Occupational skin cancer: NZ outdoor workers’ solar UVR exposure; & draft systematic review evidence of primary prevention intervention effectiveness.

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Bronwen McNoe

Forum on Workplace Carcinogens, November 28th 2013, Te Papa Museum, Wellington NZ
This presentation is in four parts

1. Skin cancer: significance & rationale for primary prevention

2. NZ outdoor workers’ solar UVR research evidence:
   a) exposure measurement
   b) protective practices
   c) some conclusions

3. CDC Community Guide evidence - Preventing skin cancer: interventions in outdoor occupational settings
   - Draft 2013 systematic review update

4. Some conclusions & evidence based recommendations
1
Skin cancer: significance & rationale for primary prevention
“Time to get serious about skin cancer prevention”

1 Lazovich D, Choi K, Vogel RI. Time to get serious about skin cancer prevention. *Cancer Epidemiology Biomarkers & Prevention* 2012; 21(11):1893-1901

The burden of skin cancer on NZ

- Males – higher incidence / deaths
- NMSC incidence not routinely quantified in NZ since 1958
- BoP 1998 NMSC rate 1,718 / 100,000, comparable to Australia\(^1\)
- NMSC estimate: around 67,000 new diagnoses annually
- Cannot calculate the proportion of skin cancers caused by occupational solar UVR exposure

### 2010 skin cancer deaths (\(n\))

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMM</td>
<td>199</td>
<td>125</td>
<td>324</td>
</tr>
<tr>
<td>NMSC</td>
<td>76</td>
<td>54</td>
<td>130</td>
</tr>
<tr>
<td>TOTALS</td>
<td>275</td>
<td>179</td>
<td>454</td>
</tr>
</tbody>
</table>

### Estimated 2006 skin cancer costs \(^1\)

<table>
<thead>
<tr>
<th></th>
<th>Treatment</th>
<th>Lost production</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMM</td>
<td>5.7</td>
<td>59.3</td>
<td>65.0</td>
</tr>
<tr>
<td>NMSC</td>
<td>51.4</td>
<td>6.7</td>
<td>58.1</td>
</tr>
<tr>
<td>TOTALS</td>
<td>57.1</td>
<td>66.0</td>
<td>123.1</td>
</tr>
</tbody>
</table>

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The burden of skin cancer on NZ

Why focus on primary prevention?

• >90% skin cancers are considered potentially preventable\(^1\) in high UVR exposure contexts, as NZ is seasonally\(^2\)
• with the highest international melanoma incidence & mortality rates, NZ (and Australia) have much to gain
• the already high numbers of NMSC’s in NZ may be increasing\(^3,\,4\)
• skin cancer is an acknowledged target for NZ primary prevention intervention strategies\(^5\)

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Why focus on outdoor workers?

- often spend a substantial part of their work day in the sun
- are at increased risk of skin cancers from occupational solar UVR exposure - which may include melanoma on highly exposed sites
- risk is likely substantially under-estimated from poor surveillance, as is risk by skin types - given occupational self-selection by those with less vulnerable skin
- regular sunscreen use may be effective in preventing melanoma among outdoor workers, more so than in the general population

Why focus on NZ outdoor workers?

- following 1992 Health & Safety in Employment Act, harm minimisation for solar UVR in outdoor workplaces has been required for 20 years
- an estimated 14% of the NZ workforce routinely works outdoors, may experience extreme seasonal UVR & be especially at risk of NMSC
- the design and implementation of appropriate & effective interventions requires knowledge about target groups
- relatively little was known about workplace sun-protection among NZ outdoor workers or factors associated with that protection
- preliminary evidence suggested:
  - pervasive ‘nonchalant’ attitudes towards sun exposure & sun-protection
  - perceived workplace support for sun protection positively associated with protective practices

NZ outdoor workers’ solar UVR research evidence
a) Measuring NZ workers’ solar UVR exposure

Methods

Electronic dosimeters recorded time-stamped, solar erythemal UVR exposure of 77 outdoor workers:

• building, horticultural & road work sites
• in Central Otago
• over 5 consecutive working days, January-March 2007
• during peak UVR 11am – 4pm

Also assessed sun-protective:

• knowledge, attitudes & beliefs
• practices
a) Measuring NZ workers’ solar UVR exposure

Results

- geometric mean total daily UVR = 5.32 SED
- exceeded mean daily exposure guidelines limit (30 J/m per 8 hour period = 1.08 SED/day)
- mean UVR exposure:
  - dipped 1200-1300 hours – i.e. during peak ambient UVR
  - peaked 1400-1500 hours – i.e. during decreasing ambient UVR
  - statistically significant differences for exposure and % ambient (p<0.005)
  - confirmed potential influence of behavioural factors
    - e.g. shade seeking during lunch break

b) NZ outdoor workers’ UVR protection

Three objectives

Among 1,061 workers in 9 key occupational groups (forestry, roading, sawmilling, postal delivery, viticulture, landscaping, construction, horticulture & farming) to:

1. describe:
   • workers’ sun-protective attitudes & practices at work
   • workplace support for sun-safety

2. investigate associations of demographic, personal & occupational factors with workers’ sun-protective practices

3. identify potential strategies for optimising occupational sun-protection
“John Stewart is a roofer and his new puppy Ben (4.5 months) has taken to the roof quite happily.”
Reproduced courtesy of the *Marlborough Express*.

### Table 1: Predictors of Personal Sun-protection Scores

<table>
<thead>
<tr>
<th>Potential predictors</th>
<th>Unadjusted</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff</td>
<td>95% CI</td>
</tr>
<tr>
<td></td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td><strong>Sex (Male)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.58</td>
<td>0.34</td>
</tr>
<tr>
<td><strong>Age (Per 5 years)</strong></td>
<td>0.03</td>
<td>-0.01</td>
</tr>
<tr>
<td><strong>Ethnicity (NZ European)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maori</td>
<td>-0.08</td>
<td>-0.58</td>
</tr>
<tr>
<td>Pacific</td>
<td>-0.32</td>
<td>-0.80</td>
</tr>
<tr>
<td>Asian</td>
<td>-0.35</td>
<td>-0.60</td>
</tr>
<tr>
<td>All other</td>
<td>-0.61</td>
<td>-1.24</td>
</tr>
<tr>
<td><strong>Education (Secondary)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post secondary</td>
<td>0.24</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Occupation (Roading)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forestry</td>
<td>-0.69</td>
<td>-1.05</td>
</tr>
<tr>
<td>Sawmilling</td>
<td>-0.04</td>
<td>-0.51</td>
</tr>
<tr>
<td>Postal</td>
<td>0.04</td>
<td>-0.36</td>
</tr>
<tr>
<td>Viticulture</td>
<td>0.17</td>
<td>-0.27</td>
</tr>
<tr>
<td>Landscaping</td>
<td>-0.16</td>
<td>-0.60</td>
</tr>
<tr>
<td>Construction</td>
<td>-0.53</td>
<td>-1.06</td>
</tr>
<tr>
<td>Horticulture</td>
<td>-0.54</td>
<td>-0.96</td>
</tr>
<tr>
<td>Farming</td>
<td>-0.44</td>
<td>-0.85</td>
</tr>
<tr>
<td><strong>Pro-tan Attitude Score</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Range 4–20, per unit increase)</td>
<td>-0.07</td>
<td>-0.10</td>
</tr>
<tr>
<td><strong>Deficient Knowledge Score</strong></td>
<td>0.12</td>
<td>0.09</td>
</tr>
<tr>
<td>(Range 4–12, per unit increase)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Skin response (Always burns)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usually burns</td>
<td>-0.18</td>
<td>-0.52</td>
</tr>
<tr>
<td>Sometimes burns</td>
<td>-0.58</td>
<td>-0.89</td>
</tr>
<tr>
<td>Rarely burns</td>
<td>-0.94</td>
<td>-1.27</td>
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<tr>
<td><strong>Perception of Skin Cancer Risk Score</strong></td>
<td>0.02</td>
<td>0.00</td>
</tr>
<tr>
<td>(Range 0-100, per 5% increase)</td>
<td></td>
<td></td>
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<tr>
<td><strong>Workplace Sun-safety Culture Score</strong></td>
<td>0.22</td>
<td>0.17</td>
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<tr>
<td>(Range 3–15, per unit increase)</td>
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<tr>
<td><strong>Workplace Provision Score</strong></td>
<td>0.29</td>
<td>0.19</td>
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<tr>
<td>(Range 0–4, per unit increase)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Indicates statistical significance.
NZ study findings: so what?

- NZ outdoor workers are exposed to solar UVR at potentially harmful levels during normal activities.
- No occupation had a mean Personal Sun-protection Score ≥50% of maximum.
- For the comprehensive occupational interventions recommended, workplace rather than personal factors likely to be the most critical components.
- Efforts at higher organisational levels are likely to help surmount workplace / personal obstacles & achieve greatest impact.
- We need to “get serious about skin cancer prevention” among outdoor workers.

Preventing skin cancer in outdoor occupational settings

moving from this .................. to this
“Systematic reviews provide the highest level of evidence”

Adele Green, Berghofer Medical Research Institute (QIMR)
3

Preventing skin cancer: interventions in outdoor occupational settings - Community Guide review
Coordination Team for Community Guide skin cancer prevention review update

Centers for Disease Control & Prevention, Atlanta

The Community Guide staff
• Paramjit Sandhu
• Randy Elder
• Qaiser Mukhtar

Community Preventive Services Task Force
• Karen Glanz* - University of Pennsylvania

External Partners
• Frank Perna - National Institutes of Health
• Robert Smith - American Cancer Society
• David Buller - Klein Buendel Inc.
• Craig Sinclair & Jen Makin - Cancer Council Victoria
• Tony Reeder & Bronwen McNoe - Cancer Society Social & Behavioral Research Unit, NZ

CDC Library Specialist
Epidemiology Analysis Program Office
• Onnalee Gomez

Division of Cancer Prevention & Control
• Mona Saraiya*
• Dawn Holman

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1 First Coordination Team meeting 06 January 2011
Interventions in occupational settings to reduce skin cancer incidence: review update

Educational & Behavioural

- Improved knowledge, attitudes, intentions, and social norms about:
  - Methods to protect against UVR
  - Skin cancer

Environmental & Policy Strategies

- Increased sun protective behaviors
  - Use of:
    - sunscreen
    - a hat
    - other protective clothing
    - sunglasses
    - shade
  - Avoidance of sun exposure (especially during peak hours)

Decrease in UV exposure

Reduced incidence:
- Sunburn
- New mole formation
- Actinic keratosis

Decreased skin cancer incidence

Reduced skin cancer morbidity & mortality

Outdoor occupational settings – *provisional update*

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Effectiveness measure</th>
<th>Summary estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunscreen use</td>
<td>Absolute percentage point change</td>
<td>Median increase +8.0 (min 7.0, max 10.1) percentage points</td>
</tr>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>1.43 (95% CI; 1.20-1.71)</td>
</tr>
<tr>
<td>Hat use</td>
<td>Absolute percentage point change</td>
<td>Median increase +8.8 (min 4.8, max 11.0) percentage points</td>
</tr>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>1.01 (95% CI; 0.86-1.18)</td>
</tr>
<tr>
<td>Protective clothing <em>(long sleeved shirts)</em></td>
<td>Percentage point change</td>
<td>Minimum increase +23.4, maximum increase +52.0 percentage points</td>
</tr>
<tr>
<td>Sunburn</td>
<td>Absolute percentage point change</td>
<td>Median decrease -5.2 (min -3.0, max -7.1)</td>
</tr>
<tr>
<td></td>
<td>Change in <em>n</em> of sunburns</td>
<td>Mean decrease <em>total</em> sunburns: -0.2 per person</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean decrease in <em>severe</em> sunburns: -0.7 per person</td>
</tr>
</tbody>
</table>

Also an almost entirely consistent pattern of favourable results for:

- other sun-protective clothing
- combinations of sun protective behaviours
- decrease in UVR exposure (skin reflectance measure)
- fewer solar keratoses & medically excised skin cancers

Greater intensity / more components associated statistically significant decrease in sunburns

Possible other benefits & potential harms

Other benefits

• reduced over-exposure to heat may prevent heat strokes
• workers discussed sun-safety at home with family members
• regular sunscreen use can stop skin photo-aging

Potential harms

• no included studies reported or evaluated potential harms associated with sun-safety interventions
• practical sun protective strategies must not create other hazards
• reduced endogenous vitamin D production / physical activity unlikely to negatively impact on outdoor workers

Some practical considerations for implementation

Workplace factors
• placing the importance of worker safety into a broader risk management context may successfully appeal to employers
• professional association partnerships may influence uptake & sustainability
• achieving high initial use of programs is important for sustainability
• greater program intensity is associated with improved protection
• scheduling of work breaks during high UVR periods
• provision of affordable sun protection gear / products

Worker factors
• peer sun-protection behaviour likely to influence co-workers
• sun-protection preferences may differ by demographics
• protection product ease of use:
  • non-sticky, easy to apply sunscreen (e.g. spray?)
  • UPF-rated clothing made of lightweight, breathable materials
4
Some general conclusions & recommendations
Some general conclusions

- Outdoor workers are at increased risk of skin cancer from UVR exposure.
- It is not possible to quantify risk in NZ because no routine recording of NMSC incidence and occupational history.
- NZ outdoor workers are exposed to high levels of solar UVR.
- NZ Health & Safety legislation requires UVR harm minimisation.
- Sun protection among NZ outdoor workers needs greater attention.
- Systematic review evidence indicates workplace interventions are effective in changing behaviours/intermediate health outcomes.
Behaviour change


Victorian SunSmart programme

‘Large impact’
‘Sustained modest investment is excellent value for money’

For every $1 invested in primary prevention, $2.30 is saved on treatment.
Some recommendations

In NZ we should:

• be guided by NZ & international research evidence regarding primary prevention of occupational skin cancer
• increase & sustain investment in skin cancer prevention
• update estimates of the cost of skin cancer
• consider recording NMSC incidence & occupational history in databases linkable with the NZ Cancer Registry
• monitor UVR harm minimisation under H&S guidelines
• implement & rigorously evaluate workplace UVR interventions
• respond to evaluation findings in a timely fashion
Acknowledgements

Research Support
Nathalie Huston

Funding *(UVR exposure study)*
- Cancer Society of NZ: support for Dr Reeder & SBRU
- University of Otago: support for Dr Reeder, Dr Hammond & SBRU

Funding *(Predictors of protection study)*
- Wellington Division of the Cancer Society of NZ: support for *data collection*
- Cancer Society of NZ: support for Dr Reeder & SBRU
- University of Otago: support for Dr Reeder & SBRU

*We thank all the employers & workers for their participation in the NZ studies reported*
Four of the 101 forestry workers in the study

Photo: by unnamed forestry worker using Bronwen McNoe’s camera

Bronwen McNoe, Dr Kirsten Lovelock, Assoc Prof Tony Reeder
Generic analytic framework: educational, behavioural, environmental & policy interventions to prevent skin cancer

1. Intervention types
   - Educational & behavioral
   - Environmental & policy

2. Appropriate changes in knowledge, attitudes, intentions & social norms regarding:
   - UVR effects
     - photo damage
     - wrinkling
   - Skin cancer types - prevention related
   - UVR protection - knowledge of how to protect oneself
   - UVR exposure
     - during peak hours
     - limiting exposure
   - Indoor tanning practices

3. Increase in appropriate UVR protection
   - Increased UV protective behaviors:
     - hat wearing
     - other clothing use
     - shade use
     - SPF30+ sunscreen
     - use of sunglasses
   - Limited exposure during peak solar UVR hours
   - Indoor tanning avoided

4. Reduction in harmful UVR exposure

5. Intermediate health indicators
   - Reduced incidence:
     - erythema
     - nevi formation
     - actinic keratosis

6. Improved population health outcomes
   - Reduced skin cancer:
     - incidence
     - morbidity
     - mortality
     - inequalities

Other possible harms / benefits
- Vitamin D deficiency
- Reduced physical activity
- Unnecessary diagnostic visits
- Improved early detection