Australian Work Exposures Study (AWES)

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Occupational Carcinogens

- Over 165 occupational carcinogens identified by IARC, plus 18 occupations or circumstances
- Occupational exposures of particular concern because encountered involuntarily
  - Also more likely amenable to risk reduction
- Exposures contribute to burden of cancer
  - In UK, 8.2% of cancers in males and 2.3% in females estimated to be occupational

Prevalence of Exposure

- Significant knowledge gaps regarding prevalence
  - Important for understanding pattern, targeting prevention, estimating burden
- Existing studies generally:
  - Rely on job title; and/or
  - Focus on specific exposures or industries
- Need large-scale community-based studies
  - E.g. NHEWS survey (Australia) 2008 – n=4500

Exposure Assessment Methods

- Number of methods of exposure assessment may be applied in large studies
  - Job Exposure Matrices (JEMs)
  - Self-report
  - Expert assessment (gold standard)
- Automated expert assessment - OccIDEAS

Australian Work Exposures Study (AWES)

- Aimed to investigate prevalence of current occupational exposure to carcinogens
  - Using automated expert assessment method
- Cross-sectional telephone survey of Australian workers aged 18 to 65

Priority Carcinogens

A priority list of occupational carcinogenic agents for preventative action in Australia

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Abstract

Objective: To develop a list of carcinogens to guide decisions on priorities for preventive action in Australian workplaces.

Approach: The following criteria provided the assessment framework to establish a list of priority carcinogens: evidence of carcinogenicity using International Agency for Research on Cancer (IARC) criteria; use in occupational circumstances; and use in Australia industry. Literature from national and international agencies relating to carcinogens and industrial practice informed the assessment.

Conclusion: The final priority list contained 38 established or probable carcinogenic agents that are present in Australian workplaces. Agents were grouped into the following categories: combustion products, inorganic dusts, organic dusts, metals, radiation, other industrial chemicals and non-chemical agents. The priorities are based primarily on the potential for occupational exposure and evidence of use in Australian industry because there is limited information on the prevalence and level of exposure to occupational carcinogens in Australia.

Implications: The priority list of agents can provide direction for future disease burden studies to establish the prevalence and levels of exposure to carcinogens amongst Australian workers. From a policy viewpoint, a priority list will allow regulators to focus on activities such as setting exposure standards and restricting importation and use.

Key words: occupation, carcinogen, exposure, cancer

Aust NZ J Public Health. 2012; Online doi: 10.1111/j.1753-6405.2011.00849.x

Occupational cancers represent a largely preventable group of diseases. In industrialised countries, the average burden of occupational cancer has been estimated to be about 5%, ranging between 1% and 10%.[1] Cancers commonly attributed to occupational exposure to carcinogens include mesothelioma, non-melanoma skin cancer and cancers of the lung, bladder, sinonasal cavity and larynx.[1,2] In some cancers, the burden from occupational exposure is unfavourably distributed among blue collar workers and could be much higher than 5%. A study of Swedish workers estimated that the burden of occupational-related lung cancer was 22% in white collar workers and 57% in blue collar workers.[3]

Approximately 1.5 million Australian workers may be exposed to occupational carcinogens in their current job.[4] This estimate was produced by applying European Union (EU) exposure estimates to Australian employment data because there are no comprehensive data on occupational exposure to carcinogens or on occupational cancer in Australia. The absence of reliable data has meant there is little impetus or guidance for Australian policy makers and cancer organisations to direct attention and resources towards preventing exposures to carcinogens at work and consequent disease.[4]

The first step in preventing occupational cancers is to identify the carcinogenic exposures that are present at work and the likely level (intensity and duration) of exposure to those carcinogens. Exposure to the carcinogens can then be minimised by implementing the hierarchy of control (elimination, substitution, separation,

Submitted: May 2011 Revision requested: July 2011 Accepted: August 2011

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- 38 carcinogens relevant to working conditions in Australia
- 3 criteria for prioritisation:
  - Evidence of carcinogenicity (IARC)
  - Use in occupational circumstances
  - Evidence of use in Australian industry

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Priority Carcinogens (2)

- Final list comprising 7 groups:
  - 3 combustion products
  - 2 inorganic dusts
  - 2 organic dusts
  - 7 metals
  - 4 sources of radiation
  - 19 industrial chemicals
  - 1 non-chemical agent (shiftwork)

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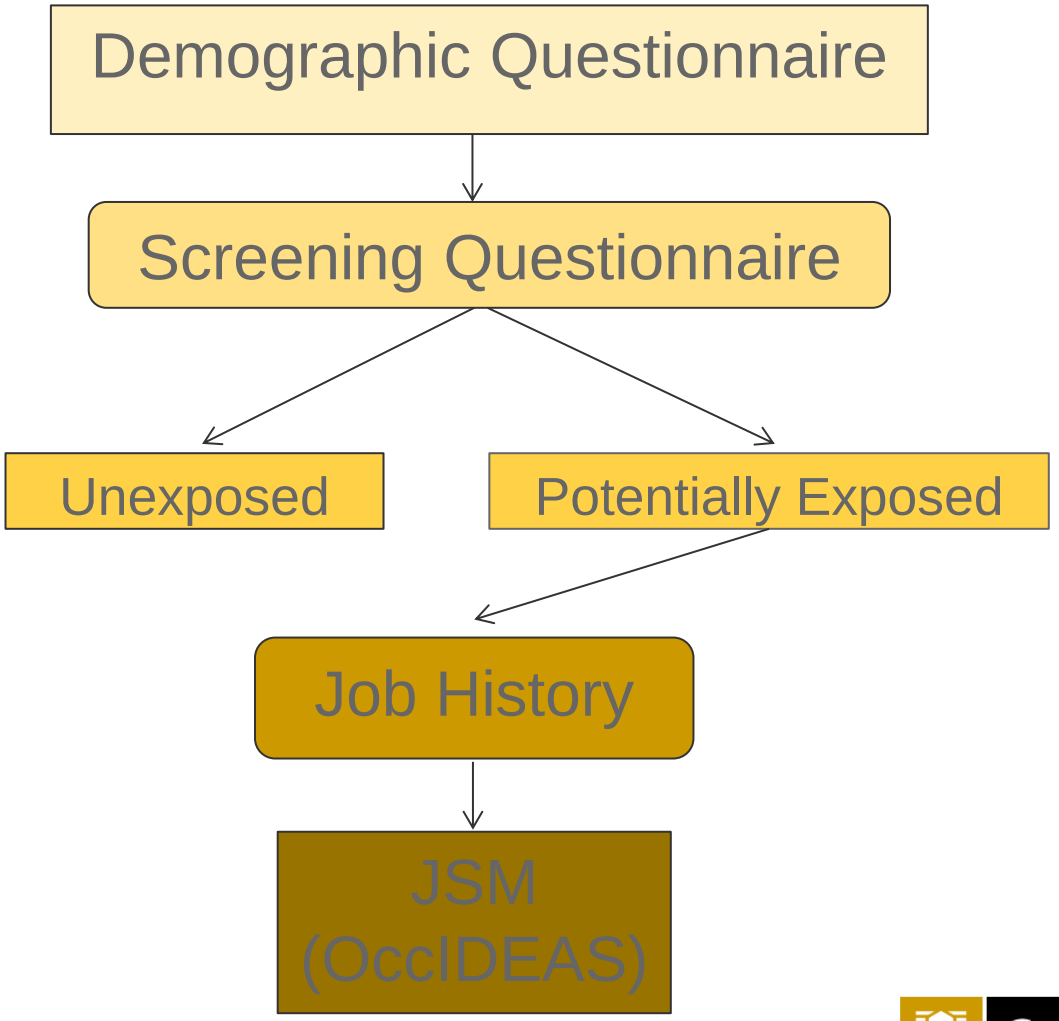
Interview process



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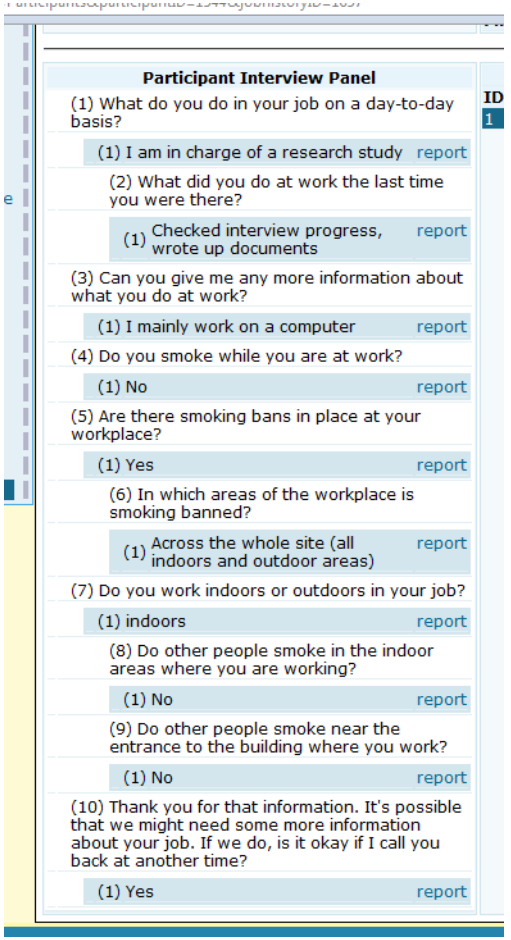
Job Specific Modules (JSMs)

- Developed JSMs for 57 jobs/industries
- Questions on determinants of exposure and use of controls
  - Frequency of tasks
  - Task method
- Also generic JSM if appropriate JSM could not be determined



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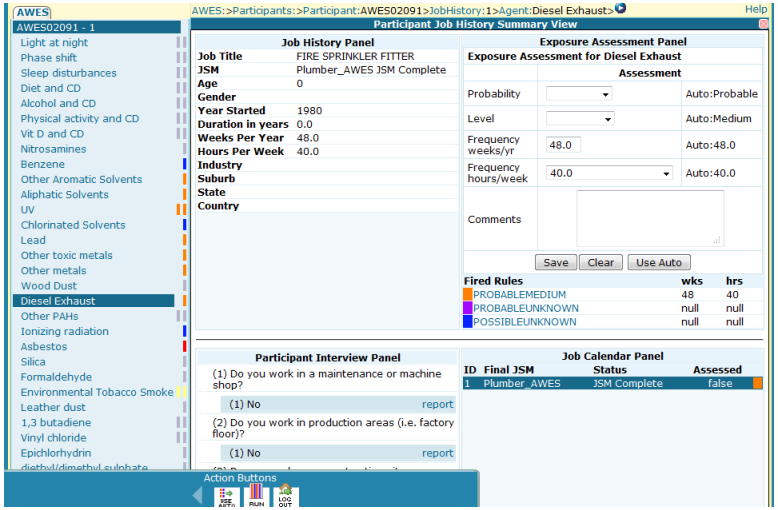
Exposure Assessment - OccIDEAS

- Automated rule-based expert assessment method
  - JSM answers trigger rules which relate to exposure
  - Rules from literature and expert opinion
- Reviewed by project coordinator and occupational hygienists where necessary



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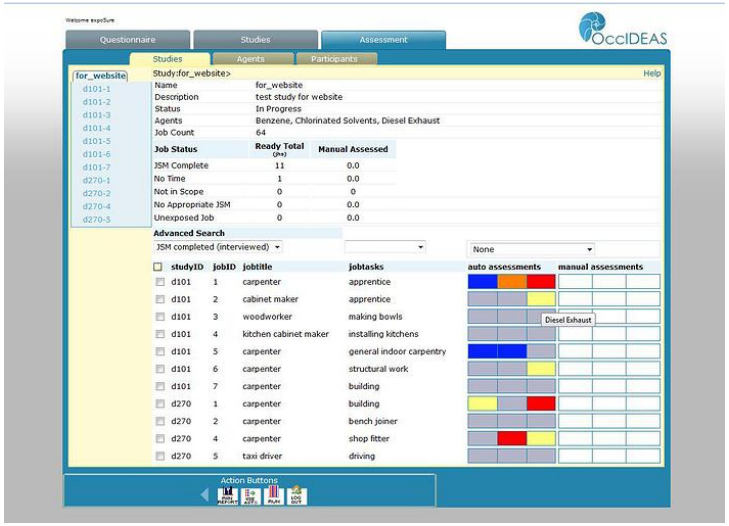
Exposure Assessment (2)

- Probability – probable, possible, none
- Level – high, medium, low, unknown
- Frequency (hours per week, weeks per year)



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Participants

- 5,023 Australian workers
- 55% male
- Mean age 46 (SD=11)
- 80% born in Australia
- Respondents significantly older and more likely to have been born in Australia
  - Similar to Census population in terms of gender, SES, education
- Overall 72% cooperation rate

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Exposures

- 1,880 respondents (38%) exposed to at least one carcinogen
- 100% of farmers, heavy vehicle drivers, plumbers, miners, and painters exposed
- But respondents in all occupational groups exposed (including office workers, 9% exposed)

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Most Common Exposures

1. Solar radiation (22%)
2. Diesel engine exhaust (18%)
3. Environmental tobacco smoke (14%)
4. Benzene (10%)
5. Wood dust (7%)
6. Silica (6%)
7. Shiftwork (6%)
8. Lead (6%)
9. Other polycylic aromatic hydrocarbons (6%)
10. Artificial ultraviolet radiation (5%)

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Demographic Differences

- Exposures higher among:
  - Male workers (53% exposed) vs. female workers (19%)
  - Those aged under 35 (44% exposed) vs. 35 to 54 (36%) or 55+ (39%)
  - Those who had completed a trade certificate (51% exposed) vs. high school education (41%) or bachelor degree (23%)
- No difference between Australian-born (38%) and migrant workers (36%)

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Extrapolation to Australian Population

- Extrapolated exposures to Australian working population
  - Conducted separately by occupational group and gender
- Overall 3.6 million workers (40%, 95% CI 39-42) expected to be exposed
  - 2.7 million male workers (58%; 95% CI 56-60)
  - 0.9 million female workers (21%; 95% CI 19-22)

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Exposures by Occupation - Farmers

- 148 farmers, 76% male
- All exposed to at least one carcinogen, mean 5.6
- Most prevalent exposures solar UV, diesel exhaust, benzene
- Exposure differences by gender, farm type

Carcinogen	%
Solar UV	98
Diesel Engine Exhaust	93
Benzene	80
Other PAHs	74
Wood Dust	70
Artificial UV	43
Silica	25
Lead	24
Chromium VI	10
Nickel	8
Trichloroethylene	8

Exposures by Carcinogen – Wood Dust

- 341 workers (7%) exposed to wood dust
  - 44% at low level, 25% medium, 30% high
  - 1% at unknown level (n=3)
- Most commonly exposed occupations:
  - Carpenters (92% exposed)
  - Painters (83%)
  - Farmers (70%)
  - Handypersons (45%)

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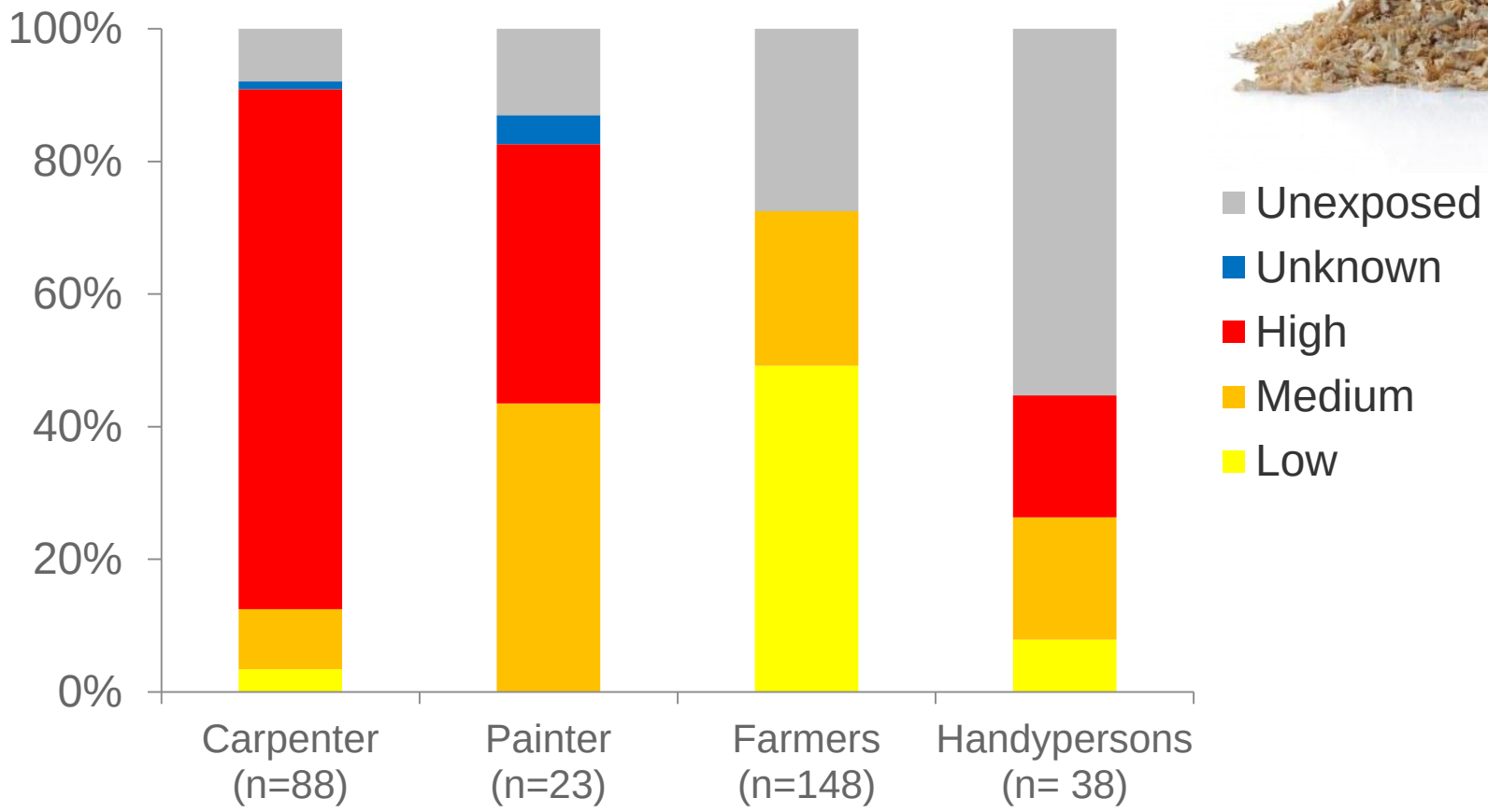
Exposures by Carcinogen – Wood Dust (2)



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Exposures in Western Australia

- AWES-WA - investigating prevalence of current occupational exposure to carcinogens among WA workers
- Possible that prevalence higher in WA
  - AWES found slightly higher prevalence of exposure in WA (43% vs 38% national), not significant when controlling for occupation
  - Possibly due to different pattern of industries – higher percentage employed in construction (10.4% vs 8.4% national) and mining (6.3% vs 1.8%)
  - Workplace regulations governed by state

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AWES-WA Participants

- 505 Western Australian workers
  - 61% male
  - Mean age 47 (SD=11)
  - 71% born in Australia
- Combined with 561 WA workers from national AWES – final sample 1,066 respondents
- Respondents significantly older and more likely to have completed a higher education degree (compared with Census)
  - Similar to Census population in terms of gender, SES, occupation

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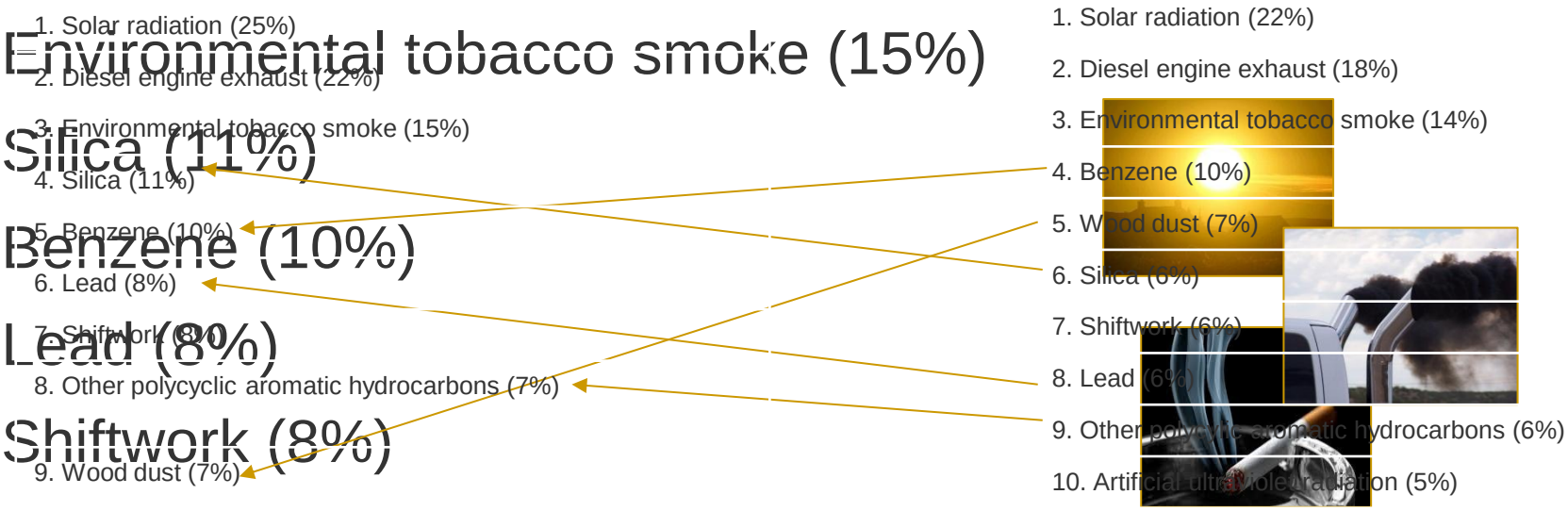
Prevalence of Exposure - WA

- 447 respondents (42%) probably exposed to at least one carcinogen
  - Significantly higher than national study (38%)
- Extrapolated to 429,500 WA workers (44%) – 329,250 males (63%) & 100,250 females (22%)
  - Again significantly higher than national study (40%)

Most Common Exposures - WA

1. Solar radiation (25%)
2. Diesel engine exhaust (22%)
3. Environmental tobacco smoke (15%)
4. Silica (11%)
5. Benzene (10%)
6. Lead (8%)
7. Shiftwork (8%)
8. Other polycyclic aromatic hydrocarbons (7%)
9. Wood dust (7%)
10. Artificial ultraviolet radiation (7%)



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Demographic Differences - WA

- Exposures higher among:
  - Male workers (53% exposed) vs. females (26%)
  - Those who had completed trade certificate (53% exposed) vs. high school (47%) or higher education (29%)
  - Those who live in remote or very remote areas (64%) vs. major city (37%) or regional areas (52%)
- No differences between Australian-born (41% exposed) and migrant workers (43%)

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Differences by Occupation – Males (WA)

- In males, 100% of respondents in 12 of 30 occupational groups exposed

Occupation	Common Exposures
Heavy Vehicle Drivers	DEE, Solar UV
Farmers	DEE, Solar UV
Vehicle Trades	DEE, Asbestos
Animal & Horticultural	Solar UV, Benzene
Miners	Silica, ETS
Carpenters	Wood Dust, Solar UV
Painters	Solar UV, Wood Dust
Plumbers	Solar UV, Silica
Automobile Drivers	DEE, Benzene
Outdoor Work NEC	Solar UV, Wood Dust
Passenger Transport	DEE, ETS
Nurses	Other PAHs, Shiftwork

Differences by Occupation – Females (WA)

Occupation	Common Exposures
Farmers	DEE, Solar UV
Automobile Drivers	Solar UV, Benzene
Passenger Transport	Shiftwork, DEE
Warehousing	DEE, Wood Dust
Emergency Workers	DEE, Other PAHs
Heavy Vehicle Drivers	DEE, ETS
Metal Workers	DEE, Artificial UV
Carpenters	Formaldehyde, Wood Dust
Construction Workers	Silica, Solar UV
Electrical Workers	Benzene, DEE
Engineers	Silica, Solar UV
Miners	DEE, Silica
Vehicle Trades	DEE, ETS

- In females, 100% of respondents in 13 of 30 occupational groups exposed

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Summary

- Prevalence of exposure to occupational carcinogens quite high among Australian workers
  - Higher among WA workers
- Exposures across all occupational groups, including those traditionally thought unexposed, but patterns of exposure different

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Limitations

- Exposure assessments based on self-report of tasks
- Under-representation of younger and migrant workers
- Relatively low response fraction

Conclusions and Implications

- Methodology useful in pinpointing areas where controls inadequate
- Population-based approach and ability to capture exposures across occupations and demographic groups particular strengths of study
- Results will allow more accurate planning of prevention activities
  - Will be used to estimate lifetime risk of future occupational cancers in Australia and potential success of intervention strategies
  - Can suggest areas where regulatory activities may be of most use

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Acknowledgements

- AWES Cancer team

  Lin Fritschi
  Deborah Glass
  Alison Reid
  Ellie Darcey
  Renae Fernandez
  Tim Driscoll
  Susan Peters
  Geza Benke
  Si Si

- National Health and Medical Research Council; Cancer Councils of Western Australia and Australia
- Survey Research Centre, Edith Cowan University

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