Fall 2005

Occupational Medicine Clinical Update

Occupational Health Clinics for Ontario Workers, Sarnia-Lambton

95% - the percentage of lung carcinogens that have been identified by studying occupational groups
77% - the percentage of all carcinogens (minus drugs) identified by studying occupational groups
- Infante

Occupational Carcinogens - What makes it on the list

Physicians are sometimes faced with patients concerned that working with a substance caused their malignancy. Wouldn't it be nice to know which substances have at least been studied enough to be recognized as culpable?

Apparently Montreal-based Dr. Jack Siemiatycki thought so. He and a cadre of like-minded epidemiologists took on the daunting task of organizing this information, and not just by arcane substances (since there are 85,000 chemicals in use the workplace) but in terms physicians can relate to – by cancer site [Siemiatycki et al 2004].

The material was derived largely through evaluations from the authoritative International Agency for Research on Cancer (IARC). Since 1971 this agency has been selecting substances for evaluation based on two simple criteria: humans are exposed and there is suspicion the substance is carcinogenic.

(Continued on page 2)

Table 1. Occupations/industries evaluated by IARC as definitely (group 1), probably (group 2A), or possibly (group 2B) entailing excess risk of cancer among workers (reproduced with permission from *Environmental Health Perspectives).*

Occupation or industry	Suspected substance	*IARC Monograph* Volume (year)[a]	Group	Site(s)
Aluminum production	Pitch volatiles, aromatic amines	Suppl. 7 (1987)	1	Lung[b], bladder[b]
Auramine manufacture	2-Naphthylamine, auramine, other chemicals, pigments	Suppl. 7 (1987)	1	Bladder[b]
Boot & shoe manufacture/repair	Leather dust, benzene & other solvents	Suppl. 7 (1987)	1	Leukemia[b], nasal[b], paranasal sinuses[b], bladder[b]
Carpentry & joinery	Wood dust	Suppl. 7 (1987)	2B	-
Coal gasification	Coal tar, coal-tar fumes, PAHs	Vol.34 (1984)	1	Skin (incl. scrotum)[b], bladder[b], lung[b]
Coke production	Coal-tar fumes	Suppl. 7 (1987)	1	Skin (scrotum)[b], lung[b], bladder[c], kidney[c]
Dry cleaning	Solvents & chemicals used in "spotting"	Vol.63 (1995a)	2B	-
Furniture & cabinet making	Wood dust	Suppl. 7 (1987)	1	Nose & sinonasal cavities[b]
Hairdressers & barbers	Dyes (aromatic amines, amino-phenols with hydrogen peroxide), solvents, propellants, aerosols	Vol.57 (1993b)	2A	Bladder[c], lung[c], non-Hodgkin lymphoma[c], ovary[c]
Hematite mining	Radon daughters, silica	Suppl. 7 (1987)	1	Lung[b]
Iron & steel founding	PAHs, silica, metal fumes, formaldehyde	Suppl. 7 (1987)	1	Lung[b]
Isopropanol manufacture, strong-acid process	Diisopropyl sulfate, isopropyl oils, sulfuric acid	Suppl. 7 (1987)	1	Paranasal sinuses[b], larynx[b], lung[c]
Magenta manufacture	Magenta, *ortho*-toluidine, 4,4´ -methylene bis(2-methylaniline), *ortho*-nitrotoluene	Vol.57 (1993b)	1	Bladder[b]
Painters		Vol.47 (1989c)	1	Lung[b], bladder[c], stomach[c]
Petroleum refining	PAHs	Vol.45 (1989b)	2A	Bladder[c], brain[c], leukemia[c]
Printing processes	Solvents, inks	Vol.65 (1996)	2B	-
Production of art glass, glass containers, and pressed ware	Lead, arsenic, antimony oxides, silica, asbestos, other metal oxides, PAHs	Vol.58 (1993a)	2A	Lung[c]
Rubber industry	Aromatic amines, solvents	Suppl. 7 (1987)	1	Bladder[b], stomach[c], larynx[c], leukemia[c], lung[c]
Textile manufacturing industry	Textile dust in manufacturing process, dyes and solvents in dyeing and printing operation	Vol. 48 (1990b)	2B	-

[a]Most recent IARC evaluation; for those referenced as Supplement 7 (IARC 1987), it is possible that the 1987 review was quite perfunctory and that the essential evidence was accumulated at an earlier date. [b]Authors judged that evidence for an association with this site was strong. [c]Authors judged that evidence for an association with this site was suggestive.

(Continued from page 1)

So far (from 1972 to 2003) 880 substances, complex mixtures and industrial processes have undergone systematic scrutiny. From these 880, 89 were declared, 'Definite', 64 'Probable' and 264 as 'Possible' human carcinogens.

These substances were all reviewed by Siemiatycki et al and those considered "occupational exposures" involving a significant number of workers were tagged for inclusion. Based on this information the authors came up with a list of 28 definite, 27 probable, and 113 possible occupational carcinogens. They then produced an exhaustive array of tables listing the substances/industries and processes in a variety of ways to allow easy access to the information.

For simplicity, we have distilled Siemiatycki's paper down to the tables most relevant for the practicing MD. The first, seen on page 1, identifies occupations or industries that entail to varying degrees, excess risk of cancer amongst their respective workers. The second sorts definite or probable carcinogens or processes by cancer site.

ABOUT THE OCCUPATIONS / INDUSTRIES TABLE (page 1)

Occupations or industries appearing in the table on page 1 have been reviewed because of specific concerns. It should be kept in mind that *absence* of an occupation or industry from Table 1 does not necessarily mean there is no known risk therein.

Firefighting is a good example. Firefighters have been shown in numerous studies to suffer excesses of a wide variety of cancers, and these are being recognized by compensation boards globally. However, an IARC evaluation has not occurred.

Table 2. Definite or probable occupational carcinogens and carcinogenic circumstances, by cancer site (adapted from Siemiatycki et al).

Site	Strength of evidence[a]	High-risk industries/occupations	High-risk substances/processes
Bladder	Strong	Rubber industry	Aluminum production,4-aminobiphenyl, auramine manufacture, benzidine, coal gasification , magenta manufacture, 2-naphthylamine
	Suggestive	Boot and shoe manufacture/repair, hairdressers and barbers, painters, petroleum refining	Benz[a]anthracene, benzidine-based dyes, benzo[a]pyrene; 4-chloro-*ortho*-toluidine, coal tars and pitches, coke production, dibenz[a,h]anthracene, diesel engine exhaust, 4,4'-methylene bis(2-chloroaniline), mineral oils (untreated and mildly treated), *ortho*-toluidine
Bone	Strong		Ionizing radiation
Brain	Suggestive	Petroleum refining	Nonarsenical insecticides
Cervix	Suggestive		
CNS	Suggestive		Epichlorohydrin
Esophagus	Suggestive		Soots, tetrachloroethylene
Gastrointestinal tract	Suggestive		Asbestos
Kidney	Suggestive		Coke production
Kidney (renal cell)	Suggestive		Trichloroethylene
Larynx	Strong		Isopropanol manufacture, strong acid process, inorganic acid mists containing sulfuric acid, mustard gas
Leukemia	Strong	Boot and shoe manufacture/repair	Benzene, ethylene oxide, ionizing radiation
Liver & biliary tract	Strong		Aflatoxin, ionizing radiation
	Suggestive		Polychlorinated biphenyls, trichloroethylene
Liver (angiosarcoma)	Strong		Vinyl chloride
	Suggestive		Arsenic and arsenic compounds
Liver (hepatocellular)	Suggestive		Vinyl chloride
Lung	Strong	Iron and steel founding, painters	Aluminum production, arsenic and arsenic compounds, asbestos, beryllium, cadmium & cadmium compounds, chromium (hexavalent) compounds, coal gasification, coke production, hematite mining (underground) with radon exposure, involuntary (passive) smoking, ionizing radiation, selected nickel compounds , silica (crystalline), soots, talc containing asbestiform fibers

Occupational cancers in women is a more extreme example of a group of workers that have fallen below the radar in occupational research in general. A review of 1,233 occupational cancer papers published between 1971 and 1990 showed only 7% had detailed results for white women and 1% for nonwhite women [Zahm and Blair, 2003].

THE CANCER SITE TABLE (pages 2 & 3)

Table 2 summarizes the occupational carcinogens or exposures that are considered to be definite or probable by IARC. There are, as with all information, limits to IARC's material that should be recognized . They do not provide any indication of the strength of effect for individual carcinogens. Furthermore, there has been considerable controversy about the manner in which IARC reaches its designations of carcinogenicity.

Although there is some security in knowing that some obvious carcinogens have been identified, there are many reasons for caution:

- Only **880** substances/processes have been evaluated by IARC to 2003 (~1% of substances in use).
- About **85,000** chemicals are in the workplace with constant introduction of new ones (~1500-3000 per year) hence regulatory agencies are falling further behind each year.
- There is a shift away from occupational research in the epidemiological community.
- There are increased barriers to occupational research (exposure assessment, access to subjects, etc).

(Continued on page 4)

Table 2 continued.

Site	Strength of evidence[a]	High-risk industries/occupations	High-risk substances/processes
Lung	Suggestive	Hairdressers and barbers, rubber industry	Benz[*a*]anthracene, benzo[*a*]pyrene, a-chlorinated toluenes, coal tars & pitches, dibenz[*a,h*]anthracene, diesel engine exhaust, epichlorohydrin, inorganic acid mists containing sulfuric acid, isopropanol manufacture (strong acid process), mineral oils (untreated and mildly treated), nonarsenical insecticides, mustard gas, production of art glass, glass containers and pressed ware, TCDD
Lung (oat cell)	Strong		Bis(chloromethyl) ether & chloromethyl methyl ether (technical grade)
Lympho-hematopoietic	Suggestive		1,3-Butadiene
Lymphoma (non-Hodgkin)	Suggestive	Hairdressers and barbers	Nonarsenical insecticides, TCDD, tetrachloroethylene (aka perchlorethlyene), trichloroethylene
Melanoma	Strong		Solar radiation
Mesothelioma	Strong		Asbestos, erionite, talc containing asbestiform fibers
Multiple myeloma	Suggestive		Nonarsenical insecticides
Nasal cavities & paranasal sinuses	Strong	Boot and shoe manufacture/repair, furniture & cabinet making	Isopropanol manufacture, strong acid process, selected nickel compounds including combinations of nickel oxides & sulfides in the nickel refining industry, wood dust
	Suggestive		Chromium (hexavalent) compounds, formaldehyde, mineral oils (untreated and mildly treated)
Ovary	Suggestive	Hairdressers and barbers	
Pancreas	Suggestive		Acrylamide
Pharynx & nasopharynx	Suggestive		Mustard gas, formaldehyde
Sarcoma	Suggestive		TCDD
Skin	Strong		Arsenic and arsenic compounds, coal tars & pitches, coal gasification, coke production, dibenz[*a,h*]anthracene, mineral oils (untreated and mildly treated), shale oils or shale-derived lubricants, solar radiation, soots
	Suggestive		Benz[*a*]anthracene, benzo[*a*]pyrene, creosotes
Stomach	Suggestive	Painters, rubber industry	
Thyroid	Strong		Ionizing radiation
Other sites	Suggestive		Ionizing radiation[b]
All sites combined	Strong		TCDD[c]

TCDD - 2,3,7,8-tetrachlorodibenzo-*para*-dioxin. [a]Authors judgment of strength of evidence regarding each site. [b]There is suggestive evidence of an effect of ionizing radiation on several sites in addition to those shown here. [c]The evidence for an association with TCDD only becomes strong when data are combined for all cancer sites.

(Continued from page 3)

Despite these caveats, the information in these tables represents a huge amount of research and review. If you suspect, based on the information presented or other evidence that your patient's cancer is work-related, you should notify the appropriate compensation board (in Ontario the WSIB, through a Form 8) and allow it to investigate.

"DOUBT IS OUR PRODUCT"

One of the most serious barriers to the determination of substances as carcinogenic are companies with vested interests doing research on their own occupational cohorts. As David Michaels, an epidemiologist at George Washington University states [Michaels 2005]:

Uncertainty is an inherent problem of science, but manufactured uncertainty is another matter entirely. Over the past three decades, industry groups have frequently become involved in the investigative process when their interests are threatened.

Michaels, a former Assistant Secretary of Energy for Environment, Safety and Health in the U.S. also writes,

In 1969 an executive at Brown & Williamson, a cigarette maker now owned by R. J. Reynolds Tobacco Company, unwisely committed to paper the perfect slogan for his industry's disinformation campaign: "Doubt is our product since it is the best means of competing with the 'body of fact' that exists in the mind of the general public."

"Doubt is our product since it is the best means of competing with the 'body of fact' that exists in the mind of the general public."

- Tobacco executive

In recent years, many other industries have eagerly adopted this strategy. Corporations have mounted campaigns to question studies documenting the adverse health effects of exposure to beryllium, lead, mercury, vinyl chloride, chromium, benzene, benzidine, nickel, and a long list of other toxic chemicals and medications.

Emphasizing uncertainty on behalf of big business has become a big business in itself. The product-defense firms have become experienced and successful consultants in epidemiology, biostatistics and toxicology.

"Where there is reasonable evidence of an impending threat to public health, it is inappropriate to require proof of causation beyond a reasonable doubt before taking steps to avert the threat."

- Justice Krever

AVERTING THREATS WITH REASONABLE EVIDENCE

The sheer magnitude of substances in the workplace, and the forces against regulation, make it clear that waiting for incontrovertible scientific proof will continue to fail miserably in the arenas of occupational medicine and public health. It is because of such conflicts that the ***Precautionary Principle*** began to evolve.

During the late 1990's federal inquiry into the tainted blood scandal Justice Krever stated the Precautionary Principle in this way, "Where there is reasonable evidence of an impending threat to public health, it is inappropriate to require proof of causation beyond a reasonable doubt before taking steps to avert the threat."

Recognizing the limitations of science in identifying carcinogens, and other health hazards in our workplaces, may help guide physicians in primary prevention teaching with patients and workers. As the healthcare system lumbers toward further breakdown, we have to do a better job finding our ounce of prevention, because we clearly can't afford the pound of cure.

References

Infante P. Cancer and Blue Collar Workers: Who Cares? New Solutions, 1995 (52): 52-57.

Michaels, D. Doubt is Their Product. Scientific American 2005;292(6):96-101.

Siemiatycki J, Richardson L, Straif K, Latreille B, Lakhani R, Campbell S, Rousseau MC, Boffetta P. Listing Occupational Carcinogens. Environ Health Perspect. 2004 Nov;112(15):1447-59.

Zahm SH, Blair A. Occupational Cancer Among Women: Where Have We Been and Where Are We Going? Am. J. Ind. Med. 2003 44:565-575.

Occupational Health Clinics for Ontario Workers Inc.

Occupational Health Clinics for Ontario Workers Inc, Sarnia-Lambton

171 Kendall Street
Point Edward, Ontario
N7V 4G6

Phone: 519-337-4627
Fax: 519-337-9442
Email: sarnia@ohcow.on.ca
WEBSITE: www.ohcow.on.ca

Edited by:
Warren Teel, M.D.

Medical Staff:
Abe Reinhartz, M.D. areinhartz@ohcow.on.ca
Jim Mackenzie, M.D. jmackenzie@ohcow.on.ca
Warren Teel, M.D. wteel@ohcow.on.ca

Occupational Health Clinics for Ontario Workers (OHCOW) is a pro-active team of health professionals committed to promoting the highest degree of physical, mental and social well being for workers and their communities. At five clinics in Ontario (Sudbury, Toronto, Hamilton, Sarnia and Windsor) a team of nurses, hygienists, ergonomists and physicians see patients and identify work-related illness and injuries, promote awareness of health and safety issues, and develop prevention strategies.

Contact us for the clinic nearest you.