



Occupational cancer

Definition of the problem

- ✓ Occupational cancer accounts for about 4 to 20% of the cancer cases.
- ✓ It affects certain groups of the society much more than others.
- ✓ Occupational cancer is entirely preventable and interventions at the workplace can save millions of lives every year.

Occupational cancer(Cont.)

Operational definition

- ✓ An agent to which **substantial** numbers of workers are or have been exposed at **significant** levels of exposure.
- ✓ Substantial: > 10,000 workers
- ✓ Significant: As much as, or more than, in general environment.

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Occupational cancer(Cont.)

- Its complicated.
- It may take 20-30 years (at least 5 y) between occupational exposure and subsequent induction of cancer.
- Increase the risk of developing cancer but, development of cancer is not certain.

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Occupational cancer(Cont.)

- Solar radiation
- Lead and its inorganic compounds
- Passive smoking
- Benzene
- Crystalline silica
- Asbestos
- Diesel engine exhausts
- Formaldehyde
- Chromium VI
- Radon
- Wood dust



Occupational cancer(Cont.)

Table 1. Occupational causes of cancer

Cancer	Examples of principal carcinogenic occupational exposures
Lung cancer	Asbestos; silica; nickel; indoor radon; diesel fumes; environmental tobacco smoke (ETS) at the workplace; production and refining of arsenic, beryllium, cadmium, aluminium and chromium; mining of uranium; copper smelting; iron and steel founding; vineyard workers; roofers; asphalt workers; painters
Bladder cancer	2-naphthylamine; benzidine; 4-aminobiphenyl; manufacturing of magenta, auramine, p-chloro-o-toluidine, pigment chromate, and dyes; synthetic latex production; tyre curing, calendar operatives, reclaim, cable makers, gas-retort house workers
Mesothelioma	Asbestos
Leukaemia	External ionizing radiation, benzene, ethylene oxide, rubber industry, boot and shoe manufacturing and repair
Laryngeal cancer	Sulfuric acid, mineral oils and asbestos, pickling operations
Skin cancer	Intensive solar radiation; coal-tar pitches; coal tar, shale oils; arsenic; mineral oils; polycyclic-aromatic hydrocarbons (PAH); production of coke; vineyard workers; fishermen
Sinonasal and nasopharyngeal cancer	Wood dust; nickel compounds; hexavalent chromium; boot and shoe manufacturing and repair; manufacturing of isopropanol using strong acid process; furniture and cabinet making; carpenters, formaldehyde
Kidney cancer	Coke production
Liver cancer	Vinyl chloride; occupational infections with hepatitis B and C, health care workers

Occupational cancer(Cont.)

- ❖ Occupational cancer required two stages:
 - Stem cells mutates → Initiation, then with other exposure cell intermediate proliferation increase
→ Promotion
 - Further mutation → Malignant cancer
(progression)

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Primer strategies for discovering carcinogens

Epidemiology

Animal experimentation (toxicology)

Other biological effects

- Mutagenesis
- Genotoxicity
- Etc.

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The importance of occupational cancer epidemiology

- Nearly half of known human carcinogens are substances found essentially in the occupational environment
- Once identified, control measures are often feasible
- The discovery of occupational carcinogens has importance outside the factory walls
- Provides a basis for compensating victims
- Informs understanding of carcinogenesis

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Some challenges in occupational cancer epidemiology

Exposure assessment

Exposure assessment

Exposure assessment

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Components of Risk Assessment

Hazard Identification

Dose-Response Assessment

Exposure Assessment

Risk Characterization

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Uses of Exposure Assessment in Risk Assessment



- Used to estimate internal dose which, with dose response data (usually in animals), is used to estimate risk.
- For risk-based regulations, provides the link to emissions (point source, consumer products, area sources).
- Evaluation of efficacy of cleanup (risk to most exposed subgroup).

Marc Rigas, PhD, 2001

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Illustration of Exposure Pathways

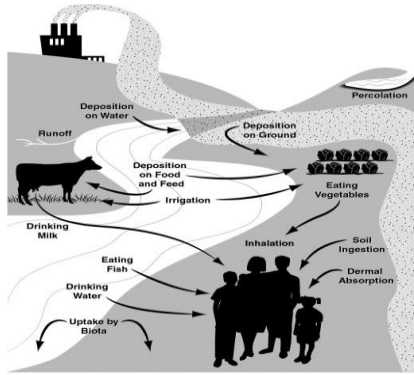


Figure 1. Illustration of Exposure Pathways

Paustenbach, DJ. (2000) The practice of exposure assessment: a state-of-the-art review. *J Toxicol Env Health*, 3:179-291

***** Cancer Assessment Categories

TABLE 21.3. EPA Cancer Assessment Categories

Group A — human carcinogen	Sufficient human evidence for causal association between exposure and cancer Limited evidence in humans
Group B1 — probably human carcinogen	Inadequate evidence in humans, sufficient evidence in animals
Group B2 — probably human carcinogen	Limited evidence in animals
Group C — possible human carcinogen	Inadequate evidence in animals
Group D — not classifiable as to human carcinogenicity	At least two adequate animal tests or both epidemiology and animal studies which are negative
Group E — no evidence of carcinogenicity in humans	

EPA=Environmental Protection Agency



Exposure Assessment

- Exposure assessment involves describing the nature and size of various populations exposed to a chemical agent, and the magnitude and duration of their exposures.
 - Without exposure there can be no toxicity.

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Steps In Exposure Assessment

- Characterization of exposure setting
- Identification of exposure pathways
- Quantification of exposure

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Factories and air pollution as an occupational causes for cancer



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Example of initiation and promotion:

☐ Benzo (α) pyrene \rightarrow initiator (I)

☐ Croton oil \rightarrow promoter

Identical area of skin of a group of mice



Painted with Benzo (α)pyrene (I)

No skin tumor develop



Followed by several application
of Croton oil (P)

Many cancer develop

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Occupational cancer (cont.)

- Initiation → rapid → cause irreversible DNA modification.
- Most occupational carcinogens w have been discovered to date, are mutagens

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Comparison between initiators and promoter

- | | |
|--|--|
| <ul style="list-style-type: none"> • <u>Cancer initiators</u> : ➤ Has long latency. <p>(period which is required for further mutations to occur)→
cancer</p> | <ul style="list-style-type: none"> ➤ <u>Cancer promoters</u> : ➤ Has shorter latency. <p>Some occupational carcinogens (acts as promoters) for example:</p> <ul style="list-style-type: none"> ❖ benzene. ❖ arsenic ❖ Phenoxyherbicides |
|--|--|

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How to prevent occupational cancer:

✦ Increase awareness about carcinogen:

For example, through the presentations or posters.

✦ Wearing protective clothes.

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How to prevent occupational cancer (cont.)

✦ Avoid the use of recognized human carcinogen.

→ i.e. removal of the carcinogens once their carcinogenicity has been established.

→ e.g Recognized carcinogens such as asbestos, nickel, arsenic, have been progressively reduced in industrialized countries.

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Question:

Q. Is the occupational environment an important source of human carcinogens?

A. Probably