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

Research Associate Professor Tony Reeder
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]

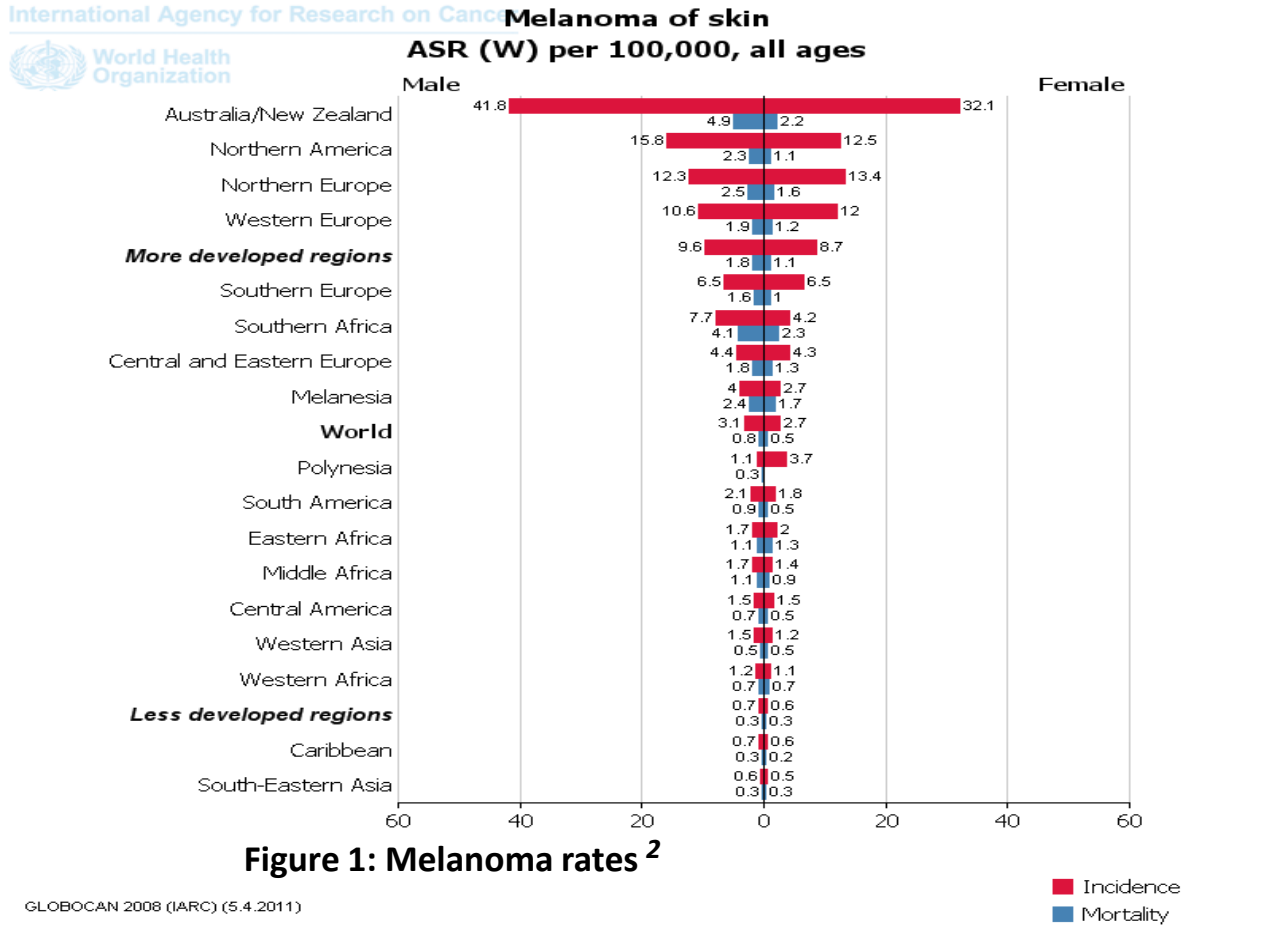


Figure 1: Melanoma rates [2]

1. Lazovich D, Choi K, Vogel RI. Time to get serious about skin cancer prevention. *Cancer Epidemiology Biomarkers & Prevention 2012; 21(11):1893-1901*
2. Ferlay J, Shin HR, Bray F, Forman D, Mathers C, Parkin DM. *GLOBOCAN 2008, Cancer Incidence & Mortality Worldwide: IARC CancerBase No. 10.* Lyon, France: International Agency for Research on Cancer. http://globocan.iarc.fr

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)*

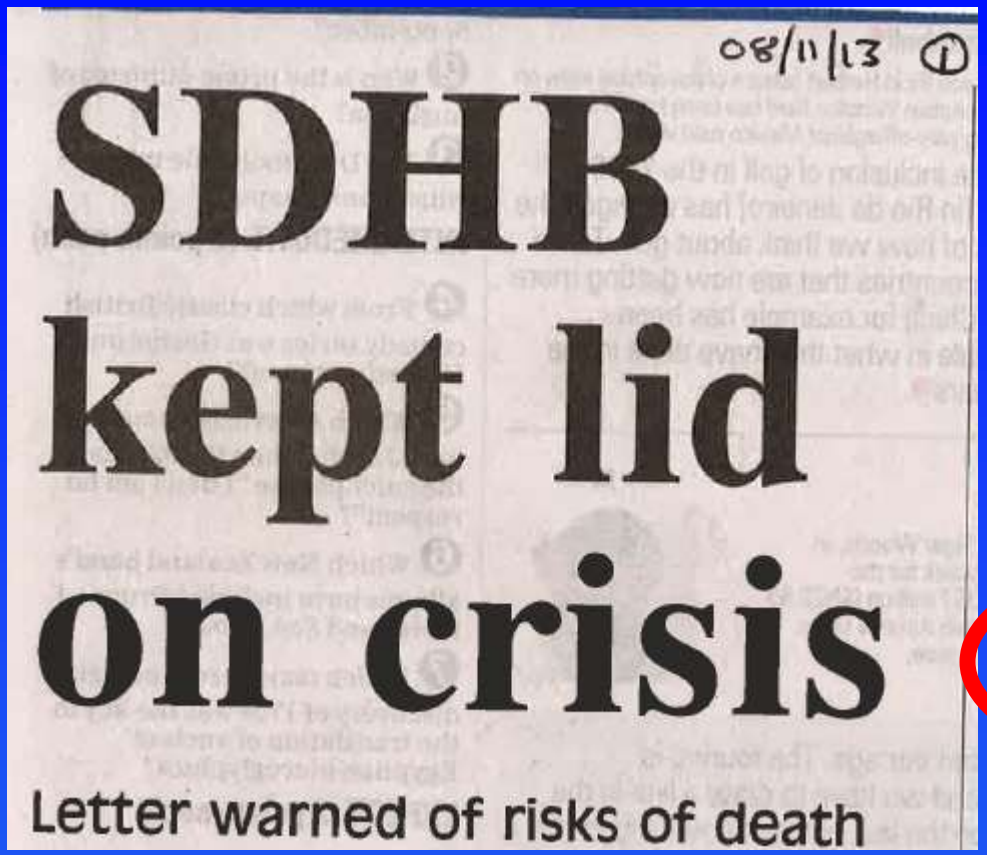
	Males	Females	TOTALS
CMM	199	125	**324**
NMSC	76	54	**130**
TOTALS	**275**	**179**	**454**

Estimated 2006 skin cancer costs [1] *(NZ $ millions excl. GST)*

	Treatment	Lost production	TOTALS
CMM	5.7	59.3	**65.0**
NMSC	51.4	6.7	**58.1**
TOTALS	**57.1**	**66.0**	**123.1**

1. O'Dea, D. *The costs of skin cancer to New Zealand, 2006*. Report to CSNZ, Wellington School of Medicine, 2008.

The burden of skin cancer on NZ



08/11/13 ①

SDHB kept lid on crisis

Letter warned of risks of death

The crisis developed when the board halted outsourcing to Mercy Hospital, in Dunedin, in the middle of last year, to cut costs. Outsourcing some child and skin cancer patients had been used to take pressure off waiting lists as the Dunedin department lacked in-house treatment capacity.

"The waiting times for skin cancer are now unacceptable and are resulting in patients requiring more extensive sur-

gery [such as neck dissections for lymph node metastasis] and the need for a general anaes-

"The risk of an avoidable death from delayed treatment for melanoma or squamous cell carcinoma is very real."

The department's workload had doubled in the past decade

Otago sun exposure and the ageing population.

1. Eileen Goodwin. "SDHB kept lid on crisis. Letter warned of risks of death." Headline article, *Otago Daily Times,* November 8th 2013.

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]

1. Armstrong BK. How sun exposure causes skin cancer: an epidemiological perspective, in: D. Hill, J.M. Elwood & D.R. English, Eds. *Prevention of skin cancer.* Klumer Academic Publishers, Dordrecht, 2004.
2. McKenzie RL, Bodeker GE, Connor BJ. Increased UV radiation in New Zealand: a cautionary tale. Water and Atmosphere 1999, 7(4):7-8.
3. Brougham NDL, Dennett ER, Tan ST. Non-melanoma skin cancers in New Zealand—a neglected problem. *New Zealand Medical Journal, 2010. 123(1325):59-65.*
4. Brougham, NDL., E.R. Dennett ER, Tan ST. Changing incidence of non-melanoma skin cancer in New Zealanders. *ANZ Journal of Surgery, 2011. 81(9):633-636.*
5. Cancer Control Taskforce. *The New Zealand Cancer Control Strategy Action Plan 2005-2010.* Wellington: Ministry of Health, 2005.

Why focus on outdoor workers?

- often spend a substantial part of their work day in the sun [1]
- are at increased risk of skin cancers from occupational solar UVR exposure [2, 3] - which may include melanoma on highly exposed sites [4,5]
- risk is likely substantially under-estimated from poor surveillance,[6] as is risk by skin types - given occupational self-selection by those with less vulnerable skin [7]
- regular sunscreen use may be effective in preventing melanoma among outdoor workers, more so than in the general population [8]

1. Stepanski BM, Mayer JA. Solar protection behaviors among outdoor workers, *J Occup & Environmental Med* 1998; 40(1): 43-48.
2. Schmitt J, Seidler A, Diepgen TL, Bauer A. Occupational UV-light exposure increases the risk for the development of cutaneous squamous cell carcinoma: A systematic review and meta-analysis. *British Journal of Dermatology,* 2011; 164(2): 291-307.
3. Fartasch M, Diepgen L, Schmitt J, Drexler H. The relationship between occupational sun exposure and non-melanoma skin cancer. *Deutsches Ärteblatt International* 2012; 109(43):715-20.
4. Kvaskoff M, Pandeya N, Green AC et al. Site-specific determinants of cutaneous melanoma: a case-case comparison of patients with tumors arising on the head and trunk. *Cancer Epidemiology Biomarkers and Prevention,* 2013, in press.
5. Vågero D, Ringbäck G, Kiviranta H. Melanoma and other tumors of the skin among office, other indoor and outdoor workers in Sweden 1961-1979. *British Journal of Cancer*, 1986; 53:507-12.
6. Rushton L, Bagga S. Bevan R et al. The burden of occupational skin cancer in Great Britain. London:Health & Safety Executive, 2010
7. Green A, Battistutta D.m, Hart V, Leslie D, Weedon D. Skin cancer in a subtropical Australian population: incidence and lack of association with occupation. The Nambour Study Group. *American Journal of Epidemiology*, 1996; 144(11): 1034-40.
8. Green AC, Williams GM, Logan V, Strutton GM. Reduced melanoma after regular sunscreen use: randomized trial follow-up, *J Clinical Oncology* 2011; 29(3): 257-63.

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[1]
- an estimated 14% of the NZ workforce routinely works outdoors,[2] may experience extreme seasonal UVR & be especially at risk of NMSC[3]
- 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 [4]
  - perceived workplace support for sun protection positively associated with protective practices [5]

1. Health and Technical Services, Occupational Safety and Health Service. *Guidance notes for the protection of workers from solar ultraviolet radiation,* Wellington: Department of Labour, 1994.
2. Statistics NZ, *Household Labour Force Survey*, Wellington 2012.
3. Reeder AI. Non-melanoma skin cancer. *New Zealand Medical Journal*, 2011; 124 (1329): 99-100.
4. McCool JP, Reeder AI, Robinson EM, Petrie KJ, Gorman DF. Outdoor workers perceptions of the risk of excess sun exposure. *Journal of Occupational Health* 2009; 51:404-11.
5. Hammond VA, Reeder AI, Gray R, Bell M. Are workers or their workplaces the key to occupational sun protection? *Health Promotion Journal of Australia,* 2008; 19(2): 97-101.

2
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 [1]
- exceeded mean daily exposure guidelines limit (30 J/m per 8 hour period [2] = 1.08 SED/day [3])
- 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

1. Hammond V, Reeder AI. Gray A. Patterns of real-time occupational ultraviolet radiation exposure among a sample of outdoor workers in New Zealand. *Public Heal*th 2009; 123:182-7
2. International Commission on Non-Ionizing Radiation Protection. ICNIRP statement on protection of workers against ultraviolet radiation. *Health Physics* 2010; 99(1):66-87.
3. Moehrle M, Dennenmoser B, Garbe C. Continuous long-term monitoring of UV radiation in professional mountain guides reveals extremely high exposure. *International Journal of Cancer* 2003; 103:775-8.

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

Reeder AI, Gray AR, McCool JP. Occupational sun-protection: workplace culture, equipment provision and outdoor workers' characteristics. *Journal of Occupational Health* 2013; 55:84-97.

"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*.

b) NZ outdoor workers' UVR protection

Table 1: Predictors of Personal Sun-protection Scores

	Unadjusted				Adjusted				
Potential predictors	Coeff	95% CI		*p*-value	Coeff	95% CI		***p*-value**	
		Lower	Upper			Lower	Upper		
Sex *(Male)*									
Female	0.58	0.34	0.83	**<0.001**	0.32	0.05	0.58	**0.021**	
Age ***(Per 5 years)***	0.03	-0.01	0.07	0.133	0.02	-0.02	0.06	0.244	
Ethnicity *(NZ European)*				**0.044**				0.468	
Maori	-0.08	-0.58	0.41		0.20	-0.33	0.73		
Pacific	-0.32	-0.80	0.15		0.19	-0.28	0.66		
Asian	-0.35	-0.60	-0.10		-0.03	-0.28	0.22		
All other	-0.61	-1.24	0.02		-0.56	-1.39	0.27		
Education *(Secondary)*									
Post secondary	0.24	0.07	0.41	**0.007**	0.09	-0.07	0.26	0.273	
Occupation *(Roading)*				**<0.001**				**0.049**	
Forestry	-0.69	-1.05	-0.33		-0.45	-0.88	-0.03		
Sawmilling	-0.04	-0.51	0.43		-0.06	-0.49	0.37		
Postal	0.04	-0.36	0.44		-0.53	-0.86	-0.20		
Viticulture	0.17	-0.27	0.60		-0.18	-0.59	0.23		
Landscaping	-0.16	-0.60	0.29		-0.39	-0.70	-0.07		
Construction	-0.53	-1.06	-0.01		-0.48	-0.84	-0.12		
Horticulture	-0.54	-0.96	-0.13		-0.47	-0.87	-0.07		
Farming	-0.44	-0.85	-0.02		-0.53	-0.98	-0.09		
Pro-tan Attitude Score *(Range 4–20, per unit increase)*	-0.07	-0.10	-0.03	**<0.001**	-0.04	-0.08	-0.01	**0.022**	
Deficient Knowledge Score *(Range 4–12, per unit increase)*	0.12	0.09	0.15	**<0.001**	0.03	-0.01	0.07	0.201	
Skin response *(Always burns)*				**<0.001**				**<0.001**	*
Usually burns	-0.18	-0.52	0.16		-0.02	-0.34	0.30		
Sometimes burns	-0.58	-0.89	-0.27		-0.27	-0.56	0.01		
Rarely burns	-0.94	-1.27	-0.60		-0.55	-0.87	-0.23		
Perception of Skin Cancer Risk Score *(Range 0-100, per 5% increase)*	0.02	0.00	0.05	**0.021**	0.01	-0.02	0.03	0.634	
Workplace Sun-safety Culture Score *(Range 3–15, per unit increase)*	0.22	0.17	0.26	**<0.001**	0.16	0.11	0.21	**<0.001**	*
Workplace Provision Score *(Range 0–4, per unit increase)*	0.29	0.19	0.38	**<0.001**	0.14	0.06	0.23	**0.001**	*

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,[1] *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"* [2] among outdoor workers

1. Glanz K, Buller DB, Saraiya M. Reducing ultraviolet radiation exposure among outdoor workers: State of the evidence and recommendations. *Environmental Health* 2007; 6:22. doi:10.1186/1476-069X-6-22
2. Lazovich D, Choi K, Vogel RI. Time to get serious about skin cancer prevention. *Cancer Epidemiology, Biomarkers & Prevention* 2012; 21(11):1893-1901.

Preventing skin cancer in outdoor occupational settings

moving from this …….. to this

2nd International Conference on UV and Skin Cancer Prevention

Under the auspices of UICC

"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 [1]

Centers for Disease Control & Prevention, Atlanta

The *Community Guide* staff
- **Paramjit Sandhu**
- **Randy Elder**
- **Qaiser Mukhtar**

CDC Library Specialist

Epidemiology Analysis Program Office
- **Onnalee Gomez**

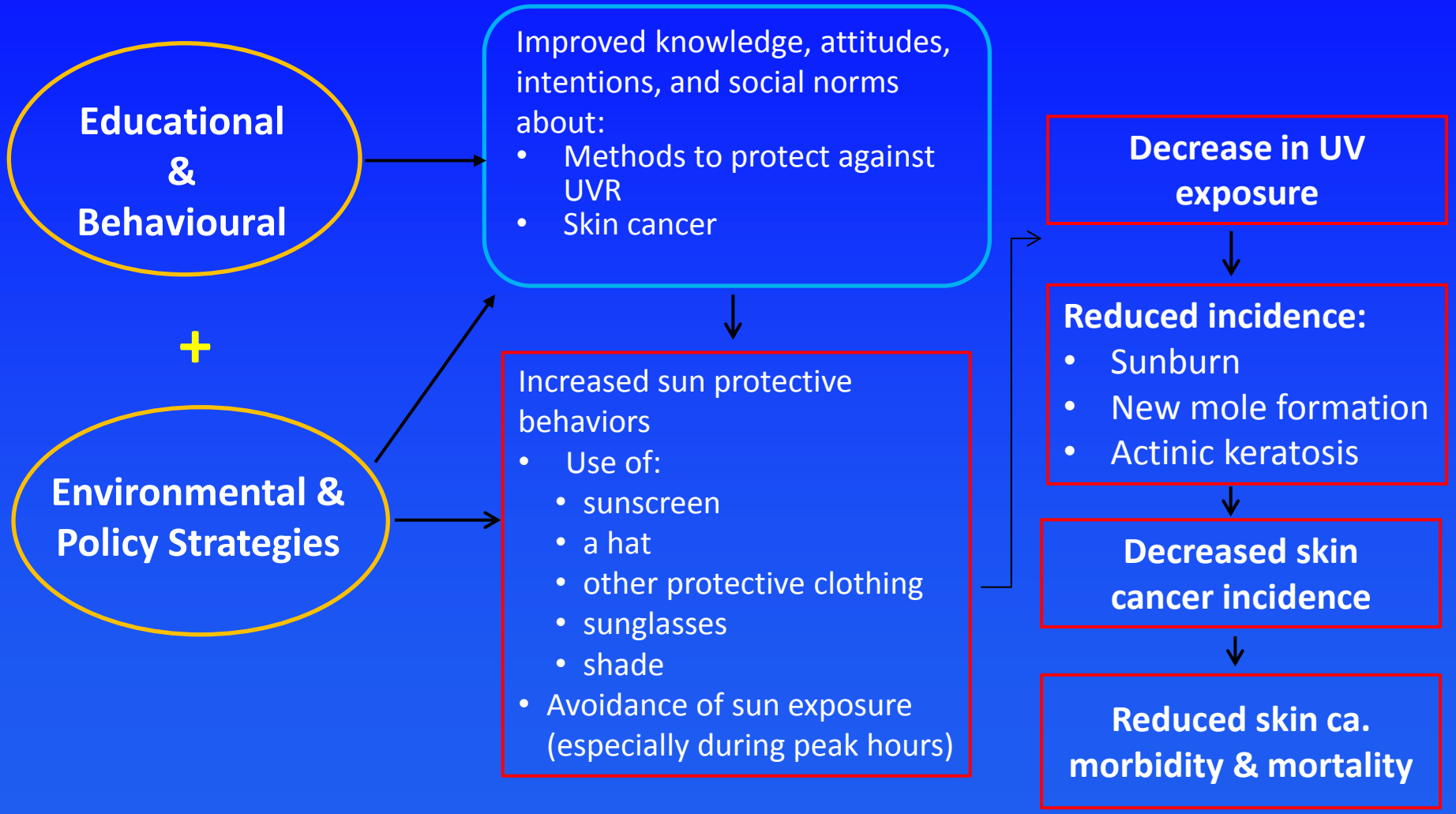
Division of Cancer Prevention & Control
- **Mona Saraiya***
- **Dawn Holman**

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*

[1] First Coordination Team meeting 06 January 2011

Interventions in occupational settings to reduce skin cancer incidence: review update



Based on: Saraiya M, Glanz K, Briss PA et al. Interventions to prevent skin cancer by reducing exposure to ultraviolet radiation. A systematic review. *Am J Prev Med* 2004;27(5):422-66.

Outdoor occupational settings – *provisional update*

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

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

http://www.thecommunityguide.org/cancer/skin/education-policy/RRoutdooroccupations.html

Possible other benefits & potential harms

Other benefits

- reduced over-exposure to heat may prevent heat strokes [1]
- workers discussed sun-safety at home with family members [2]
- regular sunscreen use can stop skin photo-aging [3]

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

1. Glantz K, Buller D, Saraiya M. Reducing ultraviolet radiation exposure among outdoor workers: State of the evidence and recommendations. *Environmental Health* 2007; 6(22). doi:10.1186/1476-069X-6-22
2. Andersen PA, Buller DB, Voeks JH, Walkosz BJ, Scott MD, Cutter GR, Dignan MB. Testing the long-term effects of the Go SunSmart worksite health communication campaign: A group-randomized experimental study. *Journal of Communication* 2008; 58:447-71
3. Hughes MC, Williams GM, Baker P, Green AC. Sunscreen and prevention of skin aging: a randomized trial. *Annals of Internal Medicine* 2013;158(11):781-90.

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

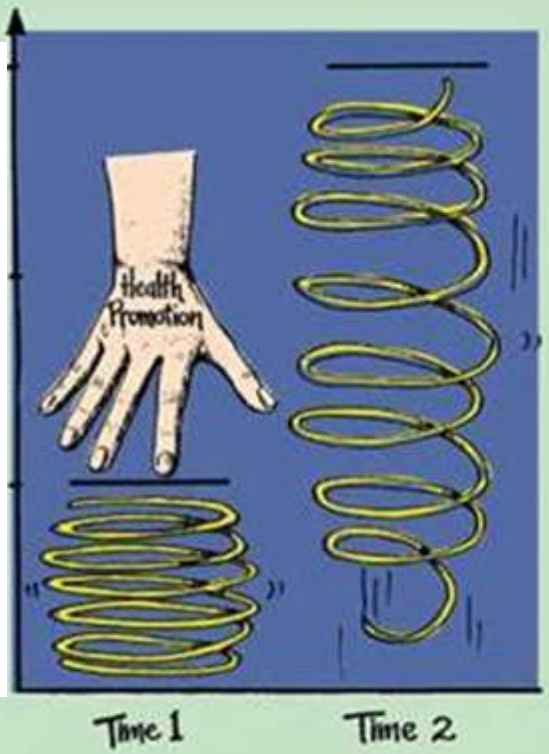
- peer sun-protection behaviour likely to influence co-workers
- sun-protection preferences may differ by demographics
- protection product ease of use:
- non-sticky, easy to apply sunscreen (e.g. spray?)
- UPF-rated clothing made of lightweight, breathable materials

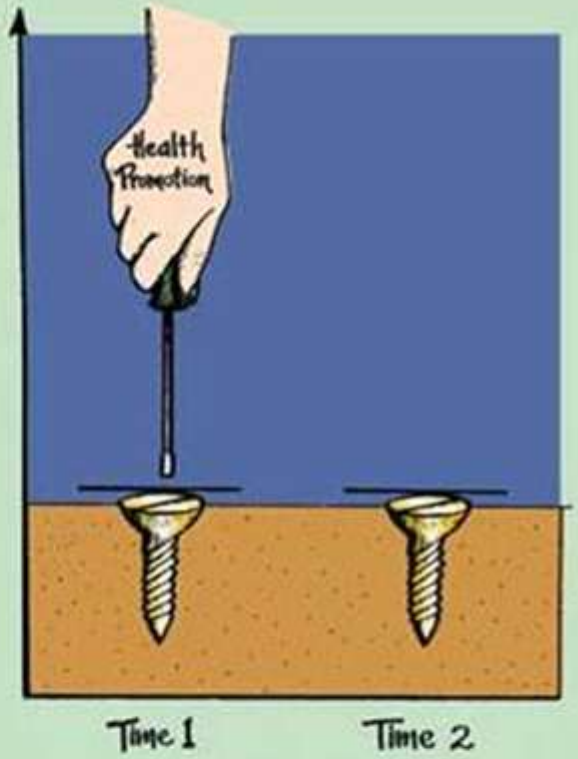
4
Some general conclusions & recommendations

Some general conclusions

- outdoor workers are at increased of skin cancer from UVR exposure
- not possible to quantify risk in NZ because no routine recording of NMSC incidence & 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[1]





Spring ... or ... Screw?

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.

1. Hill D, Marks R. Health promotion programs for melanoma prevention: Screw or spring? *Archives of Dermatology* 2008; 144(4): 538-40.
2. Shih S T-F, Carter R, Sinclair C, Mihalopoulos C, Vos T. Economic evaluation of skin cancer prevention in Australia. *Preventive Medicine* 2009, 49:449-53

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

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Cancer Society of NZ: *support for Dr Reeder & SBRU*

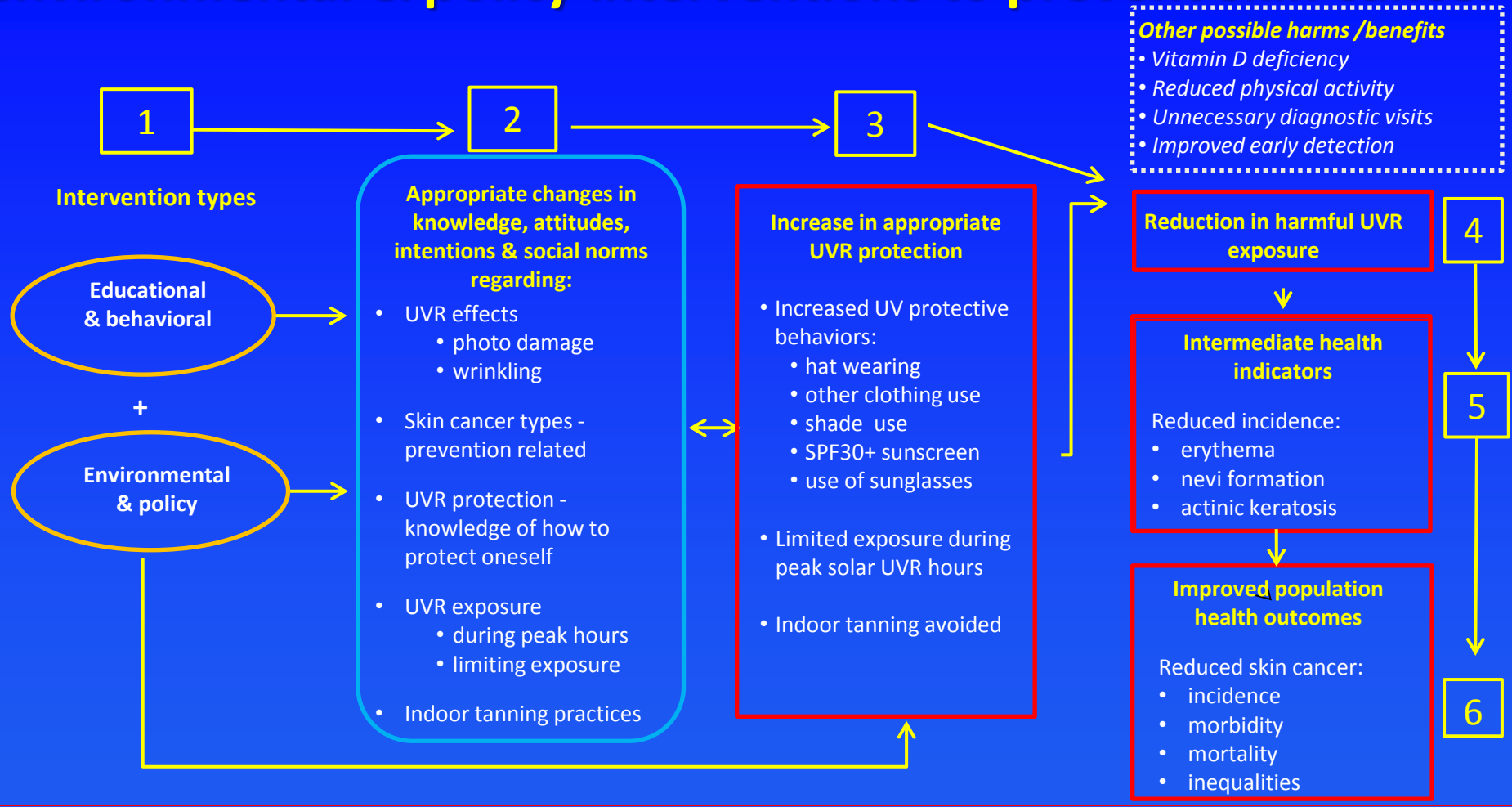
University of Otago: *support for Dr Reeder & SBRU*

We thank all the employers & workers for their participation in the NZ studies reported

Bronwen McNoe, Dr Kirsten Lovelock, Assoc Prof Tony Reeder

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

Generic analytic framework: educational, behavioural, environmental & policy interventions to prevent skin cancer



Extended framework adapted from *Community Guide* team revision of Saraiya M, Glanz K, Briss PA et al. Interventions to prevent skin cancer by reducing exposure to ultraviolet radiation. A systematic review. *Am J Prev Med* 2004;27(5):422-66.

University of Otago NEW ZEALAND

***Cancer Society* Social & Behavioural Research Unit (SBRU)**

Te Hunga Rangahau Ārai Mate Pukupuku

23 years of social & behavioural research in cancer control

Cancer Society