)	131	0.012%	213	0.023%	343	0.017%
<group 2B> Engine exhaust, gasoline	415	0.040%	177	0.019%	592	0.030%
<group 2B> Ethylbenzene	126	0.012%	54	0.006%	180	0.009%
<group 2B> Firefighter (occupational exposure as a)	230	0.022%	187	0.020%	417	0.021%
<group 2B> Fuel oils, residual (heavy)	31	0.003%	13	0.001%	44	0.002%
<group 2B> Gasoline	726	0.069%	293	0.031%	1,019	0.051%
<group 2B> Gasoline engine exhaust	2,026	0.193%	1,047	0.112%	3,074	0.155%
<group 2B> Heptachlor	815	0.078%	454	0.049%	1,270	0.064%
<group 2B> Hexachloroethane	74	0.007%	25	0.003%	98	0.005%
<group 2B> Hydrazine	494	0.047%	314	0.034%	807	0.041%
<group 2B> Magnetic fields, extremely low frequency	1,188	0.113%	487	0.052%	1,675	0.084%
<group 2B> Methylene chloride (dichloromethane)	262	0.025%	126	0.013%	388	0.020%
<group 2B> Mirex	815	0.078%	454	0.049%	1,270	0.064%
<group 2B> Nitrobenzene	126	0.012%	54	0.006%	180	0.009%
<group 2B> Nitromethane	126	0.012%	54	0.006%	180	0.009%
<group 2B> Ochratoxin B	159	0.015%	115	0.012%	274	0.014%
<group 2B> Ortho-anisidine	126	0.012%	54	0.006%	180	0.009%
<group 2B> Para-dichlorobenzene	941	0.090%	508	0.054%	1,449	0.073%
<group 2B> Printing processes (occupational exposures in	121	0.012%	101	0.011%	222	0.011%
<group 2B> Propylene oxide	126	0.012%	54	0.006%	180	0.009%
<group 2B> Styrene	3,168	0.302%	1,429	0.153%	4,596	0.231%
<group 2B> Tetranitromethane	126	0.012%	54	0.006%	180	0.009%
<group 2B> Textile manufacturing industry (work in)	71	0.007%	106	0.011%	178	0.009%
<group 2B> Toxaphene (polychloronated camphenes)	815	0.078%	454	0.049%	1,270	0.064%
<group 2B> Vinyl acetate	126	0.012%	54	0.006%	180	0.009%
<group 2B> Welding fumes	2,116	0.202%	412	0.044%	2,528	0.127%

NZ-CAREX

THE DATABASE

OVERVIEW INDUSTRIES EXPOSED BY CARCINOGEN

REPORT: INDUSTRIES BY CARCINOGEN

		n employed	% exposed	n men exposed	n women exposed	n exposed
<group 1> 1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCN				212	850	1,063
O86	Health Services	106305	1 %	212	850	1,063
<group 1> 1,3-Butadiene				574	270	844
C28	Machinery and Equipment Manufacturing	42654	1 %	344	83	427
Q96	Other Services	41739	1 %	230	187	417
<group 1> 1,4-Butanediol dimethanesulfonate (Myleran)				212	850	1,063
O86	Health Services	106305	1 %	212	850	1,063
<group 1> 8-Methoxypsoralen (Methoxsalen) plus ultraviolet A radiation				212	850	1,063
O86	Health Services	106305	1 %	212	850	1,063
<group 1> Aflatoxins (naturally occurring mixtures of)				846	786	1,633
C21	Food, Beverage and Tobacco	54789	1 %	354	194	548
G51	Food Retailing	81024	1 %	333	478	810
I66	Services to Transport	22272	1 %	124	99	223
I67	Storage	5172	1 %	36	16	52
<group 1> Aluminium production				225	43	267
C27	Metal Product Manufacturing	26745	1 %	225	43	267
<group 1> Arsenic and arsenic compounds				1,500	850	2,350
A01	Agriculture	108066	1 %	688	393	1,081
A02	Services to Agriculture; Hunting and Trapping	18069	1 %	127	62	189
B13	Metal Ore Mining	438	1 %	4	1	4
B15	Services to Mining	927	1 %	8	1	9
C23	Wood and Paper Product Manufacturing	22980	1 %	191	39	230
C26	Non-Metallic Mineral Product Manufacturing	9822	1 %	56	12	68
C27	Metal Product Manufacturing	26745	1 %	225	43	267
P92	Libraries, Museums and the Arts	15801	1 %	71	87	158
Q95	Personal Services	34299	1 %	131	213	343
<group 1> Asbestos				5,179	2,790	7,968
A04	Commercial Fishing	2862	1 %	22	6	29
B11	Coal Mining	771	1 %	7	1	8
B15	Services to Mining	927	1 %	8	1	9
C21	Food, Beverage and Tobacco	54789	1 %	354	194	548
C23	Wood and Paper Product Manufacturing	22980	1 %	191	39	230
C24	Printing, Publishing and Recorded Media	22242	1 %	121	101	222
C26	Non-Metallic Mineral Product Manufacturing	9822	1 %	56	12	68
C27	Metal Product Manufacturing	26745	1 %	225	43	267
C28	Machinery and Equipment Manufacturing	42654	1 %	344	83	427

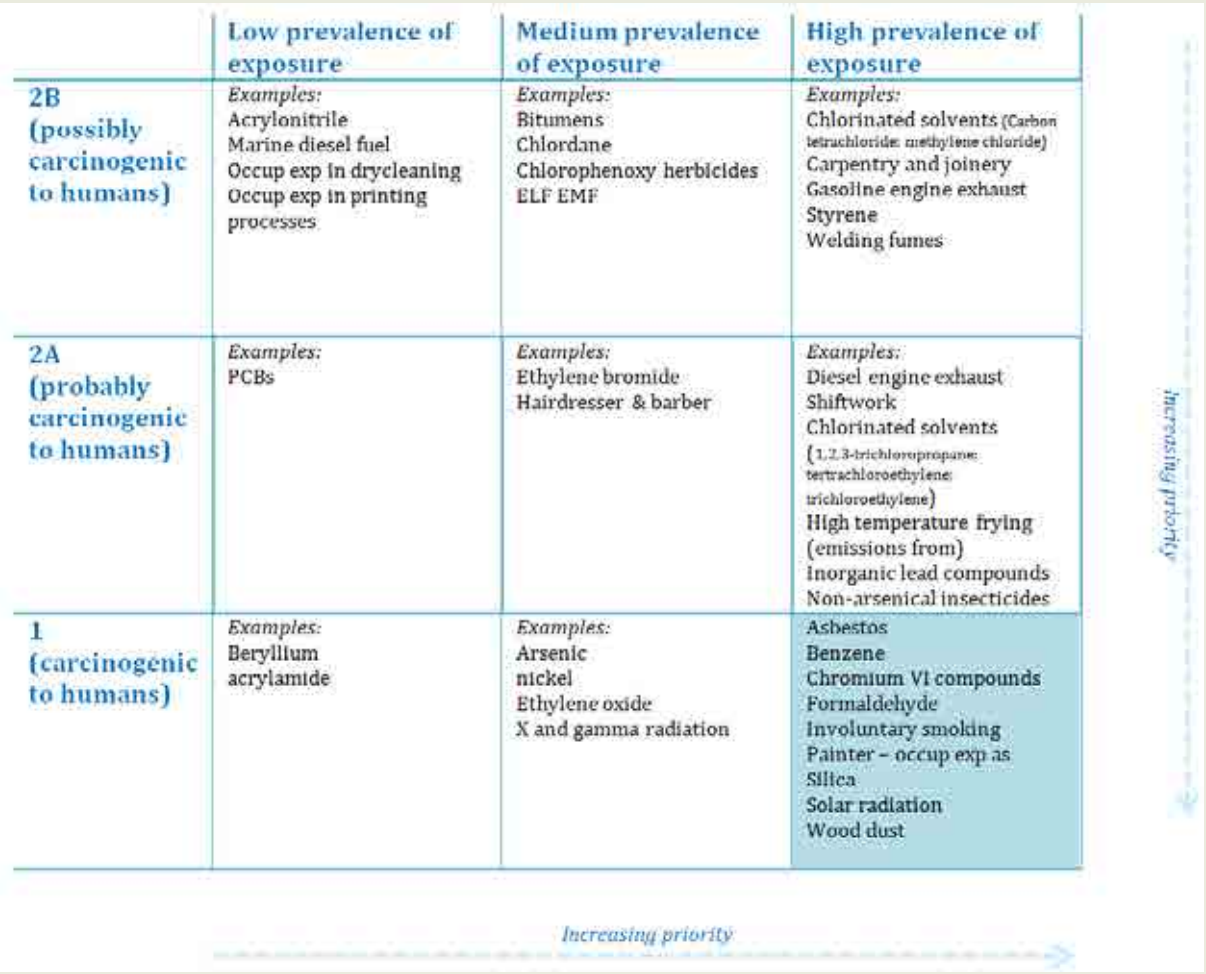
NZ-CAREX prioritizing intervention: industries

	Low number exposed	Medium number exposed	High number exposed
Not associated with increased cancer risk/ not studied	Storage Communication services Property services Government administration Community services Motion picture/radio/tv services Sport and recreation	Machinery & motor vehicle wholesaling	Personal and household good retailing
Occasionally associated with increased cancer risk	Commercial fishing Food, beverage Electricity & gas supply Defence Libraries, museums, arts	Food retailing Motor vehicle retailing Accommodation, cafes &restaurant education	Printing & publishing Petroleum & chemical
Repeatedly associated with increased cancer risk	Forestry and logging Mining and extraction	Textile, clothing, footwear Transport Business services (Includes painting, carpentry, chimney sweeping Personal services (Includes hairdressers)	Agriculture Construction Health services Machinery & equipment mfg Metal product mfg Wood & paper product mfg

Increasing priority

Increasing priority

NZ-CAREX prioritizing intervention: exposures



	Low prevalence of exposure	Medium prevalence of exposure	High prevalence of exposure
2B (possibly carcinogenic to humans)	*Examples:* Acrylonitrile Marine diesel fuel Occup exp in drycleaning Occup exp in printing processes	*Examples:* Bitumens Chlordane Chlorophenoxy herbicides ELF EMF	*Examples:* Chlorinated solvents (Carbon tetrachloride; methylene chloride) Carpentry and joinery Gasoline engine exhaust Styrene Welding fumes
2A (probably carcinogenic to humans)	*Examples:* PCBs	*Examples:* Ethylene bromide Hairdresser & barber	*Examples:* Diesel engine exhaust Shiftwork Chlorinated solvents (1,2,3-trichloropropane; tertrachloroethylene; trichloroethylene) High temperature frying (emissions from) Inorganic lead compounds Non-arsenical insecticides
1 (carcinogenic to humans)	*Examples:* Beryllium acrylamide	*Examples:* Arsenic nickel Ethylene oxide X and gamma radiation	Asbestos Benzene Chromium VI compounds Formaldehyde Involuntary smoking Painter – occup exp as Silica Solar radiation Wood dust

Increasing priority

Increasing priority

NZ-CAREX

Main conclusions:

- There are more than 50 known human carcinogens commonly present in New Zealand workplaces.
- The most common of these are: Asbestos; Benzene; Chromium VI compounds; Formaldehyde; Involuntary smoking; occupational exposures as a Painter; Silica; Solar radiation; Wood dust.
- There are more than an additional 100 possible or probable human carcinogens present in New Zealand workplaces.
- The industries for which an increased cancer risk has been observed repeatedly in epidemiological studies and have the highest number of potentially exposed workers include: Agriculture; Construction; Health services; Machinery & equipment manufacturing (mfg); Metal product mfg; Wood & paper product mfg.
- The specific outputs of this study (literature review, list of carcinogens, NZ-CAREX, NZ-ACEM) can contribute towards improving access to knowledge regarding the occurrence of carcinogens in New Zealand workplaces.

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