

Occupational sun exposure in Canada



Presenter:
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UNIVERSITY OF
CALGARY



Conflict of interest statement

- I have received peer-reviewed grant funding from CIHR, WorkSafeBC, Alberta Labour, and the O'Brien Institute for Public Health.



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- **Co-investigators:** Victoria Arrandale, Sunil Kalia, Thomas Tenkate, Linn Holness, Lindsay Forsman-Phillips
- **Collaborators:** Steve Quantz, Judith Purcell, Brenda Marsh, Nicole Braun, Merrill O'Donnell, Terry Parker, and Carmen Skelton
- **My team members:** Nicole Slot, Brandon Leong, Ela Rydz, Andy Harper, Joanne Telfer
- Participants in the studies, and managers and employers who helped with recruitment
- **Funding for Sun Safety at Work Canada and CAREX Canada:** Canadian Partnership Against Cancer



<https://www.carexcanada.ca/special-topics/sun-safety/>

Learning objectives

At the end of this seminar the attendee will be able to:

1. Explain the importance of sun exposure in Canada's outdoor workers
2. Understand how exposure assessment for solar UV radiation works in practice
3. Point to resources that can be used to support skin cancer prevention in outdoor workers



Outline

PART 1: IMPORTANCE AND CHALLENGES

- Why is occupational ultraviolet radiation (UVR) exposure important?
- Burden of occupational sun exposure
- Challenges of exposure assessment

PART 2: MEASUREMENTS STUDY

- Measurement study of UVR exposure in Alberta

PART 3: SUN SAFETY PROGRAMS FOR WORKPLACES

- Resources and tools to support skin cancer and heat stress prevention efforts

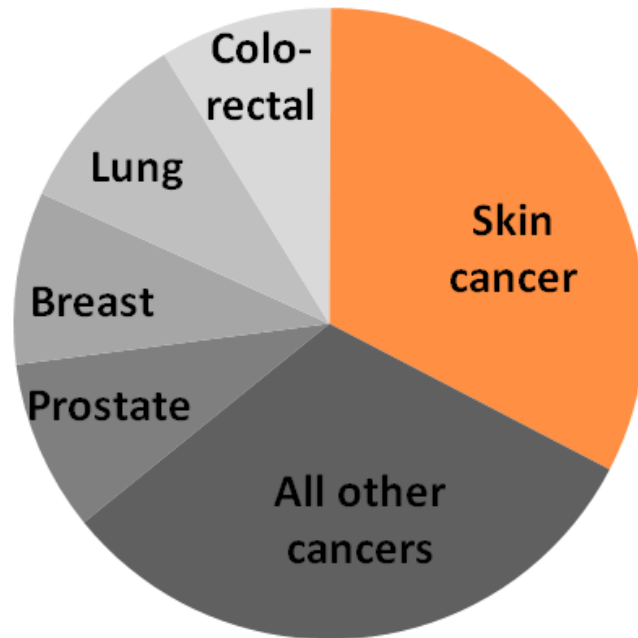


PART 1: IMPORTANCE AND CHALLENGES



What is the issue?

Skin cancer = ~88,000
of ~269,000 new
cancer cases (2015)



- #1 predictor of how much sun exposure a person gets: are they an outdoor worker?



CAREX Canada – Occupational estimates



- How many people are potentially exposed at work?
- Where do they work (industry); what do they do (occupation)?
- Where do they live and work in Canada?
- What levels are they exposed to?



Exposure level estimation

DEFINITION

Outdoor work
>75% of the
time

EXAMPLES



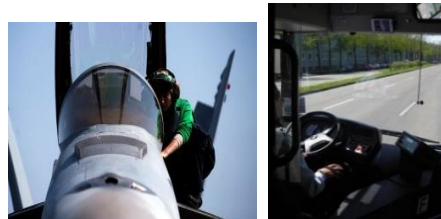
EXPOSURE LEVEL



Indoor and
outdoor work

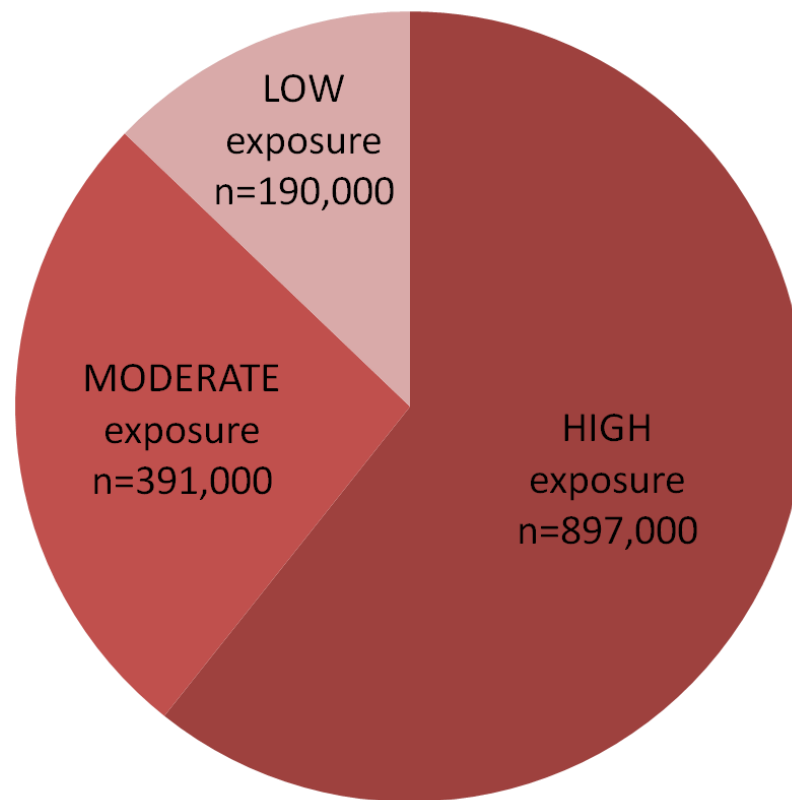


Outdoor work
less common
or intense



Number of outdoor workers in Canada

- 1.5 million exposed
- 8.8% of the working population
- Most of those exposed are men (82%)



Peters CE, Nicol AM, Demers PA. Prevalence of exposure to solar ultraviolet radiation (UVR) on the job in Canada. Can J Public Health. 2012. 103(3):223-6



Amusement & Recreation
45,000 exposed



Farming
264,000 exposed



Foundation & Building Exterior Contractors
68,000 exposed

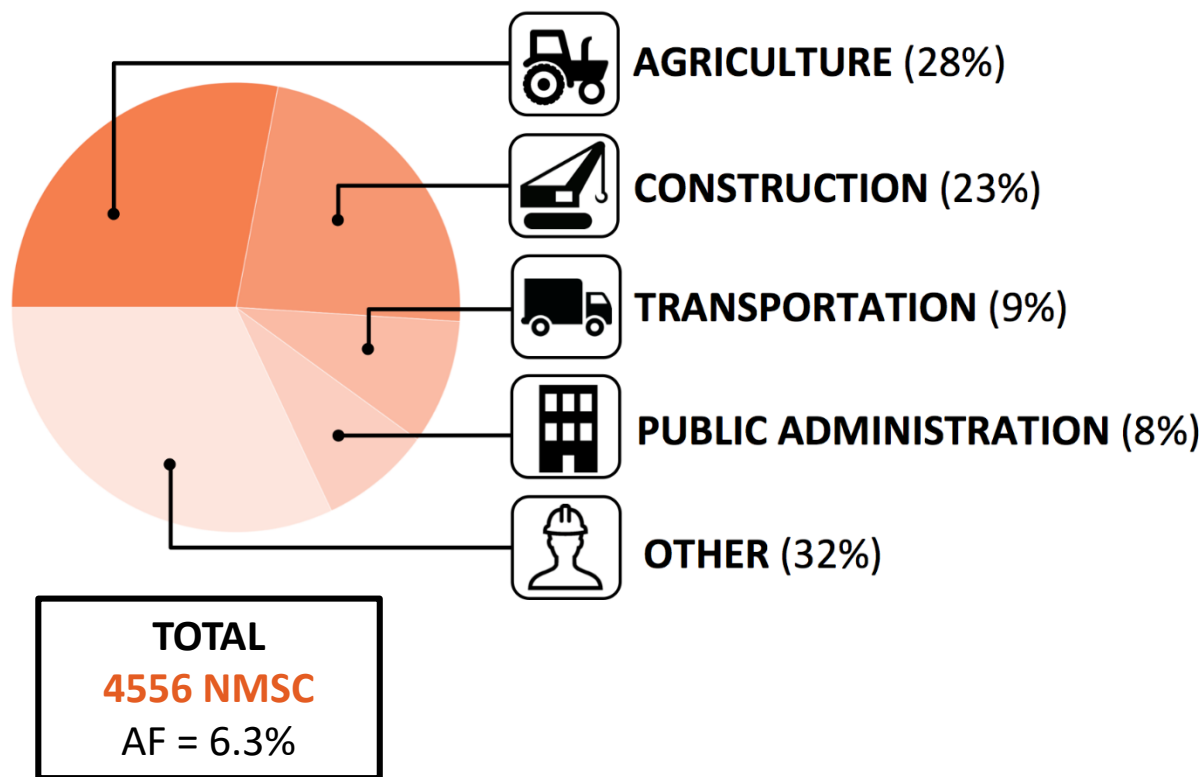
Residential Building Construction
108,000 exposed



Services to Buildings
83,000 exposed



Burden of occupational skin cancer



How to do skin cancer prevention in outdoor workers?

1. Evaluation challenges
2. Measurement challenges
 - exposure
 - outcome
3. Cultural challenges (attitudes) of the workplace, location
4. Practical challenges



Exposure assessment methods

1. Questionnaires or JEMs

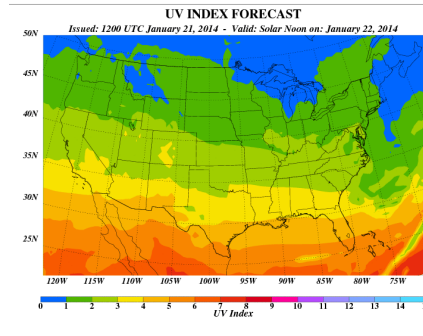
- 'Yes-no'
- Self-reported time outside
- Instances of sunburn

For each question listed, please select the one answer that is the best response to the question.

Section 1 -Sun Habits

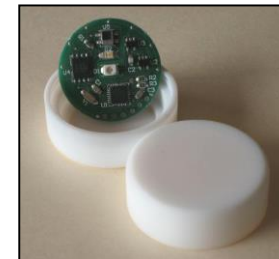
- In the summer, on average, how many hours are you outside per day between 10 AM and 4 PM...on WEEKDAYS (Monday-Friday) ?
 - 30 minutes or less
 - 31 minutes to 1 hour.....
 - 2 hours.....
 - 3 hours.....
 - 4 hours.....
 - 5 hours.....
 - 6 hours.....
- In the summer, on average, how many hours are you outside per day between 10 AM and 4 PM...on WEEKEND DAYS (Saturday & Sunday) ?
 - 30 minutes or less
 - 31 minutes to 1 hour.....
 - 2 hours.....
 - 3 hours.....
 - 4 hours.....
 - 5 hours.....
 - 6 hours.....

2. Environmental measures

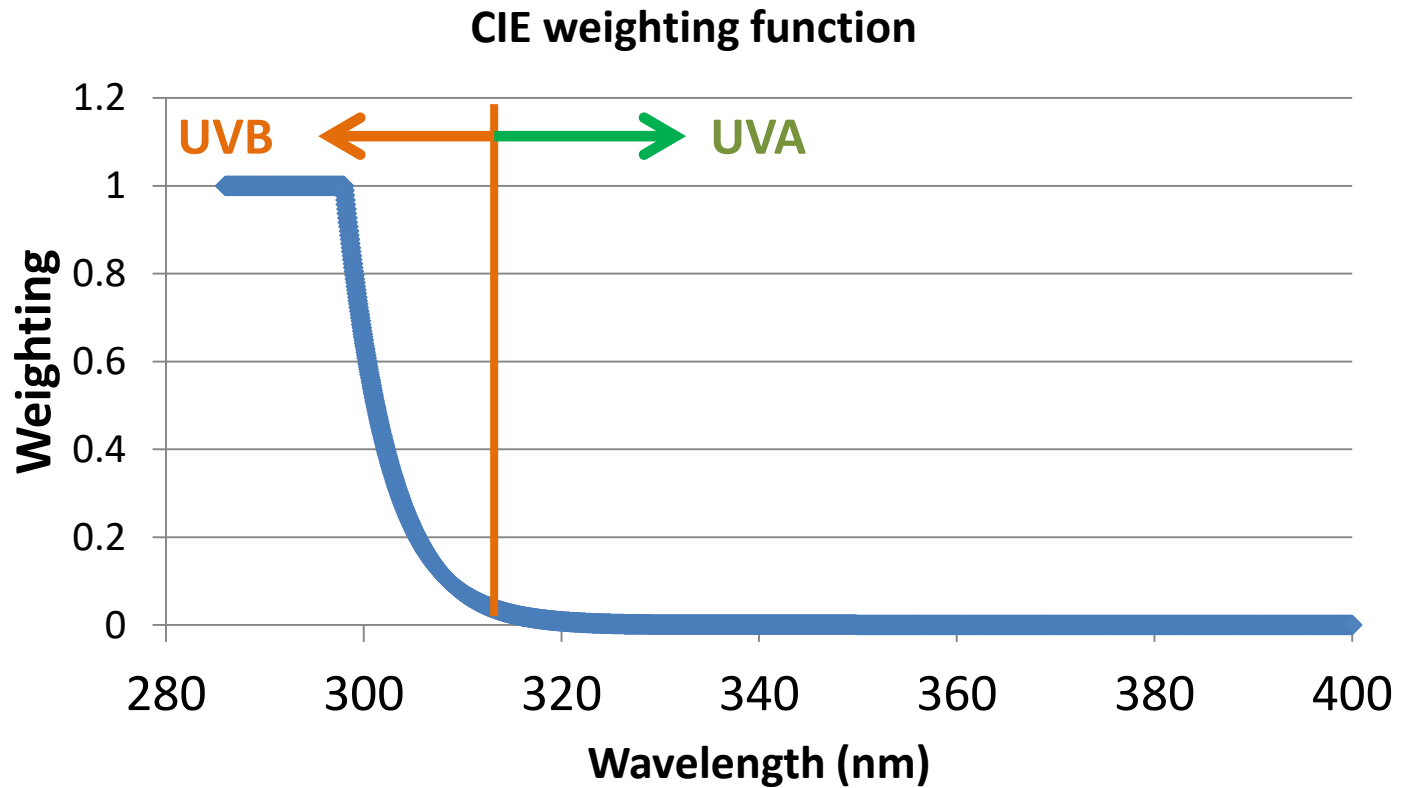


3. Personal dosimetry

- Chemical
- Biological
- Electronic
- Skin measures

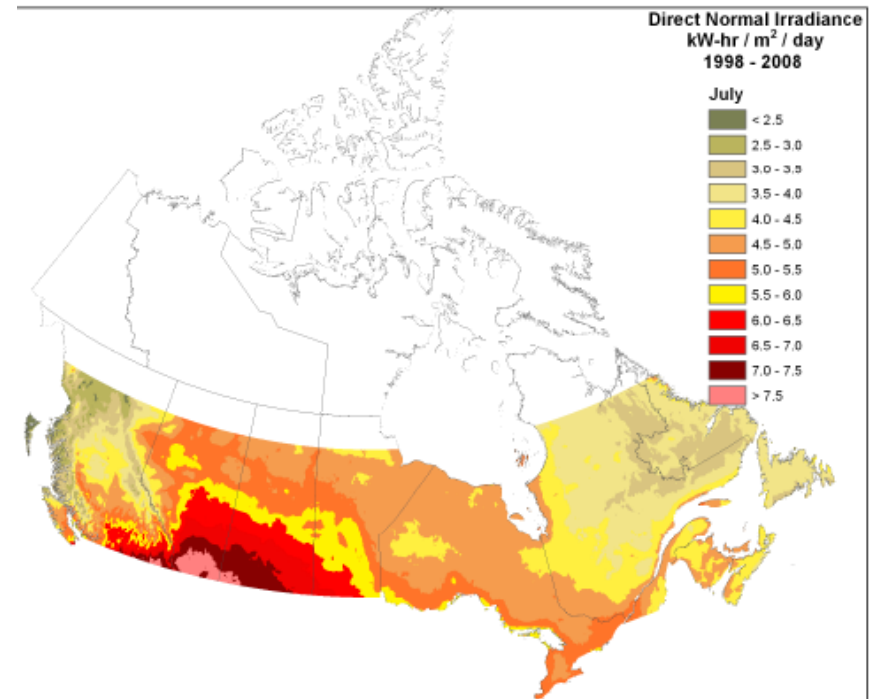
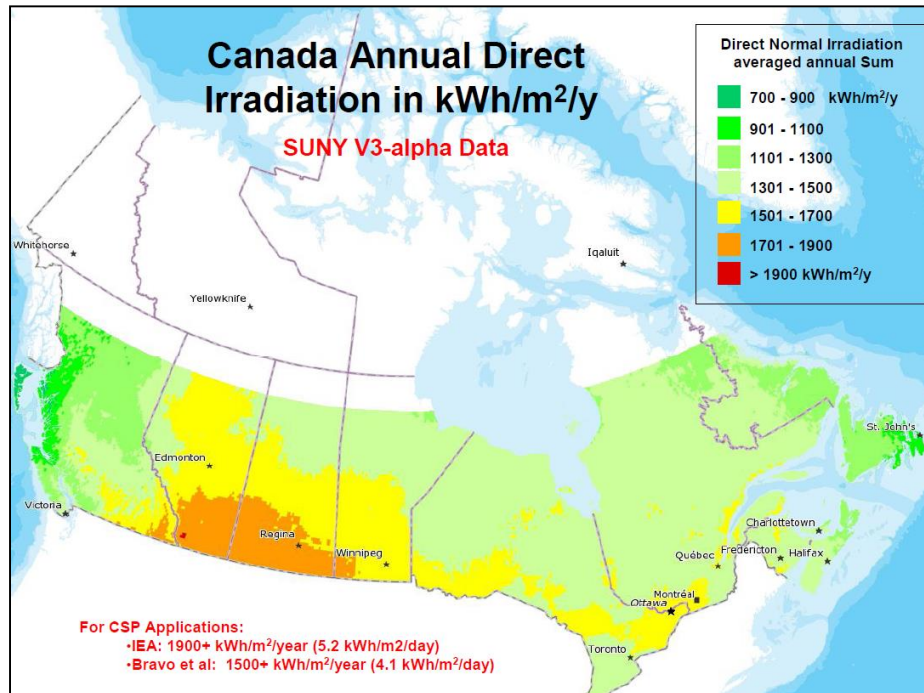


Concepts on quantifying UVR



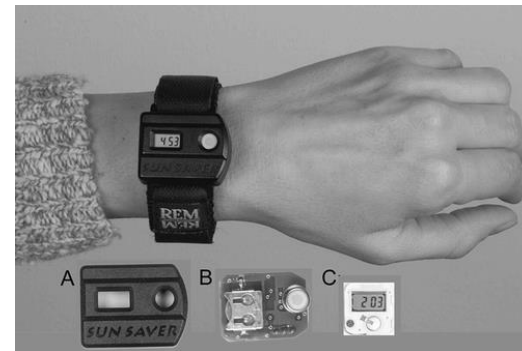
Environmental measures

Satellite –Derived Estimates of Solar Irradiance



Dosimetry: Wearable monitors

1. Biological
 - UV sensitive spores (measure inactivation), DNA (measure DNA damage)
2. Chemical (measure a predictable colour change)
 - Normally polysulfone
3. Electronic (photodiodes)
4. More unique: monitor vitamin D levels, change in skin colour



Summarizing Part 1 on the challenges

1. Lack of awareness as an occupational hazard, even though it has a large impact
2. Unclear how to do effective prevention
3. Exposure assessment challenges



PART 2: MEASUREMENT STUDY



The Outdoor Workers Study: Solar exposure in Alberta's outdoor workers

Research questions:

1. What are the typical full-day UVR exposure levels for outdoor workers in Alberta?
2. What are the determinants of UVR exposure?



Rydz E et al. 2020. 'Solar ultraviolet radiation exposure among outdoor workers in Alberta, Canada.' *Environmental Research*; 189. <https://doi.org/10.1016/j.envres.2020.109902>

Outdoor Workers Study (Alberta)

1. UV dosimeter



2. Questionnaire

2. In the summer, on average, how many hours are you outside per day between 10 AM and 4 PM... on days when you are NOT AT WORK?

1 hour or less.....0
 2 hours.....0
 3 hours.....0
 4 hours.....
 5 hours.....0
 6 hours.....0

3. How often do you spend time in the sun in order to get a tan?

NEVER RARELY SOMETIMES OFTEN ALWAYS

4. How many times LAST SUMMER did you have a red OR painful sunburn that lasted (Circle one response)

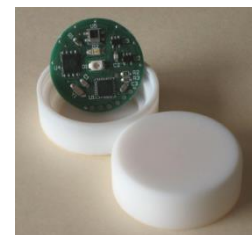
0 1 2 3 4 5+

a place of mind Page 1 of 4 Questionnaire



1. Dosimeters

- The Mark II electronic dosimeter
- Wireless, data-logging. Stores >1,000,000 data points (2MB)
 - Frequency: 8 seconds to 18 hours, battery life 1 year (rate dependent)
 - Programmable for time of day
 - Measures in erythemal dose ('sun-burning' UV radiation)
 - Requires regular calibration



(a)



(b)



2. Questionnaires

- Risk factors:
 - Skin type (pigmentation, freckling, hair/eye colour)
 - Demographics (age, sex, family history)
 - Past exposure (childhood sunburns)
 - Tanning and sun protection behaviours
- Information on current job, longest job

2. In the summer, on average, how many hours are you outside per day between 10 AM and 4 PM.. on days **when you are NOT AT WORK?**

1 hour or less.....0
2 hours.....0
3 hours.....0
4 hours.....
5 hours.....0
6 hours.....0

3. How often do you spend time **in the sun** in order to get a tan?

NEVER RARELY SOMETIMES OFTEN ALWAYS

4. How many times **LAST SUMMER** did you have a red OR painful sunburn that lasted
(Circle one response)

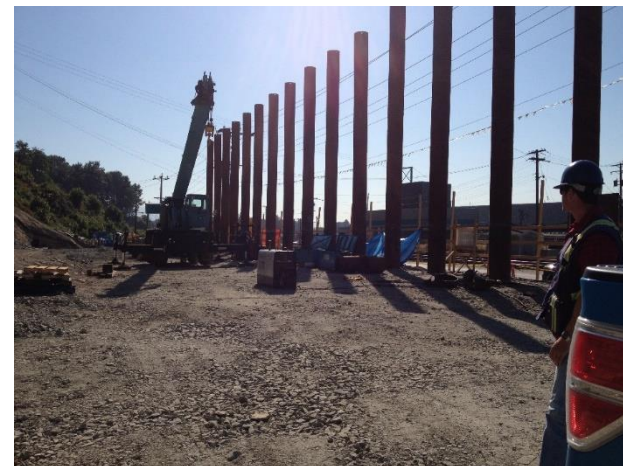
0 1 2 3 4 5+

a place of mind Page 1 of 4 Questionnaire



Statistical analysis

- Jobs categorized into groups:
 1. **Trades** (e.g. carpenters, concrete labourers, plumbers)
 2. **Recreation** (e.g. coaches, dog walkers)
 3. **Landscape/maintenance** (e.g. golf course maintenance, groundskeepers, parks labourers)
 4. **Security** (e.g. campus security, parking enforcement)
 5. **Professional services** (e.g. mail delivery, industrial hygienists)
- We used mixed models to allow repeated measures (person and day), outcome in SED_{day}

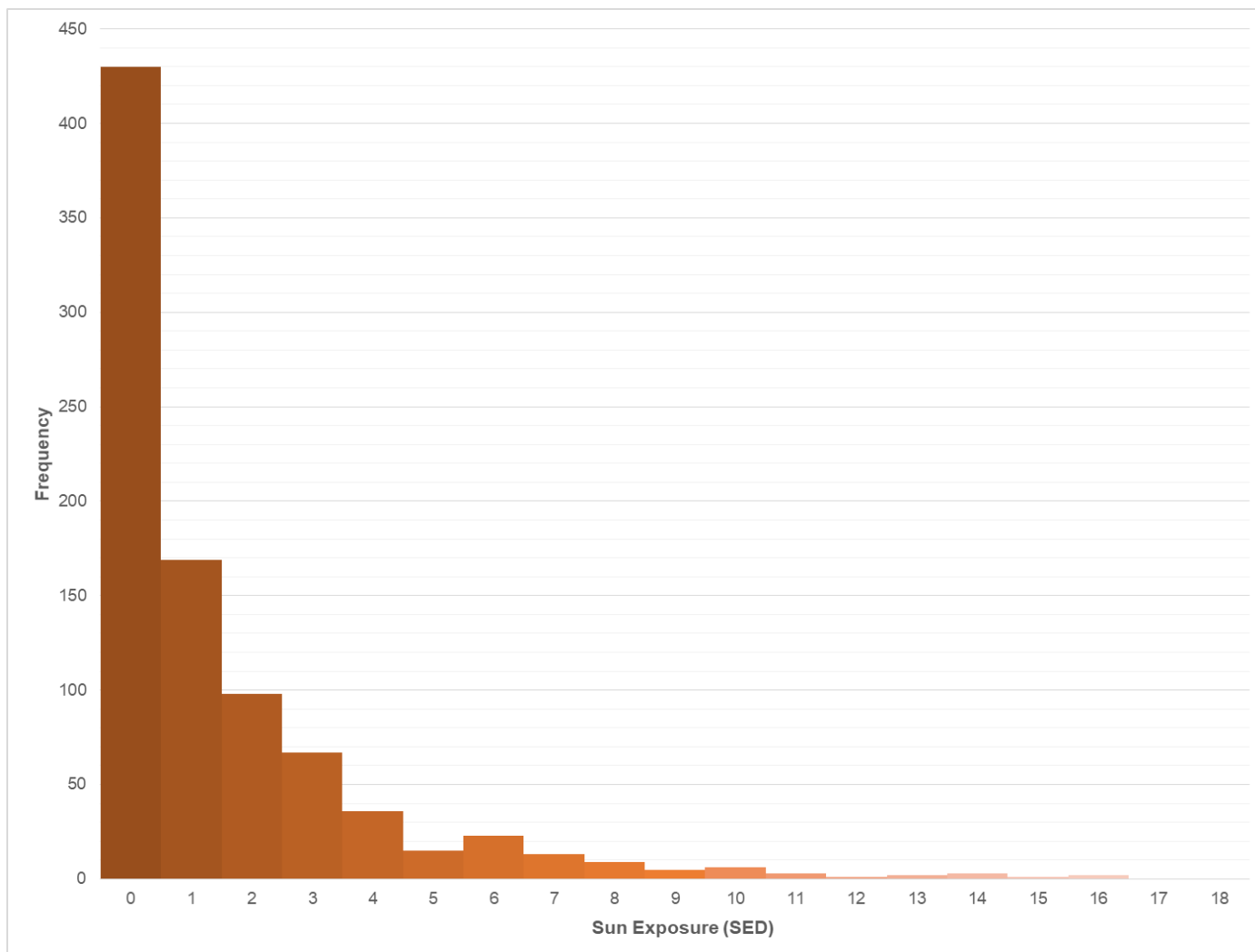


Recruitment and demographics

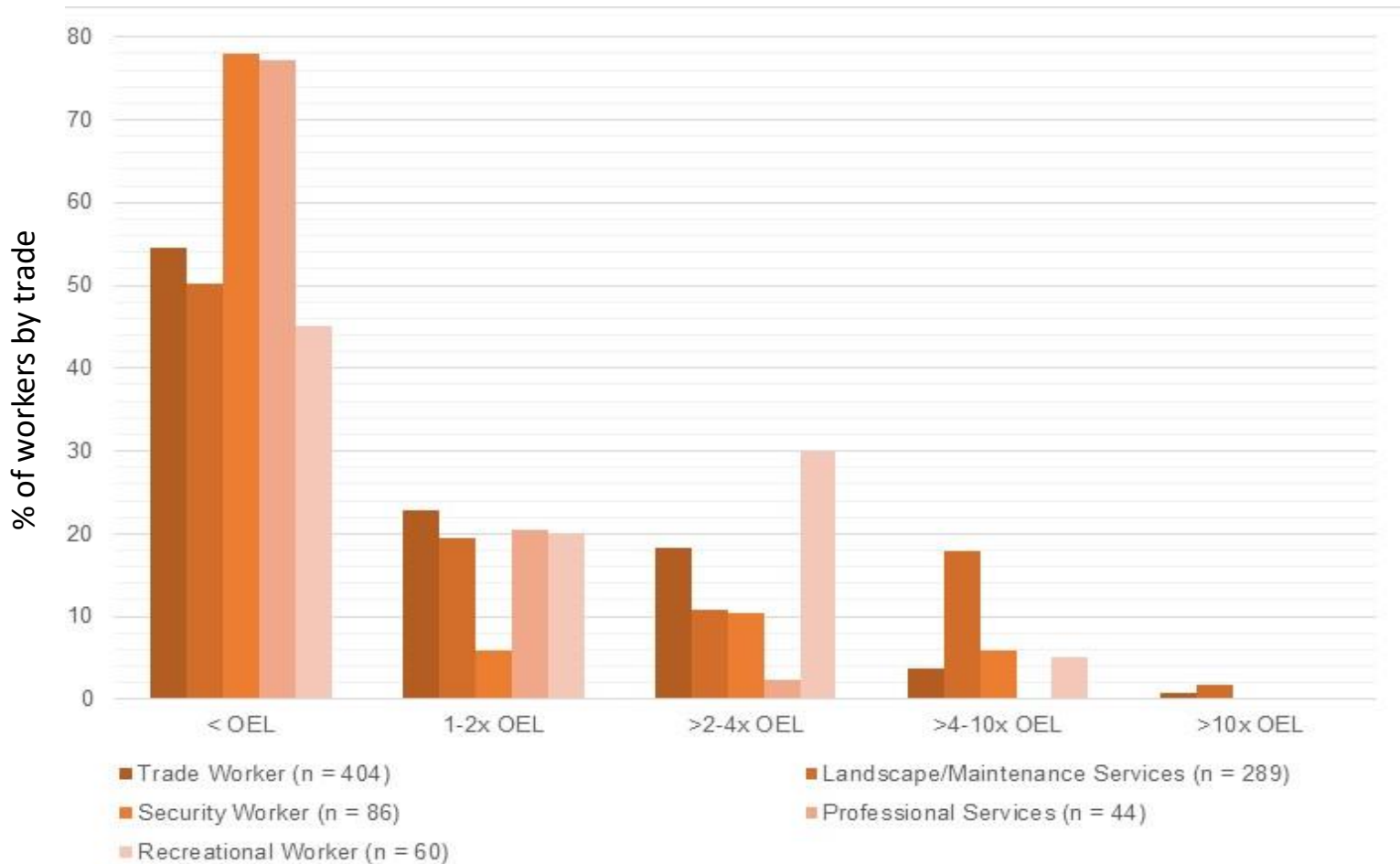
Characteristic	Outdoor workers
Total number	179
Sex (n males, %)	133 (75%)
Age (mean, range)	37 (14-70)
Race (n Caucasian, %)	134 (75%)
Yes to childhood sunburn (n, %)	99 (56%)
Blonde or red hair (n, %)	31 (17%)
Light-coloured eyes (n, %)	90 (50%)
Skin types I or II (n, %)	52 (31%)
Job group	
• Trades	82 (46%)
• Recreation	12 (7%)
• Landscaping/maintenance	52 (29%)
• Security	17 (9%)
• Professional services	16 (9%)
Weather (days)	
• Sunny	184 (21%)
• Mixed	467 (53%)
• Cloudy	232 (26%)
Location	
• Calgary	78 (44%)
• Edmonton	79 (44%)
• Other	22 (12%)



Distribution of exposure measurements



Distribution of exposure by recommended exposure limit



UVR dose results, corrected for repeated measures

Corrected for repeated date and subject	SED _{day} (SE)	p-value
Mean		
All subjects (n=179)	1.93 (0.13)	-
Sex		
Male (n=133)	2.00 (0.15)	0.388
Female (n=45)	1.74 (0.27)	
Age		
All subjects (β, SE)	0.004 (0.01)	0.639
Hair colour		
Red/light blonde (n=31)	3.01 (0.30)	0.001
Dark blonde/brown (n=64)	1.64 (0.22)	
Dark brown/black (n=84)	1.79 (0.23)	
Skin type		
I and II (very fair and fair) (n=52)	1.98 (0.25)	0.922
III (white to olive) (n=72)	1.85 (0.21)	
IV - VI (olive to brown and darker) (n=44)	1.93 (0.28)	
Job group		
Trades (n=82)	1.90 (0.19)	<0.001
Recreation (12)	1.84 (0.49)	
Landscape / maintenance services (n=52)	2.64 (0.23)	
Security (n=17)	0.73 (0.42)	
Professional services (n=16)	0.81 (0.46)	
Placement of badge		
Lapel/watch (n=152)	1.61 (0.13)	<0.001
Hardhat (n=27)	3.59 (0.30)	
Hours outside per day (at work)		
All subjects (β, SE)	0.21 (0.08)	0.011



Predictors of SED_{day}

Situational factors

Determinant of exposure	SED _{day} model*	
	Coefficient (SE)	p-value
Time outside		
Hours outside / day	0.26 (0.06)	<0.001
Forecast		
Cloudy	-0.78 (0.11)	
Mixed	-0.02 (0.10)	<0.001
Sunny	0 (ref)	
City/Region		
Edmonton	0.12 (0.17)	
Other	0.63 (0.28)	0.075
Calgary	0 (ref)	
Dosimeter placement		
Hardhat	0.46 (0.11)	0.030
Lapel/watch	0 (ref)	

Personal factors

Determinant of exposure	SED _{day} model*	
	Coefficient (SE)	p-value
Education		
High school or less	0.29 (0.18)	
Some college	-0.14 (0.17)	0.052
Completed college +	0 (ref)	
Hair colour		
Dark brown/black	-0.06 (0.16)	
Red/blonde	0.33 (0.20)	0.121
Dark blonde/light brown	0 (ref)	
Trade		
Landscape/maintenance	-0.03 (0.18)	
Professional services	-0.55 (0.31)	0.003
Recreational worker	0.18 (0.29)	
Security worker	-0.98 (0.26)	
Trades	0 (ref)	



*Other variables considered: race, sex, age, skin type, eye colour, number of burns in the previous summer

Summary: What factors predicted increased sun exposure?

Weather related factors

- Sunny + mixed = higher



Select personal factors

- Education
- Hair colour



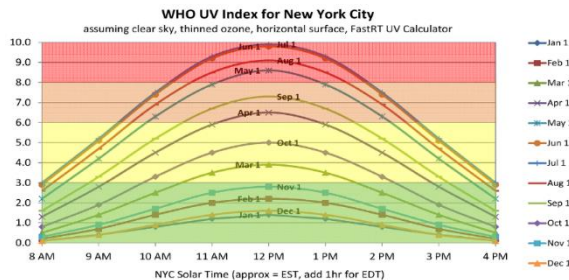
Job title

- Trades and recreation workers = higher exposure



Time outside

- Portion of day spent working outside



Badge placement

- Hardhat = higher UV measurement



Summary: Which factors *didn't* matter as much?

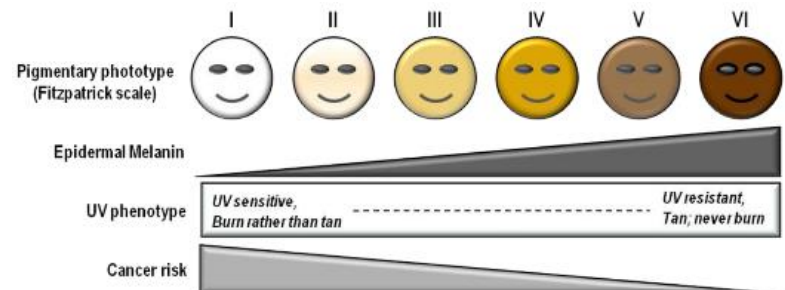
Demographics

- Age
- Race
- Sex



Physical characteristics

- Skin type (fairness)
- Number of sunburns in the previous summer
- Eye colour



Strengths & Limitations

Strengths

- First study to objectively characterize UVR exposure in Alberta
- Dosimeters are novel, wireless, and reusable
- Raising awareness and building capacity for the development of prevention programs in the future
- We lost very little data

Limitations

- Not likely representative of a “normal” Alberta summer (it was cloudy and rainy a lot of the time in the summer of 2019!)
- Comparison to other studies



Conclusions of Study



- Exposure to UV radiation from the sun is high enough to be of concern in Alberta, even in a “low” exposure summer
- There was no meaningful difference in exposure between sunny and mixed weather days
- Jobs at particular risk of high exposure were recreation workers and those in the construction trades

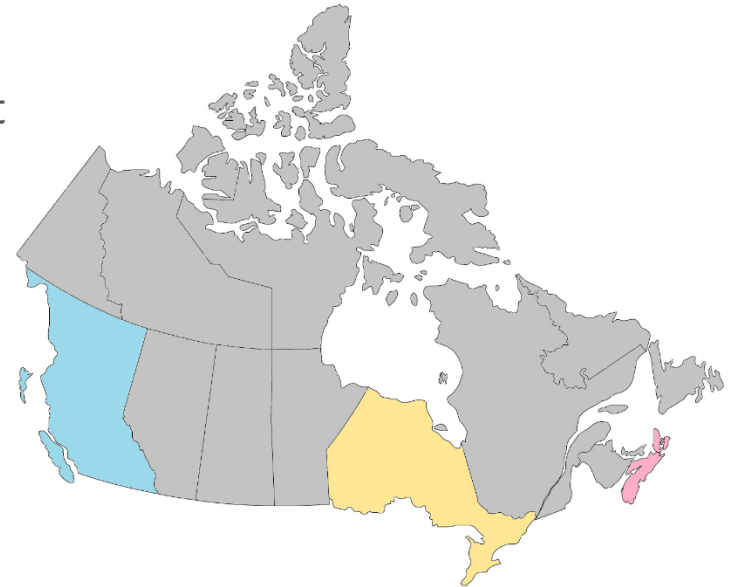


PART 3:
SUN SAFETY
PROGRAMS FOR
WORKPLACES



Sun Safety at Work Canada

- National Project
- Funded by the Canadian Partnership Against Cancer (CPAC)
- Project Partners:
Research -- Policy -- Practice
- Objective:
“Develop a nationally-applicable, evidence based, effective and sustainable sun safety program for outdoor workers that will address both skin cancer and heat stress prevention and can be implemented by individual workplaces.”
- Phase 1: trial worksites (2015-2016)
- Phase 2: broader outreach & stakeholder engagement



Municipalities (10)



Electrical Utilities (4)



University (1)



856 workers



Project Highlights

- Approach with workplaces:
 - to consider sun exposure like other workplace hazards
 - To focus on prevention and management of health risks
- Importance of sun safety and minimizing UV exposure
- Personal stories and connection to skin cancer
- Readiness to Change – varied across workplaces
- PPE use to protect workers high
- Use of education to raise awareness of the issue
 - Safety talks, daily crew talks, posters, handouts, sun safety week
- Informal Administrative Controls – i.e. monitoring of weather reports and adjusting daily work schedules
- Differences across industry

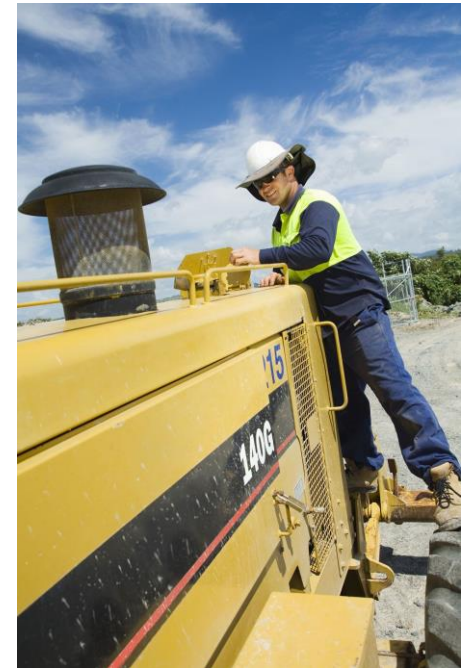


Image provided by
Queensland Department of
Health



Challenges

- Seasonality of hazard
- Hazard elimination – can the sun be completely eliminated?
- Causation of sun-related injury (recreational or occupational)
- Competing priorities of workplace hazards
 - Legislation does not include specific exposure limits regarding solar UVR
 - Stronger legislation in relation to heat stress
- Capacity of OHS Professionals
- Budgetary constraints
- Workplace culture
- Social Norms – societal attitudes and beliefs



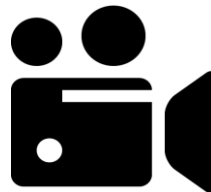
Tools & Resources

Website

sunsafetyatwork.ca



Videos



Produced in partnership with



Resources

UV Radiation & Outdoor Workers Facts



SUN EXPOSURE AT WORK
 The sun is our main source of exposure for ultraviolet (UV) radiation.
 Outdoor workers often work for an extended period of time in the sun and during the periods of the day when solar UV is strongest.
 Outdoor workers often report levels of solar UV exposure which exceed recognized standards.



SUN EXPOSURE & YOUR SKIN
 Exposure to UV from the sun and artificial sources can lead to skin damage, including:
 - Skin Cancer
 - Sunburn
 - Skin damage

SKIN CANCER
 UV from the sun is the primary cause of skin cancer.
 UV from artificial sources, such as tanning beds, are also known to cause cancer.
 Skin cancer is the most commonly diagnosed cancer in Canada, and rates are increasing.
 Outdoor Workers are 2.5 - 3.5 times more likely to be diagnosed with skin cancer*.
 Skin cancer is highly preventable.



SKIN CANCER RISK FACTORS

- Numerous, irregular, or large moles
- Fair skin, freckles, light hair and eyes
- Personal history of skin cancer
- A strong family history of skin cancer
- History of tanning sunbath



SUNBURN SYMPTOMS INCLUDE
 RED, BURNING, OR PAINFUL SKIN.
SEEK MEDICAL ATTENTION.
USE SKIN LOTIONS (AVOID TOPICAL ANAESTHETICS) AND WORK IN THE SHADE



SUN EXPOSURE & YOUR EYES
 Long term exposure to UV from the sun can affect workers and lead to eye damage, including:
 - Eye-related muscular degeneration
 - Cataracts
 - Cornea maculars and elsewhere on the eyeball
 - Pterygia (a tissue growth on the white of the eye)

PROTECT YOUR SKIN AND EYES FROM THE SUN

- 1 Cover up: wear hats, clothing, sunglasses and pants
- 2 Protect your eyes: use UV protective eyewear
- 3 Cover your head, neck and ears: wear a wide brimmed hat, band hat with a brim and use a neck flap to protect your head, neck and ears
- 4 Take your break in the shade: get out of the sun when you can, especially between 10am-4pm, when UV radiation is the strongest
- 5 Use sunscreen and lip balms: use at least a SPF 30 broad spectrum, water-resistant sunscreen, and don't forget to reapply
- 6 Be alert: self-report changes in skin spots or moles to your doctor as soon as possible and seek attention to important

SYMPTOMS OF EYE DAMAGE:

- Common symptoms include pain, inflammation of the cornea (i.e. the front part of the eye), sensitivity or reaction to light, UV burns, swollen flesh, slow healing, tear film (tear) on the UV exposed eye
- Eye damage from UV exposure can be permanent. Use eye protection and have your eyes checked annually by your eye doctor

SEE YOUR EYE DOCTOR IF YOU EXPERIENCE ANY SYMPTOMS

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 Sun and Eye Health Campaign 2017
 Produced by W.S.B.C.
 © 2017 WorkSafeBC
 www.worksafebc.com
 www.sunsafetyatwork.ca
 *The report is based on the Canadian Cancer Society and Health Canada



Website landing page

SUN SAFETY AT WORK

Glossary Resource Basket Search

ABOUT US WHAT IS SUN SAFETY? SUN SAFETY PROGRAMS RESOURCE LIBRARY

Enhancing Sun Safety in Canadian Workplaces

WHAT IS SOLAR ULTRAVIOLET RADIATION?

UV INDEX

1

CALGARY, AB
© Don't use device detection

YOUR SUN SAFETY PROGRAM

Build Your Own Sun Safety Program

YOUR ROLE IN SUN SAFETY

Considerations for sun safety based on your role and responsibilities.

HOW CAN HEAT FROM THE SUN HARM US?

HUMIDEX

-1

SUN SAFETY FACTS

EVEN IN WINTER, YOU NEED TO BE AWARE OF THE SUN AND UV RADIATION.

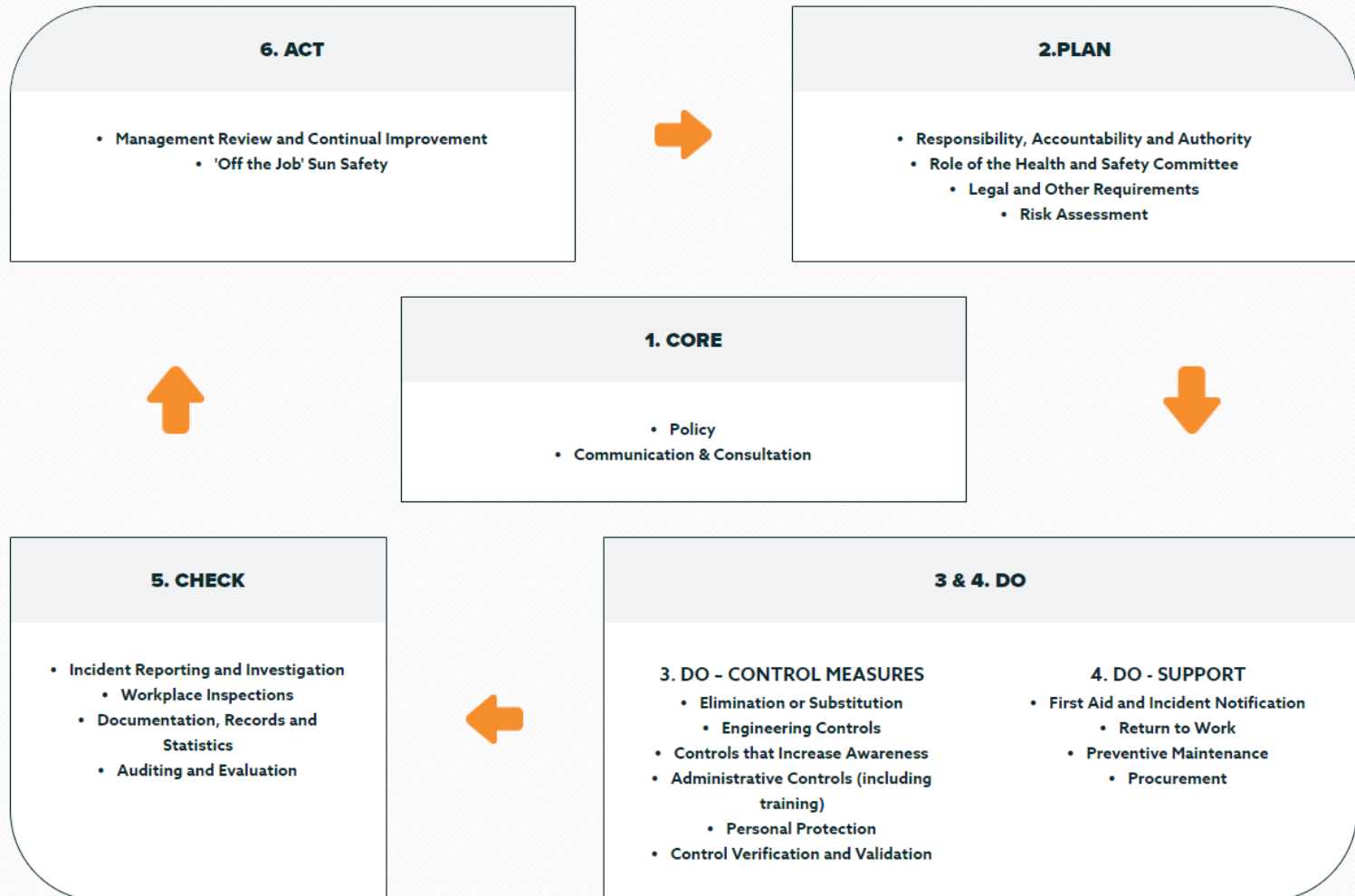
LEGAL REQUIREMENTS

Legal considerations based on your residing province.



Tools and supports for customizing a sun safety program

MODEL SUN SAFETY PROGRAM



Summary & next steps



UVR sampling campaigns should be undertaken in subsequent summers in AB & Canada



Improving exposure assessment and skin cancer surveillance will improve understanding



Other hazards experienced by outdoor workers – these should be part of the conversation



A few more references

1. Rydz E, Arrandale VH, Kalia S, Harper A, Leong B, Forsman-Phillips L, Holness DL, Tenkate T, Peters CE. 'Sun protection use at work and leisure by outdoor workers in Alberta, Canada.' *JOEM*, published online, December 2020.
https://journals.lww.com/joem/Abstract/9000/Sun_Protection_Use_at_Work_and_Leisure_by_Outdoor.97993.aspx
2. Peters CE, Heer E, Tenkate T, O'Reilly R, Kalia S, Koehoorn MW, 2020. 'Strategic task and break timing to reduce occupational exposure to solar ultraviolet radiation.' *Frontiers in Public Health*:
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4. Peters CE, Pasko E, Strahlendorf P, Holness DL, Tenkate T. 'Solar ultraviolet radiation exposure among outdoor workers in three Canadian provinces.' *Annals of Work Exposures and Health*, 63(6):679-688.
5. Mofidi A, Tompa E, Spencer J, Calcevich C, Peters CE, Kim J, Mortazavi SB, Demers PA. 2018. 'The Economic Burden of Occupational Non-Melanoma Skin Cancers Due to Solar Radiation,' *J Occup Environ Hyg*, 15(6):481-491
6. Peters CE, Demers PA, Kalia S, Nicol AM, Koehoorn MW. 2016. 'Levels of occupational exposure to solar ultraviolet radiation in Vancouver, Canada.' *Ann Occup Hygiene*, 60(7):825-35.
7. Peters CE, Koehoorn MW, Demers PA, Nicol AM, Kalia S. 2016. 'Outdoor workers' use of sun protection at work and leisure.' *Safety and Health at Work*, 7(3):208-212.



Thank you!

Questions?

<https://www.carexcanada.ca/resources/communications/>
@CAREXCanada on Twitter

I would like to acknowledge the funding support for monitoring study from Alberta Labour and Immigration's OHS Futures grant program, and the Canadian Partnership Against Cancer for funding CAREX Canada and the Sun Safety at Work Canada Program

