The IARC Monographs Programme
The Identification of Occupational Carcinogens

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International Agency for Research on Cancer
Lyon, France

Toronto, 24 February 2014
Presentation Outline

- The IARC Monographs and the Volume 100 series
- Tumour concordance and mechanisms of carcinogenesis
- Selected recent highlights
- Future plans, Quantitative risk characterization
- Medium- and long-term planning of Monographs
  - Identify research gaps and recommendations
  - Pre- and post-meeting research by IMO scientists
- Upcoming Monographs and Advisory Group Meetings
- Re-launch of IARC Handbooks of Cancer Prevention
Global burden and control of cancer

- **Rising burden of cancer**: estimates by 2025 19.3 million new cases/a compared to 14.1 million in 2012
- Majority of the increase in cancer burden expected in **low- and middle-income countries (LMIC)**
- **Prevention** probably the **single most effective response** to these challenges, particularly in LMIC where health services are least able to meet the impending challenge.
- The first step in cancer prevention is to **identify the causes of human cancer**
“The encyclopaedia of carcinogens”

The *IARC Monographs* evaluate

- Chemicals
- Complex mixtures
- Occupational exposures
- Physical and biological agents
- Lifestyle factors

More than 950 agents have been evaluated

- 113 are *carcigenic to humans* (Group 1)
- 66 are *probably carcigenic to humans* (Group 2A)
- 285 are *possibly carcigenic to humans* (Group 2B)

National and international health agencies use the *Monographs*

- As a source of scientific information on known or suspected carcinogens
- As scientific support for their actions to prevent exposure to known or suspected carcinogens

International Agency for Research on Cancer
You are part of a worldwide endeavour that since 1971 has involved over 1000 scientists from over 50 countries.
Overall carcinogenicity evaluation

<table>
<thead>
<tr>
<th>EVIDENCE IN HUMANS</th>
<th>EVIDENCE IN EXPERIMENTAL ANIMALS</th>
<th>Group 1</th>
<th>Group 2A</th>
<th>Group 2B</th>
<th>Group 3</th>
<th>Group 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sufficient</td>
<td>Sufficient</td>
<td></td>
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<tr>
<td>Limited</td>
<td>Limited</td>
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<tr>
<td>Inadequate</td>
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<td>ESLC</td>
<td>ESLC</td>
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</tr>
</tbody>
</table>

- 1 strong evidence in exposed humans
- 2A strongly evidence mechanism also operates in humans
- 2A belongs to a mechanistic class
- 2B with supporting evidence from mechanistic and other relevant data
- 2A belongs to a mechanistic class
- 2B with strong evidence from mechanistic and other relevant data
- 4 consistently and strongly supported by a broad range of mechanistic and other relevant data
IARC Monographs, Volume 100
A Review of Human Carcinogens

• Scope of volume 100
  – Update the critical review for each carcinogen in Group 1
  – Identify tumour sites and plausible mechanisms
  – Compile information for subsequent scientific publications

• The volume was developed over the course of 6 meetings
  A. Pharmaceuticals (23 agents, Oct 2008)
  B. Biological agents (11 agents, Feb 2009)
  C. Metals, particles and fibres (14 agents, Mar 2009)
  D. Radiation (14 agents, June 2009)
  E. Lifestyle factors (11 agents, Sept 2009)
  F. Chemicals and related occupations (34 agents, Oct 2009)
Known and suspected causes of cancer

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>Carcinogenic agents with sufficient evidence in humans</th>
<th>Agents with limited evidence in humans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung</td>
<td>Aluminum production</td>
<td>Acid mists, strong inorganic</td>
</tr>
<tr>
<td></td>
<td>Arsenic and inorganic arsenic compounds</td>
<td>Art glass, glass containers and pressed ware (manufacture of)</td>
</tr>
<tr>
<td></td>
<td>Asbestos (all forms)</td>
<td>Biomass fuel (primarily wood), indoor emissions from household combustion of</td>
</tr>
<tr>
<td></td>
<td>Beryllium and beryllium compounds</td>
<td>Bitumens, occupational exposure to oxidized bitumens and their emissions during roofing</td>
</tr>
<tr>
<td></td>
<td>Bis(chloromethyl)ether; chloromethylmethyl ether (technical grade)</td>
<td>Bitumens, occupational exposure to hard bitumens and their emissions during mastic asphalt work</td>
</tr>
<tr>
<td></td>
<td>Cadmium and cadmium compounds</td>
<td>Carbon electrode manufacture</td>
</tr>
<tr>
<td></td>
<td>Chromium(VI) compounds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coal, indoor emissions from household combustion</td>
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<tr>
<td></td>
<td>Coal gasification</td>
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<td></td>
<td>Coal-tar pitch</td>
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<td></td>
<td>Coke production</td>
<td></td>
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<tr>
<td></td>
<td>Engine exhaust, diesel</td>
<td></td>
</tr>
</tbody>
</table>
Dissemination of information

International Agency for Research on Cancer

World Health Organization

IARC Monographs on the Evaluation of Carcinogenic Risks to Humans

http://monographs.pubcan.org/organ.php
Dissemination of information

Future linkage with other databases

- IARC database (eg p53 database)
- WHO databases (ICD-11, risk factors for neoplasms)
- NCI (eg NCI Grants database)
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Vol. 100 Workshops

- **Tumour (Site) Concordance between Humans and Animals**
  - Increase understanding of the correspondence across species
  - Identify human cancer sites without good animal models

- **Mechanisms Involved in Human Carcinogenesis**
  - Organized by mechanism to facilitate joint consideration of agents that act through similar mechanisms
  - Identify biomarkers that could be influential in future studies
  - Identify susceptible populations and developmental stages
  - Promote research that will lead to more confident evaluations

**Preventable Exposures Associated With Human Cancers**

Vincent James Cogliano, Robert Baan, Kurt Straif, Yann Grosse, Béatrice Lauby-Secretan, Fatiha El Ghissassi, Véronique Bouvard, Lamia Benbrahim-Tallaa, Neela Guha, Crystal Freeman, Laurent Galichet, Christopher P. Wild
# Tumour (Site) Concordance between Humans and Animals

<table>
<thead>
<tr>
<th>Sites</th>
<th>Human S + Any Animal</th>
<th>Human L - Any Animal</th>
<th>Human S but No Animal</th>
<th>Animal Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>lip</td>
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<tr>
<td>nose</td>
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<td>oral cavity</td>
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<tr>
<td>tongue</td>
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<td>pharynx</td>
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<td>larynx</td>
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<tr>
<td>trachea</td>
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<tr>
<td>lung</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>salivary gland</td>
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<tr>
<td>digestive tract</td>
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<tr>
<td>liver</td>
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<tr>
<td>gallbladder</td>
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<tr>
<td>bile ducts (intrahepatic &amp; extr. gallbladder)</td>
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<tr>
<td>pancreas</td>
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<td>CHN</td>
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<tr>
<td>adrenal medulla</td>
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<tr>
<td>adrenal gland NOS</td>
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<tr>
<td>pituitary gland</td>
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<tr>
<td>thyroid</td>
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<tr>
<td>urinary tract/urethra</td>
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<tr>
<td>haematopoietic tissue</td>
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<td>lymphoid tissue</td>
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<tr>
<td>leukaemia NOS</td>
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<td>hard connective tissue</td>
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<td>breast</td>
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<td>bone</td>
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<td>prostate</td>
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<td>ovary</td>
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<td>testis</td>
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<td>1st/2nd/3rd combined</td>
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<tr>
<td>all cancers combined</td>
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</tbody>
</table>

**Agent**

- Azathioprine
- Chlorambucil
- Combined oral contraceptives
- Cyclophosphamide
- Diethylstilbestrol
- Estrogen only menopausal therapy
- Methosalen in combination with UV
- Phenacetin
- Plants containing aristolochic acid
- Tamoxifen
- Thiopeta
- Arsenic and Arsenic Compounds
- Asbestos
- Berillium and Berillium compounds
- Cadmium and cadmium compounds
- Chromium (VI) compounds
- Erionite
- Nickel and nickel compounds
- Silica dust, crystalline (quartz or other)
- Fission products including Sr-90
- Neutrons
- Solar radiation
- X rays, Gamma rays
- alpha particle emitters (Am-241)
- alpha particle emitters (Cf-249)
- alpha particle emitters (Cf-252)
- alpha particle emitters (Cm-244 and Cm-244)
- alpha particle emitters (Np-237)
- alpha particle emitters (Po-210)
Mechanisms Involved in Human Carcinogenesis

New research continues to find additional human carcinogens & Use of mechanistic data to identify carcinogens is accelerating

Types of mechanistic upgrades

**Ethylene oxide**: Dose-related increase in the frequency of SCE, CA, and MN in lymphocytes of exposed workers.

DNA adducts and A:T→T:A transversions in TP53 identified **aristolochic acid** as the carcinogen in herbal remedies -> environmental exposures: cereal fields in the Balkans where *Aristolochia* plants grow as weeds

**Benzidine-based dyes**: Metabolism results in the release of free benzidine in humans and in all experimental animal species studied.
Key Characteristics of Carcinogens

• Electrophilicity and Metabolic activity
  – electron-seeking molecules that commonly form addition products, commonly referred to as adducts
  – binds with DNA, RNA and proteins

• Genotoxicity
  – induces DNA damage

• Altered repair and genomic instability
  – alters DNA replication fidelity

• Chronic inflammation
  – disrupts local tissue homeostasis and alters cell signaling

• Oxidative stress
  – creates an imbalance in reactive oxygen formation and/or alters their detoxification
Key Characteristics of Carcinogens (2)

- Receptor-mediated
  - acts act as ligands via nuclear and/or cell-surface and/or intracellular receptors
- Altered cellular proliferation and/or death
  - alterations in cellular replication and/or cell-cycle control resulting in escape from growth control or mutations or inflammation
- Immunosuppression
  - reduces the capacity of the immune system to respond effectively to antigens on tumour cells
- Epigenetic alterations
  - Induces stable and heritable changes in gene expression and chromatin organization that are independent of the DNA sequence itself
- Immortalization
  - DNA and RNA viruses that produce viral-encoded oncoproteins targeting the key cellular proteins that regulate cell growth
Mechanisms of Carcinogenesis in Future Cancer-Hazard Evaluations

• Link between concordance of tumours and mechanisms of carcinogenesis
  ✓ Concordance confirmed by mechanistic data
  ✓ Discordance explained by mechanistic data

• Use of mechanistic data can help identify additional cancer sites
• Use of mechanistic data can help identify whether the carcinogenic potential is limited to certain dose levels
• Mechanistic data may help understand interactions of multiple factors acting jointly, and thus may help identify new carcinogens
• Identify populations and developmental stages that may be more susceptible
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Carcinogenicity of trichloroethylene, Vol. 106

- TCE was widely used for degreasing metal parts until the 1990s, and in dry cleaning from the 1930s to 1950s, main current use is in chlorinated chemical production.
- A French case-control study in an area with high prevalence of occupational exposure to TCE, OR 2.16 (95% CI 1.02–4.60) for people with high cumulative exposure after adjusting for smoking and body-mass index (Charbotel 2006)
- In an eastern European study, OR 1.63 (95% CI 1.04–2.54) for any exposure to TCE and 2.34 (1.05–5.21) in the highest category of exposure intensity (Moore, 2010)
- Consistent with the importance of glutathione conjugation for kidney carcinogenesis, TCE-exposed people with an active GSTT1 enzyme had an increased risk (OR 1.88, 95% CI 1.06–3.33), but people without GSTT1 activity did not (0.93, 0.35–2.44) (Boice, 2006)
- A meta-analysis also reported significant RRs of kidney cancer; 1.3 overall and 1.6 for high-exposure groups (Scott, 2011)

Sufficient evidence for carcinogenicity, Group 1
Outdoor air pollution, IARC Vol 109

- A complex mixture with many manmade and natural sources
- Determined by local, regional and global sources and atmospheric processes
- Transport, industry, power generation, agriculture, home heating & cooking are important sources
- Often measured by levels of regulated pollutants: particulate matter, nitrogen-oxides, sulfur-dioxide, etc
- PM$_{2.5}$ global range of annual average concentrations from < 10 to >>100 µg/m$^3$.
- In many areas WHO and national air quality guidelines for PM$_{2.5}$ and other air pollutants are substantially exceeded.
Cancer in humans

- Lung cancer positively associated with indicators of air pollution in most studies
- Most consistent associations with particulate matter; PM$_{2.5}$ often ranged from 10 to 30 µg/m$^3$
- Similar effects in non-smokers
- Risk increases with increasing exposure

There is *sufficient evidence* in humans for the carcinogenicity of *outdoor air pollution*. There is *sufficient evidence* in humans for the carcinogenicity of *particulate matter in outdoor air pollution*.
Cancer in experimental animals

- sufficient evidence in experimental animals for the carcinogenicity of organic solvent-extracted material from particles collected from outdoor air pollution.
- sufficient evidence in experimental animals for the carcinogenicity of particulate matter in OAP.
- sufficient evidence in experimental animals for the carcinogenicity of OAP.

- For the 2nd evaluation, the WG considered the data on solvent-extracted material from particles collected from outdoor air and the evidence on carcinogenicity of diesel engine exhaust particles. The 3rd evaluation was based on findings of studies in experimental animals exposed to polluted outdoor air (Sao Paolo) in conjunction with updating and confirming previous pertinent evaluations.
Other relevant data

- Studies of people exposed occupationally to outdoor air pollution have demonstrated enhanced frequencies of chromosome aberrations and micronuclei in lymphocytes.
- Studies of people exposed to polluted outdoor air in occupational settings or urban and industrial areas show altered expression of genes involved in DNA damage and repair, cell cycle control, inflammation, and the response to oxidative stress.
- Observations of cytogenetic damage, DNA damage and mutations in cells of animals, birds and plants exposed to outdoor air pollution.
- Atmospheric mutagenic activity varies > 5 orders of magnitude across locations and increased activity is quantitatively related to increased levels of atmospheric PM.
Overall evaluation

• Outdoor air pollution is *carcinogenic to humans* (Group 1)

• Particulate matter in outdoor air pollution is *carcinogenic to humans* (Group 1)

• Overall evaluation also strongly supported by other relevant data showing that exposures are associated with increases in genetic damage that have been shown to be predictive of cancer in humans.
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Need for Quantitative Risk Characterization

• "International cancer experts have moved tanning beds and other sources of ultraviolet radiation into the top cancer risk category, deeming them as deadly as arsenic and mustard gas.‘‘ (Associated Press, 2009)

• “Evaluations in the IARC Monographs provide a qualitative assessment of carcinogenicity. The HPV types that have been classified as carcinogenic to humans can differ by an order of magnitude in risk for cervical cancer. The Working Group cautions that the design of HPV screening tests must also consider other factors that are discussed in the General Remarks.‘‘ (Vol. 90)
Suggestions for enhancements of the *Monographs* that would be likely to result in contributions to QRC:
- review cancer burden and other risk scenarios from the literature
- summarize exposure–response relationships seen in epidemiological studies
- should not formally review existing national risk assessments

Additional resources will be needed to pursue QRC to the point of developing risk estimates, combining these risks with exposures and predicting cancer burden.
UK HSE Burden of occupational cancer

Methods

- All IARC Group 1 and 2A carcinogens with “strong” or “suggestive” evidence at specific site in humans.
- Risk estimates from published literature taking into account validity of studies and relevance to the UK.
- National data sources (UK-CAREX, the annual Labour Force Survey (LFS) and the Census of Employment) for proportion of exposed population.
- Latency: 10–50 years for solid tumours, 0–20 years for haematopoietic neoplasms
- LFS data for employment turnover, numbers employed
- Avoid double counting in scenarios of overlapping exposures
UK HSE Burden of occupational cancer
Results

Occupational AF for cancers of lung, bladder, non-melan. skin, sinonasal cancers, leukaemia, mesothelioma:

All cancer deaths
- Group 1, 3.6% of (6% in men)
- Group 1 & 2A, 4.9% in total (8.0% in men)

Lung cancer
- Group 1, 16.5%
- Group 1 & 2A, 21.6%

Lung cancer more than 60% of occupational cancers, Asbestos > 50% of occupational cancer deaths

Avg. exposure levels for majority of top 19 carcinogens in 1986-2001 above current British OEL (Cherrie et al, 2007)
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Research Recommendations for Selected IARC-Classified Agents


- Acetaldehyde
- Atrazine
- Carbon black
- Chloroform
- Cobalt metal with tungsten carbide
- Dichloromethane
- Diesel engine exhaust
- Di-2-ethylhexyl phthalate
- Formaldehyde
- Indium phosphide
- Lead and lead compounds
- Polychlorinated biphenyls (PCB)
- Propylene oxide
- Refractory ceramic fibers
- Shiftwork that involves nightwork
- Styrene
- Tetrachloroethylene
- Titanium dioxide
- Trichloroethylene
- Welding fumes
<table>
<thead>
<tr>
<th>Working time</th>
<th>Workhours/week</th>
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<tbody>
<tr>
<td>Night work</td>
<td>At least 3 hrs of work between midnight and 5 am</td>
</tr>
<tr>
<td>Duration</td>
<td>Years employed in non-day shift work</td>
</tr>
<tr>
<td>Intensity</td>
<td>Number of non-day shifts per month/year</td>
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<tr>
<td>Cumulative exp.</td>
<td>Duration times intensity over the work history</td>
</tr>
<tr>
<td>Permanent shift</td>
<td># consecutive days of night work, followed by # days off</td>
</tr>
<tr>
<td>Rotating type</td>
<td>Continuous (365 days/year) or dis-continuous</td>
</tr>
<tr>
<td>Direction of rotation</td>
<td>Forward (morning → afternoon/evening → night)</td>
</tr>
<tr>
<td></td>
<td>backward (afternoon/evening → morning → night)</td>
</tr>
<tr>
<td>Rate of rotation</td>
<td>Daily change, 2-3-4 day change, weekly, etc.</td>
</tr>
<tr>
<td>Morning shift</td>
<td># consecutive days of early morning shift (before 6 am)</td>
</tr>
<tr>
<td>Start/end time</td>
<td>Displacement from solar day, duration of the working hours</td>
</tr>
<tr>
<td>Rest after shift</td>
<td>Number of rest-days after night shifts</td>
</tr>
<tr>
<td>Jetlag</td>
<td>No of time zones crossed; eastward vs. westward</td>
</tr>
<tr>
<td>Sleep</td>
<td>Sleep duration &amp;</td>
</tr>
<tr>
<td>Light at night</td>
<td>During sleep period</td>
</tr>
<tr>
<td>Characteristics of the individual</td>
<td>Diurnal type (mor</td>
</tr>
</tbody>
</table>

Considerations of circadian impact for defining ‘shift work’ in cancer studies: IARC Working Group Report

Pre- and post-Monograph meeting analyses of pooled datasets and meta-analyses

• 16 case-control studies from 16 countries
• 19,369 lung cancer cases; 23,670 controls
• SYN-JEM, routine measurement data for PAH asbestos, crystalline silica, chromium/nickel
• Lifetime smoking and occupational histories
• ~1,000 never smoking lung cancer cases
• ~20% Women

• Research platform for occupational lung cancer research
• Diesel engine exhaust: Olsson et al, 2011
• Meta-consortium with ILCCO: alcohol drinking & lung cancer?

Exposure to Diesel Motor Exhaust and Lung Cancer Risk in a Pooled Analysis from Case-Control Studies in Europe and Canada

Ann C. Olsson¹,², Per Gustavsson², Hans Kromhout³, Susan Peters³, Roel Vermeulen³, Irene Brüske⁴,
Cholangiocarcinoma among workers in the printing industry

• 16 cases of intrahepatic or extrahepatic cholangiocarcinoma among male (former) employees in a printing plant (around 70 workers) in Osaka, Japan
• Age range of 16 cases: 20 to 49 years
  - no chronic biliary inflammation such as primary cirrhotic cholangitis, intrahepatic cholelithiasis and liver fluke infection,
  - no chronic hepatitis B nor C
  - no malfusion of pancreaticobiliary ducts.
• SIR for biliary tract cancer ~1200 (95%CI 714-1963)
• Kumagai et al, Short report published in OEM-online 3/2013
• Suspected chemicals: 1,2-dichloropropane & dichloromethane
Cholangiocarcinoma among workers in the printing industry

- Informed by Ministry of Health via WHO HQ, summer 2012
- Finding generalizable to:
  - printing industry at large?
  - Exposure to (these specific) chlorinated solvents?
- Nordic Occupational Cancer (NOCCA) database
- All subjects aged 30–64 years from 1960, 1970, 1980/1981, and/or 1990 censuses in Finland, Iceland, Norway, and Sweden, & still alive and living in the respective countries on 1st January in the year following the census
- Cohort followed-up for cancer incidence from 1st January of the year after the first available census through emigration, death, or to 31st December of the following years: in Finland 2005, in Iceland 2004, in Norway 2003, and in Sweden 2005.
Cholangiocarcinoma among workers in the printing industry

<table>
<thead>
<tr>
<th></th>
<th>Liver cancer</th>
<th></th>
<th>Intrahepatic cholangiocarcinoma</th>
<th></th>
<th>Extrahepatic CC, ampulla of Vater, and gall bladder</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obs</td>
<td>SIR</td>
<td>Obs</td>
<td>SIR</td>
<td>Obs</td>
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<tr>
<td><strong>Men</strong></td>
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</tr>
<tr>
<td>All printers &amp; related workers</td>
<td>142</td>
<td>1.35 (1.14-1.60)</td>
<td>21</td>
<td>2.34 (1.45-3.57)</td>
<td>53</td>
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<tr>
<td>Typographers</td>
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<td>11</td>
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<tr>
<td>Printers</td>
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<td>3.54 (1.30-7.70)</td>
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<tr>
<td>Lithographers</td>
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<td>3.91 (0.47-14.1)</td>
<td>[2.02]†</td>
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<td>1.17 (0.03-6.54)</td>
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<td><strong>Women</strong></td>
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<tr>
<td>All printers &amp; related workers</td>
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<td>8</td>
<td>1.95 (0.84-3.85)</td>
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<tr>
<td>Typographers</td>
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<td>1.22 (0.45-2.65)</td>
<td>3</td>
<td>3.14 (0.65-9.17)</td>
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</tr>
<tr>
<td>Printers</td>
<td>2</td>
<td>0.55 (0.07-1.98)</td>
<td>1</td>
<td>1.38 (0.03-7.68)</td>
<td>5</td>
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<tr>
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<td>2</td>
<td>5.03 (0.61-18.2)</td>
<td>1</td>
<td>10.34 (0.26-57.6)</td>
<td>[0.68]†</td>
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<tr>
<td>Bookbinders</td>
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<td>1.35 (0.80-2.14)</td>
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<td>0.50 (0.01-2.81)</td>
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<tr>
<td>Other occupations</td>
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<td>2.67 (0.73-6.84)</td>
<td>2</td>
<td>5.93 (0.72-21.4)</td>
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</table>

International Agency for Research on Cancer

World Health Organization
Presentation Outline

- The IARC Monographs and the Volume 100 series
- Tumour concordance and mechanisms of carcinogenesis
- Selected recent highlights
- Future plans, Quantitative risk characterization
- Medium- and long-term planning of Monographs
  - Identify research gaps and recommendations
  - Pre- and post-meeting research by IMO scientists
- Upcoming Monographs and Advisory Group Meetings
- Re-launch of IARC Handbooks of Cancer Prevention
Upcoming Meetings

Meeting 110: Perfluoro-octanoic acid, Tetrafluoroethylene, Dichloromethane, 1,2-Dichloropropane, and 1,3-Propane sulfone (3-10 June 2014)

- Call for Data (closing date 3 May 2014)
- Call for Experts (closing date 30 September 2013)
- Request for Observer Status (closing date 3 February 2014)
- WHO Declaration of Interests for this volume

Meeting 111: Some Nanomaterials and Some Fibres (30 September - 7 October 2014)

- Call for Data (closing date 3 September 2014)
- Call for Experts (closing date 30 January 2014)
- Request for Observer Status (closing date 3 June 2014)
- WHO Declaration of Interests for this volume
Acetaldehyde (Vol 100F)
Acrylamide and furan
Air pollution (Vol 109)
Bitumen (Vol 103)
Carbon-based nanomaterials (V.111)
Crystalline fibres other than asbestos
Growth hormone
Iron and iron oxides
Malaria (Vol 104)
Motor vehicle engine exhausts (V 105)
Nucleoside-analogue antiviral drugs
PFOA, other perfluorinated compounds (Vol 110)

► Never before reviewed
► Bold: Meeting still to be planned

Polyomaviruses (SV40, BK, JC, Merkel cell virus) (Vol 104)
Radiofrequency electromagnetic fields and radar (includes mobile telephones) (Vol 102)
Sedentary work
Statins
Stress
Testosterone & other androgenic steroids
Ultrafine particles
Welding
Agents recently tested in experimental animals (Vol 101)
Call for nomination of agents distributed via GC and SC members, WHO Regional Offices and Collaborating Centres, Monograph participants, IARC RSS news feed; IMO staff searching new evaluations of other agencies.

Broad variety of nominations: Bisphenol A, chlorinated drinking water, ENDS, Human cytomegalovirus, CT scans, mammary carcinogens, …

Fine-tuning of procedures: Expert reviews, systematic reviews, quantitative risk characterization, communication strategy,
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IARC Handbooks of Cancer Prevention

- Launch in 1995 to complement the IARC Monographs’ evaluations of carcinogenic hazards with evaluations of cancer-preventive agents.
- Working procedures and evaluation scheme closely mirror those of the Monographs.
- For the Tobacco Control HB, IMO scientists helped develop the series, when institutional memory was no longer available.
- Monographs and Cancer Prevention HBs existed in parallel for the past 15 years.
IARC Monographs & IARC Cancer Prevention Handbooks

Chemicals & mixtures
Vol 1 Some Inorganic Substances
Vol 25 Wood, Leather and some associated Industries

Personal habits
Vol 37 Smokeless tobacco
Vol 38 Tobacco smoking
Vol 44 Alcohol drinking

Radiation
Vol 43 Radon
Vol 55 Solar radiation
Vol 75 Ionizing radiation I
Vol 80 Non-Ionizing radiation I

Biological agents
Vol 59 Hepatitis viruses
Vol 61 H. pylori, schistosoma
Vol 64 HPV

Preventive Agents
Vol 1 NSAIDs
Vol 2 Carotenoids
Vol 3 Vitamin A
Vol 4 Retinoids
Vol 5 Sunscreens
Vol 6 Weight Control & Physical Activity
Vol 8 Fruit and Vegetables
Vol 9 Cruciferous Vegetables, Isothiocyanates and Indoles

Screening
Vol 7 Breast Cancer Screening
Vol 10 Cervix Cancer Screening

Tobacco Control
Vol 11 Reversal of Risk after Quitting Smoking
Vol 12 Methods for Evaluating Tobacco Control Policies
Vol 13 Evaluating the Effectiveness of Smoke-free Policies
Vol 14 Tax and price policies in tobacco control
Future Handbooks of Cancer Prevention

Cancer screening
• **Breast cancer screening**: recent improvements in treatment outcomes for late-stage breast cancer and concerns regarding over-diagnosis, new modalities, e.g. MRI, ultrasonography, best implementation (including in low- and middle-income countries).
• **Cervical cancer screening** new approaches such as HPV testing, implementation of screening in the context of HPV vaccination.
• **Screening for cancers of the lung, and colon, prostate**

Preventive activities and agents
• **Weight control and physical activity**
• **Aspirin**
• **Sunscreens**
• **Vitamin D and vitamin B**
Acknowledgements

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- European Commission, DG Employment, Social Affairs and Inclusion (since 1986)
- U.S. National Institute of Environmental Health Sciences (since 1992)