Sun safety and outdoor workers:

Review of the literature on intervention effectiveness.

17 November 2025

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Cancer Council NSW is proud to be supported by the EML Group on this project.

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Foreword

Cancer Council NSW is a community funded not for profit. We are the largest cancer charity in NSW and our point of difference is that we work across every area of every cancer, including research, prevention, advocacy and support.

We believe in a cancer-free future. Our guiding principles are the foundation for ongoing strategic decision making across the organisation.

- **We are evidence based and focused on impact:**
  Our work is informed by research, evidence and data, and we prioritise activities with the greatest impact.
- **We are community focused:**
  We put people at the centre of what we do and how we do it.
  We develop long-lasting relationships with our communities.
- **We strive for equitable cancer outcomes:**
  We are committed to addressing disparities in those disproportionately affected by cancer.
- **We work where we are effective and best placed to lead:**
  We prioritise our efforts based on our expertise, and we partner with others to maximise impact and reduce duplication.

Cancer Council NSW has focused on promoting skin cancer prevention for several decades. The goal of the Skin Cancer Prevention Unit within Cancer Council NSW is to reduce the burden of skin cancer amongst the general population by encouraging the uptake of regular sun protection practices that reduce overexposure to UV radiation.

The priorities of the Skin Cancer Prevention Unit reflect the strategic focus of the Cancer Institute NSW, the lead government agency for skin cancer prevention in New South Wales, represented through the NSW Skin Cancer Prevention Strategy[1].Our priority populations are children, adolescents, young adults, outdoor workers and men aged 40+ years. Our priority settings are those where people live, learn, work and play, and include education, workplaces, sporting organisations and recreational settings. The team works to provide supportive sun safe environments and enable individual behaviours that reduce the risk of skin cancer and improve the health and wellbeing of people living in NSW. The team takes a settings-based approach to health promotion, and utilises evidence, best practice theories and approaches to developing innovative programs and services. We focus on primary prevention strategies as they are the most effective in preventing sun damage before it occurs.

Cancer Council NSW is proud to be supported by the EML Group on this outdoor worker sun safety project. This project closely aligns with goal 1 of the NSW Skin Cancer Prevention Strategy and the three priorities identified under this goal:

- To build capacity and leadership of public, private sector and community partners to implement skin cancer prevention in their respective settings.
- To continue to develop, share and promote adoption of evidence-based sun/UV radiation protection policies and procedures.
- To align skin cancer prevention with actions focused on complementary benefits of sun/UV protection.

This literature review has been developed to have national applicability for all those interested in making a difference and protecting all Australians who work outdoors from the harsh UV radiation from the sun.

Executive Summary

Sun safety in the workplace is a critical health and safety concern, particularly for workers who are regularly exposed to ultraviolet radiation (UV) from the sun. In Australia, repeated and long-term occupational exposure to UV is a significant contributor to skin cancer.[2] A review of global literature conducted by Cancer Council NSW highlights several common workplace risks related to UV exposure, including increased risk of skin cancer, eye damage, and premature aging. National estimates indicate that workplace exposure leads to approximately 200 melanomas and 34,000 non-melanoma skin cancers (NMSCs) annually.[3] More recent data from 2021 suggests that 2.4 million Australian workers were occupationally exposed to solar UV, with projections estimating 8,850 future melanomas attributable to lifetime workplace exposure.[4]

The financial and legal implications of workplace sun exposure are substantial. Between 2000 and 2009, sun exposure accounted for 51% of compensated cancer claims in Australia.[5] From 2008-09 to 2021-22 1,688 workers' compensation claims were accepted for sun-related injuries and diseases, costing $63.6 million in compensation payments.[6]

Evidence supports various workplace interventions that can effectively reduce the incidence of skin cancer and other sun-related health issues. Notably, skin cancer prevention policies in Australia have been shown to deliver a return of $3.20 for every $1.00 invested.[7]

Employers have a legal and ethical obligation to mitigate the risks associated with sun exposure by implementing protective measures, providing education, and ensuring compliance with workplace health and safety regulations.

This literature review synthesises the evidence that can underpin comprehensive and flexible, fit-for-purpose approaches to applying occupational risk mitigation strategies against skin cancers. The key insights include:

Workplace health and safety obligations relating to sun safety

Workplace health and safety regulations require employers to assess and manage risks associated with sun exposure. These obligations include:

- **Policy implementation:**
  Establishing and enforcing sun safety policies that align with national occupational health and safety guidelines.
- **Risk assessment and control measures:**
  Identifying hazards related to sun exposure and implementing control measures to minimise risks.
- **Provision of protective equipment:**
  Supplying sun-protective clothing, hats, sunglasses, and broad-spectrum sunscreen to outdoor workers that comply with Australian standards.
- **Work scheduling adjustments:**
  Where possible, scheduling outdoor tasks during early mornings or late afternoons when UV levels are lower.
- **Education and training:**
  Ensuring workers are adequately inducted and informed about the dangers of UV exposure and trained on effective sun protection strategies.

Common workplace risks related to sun safety

The academic literature identifies several workplace risks associated with sun exposure for outdoor workers. These risks include:

- **Skin cancer:**
  Prolonged exposure to UV significantly increases the risk of developing melanoma and non-melanoma skin cancers.
- **Eye damage:**
  UV exposure can lead to cataracts, photokeratitis, and other vision-related issues.
- **Premature aging and skin damage:**
  Sunburn, pigmentation disorders, and premature aging are common consequences of excessive sun exposure.
- **Heat stress and dehydration:**
  High temperatures combined with sun exposure can lead to heat-related illnesses, including heat exhaustion and heat stroke.
- **Lack of awareness:**
  Many workers underestimate the risks of UV exposure, particularly on cloudy or cooler days, leading to inadequate protection.

Evidence supporting workplace interventions to prevent skin cancer

Research supports several effective workplace interventions that are sustained and multi-faceted to reduce sun-related health risks:

The following themes were found to be effective across studies:

1. **Workplace leadership and culture matter**
   Leadership, champions and organisational support were critical enablers.

2. **Policy alone is not enough**
   Policy interventions need to be supported by other strategies.

3. **Sustained multi-component outcomes are most effective**
   Multicomponent interventions consistently outperformed single strategies.

4. **Worker involvement enhanced outcomes**
   Participatory and flexible approaches improved effectiveness.

5. **Educational approaches are important**
   Educational strategies were consistently found to be effective across multiple studies.

These interventions have been shown to significantly reduce the incidence of skin cancer and other sun-related health issues among workers, reinforcing the importance of proactive and multicomponent sun safety measures in occupational settings.

This literature review provides a comprehensive summary of existing evidence and presents a compelling opportunity for employers to adopt best-practice approaches to managing identified risks.

Introduction

Sun safety in the workplace is a critical health and safety concern, particularly for workers who are regularly exposed to ultraviolet radiation (UV) from the sun. This literature review is designed to outline the key evidence supporting the need for improved UV protection practices in workplaces with outdoor workers, and to summarise best-practice approaches that have been proven to make a difference. It is intended for those seeking a deeper understanding of UV exposure in occupational settings and what works in terms of intervention strategies. The review may be particularly relevant to health professionals, researchers, policy makers and practitioners.

To support broader engagement, Cancer Council NSW has also developed concise one-page and three-page summaries of the findings. These may be especially useful for workplace managers and decision-makers looking for practical insights and quick reference materials.

The literature review report is set out in four key sections:

Section 1: An overview of the impact of skin cancer, to set the population context of UV exposure and skin cancer risk.

Section 2: A summary of the current context of skin cancer in the workplace, to set the scene with respect to workplace risks, legislation and compensation claims.

Section 3: A literature review of published studies evaluating UV safety workplace intervention effectiveness.

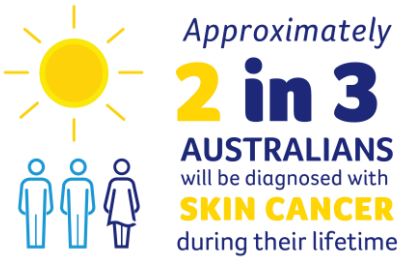
Section 4: Recommendations for best practice sun safety strategies in workplaces.

More detailed summaries of the literature that was reviewed as part of this project can be found in **Appendix 3**.

1: An overview of the impact of skin cancer

Australia has the highest rates of skin cancer and melanoma

The International Agency for Research on Cancer (IARC) estimates that in 2020, Australia had the highest age-standardised melanoma incidence rate and the equal sixth highest mortality rate of melanoma in the world.[8]



- Melanoma incidence rates in Australia and New Zealand are around 2-3 times higher than those in Canada, the United States and the United Kingdom.[8]
- Although mortality rates are quite low in Australia and New Zealand, they are still around 1.5-2.5 times higher those in Canada, the United States, and the United Kingdom.[8]
- Two in three Australians will be diagnosed with skin cancer in their lifetime.[9]

Within Australia, skin cancer is the most commonly occurring cancer

Skin cancer, including both non-melanoma skin cancer and melanoma, accounts for nearly 80% of all newly diagnosed cancers in Australia.[10] While many Australians have fair skin that puts them at greater risk of developing skin cancer,[11] people of any skin type can develop skin cancer.

The incidence and mortality rates for skin cancer by gender are summarised in Table 1.

Table 1. Australian incidence and mortality for non-melanoma skin cancer (NMSC) and melanoma

		Men	Women	Total
Incidence	NMSC (# of paid Medicare treatment services)[12]	694,020	413,817	1,107,837
	Melanoma cases[13]	11,034	7,930	18,764
	Total	n/a	n/a	n/a
Mortality	NMSC cases[14]	514	251	765
	Melanoma cases[14]	958	947	1,455
	Total	**1,472**	**748**	**2,220**

**Medicare data for numbers of services for NMSC in 2022 are available,[12] otherwise latest incidence data for NMSC is from 2002.[10] NMSC mortality includes deaths from the most common skin cancers i.e. Squamous cell carcinoma and basal cell carcinoma, and deaths from rarer NMSCs.*

- Skin cancer causes approximately 2,200 deaths annually,[14] nearly double the number of annual road deaths in Australia.[15]
- Medicare records show that over 1,100,000 paid services for non-melanoma skin cancers are provided annually, averaging over 3,000 treatments daily.[12]

Australian demographics have changed over the past few decades. With over half of Australia's population now born overseas or having at least one parent born overseas,[16] a growing number of people with dark pigmented skin from migrant communities have a lower risk of skin cancer compared to those with heritage from the British Isles or northern Europe.[17] For more information regarding how skin type can influence skin cancer risk, see the Fitzpatrick skin phototype fact sheet on the ARPANSA website.

There is also a photosensitivity condition where a person can develop an extreme sensitivity to solar UV or sunlight which can lead to adverse reactions such as rashes and sunburn following minimal sun exposure, caused by ingesting, inhaling or having skin contact with substances known as photosensitisers. The substances that cause photosensitivity can include industrial chemicals, medications, drugs, plants and some essential oils and fragrances.[18] **Appendix 1** includes common substances that increase photosensitivity.

Skin cancer is the most costly cancer to treat in Australia

- Skin cancer places an enormous strain on the Australian health system. It is Australia's most costly cancer to treat, costing the country more than $2.5 billion per year in 2023-24.[19]
- Approximately 75% of treatment costs reflect the number of non-melanoma skin cancers being treated.[19]
- Costs continue to escalate due to the presentation of more skin cancers with our ageing population and the increased costs for managing late-stage melanomas; costs have increased $600M in four years from $1.9 billion in 2020-21.[20]

Fortunately, skin cancer is highly preventable

It is estimated that up to 95% of melanomas and 99% of non-melanoma skin cancers (NMSC) in Australia are caused by overexposure to UV.[21,22] The fact that skin cancer is largely caused by UV means it can be prevented through the regular uptake of comprehensive sun protection habits. This is summarised by the phrase 'Slip, Slop, Slap, Seek and Slide' and is supported by the evaluations of the SunSmart strategies, campaigns and settings-based interventions conducted over several decades.[23, 24, 25]

Evidence from intervention studies show:

- When people protect their skin from UV through the use of clothing, sunscreen, hats, shade and sunglasses, they significantly reduce their risk.[26, 27]
- Regular sunscreen use can halve the chance of new melanomas developing.[28–30] Modelling suggests that daily sunscreen use by the Australian population would be more cost-effective in reducing new skin cancer cases and deaths compared to undertaking annual clinical skin examinations.[27]
- Using sun-protective clothing along with sunscreen offers more complete protection against the sun's harmful rays.[31]

While these intervention studies support the preventability of skin cancer in real-world contexts, motivating, reinforcing and sustaining behaviour change takes holistic and coordinated approaches that can be challenging to maintain.[32]

These challenges have informed the settings-based approaches that we take at Cancer Council NSW, with the goal to shape and normalise sun safety in the settings where people live, learn, work and play. Cancer Council NSW works closely with the Cancer Institute NSW and aligns evidence-based work with the NSW Strategic Plan.[1] An evaluation of their most recent Skin Cancer Prevention Strategy found that there were key elements driving the success of implementing the Strategy, including excellence in coordination and collaboration across sectors and strong leadership from government and non-government agencies.[33]

Skin cancer is the most common cancer in Australia, the most costly cancer to treat, and one of the most preventable cancers.

- Skin cancer prevention policies in Australia return $3.20 for every $1.00 invested.[7]
- For every $1 invested in skin cancer prevention public education campaigns in NSW a return of $3.85 is achieved.[34]
- Consistent adoption of sun safe behaviours has been modelled to result in the potential reduction of melanoma incidence across the Australian population by 44%.[27]
- Recent modelling has shown that if investment is made in preventing skin cancer, compared to no investment, cost savings over the next 10 years can amount to $3.63 billion based on Australia's current population of 25.6 million.[27]

Factors that influence the risk of UV to human health

UV from the sun is the primary cause of skin cancer

In 2009 the International Agency for Research on Cancer classified solar UV radiation as a grade 1 human carcinogen,[35] noting that there is sufficient evidence for its causal involvement in melanoma and non-melanoma skin cancers. This classification ranks UV with the same degree of seriousness as asbestos and tobacco.

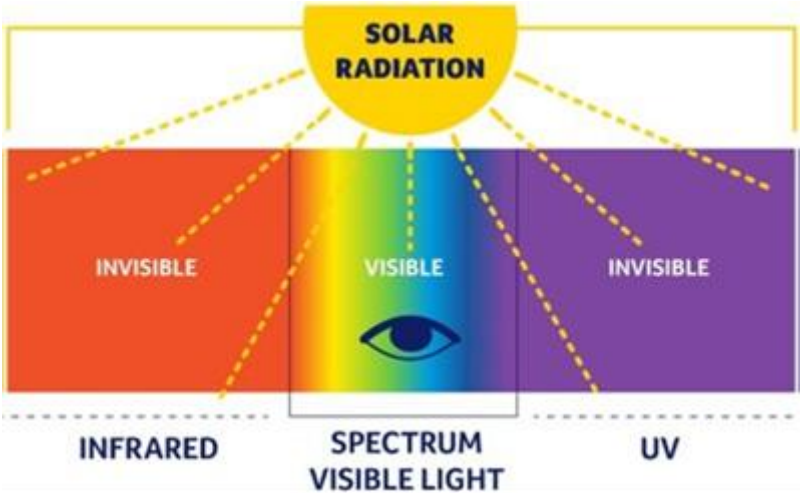
While the sun is the main source of UV, it is not the only source, as it can also come from: phototherapy; solariums; fluorescent, neon and halogen lighting; industrial arc welding; UV lamps; 'black lights'; germicidal UV lamps and UV lasers.[36]

Solar UV is part of the electromagnetic spectrum emitted by the sun and consists of three wavelengths: UVA, UVB and UVC.

- While all UVC and most UVB radiation are absorbed by the atmosphere, all UVA radiation wavelengths and about 10% of UVB radiation reaches the earth's surface.
- Both UVA and UVB are known causes of skin cancer.[35]

The sun emits different types of energy: visible light which we see as sunlight; infrared radiation which we feel as heat; and UV which we cannot see or feel.[35]

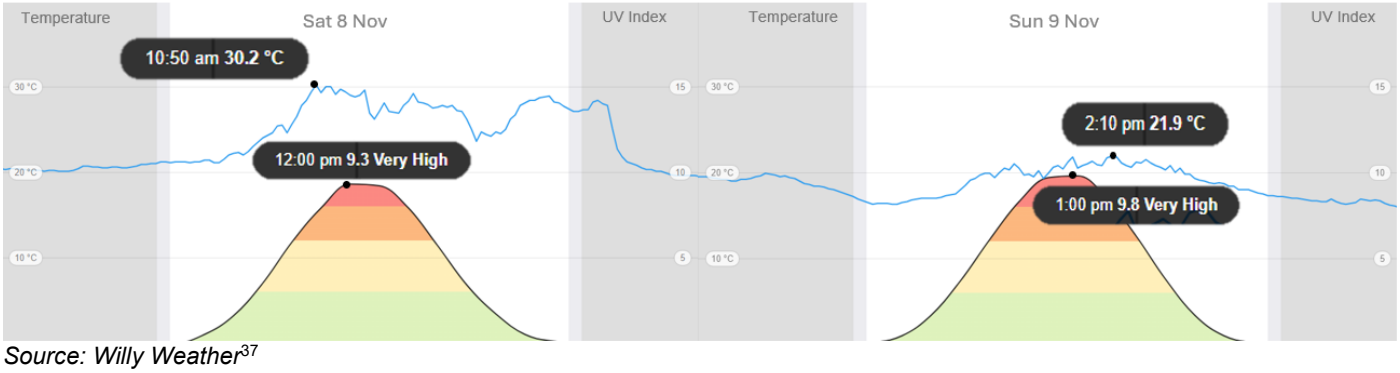
Figure 1. Electromagnetic radiation emitted by the sun



Remember you can be exposed to damaging levels of UV on cool and cloudy days – so think UV, not heat.

UV is independent of the amount of sunshine and is not related to temperature. An example is shown in Figure 2, showing a significant variation in temperature across two consecutive days in November 2025 in Sydney, where the temperature dropped by 10 degrees but the UV Index remained consistently 'very high' at 9.3 and 9.8 respectively.

Figure 2. Variation in temperature but not UV Index for two consecutive days in Sydney in 2025



Source: Willy Weather[37]

The total amount of solar UV present in the atmosphere is affected by a range of factors,[35] including:

- **Sun elevation:**
  - UV levels are higher in the middle of the day and during summer.
  - UV is greatest in summer as the sun is high in the sky, and its rays pass through less atmosphere before reaching the earth's surface.

- In winter, the sun is lower in the sky, and its rays have a longer course through the atmosphere, resulting in more UV being absorbed and lower UV levels.

- **Latitude:**
  - The closer to equatorial regions, the higher the level of solar UV.
- **Cloud cover:**
  - Solar UV can pass through light cloud cover, and on lightly overcast days the intensity of solar UV can be similar to a cloud free day.
  - Heavy cloud can reduce the intensity of solar UV.
  - Scattered cloud has a variable effect on levels of solar UV, which rise and fall as clouds pass in front of the sun.
- **Altitude:**
  - At higher altitudes, the atmosphere is thinner and absorbs less solar UV, increasing the risk of sun damage.
- **Ozone:**
  - Ozone absorbs some of the solar UV that would otherwise reach the earth's surface.
- **Reflective surfaces:**
  - Some building and ground surfaces like polished aluminium, construction materials, lightly coloured concrete and water can reflect solar UV, increasing the risk of sun damage.

Measuring the intensity of UV

The UV Index is a measure describing the strength of the sun's UV on any given day, with levels ranging from 1-2 (low) to 11+ (extreme), as shown in Figure 3. The higher the number, the greater the UV and the less time it takes for damage to occur.[38]

Sun-protection is recommended when the UVI reaches three (moderate) or above (except for prolonged time outdoors)

- When the UV Index reaches three (moderate), sun protection is recommended for the general population.
- However, those who spend prolonged periods of time outdoors, such as outdoor workers, are an exception due to the cumulative UV damage they receive. As a result, it is recommended that outdoor workers engage in sun protection measures every day of the year, regardless of the UV level.

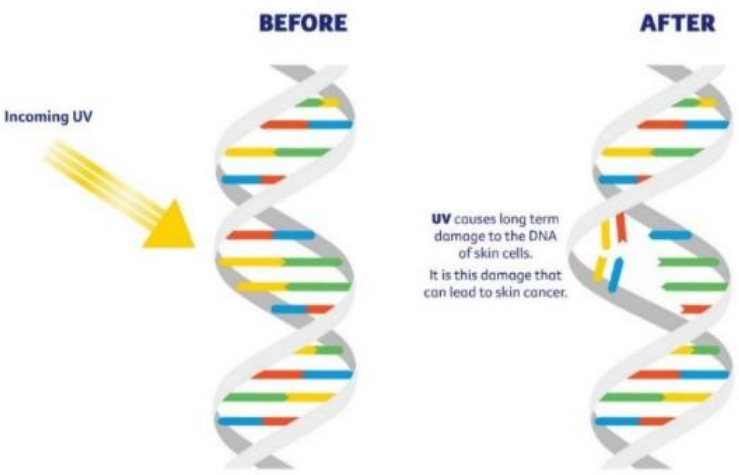
Figure 3. The UV Index

When unprotected skin is exposed to UV, DNA damage can occur, which is permanent, irreversible and increases with each exposure.[39]

- Short-term sun damage can be visible, presenting as skin reddening, sunburn or a suntan, while other damage can take many years to surface, such as premature ageing of the skin and skin cancer.[40]

When a person's skin is not protected from the sun, the incoming solar UV can damage the DNA in their skin cells. While human bodies can repair some of the DNA damage in skin cells, it can't repair all of it. The unrepaired damage builds up over time and can trigger mutations that cause skin cells to multiply rapidly. This can lead to skin cancer. See Figure 4.

Figure 4. An illustration of how UV can damage DNA



Solar UV in Australia

Australia has one of the highest levels of solar UV exposure in the world.[41] This is due to Australia's proximity to the equator and the earth's tilt in relation to the sun, resulting in the southern hemisphere being closer to the sun during its summer compared to an equivalent latitude during summer in the northern hemisphere. Table 2 shows how UV Index levels change throughout the year in different parts of Australia.

Table 2. Mean of daily maximum UV Index by month and location across Australia

Location	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Darwin	8	10	12	12	12	12	12	13	13	11	9	8
Townsville	6	8	10	11	12	12	13	13	12	9	7	6
Emerald	5	7	8	10	11	12	13	12	11	8	6	5
Alice Springs	5	7	9	10	11	12	13	13	11	8	6	5
Brisbane	4	5	7	9	10	11	12	11	9	7	5	4
Gold Coast	4	5	7	8	10	11	12	11	9	7	5	4
Perth	3	4	6	8	10	11	12	11	9	6	4	3
Newcastle	3	4	6	8	9	10	11	10	8	6	3	2
Sydney	3	4	5	7	9	10	11	10	8	5	3	2
Adelaide	2	3	5	7	9	11	11	10	8	5	3	2
Canberra	2	3	5	7	9	10	11	10	7	5	3	2
Melbourne	2	3	4	6	8	10	10	9	7	4	2	2
Kingston	1	2	3	5	7	9	10	8	6	3	2	1

UV Index exposure categories

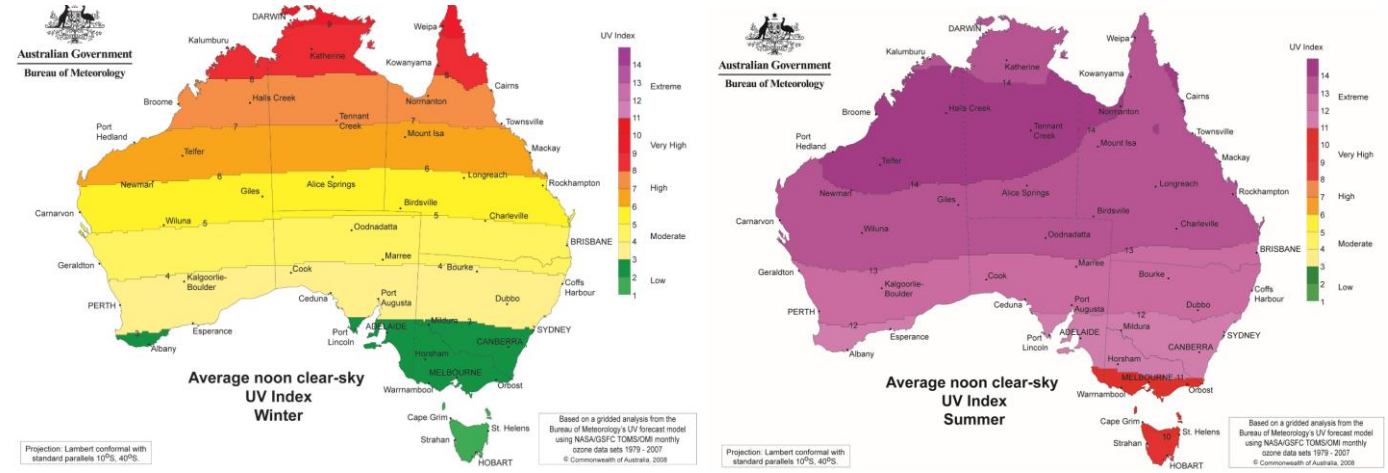
Category	Low	Moderate	High	Very High	Extreme

Sun protection is required in Australia most months of the year, and all year round for outdoor workers

Source: The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

Figure 5 shows the estimated clear-sky average for the solar UV Index at noon for an Australia winter and summer. It clearly indicates that for most of the year, the UV levels are high enough to damage unprotected skin (i.e. a UV Index of 3 or above).

Figure 5. Average UV levels for winter and summer in Australia on a clear sky day at noon



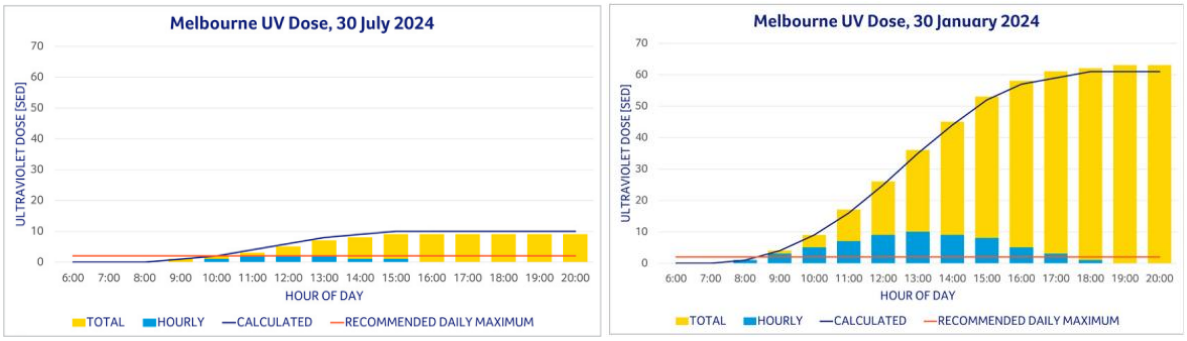
Source: Bureau of Meteorology

Measuring the duration of exposure to UV

The degree of skin damage from UV is determined by both the intensity of the UV (i.e. as measured via the UV Index) and the duration of the exposure (i.e. the dose of UV). A Standard Erythemal Dose (SED) provides a standardised measure of the dose of UV experienced over time, with just one SED per day being considered safe for most people.[42] For example, a short exposure period outside during high levels of UV may have a similar total SED to a longer period of outdoor exposure during lower UV times. A dose of two SEDs can be enough to cause a burn for people with pale skin. For example, when the UV Index is extreme, this dose can be delivered in 12 minutes or less.

Figure 6 illustrates the number of SEDs - hourly and the total - that can be accumulated on a winter and summer's day in Melbourne. The red line shows the maximum daily recommended SED (i.e. 1 SED) that is considered safe for most people; the hourly amount of UV exposure is shown in blue; and the total daily exposure of SEDs is shown in yellow. It can be seen that on a winter's day in Melbourne, where there is a maximum UV Index of 2, the dose of UV that would be experienced by someone outside the whole day is 9 times greater than the recommended daily maximum dose (i.e. 9 SEDs). During summer in Melbourne, on a day where the UV Index is due to reach 10, the daily dose of UV for someone outside all day is 63 times greater than the maximum daily dose recommended (i.e. 63 SEDs).

Figure 6. Hourly accumulation of SEDs on a winter versus summer day in Melbourne



Source: Cancer Council Victoria. Skin cancer and outdoor work. A work health and safety guide[43]

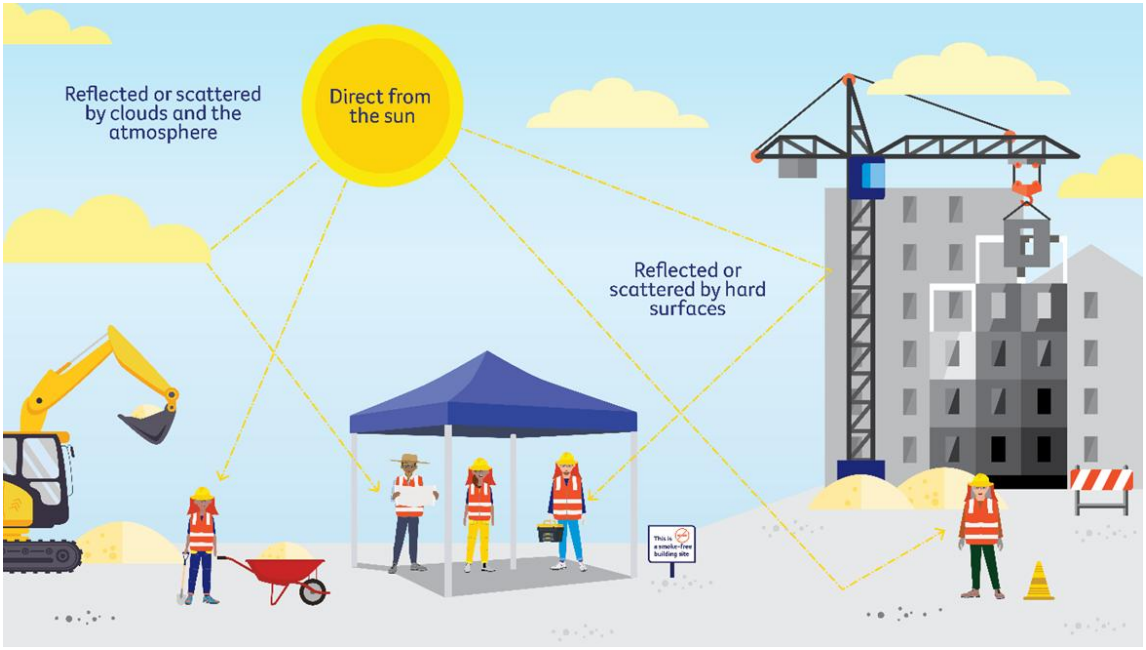
Visit arpansa.gov.au to view hourly and daily accumulated UV Dose Reports for all capital cities in Australia in SEDs.

UV and reflectivity

UV can reach a person on the ground from three sources; directly from the sun, scattered by particles in the atmosphere, and reflected by the ground and building surfaces.[44] This means that even if a person is shaded from the direct sun, they can still receive substantial UV exposure from the open sky.

Some ground and building surfaces reflect UV, including white paint, window glass, light coloured concrete and metallic surfaces. These surfaces can reflect UV onto the skin and eyes and reduce the effect of protective measures. Even when someone is shielded from direct sunlight through shade or personal protective equipment (PPE), they can still be significantly exposed to UV from the sun directly, and through scattered and reflected UV, as illustrated in Figure 7.

Figure 7. Exposure to UV from reflective surfaces



See the Safe Work Australia national guidance on solar UV radiation for more information.[45]

The consistently high levels of UV exposure in Australia presents an extreme and cumulative risk. Both the UV Index and the UV dose (SEDs) are important in assessing the UV risk to human health.

2: Current context

Outdoor workers and sun protection

Sun protection for outdoor workers is recognised as a global issue. A study led by the World Health Organization (WHO) and the International Labour Organisation[46] identified that:

- Sunlight is the third most burdensome occupational carcinogen behind asbestos and silica
- Working under the sun caused one in three deaths from non-melanoma skin cancer
- Over the period 2000 to 2019, attributable deaths to non-melanoma skin cancer and disability adjusted life years almost doubled
- Men and older age groups carried larger burden.

A key finding from this international study was that unprotected exposure to solar UV while working is largely preventable.

Within Australia, the proportion of skin cancers attributable to solar UV is even higher, due to our equatorial proximity, clear atmospheric conditions, and loss of ozone in spring and early summer.[47], [48] It is estimated that Australia outdoor workers receive up to 10 times more UV exposure compared to indoor workers[47] which contributes to Australia having the highest incidence of skin cancer in the world.[8]

Estimates showed that occupational exposure leads to approximately 200 melanomas and 34,000 NMSCs per year in Australia.[3] Analysis of the Australian occupational cancer burden was undertaken in 2021 where it was estimated that 2.4 million workers are exposed to solar UV in the workplace. This exposure is projected to result in approximately 8,850 future melanoma cases attributable to their lifetime occupational exposure.[4]

Solar UV radiation exposure while working is largely preventable.

Work Health and Safety legislation, regulation and UV guidance

Each Australian state, territory, and the Commonwealth has its own work health and safety (WHS) laws. To make these laws more consistent across the country, Safe Work Australia developed a set of uniform laws called the model WHS laws in 2011 which are currently being reviewed. Most jurisdictions, including NSW, QLD, SA, TAS, NT, ACT, WA, and the Commonwealth have adopted these model laws. Victoria has not adopted the model WHS laws, but it has similar duties and responsibilities under its own Occupational Health and Safety Act 2004 (Vic).[49]

The main objective of WHS legislation is to provide a framework that defines the duty of care to ensure safe and healthy workplaces. It aims to protect the health and safety of workers and others by requiring employers and other duty holders to eliminate or reduce risks as far as reasonably practicable.

WH&S laws require all employers or Persons Conducting a Business or Undertaking (PCBU) to ensure, so far as is reasonably practicable, a safe working environment for all workers. All workers (e.g. employees, contractors, volunteers) also have a responsibility to take reasonable care for their own health and safety and comply with the instruction from the employer or PCBU.[50] Although legislative and regulatory guidance documents do not explicitly refer to UV exposure in the workplace, the legal obligations and risk management requirements outlined in the documents clearly apply to all workplace hazards including UV. In practice this translates to the PCBU framing sun exposure as the hazard and the likelihood of harm from UV as the risk. See the Hierarchy of Control system (Figure 11) in the Recommendations section for more information.

In line with the legislation and regulations, the PCBU is required to assess and address these hazards, so that all staff are protected. Failure to comply with the legislation can result in consequences such as legal action, fines, removal from worksite, or termination of employment.

Further Work Health and Safety supportive information and guidance documents are provided in **Appendix 2**.

Aligning outdoor worker sun protection with existing WH&S legislation is a strategic way to increase the relevance of sun protection for workplaces and support implementation.

Who is an outdoor worker?

Outdoor workers are people who are required to complete any part of their core business outside, exposing themselves to hazards like UV, weather, and other environmental factors, requiring specific risk management and protection measures.

The 2008 National Hazard Exposure Worker Surveillance survey[51] identified that outdoor workers in the agricultural, forestry, fishing and construction industries were most likely to be exposed to direct sunlight. Overall the occupations and industries at risk due to the outdoor nature of the work include, but are not limited to:[17,52 53,54]

- agricultural, farming and horticultural workers
- automobile drivers
- engineers
- forestry workers
- machine operators
- outdoor council workers
- physical education / sports teachers and fitness instructors
- tradespeople (e.g. carpenters, construction workers, electricians, handypersons, painters, plumbers)
- water-based e.g. lifeguards, fishermen, marine workers
- animal workers
- civil contractors
- emergency workers
- fishing industry workers
- heavy vehicle drivers
- mining and earth resource workers
- passenger transport workers
- scientists
- tele-communication workers
- vehicle-based trades workers
- warehouse workers

While many of these occupations listed above represent stereotypical outdoor worker industries, both sporting organisations and schools face significant outdoor worker risks and are often overlooked. For example, both settings share a duty of care to protect their students &/or athletes, staff, volunteers and spectators during outdoor activities, and the parks, sports fields and swimming pools that they operate in are often managed by local, state, and/or federal governments, creating a shared responsibility for UV protection for the staff who manage these assets. Similarly, schools are required to protect their communities during routine outdoor activities such as assemblies, recess, and sporting events, as well as larger occasions like fetes, swimming and sports carnivals. In both sport and school contexts, the responsibility to manage outdoor risks is critical to ensuring the safety and wellbeing of their communities.

Any organisation that relies on staff, volunteers or patrons to carry out core activities outdoors has a duty of care to safeguard them from harmful sun exposure.

Prevalence of skin cancer among outdoor workers

Sun protection for outdoor workers is recognised as a global issue, with sunlight recognised as the third most burdensome occupational carcinogen behind asbestos and silica,[46] with older males representing those most affected.[46]

- Outdoor workers in Australia receive high levels of UV exposure, averaging 4.4 hours per day and 12.2 hours per week working under direct sunlight.[53]
- Outdoor workers are at particular risk of skin cancer as they receive up to 10 times more UV exposure compared to indoor workers.[47]
- UV is a workplace hazard that must be reduced as much as reasonably practicable.
- Within Australia, skin cancer can result from repeated and long-term exposure to UV in the workplace.[2]
- Estimates from 2014 showed that occupational exposure leads to approximately 200 melanomas and 34,000 NMSCs per year in Australia.[3]
- Analysis undertaken in 2021 on occupational cancer burden in Australia estimated that 2.4 million workers are exposed to solar UV radiation in the workplace. This exposure is projected to result in approximately 8,850 future melanoma cases attributable to their lifetime occupational exposure.[4]
- Outdoor workers are also more likely to be male and reside in lower socioeconomic and regional areas,[52,55] highlighting the need for more concerted efforts to reduce potential health inequities and related health disadvantages.

The UV risks for outdoor workers in Australia are based on:

- ***long periods of time spent working outdoors,***
- ***working in locations that experience high UV levels, and***
- ***working near surfaces that reflect UV***

Current practice amongst Australian workplaces

There is limited data available that monitors the extent to which Australian outdoor workers are exposed to UV whilst at work. The two most comprehensive and nationally representative data sources available are the SafeWork Australia National Hazard Exposure Worker Surveillance (NHEWS) survey from 2008[51] and the Australian Workplace Exposures Study (AWES), also commissioned by SafeWork Australia from 20011/12[54]. Safe Work Australia is currently in the process of preparing an updated NHEWS survey to go into field in late 2025.

The 2008 NHEWS survey provides a cross-sectional overview of 4,500 workers across 15 industries.[51] The study found that workers who were exposed to high levels of direct sunlight (more than 4 hours per day) showed a number of demographic and employment differences when compared to workers with no, low or medium exposure to sunlight. These include:

- Being male;
- Living in northern Australian states (QLD, NT, WA) than the southern states (NSW, ACT, SA, VIC, TAS);
- Working in a smaller-sized workplace; and
- Working in the agriculture, forestry and fishing, construction, and cultural, recreational and personal services industries.

The 2011/12 Australian Workplace Exposures Study (AWES) also provided a cross-sectional summary of Australian workers aged 18-65 years, with 1,113 workers from 28 industry types responding to specific questions on sun safety.[52] Key findings include:

- 99% of agricultural workers and 86% of construction workers were exposed to solar UV.
- 31% of workers in the manufacturing industry were exposed to either solar UV or artificial UV from welding
- agricultural workers, construction workers, plumbers, animal and horticultural workers, heavy vehicle drivers and miners were most likely to be exposed to solar UV for longer periods of time.

This study found that outdoor workers are also more likely to be male and reside in lower socioeconomic and regional areas,[47,52] highlighting the need for more concerted efforts to reduce potential health inequities and related health disadvantages.

Both the NHEWS and AWES studies demonstrated that at least half of Australian workers surveyed used protective clothing, sunscreen, hats or sunglasses when at work. The most commonly reported sun protection practices reported in the AWES study included sun protective clothing and hats, and that hats were more likely to be provided for those working outdoors more than four hours per day.

- Both studies demonstrated that no more than 10% of workers were fully protected while working outdoors.
- The AWES study found farmers were significantly more likely to be fully protected compared to office workers.[52]
- The most common reflective surfaces workers reported they were exposed to included water, roofing iron, glass and sand, with almost 50% of AWES workers reporting they worked near reflective surfaces.

Skin cancer compensation claims

The issue of occupational sun exposure is becoming increasingly recognised amongst workers and can be a driver for improving organisational practices. The following examples support the view that worker compensation claims related to UV exposure should be of importance to Australian employers.

- The most common cause of compensated cancer claims in Australia between 2000 to 2009 was sun exposure (51%).[5]
- Between 2008-09 and 2021-22, there were 1,688 accepted workers' compensation claims for all types of skin cancer. Over this period, skin cancer claims cost a total of $63.6 million, with the median compensation paid ranging from $4.3 million in 2020-21 to $13.9 million in 2011-12. Skin cancer claims represented 39.5% of all 'neoplasm worker compensation claims' made during that time and accounted for 11.6% of all costs associated with 'neoplasm worker compensation claims'.[6] While skin cancer-related claims tend to be lower cost on average than many other claims, industry advice is that they are underrepresented in the data due to underreporting by those effected.

Given the lag time between UV exposure and the development of skin cancer, it is likely compensation claims greatly understate the actual incidence of work-related skin cancer.

For workplaces to successfully defend a claim in a court of law, they need to show that they have sufficient sun protection measures in place, including strategies to ensure policies are implemented.

Case study 1: McKechnie and Military Rehabilitation and Compensation Commission - November 2017 – Veteran's Appeal Division.

A veteran from the Australian Defence Force was awarded compensation for malignant melanoma for UV exposure which he said was caused, aggravated or accelerated due to his former service.

McKechnie suffered significant damage to his skin while employed by the Royal Australian Regiment from 1989 to 1990 and again from 1993 to 2002. This service included a lot of outdoor training exercises including in the Northern Territory.

- As a member of the military the claimant said they were seldom indoors but were not offered sunscreen.
- In 1996 he noticed a small black lump on his right calf which was found to be a malignant melanoma. Again, in 2014 another suspicious spot appeared on his right groin which was found to be a Stage 4 metastatic melanoma.
- The second melanoma was deemed to be a recurrence of his previous melanoma removed in 1996.

Medical evidence showed that the applicant's military service had "materially contributed in more than a minimal degree to the onset of the melanoma due to sun exposure", due to a lack of sun protection training about the risk of overexposure to UV and supply of PPE to mitigate the UV exposure and reduce the risk of skin cancer.

Case study 2: Kiama Municipal Council v Manning NSWPICPD - August 2022

A worker who had been employed for 33 years doing outdoor work (such as mowing lawns and maintaining parks) developed a serious form of skin cancer. He claimed this was caused or worsened by long-term sun exposure during his job.

He took the case to the Workers Compensation Commission, asking for weekly payments starting from May 2019. The Commission agreed that his outdoor work exposed him to harmful UV rays, which accelerated his skin damage. They ruled this was a work-related injury and ordered compensation.

The employer challenged the decision, but the judge ultimately dismissed the appeal, finding:

- The injury was correctly classified as a disease worsened by work.
- The worker's job was the main reason for the skin damage.
- The original decision was well-reasoned and based on solid medical evidence.

3: Literature review of workplace intervention effectiveness

Overview and objective of the literature review

Settings-based health promotion approaches have been successfully applied in priority contexts over many decades,[56,57,58] and strategies to improve sun protection in schools, workplaces and recreational settings have been shown to be effective.[25,59,60] Settings-based approaches are important because they shift the focus from individual behaviour change to supporting the social and physical environments in which people live, work, learn and play. By embedding health promotion within the systems, structures, policies and cultures of specific settings, more sustainable, context-sensitive and wide-reaching health improvements are enabled.[61,62]

Planning and implementing public health interventions is complex.[63,64] While we know that UV exposure presents a clear risk to outdoor workers,[3,47,65,66,67] we have limited understanding of which interventions most effectively influence their sun-protection practices. Outdoor professions and workplace settings are highly diverse, and distinct organisational cultures often shape the prevailing social norms within them.[68] Drawing on 'what works' for health promotion in workplace contexts generally[69] needs to be supplemented with more detailed knowledge about the barriers and enablers to sun protection in workplace contexts specifically[30,70,71, 72,73,74,75] and what interventions are most likely to make a difference.

Methods and description of publications

Cancer Council NSW's Skin Cancer Prevention Unit conducted an international review of the literature on workplace sun safety intervention effectiveness and reviewed available grey literature and published articles for the period 2005 to 2024.

The objective of this review was to systematically examine and synthesize existing evidence on sun safety interventions targeting outdoor workers, with the aim of identifying effective strategies, implementation challenges and key success factors. This review seeks to inform the development and refinement of workplace-based skin cancer prevention programs by evaluating the impact of multi-component and single-strategy approaches across diverse occupational settings and geographic regions.

Description of publications

A total of four systematic reviews and 46 publications relating to sun safety and outdoor workers were identified, evaluating sun safety interventions across Australian and international workplaces between 2005 and 2024.[25, 59,76–120,121]

The review consisted of two stages: a Master of Public Health student placement project in late 2024, where relevant articles were sourced and reviewed, followed by a thematic analysis and synthesis of findings undertaken by the Skin Cancer Prevention Unit and summarised in this report.

The four systematic reviews of the evidence were published between 2013 and 2018,[25, 122, 123, 124] where two of these reviews were undertaken in Australia, and the remaining two in the United States[122,124]. Three of the reviews were about outdoor workers generally[25, 122,123] and one was about farmers and farm workers.[124]

As the systemic reviews included many of the same individual studies, the summary of studies does not include the systematic reviews. More detail about the systematic reviews is available in **Appendix 3.**

Sun safety interventions were undertaken across nine industry types, including but not limited to local government, construction, transport, sports and recreation, and farming. Many of the interventions analysed in these publications were included in the four systematic reviews. Interviews with some of the academics leading on these studies were undertaken by Cancer Council NSW in 2022, which provided additional qualitative insights to the evaluation findings summarised in this report.[125]

Figure 8. Publications by country

Publications by country

Country	#
USA	22
Australia	4
UK	4
Canada	3
Denmark	2
Iran	2
Italy	2
Netherlands	2
Germany	2
Egypt	1
Spain	1
Turkey	1

Figure 9. Publications by year

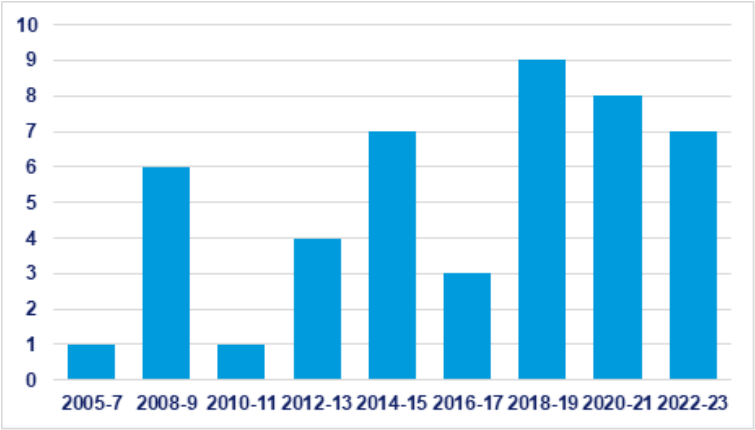


Table 3. Industries included in the literature review

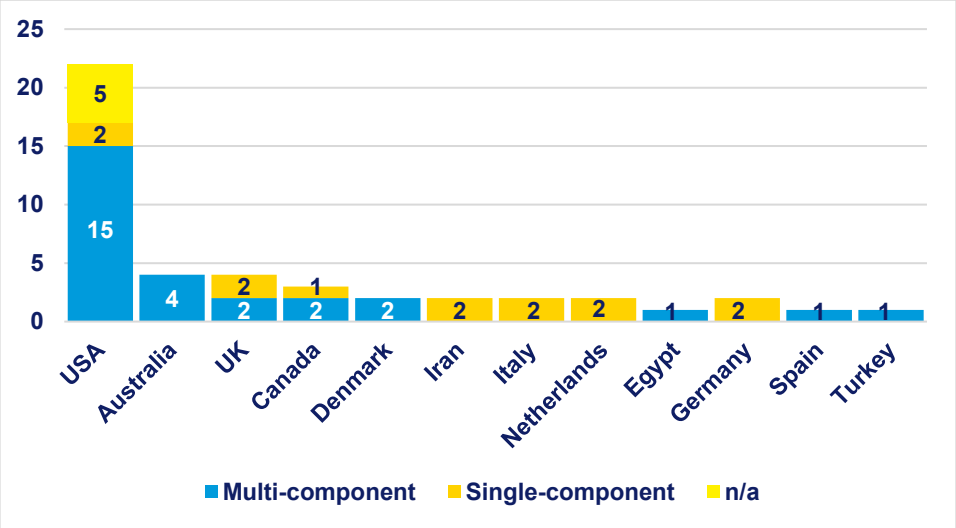
Industry	Percentage
General Outdoor Workers	26%
Sport and Recreation	22%
Construction	18%
Local Government	13%
Farming	9%
Transport	4%
Mining	2%
Firefighting	2%
Postal Services	2%
n/a	2%

Key findings from the literature review

Across studies conducted in Australia, the USA, Canada, and other countries, the evidence consistently shows that programs combining education, workplace policies, personal protective equipment (PPE), environmental supports (like shade and sunscreen access), and communication strategies are the most effective in improving sun protection behaviours and reducing sunburn.

Overall, interventions that combined one or more approach (i.e. multi-component interventions) were more likely to be aligned with a positive or lasting impact amongst workplace target audiences, whilst interventions that focused on a single strategy designed to influence outdoor worker sun safety were comparatively less effective. Figure 11 shows multi and single-component interventions by country. While some of these single-component studies were found to be effective, the lack of integrated and complementary strategies diminished their impact.

Figure 10. Multi and single-component interventions by country



The following two tables provide an overview of the insights from the studies included in the review, with Table 4 summarising the findings from the multi-component studies and Table 5 summarising the insights from the single-component studies.

Table 4. Insights from multi-component intervention studies

Multi-component intervention studies		
What employers can do	**How to do it**	**Examples of how it was done**
Implement sun safety policies	Develop and enforce workplace sun protection policies	• Introduced formal sun safety policies and PPE requirements across construction and farming sectors
Provide education and training	Deliver targeted education sessions and training materials	• Conducted farmer workshops and distributed educational materials • Provided training sessions and skin exams to reinforce sun safety
Ensure access to sun protection	Supply sunscreen, install shade, provide protective gear	• Installed shade structures and made sunscreen readily available • Added physical shade structures and sunscreen stations at pools
Use tailored communication strategies	Use culturally relevant and engaging materials[85]	• Used resort-specific posters, magnets, and newsletters • Delivered messages via a mobile app and UV dosimeter feedback
Leverage internal champions	Identify and support staff to lead initiatives	• Trained knowledge brokers within organisations to promote sun safety and support implementation

Multi-component intervention studies		
What employers can do	**How to do it**	**Examples of how it was done**
Monitor UV exposure	Use technology to track and inform workers about UV levels	• Provided UV dosimeters and app-based feedback • Used dosimeters and follow-up education to sustain awareness
Combine multiple strategies	Integrate education, PPE, sunscreen and communication	• Compared groups with different combinations; the group receiving all components (education + sunscreen + communication) showed the best outcomes

Table 5. Insights from single component intervention studies

Single component interventions		
What employers can do	**How to do it**	**Example of how it was done**
Use targeted communication strategies	Test different messaging styles (generic, targeted, tailored), include financial implications	• Exposed outdoor workers to randomised messages (generic, targeted, and tailored) with and without financial cost information
Provide access to sunscreen	Install sunscreen stations in high-traffic areas with data tracking	• Placed a smart sunscreen station in miners' common areas, collecting real-time data on usage and connectivity to assess effectiveness
Deliver multimedia education	Use DVDs, videos, or interactive lectures	• Showed a DVD-based sun safety video after a baseline survey
Offer structured training programs	Weekly sessions for farmers using lectures, discussions, and multimedia	• Offered eight weekly sessions combining lectures, group discussions, and multimedia, leading to improved sun safety behaviours and reduced barriers
Provide personalised counselling	Conduct guided interviews and develop individual sun protection plans	• Offered guided interviews and tailored counselling modules to create personal sun protection strategies
Develop practical, occupation-specific messages	Collaborate with stakeholders to create concise, relevant messages	• Crafted occupation-specific, concise sun safety messages that addressed practical challenges
Improve physical sun protection infrastructure and gear	Evaluate and provide effective shade structures and UPF-rated clothing	• Tested lifeguard t-shirts for UPF ratings, and UV measurements were taken under different shade structures to assess protection levels

Overall, the studies showed that education alone, while useful for raising awareness, often fails to produce lasting behavioural change unless reinforced by other measures. For example, interventions that included visual reminders, role modelling, and tailored messaging were more successful in sustaining sun safe practices. Workplace leadership and support emerged as critical factors: that is, when management actively supported sun safety and there were sun safe policies in place, workers were more likely to adopt protective behaviours.

Digital delivery methods, such as online training and resources, were proven to be feasible and scalable, especially in the post-COVID context. However, the studies showed that these approaches must be simple, affordable, and supported by internal champions to maintain momentum. The review also underscored the importance of tailoring messages to specific industries and cultural contexts, as seen in contrasting outcomes between countries like the UK and Denmark.

In summary, the findings reinforce the view that a single intervention, such as sunscreen access, is not enough. Effective sun safety for outdoor workers requires a holistic, sustained approach that integrates education, policy, environmental supports, and strong workplace engagement.

Additional details of the literature reviewed is provided in **Appendix 3**.

The following table summarises the enablers and barriers associated with implementation effectiveness.

Table 6. Enablers and barriers to implementation effectiveness

Barriers	Enablers
Competing WHS issues When more acute risks are present, UV safety can become a lower priority among competing WHS issues. **Lack of specific legislation** The absence of legislation specifically addressing UV exposure, beyond the general duty of care, can result in workplaces deprioritising or failing to take meaningful action. **Workplace structure and size** Larger workplaces with multiple levels of management may find it challenging to gain consistent support for UV safety throughout the organisation. Conversely, smaller workplaces can lack capacity in staffing and resources to implement change. **Outdoor workplace culture** Occupational cancer can be perceived as uncommon or be associated with historical jobs. It can be presumed as not likely to happen to younger workers who perceive the benefits of a tan more than the risks of skin cancer, and older workers can express fatalistic attitudes (i.e. the damage is already done) towards skin cancer. **Financial cost** The financial costs associated with providing UV safety controls, regardless of workplace size, may inhibit action. **Lack of time** Even proactive workplace champions may struggle to implement UV safety due to a lack of time. **Lack of sticking points** Following the finalisation of a plan, workplaces can lose momentum during the delivery phase. Strategies to support implementation	**Leadership buy-in** Making UV safety a workplace priority requires strong leadership and senior management support, which are key drivers of change. Without this backing, the adoption of UV safety is unlikely to succeed. **Multi-component and sustained approaches** Multi-component approaches provide a holistic approach to sun safety and help frame workplace cultural change. Creating a plan that guides implementation over multiple years supports leaders to allocate resources including costs, the allocation of champions' time, and can keep UV safety on the agenda, resulting in incremental and sustained sun safety outcomes. **Good planning and flexible approach** Effective UV safety relies on good planning and a flexible approach that allows workplaces to adapt actions to their current priorities while maintaining a sustained effort. **Employee engagement** Consulting with workers provides an opportunity for them to contribute and feel their workplace cares about their health. Workplace champions play a critical role. They need to be proactive, respected, able to secure management support, communicate effectively and model sun safe behaviours. **Align UV safety with other WH&S priorities** The importance of UV safety to workplaces can be enhanced within a co-benefits approach, such as integrating it with reducing heat stress experienced by outdoor workers. The Sun Safety at Work Canada program has integrated UV safety and heat stress management into their program, presenting the sun as the risk factor and UV and heat as the resulting hazards that need to be controlled. **Being viewed as an industry leader** Participating in sun safety initiatives positions workplaces as industry leaders, helping them stand out and attract greater attention from peers and clients. **Provide evidence to counter misconceptions** A study with outdoor workers in northern Queensland[119] showed no difference in core body and mean skin temperatures when wearing long pants as opposed to shorts. However, it is still

Barriers	Enablers
such as new resources, triggers and incentives can help maintain drive. **Risk of heat related stress** Working in hot conditions may contribute to worker non-compliance with the use of PPE due to its perceived thermal load. **Unintended effects** Some UV safety controls and PPE can be hazardous or lead to unexpected behaviours. For example, risk of concreters' long pants getting caught in mixers or in concrete, shade covers impacting on the field of view, or wearable dosimeters leading to intentional UV exposure. **Time taken to see change** The slow pace of behaviour change after implementing sun safety measures can be a barrier, especially when the benefits, beyond the immediate improvements of avoiding sunburn, aren't as obvious.	important to educate workplaces on fabric considerations to help workers feel cool, whilst ensuring that the fabric meets the ultraviolet protection factor (UPF) standards of 50+. **External support** Support from external sun safety experts helps to build trust with workplaces, keeps sun safety on the agenda, and reinforces its importance in the workplace. **Online approaches** Digital support tools appear to be acceptable to workplace leaders if they are affordable and uncomplicated. They can also facilitate increased uptake of support by workplaces. **Focus on easier and less expensive actions first** Starting with simpler, low-cost actions can help gain management support and build momentum for broader UV safety initiatives. **Use a variety of communication strategies** Sharing personal stories, especially from those with lived experience of skin cancer, can powerfully engage others and motivate behaviour change, particularly among less interested workers. However, these stories should be shared sensitively, especially in emotional formats like video, and always supported with factual information to reinforce key messages. For workers who are more data-driven, providing statistics and evidence-based resources can also be an effective way to boost engagement. **Providing a mix of resources and methods of communication** Workplaces, particularly larger ones, are receptive to a mix of highly visual and bright posters, brochures and communications that can be rotated to keep UV safety on the radar. An abundance of resources to influence behaviour change, and a mix of formal and informal communication strategies (e.g., toolbox talks and inductions that include UV safety plus regular reminders) are most effective **Tax deductable PPE** Tax deductions are available to the employer and employee (if required to pay for any PPE and uniform costs themselves) and should be promoted as another method to overcome cost concerns. **Gifts of appreciation** Where workers and champions are provided with a small gift for participating in UV safety programs, they feel valued and part of a supportive environment.

4: Recommendations for best practice sun safety strategies in workplaces

Recommendations

Solar UV is a major workplace hazard, and employers have a duty of care to protect their workers from UV and the risk of skin cancer.

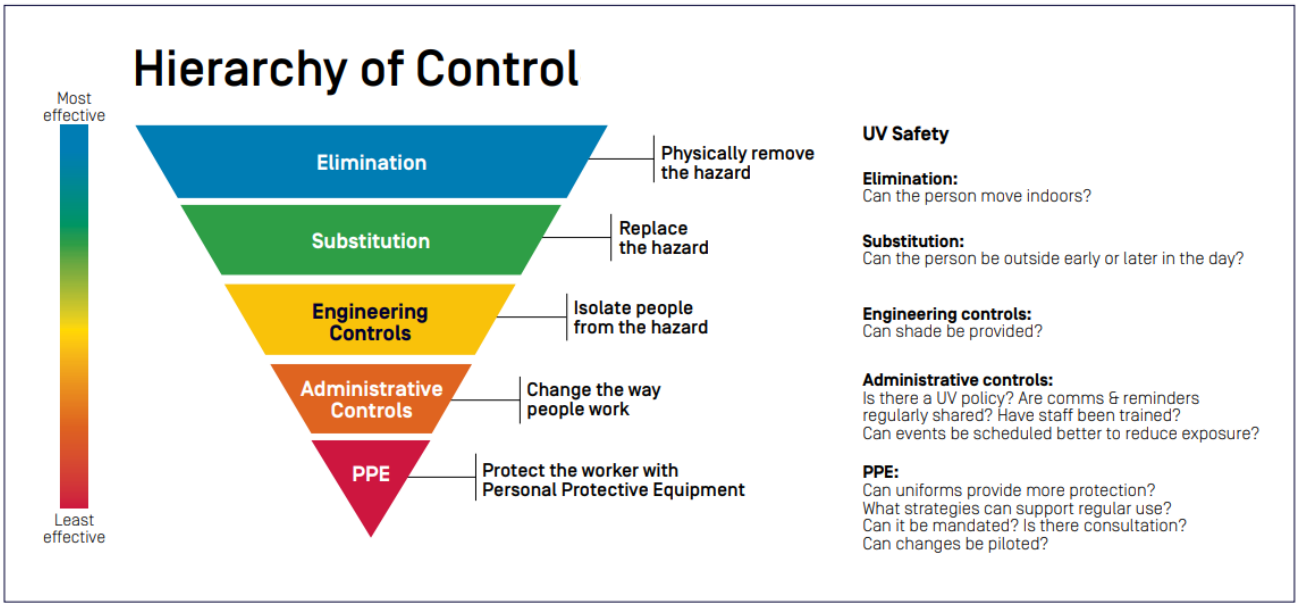
The key findings from the intervention effectiveness evidence summarised in this literature review highlight the priority activities that organisations can take to improve their sun protection culture. The box below summarises these insights.

The following themes were found to be effective across studies:

1. **Workplace leadership and culture matter**
   Leadership, champions and organisational support were critical enablers.
2. **Policy alone is not enough**
   Policy interventions need to be supported by other strategies.
3. **Sustained multi-component outcomes are most effective**
   Multicomponent interventions consistently outperformed single strategies.
4. **Worker involvement enhanced outcomes**
   Participatory and flexible approaches improved effectiveness.
5. **Educational approaches are important**
   Educational strategies were consistently found to be effective across multiple studies.

The evidence shows that sustained multi-component interventions are effective drivers for sun safety improvements in workplaces. These findings reflect the systematic approach that the Hierarchy of Control takes to managing risks and ranking control measures from most to least effective in the workplace (see Figure 11). Given that the most effective control measures of elimination and substitution/isolation are not readily applicable to sun protection, it is essential for workplaces and PCBU's to invest significant effort in developing a comprehensive approach to their administrative controls.

Figure 11. Hierarchy of Control with UV safety examples



Source: Australian Sports Commission Sun Safe Sports Position Statement [126]

The following suggestions are aligned with the five Hierarchy of Control measures used to guide how exposure to risks are reduced or controlled within organisations. These are presented in the order of most effective to least effective.

The strategies outlined below are consistent with Cancer Council's *Skin cancer and outdoor work: A work health and safety guide, which provides comprehensive, evidence-based guidance for employers and safety professionals*.[43]

Elimination

- The complete elimination of UV as a hazard may not be practical if outdoor work is unable to be completed at night or indoors.

Substitution

- Similar to elimination, the options to substitute the sun's UV are limited. Strategies could include substituting processes such as moving outdoor work tasks to earlier or later in the day during periods of lower UV exposure.

Engineering controls

- Providing shade can be a very effective control measure. Good quality shade can reduce UV exposure by up to 75%.[127] Shade can be natural from trees, built shade from permanent infrastructure or portable shade structures that can be erected and moved throughout a work site. Workplaces should consider what is feasible for their location, conditions and finances.
- Some ground and building material can reflect UV. For example, concrete can reflect up to 12% of the UV emitted from the sun. Where possible, consider moving work away from these surfaces or adding shade above.
- Clear and tinted window films on vehicles can be effective in reducing UV exposure to workers whilst driving. Consider new or retrofitting window tinting on mobile plant or vehicles.

Administrative controls

Policy/procedures

- Ensure that the organisation develops and implements a sun safety policy and/or procedures as a foundational piece to support sun safety in the organisation, with strategies in place to ensure compliance. See Appendix 2 for more information on existing resources and templates.
- Align the framing of sun safety mitigation strategies within the broader system-wide approaches your organisation takes to risk management, as an approach to help embed and sustain your efforts.

Plan an approach to guide sun safety improvements in your workplace

- Consider existing support tools, such as the Implementation Guide, Risk Assessment and Action Plan to help inform your approach. Begin with the Risk Assessment to identify and prioritize hazards, recognizing that different worksites may present unique risks requiring tailored strategies.
- Develop your course of action using the Action Plan. Secure management support and clarify staff roles and responsibilities. Establish support structures, such as a working group, to maintain momentum and ensure accountability. A downloadable toolkit to assist with implementation is currently being developed by Cancer Council NSW and is expected to be available in early 2026.
- Consult with staff early and regularly to identify opportunities and potential barriers.
- Identify and empower internal champions, such as supervisors or team members with personal experience, to drive engagement, sustain momentum, model positive behaviours, and help address barriers and enablers. These actions are critical for workplace change agents aiming to strengthen sun safety culture and align with the Hierarchy of Control approach.
- Consider what systems you already have in place that could be leveraged. For example practical guidance measures such as procurement guidelines could be adapted to include sun safety minimum standards, to help ensure a consistent and sustainable approach to sun safety across teams.
- Pilot initiatives to test ideas, build buy-in, and refine processes before scaling up across the organisation.

Education and training

- Ensure leaders and workers are regularly trained in sun safety, including during their induction. Share the importance of sun safety and information about the specific risks that your organisation faces as the rationale for making sun safety improvements to your workplace.
- Educate stakeholders about the difference between UV and heat, and the UV Index, to support an increased understanding about the safest times to work outdoors to reduce risk.

Communication

- Use UV awareness apps such as the free SunSmart Global UV App or display its associated widget on your workplace's website and include ongoing reminders (e.g. in newsletters, team communication and signage in common areas) that provide updates on the daily UV forecasts.

- Use annual events, such as National Skin Cancer Action Week held each November, to align with your workplace communications and activities calendar.
- Display a wide variety of highly visual and workplace relevant sun safety information including posters and brochures in staff areas and include in staff welcome packs.
- Align the delivery of sun safety prevention messaging with other safety and prevention systems within the business and promote the co-benefits.

Role modelling

- Ensure leaders and champions[121] are role modelling sun safe behaviours and communicating these expectations to their teams at regular intervals and build into workplace cultural norms.

Evaluation and monitoring

- Monitor how new sun safety practices are implemented and try to measure the impact of these activities. Record keeping and qualitative or quantitative data sources about how new strategies were implemented help to support project delivery and deepen your understanding of any enablers or barriers related to ongoing implementation, and overall program success.
- Collect 'good news' stories and case studies, and work with other key stakeholders in the business to find relevant ways to share these stories, so that positive changes and broader cultural change are supported.
- Regularly review how effective the implementation of sun protection strategies has been. This could include reviews of how sun protective facility upgrades are going, or any funding or grants designed to support sun protection, or the dissemination and uptake of new sun protective PPE such as feedback from staff who piloted uniform improvements.

Rotate workers doing outdoor work

- Consider where you can share outdoor tasks and/or rotate workers more so that they can reduce their exposure for long periods of time.

PPE

- Whilst PPE is considered the least effective control strategy within the relative order of the Hierarchy of Control, when it comes to sun safety it is often the most implemented strategy for outdoor workers, and when it is done well, it can be very effective. The challenge is ensuring that PPE is used correctly and consistently by all staff whilst outdoors.
- Clothing is very effective in providing a physical barrier between a person's skin and the sun and provides an easier alternative to sunscreen in achieving consistent sun protection. The goal is to cover as much skin as possible without reducing the risk of heat stress or introducing any other unintended safety risks.
- Broad-brim, bucket, legionnaire or brim attachments for hats are recommended. Peak caps (i.e. baseball caps) do not sufficiently protect the sides of the face, neck and ears and are not recommended.
- Clothing and hats with an ultraviolet protective factor (UPF) of 50 or 50+ provide excellent protection. A UPF of 50 or 50+ means the material in the product has been tested to the Australian standard for sun protective clothing AS 4399 'Sun protective clothing- Evaluation and classification' and meets minimum body coverage requirements.
- Sunglasses or protective eyewear are recommended. Glasses should meet the Australian/New Zealand Standard AS/NSZ1067 for 'Eye and face protection- sunglasses and fashion spectacles'. A combination of a broad-brimmed hat and sunglasses that meet the Australian Standard can reduce UV exposure to the eyes by up to 98%.[128]
- Sunscreen should be the last line of defence after all other PPE options have been explored. Sunscreen should be applied to all areas of skin that can't be protected via clothing. Broad-spectrum, water-resistant SPF 50 or 50+ is recommended to be made available to workers in easily accessible locations. Lip balm usage is also encouraged.

Conclusion

The literature review highlights the sustained positive outcomes achieved through multi-component sun safety interventions in workplace settings. These interventions consistently demonstrate improvements in awareness, behaviour and organisational practices. However, both Cancer Council NSW and the academic teams behind the evaluated projects have noted common challenges and implementation barriers that workplaces can encounter. These "sticking points" often relate to maintaining momentum and embedding sun safety into routine practice.

Research suggests that building on small wins is a powerful strategy for overcoming these challenges. Key steps include identifying and celebrating early successes, ensuring that actions contribute to broader change, and using feedback loops to generate further progress. Small wins not only uncover hidden obstacles and resources but also foster continuous learning and engagement.

In addition, several WH&S guidance documents developed by regulatory bodies provide practical advice on integrating sun safety into workplace processes (see **Appendix 2**). Despite having one of the highest skin cancer rates globally,

Australia has seen limited systematic and coordinated efforts to research and address this issue. These gaps underscore the need for practical, evidence-based tools that can support prevention initiatives across diverse settings.

To address this, the next phase of work will focus on developing a comprehensive toolkit to guide and strengthen workplace sun safety programs. The toolkit will combine evidence-based strategies, practical tools and clear implementation guidance to ensure usability and impact. Once developed, our goal is to pilot the toolkit to evaluate its acceptability and feasibility, to ensure the suitability of the toolkit to address the challenges, to identify areas for refinement to optimise its components before broader rollout.

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Appendices

Appendix 1. Photosensitivity as a risk factor for skin cancer

Photosensitivity is an abnormally high sensitivity of the skin or eyes to UV. This can result in more frequent burns and thus increasing the risk of skin cancer.[18]

Photosensitivity is caused by ingesting, inhaling or having skin contact with substances known as photosensitisers. The substances that cause photosensitivity can include industrial chemicals, medications, drugs, plants and some essential oils and fragrances.[18]

Table 7. Common photosensitising substances

Common substances that cause photosensitivity through skin contact include[27]:	
Coal tar and derivatives	• Anthracene, phenanthrene, creosote, pitch
Dyes	• Acridine, fluorescin, erhthrocin, rhodamine, rose bengal, eosine.
Chlorinated hydrocarbons	• Chlorobenzols, triphenyls, diphenyls
Plants	• St John's wort, bergamot, fennel, chrysanthemum, bind weed, fig, dill, lime, buttercup, lemon

Photosensitising substances represent a specific risk context and were not in the scope of this broader literature review on intervention effectiveness. Refer to the Safety Data Sheet (SDS) for all products used in the workplace to identify any photosensitising substances.

- Individuals using medications should be encouraged to talk to their doctor or pharmacist about the risk of increased photosensitivity as a result of the medicine. Alternative medication may be available.

Any risk assessment used to identify UV risks for outdoor workers should also identify any photosensitising substances which may be associated with the work situation or the individual's medical history.

Appendix 2: Further Work Health and Safety and other supportive resources

This Appendix provides an overview of:

A) National legislation, regulations and codes of practice
B) The Standard for Occupational Exposure to UV, developed by ARPANSA
C) Relevant Cancer Council resources

A) National legislation, regulations and codes of practice

- The model Work Health and Safety (WHS) laws, developed by Safe Work Australia, include the Model WHS Act, Regulations, and Codes of Practice, forming a unified national approach to workplace safety: https://www.safeworkaustralia.gov.au/law-and-regulation/model-whs-laws Businesses are accountable to these laws.
- The Safe Work Australia 'Guide on exposure to solar ultraviolet radiation' provides information on the risks of solar UV exposure, the control measures which can be used to help eliminate or minimise risk, and guidance on how to implement a UV safety program at your workplace: *Guide on exposure to solar ultraviolet radiation (UVR): National guidance*.
- Australian regulatory guidelines for sunscreen: https://www.tga.gov.au/sites/default/files/australian-regulatory-guidelines-for-sunscreens.pdf
- Australian Standard for sun protective clothing:https://www.arpansa.gov.au/our-services/testing-and-calibration/ultraviolet-services/labelling-sun-protective-clothing/au-standard
- Australian Standard for sunglasses: https://www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/sun-protection-sunglasses

B) The Standard for Occupational Exposure to UV, developed by ARPANSA

- The Radiation Protection Standard for *Occupational Exposure to Ultraviolet Radiation* developed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) provides guidance on minimising a worker's exposure to solar UV and offers a suite of control measures including engineering and administrative controls, as well as PPE.

  While this Standard is not a legal instrument, its purpose is to protect workers by setting limits on occupational exposure to UV from artificial sources in the workplace and by setting requirements for minimising worker exposure to solar UV.
- ARPANSA also developed further resources to support the Standard:
  - Management Plan for Sun Protection
  - Supplementary Information on Sun Protection,
  - Management Plan for Artificial Sources of UVR
  - Supplementary Information on Artificial Sources of UVR

C) Cancer Council resources

- Skin cancer outdoor work- A work health and safety guide: explains the link between UV exposure and skin cancer and offers practical advice to implement sun protection in your workplace.
- Sun Safety Policy Template can help to inform the development of your policy.
- Work outdoors? Use sun protection every day brochure.
- Protect your outdoor workers from UV radiation webinar: SafeWork NSW and Cancer Council NSW talk about the risks that workers are exposed to when working outdoors and how employers can manage these risks.
- Champion's Implementation Guide: a step-by-step guide to support workplace champions plan and deliver a multicomponent sun safety approach.
- Checking for skin cancer website offers guidance on how to monitor your skin for early signs of cancer.
- UV Risk Assessment template: to support workplaces assess their workers' exposure to UV assess current practice and prioritise areas for improvement.
- Action Plan template to identify strategies workplaces can adopt from their prioritised areas. Cancer Council has a range of supportive tools and resources workplaces can draw on to implement their strategies (e.g., policy templates, posters, information).
- WorkSafe SmartMove Working safety in the sun and heat for outdoor workers online learning module on the Generation SunSmart site.

Appendix 3: Additional details on literature reviewed

Summary of findings from the systematic literature reviews regarding outdoor worker sun safety

Four systematic reviews of the evidence relating to sun safety and outdoor workers were published between 2013 and 2018.[25, 122, 123, 124] Two of these reviews were undertaken in Australia, and three in the United States. Three of the reviews were about outdoor workers generally and one was about farmers and farm workers.

The following table summarises insights from the systematic reviews.

Table 8. Insights from systematic reviews

What Employers Can Do	How to Do It	Examples from Reviews
Improve sun protection and reduce sunburn among workers	Implement workplace interventions that combine education, role modelling, environmental supports (e.g., shade), and formal policies. Engage stakeholders early and consistently.	A construction company introduced shaded rest areas and trained supervisors to model sun safe behaviour.
Ensure interventions are multi-component and well-communicated	Combine PPE provision with policy and communication strategies. Avoid relying solely on policy without active education and engagement.	In one study, PPE use increased only when paired with training and visible signage about UV risks.
Support farm workers with tailored sun safety programs	Provide education and workplace support, and ensure leadership is visibly committed to sun safety. Multicomponent approaches are more effective than education alone.	A farm cooperative held seasonal sun safety workshops and distributed wide-brim hats and sunscreen.
Sustain long-term behaviour change across diverse settings	Use integrated programs that combine education, policy, equipment, tech-based reminders, and mass media campaigns. Ensure interventions are sustained over time.	A regional council used SMS reminders, posters, and policy updates to reinforce sun safety over multiple seasons.

Table 9. Systematic review summary

Systematic Reviews				
Review Title	**Location & Year**	**Scope**	**Key Findings**	**Recommendations / Insights**
The Community Preventive Services Task Force Review	USA, 2013	15 interventions (8 post-2000)	Strong evidence for workplace interventions improving sun protection and reducing sunburn	Use education, role modelling, environmental supports, and policies; stakeholder engagement critical
QUT Systematic Review	Australia, 2014	6 studies (2007–2012)	Mixed results; multi-component interventions more effective than single or policy-only	Larger studies showed PPE use increased; policy alone insufficient without communication

Systematic Reviews				
Sun Safety Among Farms and Farm Workers	USA, 2014	22 studies (1990–2013)	Farmers aware of risks but underutilize protection; education improves behaviours	Multicomponent efforts needed; workplace support and leadership improve commitment
Evidence Check: Targeted Programs for Skin Cancer Prevention	NSW, Australia, 2018	Multiple settings including workplaces	Behavioural interventions effective; strongest results from sustained, multi-component programs	Combine education, policy, equipment, and tech-based reminders; mass media campaigns effective

The Community Preventative Services Task Force, USA, 2013[122]

The Community Preventive Services Task Force, an independent group of experts supported by the United States Center for Disease Control and Prevention (CDC), published a review of 15 interventions targeting outdoor occupational settings, with eight of these studies undertaken since the year 2000.[122]

The review found strong evidence for intervention effectiveness in workplace settings, where interventions can drive sun protection behaviours and reduce sunburn in workers. The Taskforce recommended the following approaches:

- Educational approaches
  e.g., providing sun protection messages to workers through instruction, small media such as posters or brochures, or both
- Activities designed to influence knowledge, attitudes, or behaviour of workers
  e.g., role modelling or demonstrating sun safe behaviours
- Environmental approaches to encourage sun protection
  e.g., providing sunscreen or shade
- Policies to support sun protection practices
  e.g., requiring sun protective clothing

The Task Force identified some considerations relating to implementation, including:

- Employers should implement these sun safe measures within the broader context of worker safety and risk management systems.[66]
- While education and encouragement strategies to influence workers' uptake of personal sun protective behaviors is warranted, some sun protective measures are often outside of workers' control, such as access to shade and/or taking breaks during peak UV times.
- Worksite policies can increase both workers and employer accountability, and support the implementation, practice, and reinforcement of sun safety practices.
- Engaging key stakeholders to facilitate awareness, acceptance, and implementation of effective sun safety policy interventions is critical. For example, reaching out to unions and employers to identify effective and realistic messages, policies, and practices appropriate for their occupational setting may increase buy-in and sustainability of sun safety interventions.

The Task Force recommendation is most directly applicable to interventions that target workforces with substantial numbers of white men and women, regardless of age or specific occupation. Though few of the studies provided detailed information, evidence also suggests the findings apply to full-time and seasonal workers, and to people with sun-sensitive skin.

Review of interventions to decrease skin cancer in outdoor workers, Queensland, 2014[123]

A systematic review of the literature published between 2007-2012 regarding outdoor worker sun safety was undertaken by researchers at the Queensland University of Technology (QUT) [123] to provide an update to a systematic review previously undertaken in the USA by authors who had reviewed papers from 1996 to 2007.[66]

The review identified six studies that met the criteria, with 5 of the 6 studies involving worksite-based intervention strategies.[120, 108, 112]

The main outcome measure across the studies was the proportion of participants increasing their self-reported and observed sun protection behaviours; or combined sun protection scores, which presented mixed results.

- The larger studies with extended follow-up times were able to demonstrate the efficacy of educational and multi-component interventions to increase sun protection amongst outdoor workers, where increased use of PPE such as sunscreen was observed at follow-up,[89] or wearing of uniforms and PPE.[120, 97]
- However, there was less evidence supporting the effectiveness of policy-only interventions or interventions consisting of a single intervention component.[120] For example, a study in tropical north Queensland found a reduction in outdoor workers' likelihood of developing non-melanoma skin cancer when a mandatory sun protection policy was in place compared to a voluntary one. However, the mandatory sun-protection policy was not associated with an improvement in employee's knowledge and beliefs regarding the causes and prevention of skin cancer, highlighting the need for supportive communication and resources to influence overall employee attitudes towards sun protection.[120]

Including outdoor workers in the process to improve sun safety in the workplace is critical, as it helps to improve their sun protection knowledge and attitudes which in turn can influence their support for multi-component approaches.

Review of sun safety among farms and farm workers, USA, 2014[124]

The objective of this review was to evaluate the evidence from behavioral and intervention studies related to sun safety among farmers and farmworkers, and to identify any gaps in the literature.[124] The review identified 22 studies that were conducted between 1990 and 2013; regarding the sun safe behaviors and or sun safety health interventions amongst farmers and farm workers. Fifteen of the studies related to the USA and seven were international, consisting of one Australian and two New Zealand studies.

In general, the results of this review identified that male farmers were more likely to wear some type of protective headgear and less likely to use sunscreen and long-sleeved shirts than females. Although the level of knowledge about sun protection varied among farmers, most studies reported that farmers were aware of the dangers and risks posed by excessive sun exposure but typically did not wear adequate protection when working outdoors.

All the studies with sun safety educational interventions reported positive increases in behavioural change. Overall, while targeted education was found to be key to making improvements in sun protection behaviours, the authors noted the need for multicomponent and determined efforts.

Compared to farmers in other countries, those in Australia and New Zealand - where skin cancer control efforts have been sustained for a greater time - were associated with an increased prevalence of skin protection behaviours.

- An Australian study[129] found that 75% of those farmers surveyed reported wearing wide-brim hats and were aware of the risks of developing skin cancers; however, other sun protection practices, such as the wearing of sunglasses or sunscreen, were much lower.
- A New Zealand study[130] investigated the factors that predict sun protection use amongst outdoor workers. A survey of three outdoor occupational groups (i.e. horticulture, road work and paving, and building/roofing industries) and a record of sun protection practices over five consecutive working days during summer, identified that sun protection behaviours were predicted by beliefs of personal susceptibility to skin cancer, suntan attitudes and perceived workplace support.

When staff perceive that sun safety is supported by their workplace, their commitment to sun safety also improves.

Thus, leadership and commitment from management is a critical step in the cycle of organisational change.

Evidence check: Targeted programs for skin cancer prevention, NSW, 2018[25]

This systematic review was commissioned by the Cancer Institute NSW and undertaken to determine which skin cancer prevention programs are effective in encouraging people to protect their skin from harmful UV from the sun.[25] While this review focused on interventions across a number of population settings, it also included workplaces and their targeting outdoor workers.

The review found that behavioural change interventions for skin cancer prevention were beneficial in the education, health and outdoor settings. This included primary schools, secondary schools, early childhood settings, outdoor occupational settings, outdoor recreational settings, and health care settings. Stronger results were achieved in most settings where interventions were sustained and had multiple components. Successful programs included:

- educational components alongside policy;
- formal recognition of skin cancer prevention efforts, such as membership programs;
- provision of sun protection equipment and behavioural reminders in settings where UV exposure is likely, including via mobile technology.

Mass media campaigns were also associated with improved sun protection behaviours, reduced sunburn incidence, and decreasing age-specific incidence of melanoma in younger age groups.

The review of outdoor worker sun safety interventions included the four systematic reviews [131, 122, 123, 124] which have been summarised above. The Evidence Check also reviewed 16 articles regarding 11 interventions, where 9 of these articles were included in the previous systematic reviews.

Key findings from the studies reviewed included:

- The most commonly reported interventions were one-off educational approaches, of varying duration and study quality.
- Some of the more comprehensive programs were theory based, such as the Go SunSmart program, based principally on the diffusion of innovations theory, and the Pool Cool program which incorporated training and education in a peer-driven approach.

More information regarding the Go SunSmart and Pool Cool programs is provided in the section below, where the evaluation findings from individual programs are highlighted.

Summary of findings from the Cancer Council NSW literature review undertaken in 2025

A total of 46 publications were identified, evaluating sun safety interventions across Australian and international outdoor workplaces between 2005 and 2024.[25, 59,76–120] .

Table 10. Highlights of multi-component interventions targeting outdoor workers

Intervention Studies				
Multi-component				
Intervention	**Location & Duration**	**Target Group**	**Key Components**	**Outcomes & Insights**
Pool Cool & Pool Cool Plus	USA, 1998–2007	Children, parents, lifeguards	Lessons, activities, guides, awards, shade structures	Enhanced version reduced sunburn; dose of messaging matters
Go SunSmart	USA & Canada, 2004–2007	Ski resort employees	Posters, training, newsletters, magnets	Enhanced delivery with personalised support and diverse communication materials led to better sun protection; industry partnerships crucial
Outdoor Worker Sun Safety Project	Australia, 2010–2013	Construction, farming, public sector	Policy, PPE, education, role modelling, skin exams	Improved sun protection; tailored interventions preferred; visual resources effective
Sun Safe Workplaces	USA, 2010-ongoing	Public works, safety, parks	Education, shade, sunscreen access, online resources	Sustained practices; digital delivery feasible; policy essential
Sun Solutions	USA, 2012–2013	Operating engineers	Communication + sunscreen strategies	All groups improved; most comprehensive group had best outcomes

Intervention Studies				
Multi-component				
Sun Safety at Work Canada	Canada, 2015–2016	Electrical, utility, government	Training, tailored resources, knowledge brokers	Improved practices; internal champions recommended; short duration limited impact
UK Construction Worker Study	UK, 2019	Construction workers	UV dosimeters, app, messages, sunscreen, vitamin D	Increased UV exposure; cultural attitudes influenced results
Denmark Follow-up Study	Denmark, 2020	Outdoor workers	UV dosimeters, sunscreen, education, skin exams	Sustained awareness and sunscreen use; context matters
Egypt Farmer Pilot	Egypt, 2022	Farmers	Education, PPE, info materials	Improved knowledge and behaviours; tailored messaging needed

<u>'Pool Cool' and 'Pool Cool Plus', 1998-2007, USA</u>

- The Pool Cool intervention launched in 1998 and was developed to reduce sun exposure and increase sun protection within outdoor pool settings. The program ran for 9 years.
- The intervention initially consisted of strategies targeting children and parents including; short sun safety lessons incorporated into children's swimming lessons, sun-safe poolside activities and sun safety resources provided within the pool setting.[132]
- In 2007, an enhanced version – 'Pool Cool Plus' – was implemented at 17 pools and included lifeguards as a target audience. Pools that received the enhanced intervention received additional strategies including further educational support, encouragement to form a sun safety planning team, sun safety guides, an awards program, Pool Cool networking webpages, posters, and shade structures for the pools, to improve sun protection practices of the lifeguards.[82,80,96]
- Workers who taught sun safety lessons reported improved sun protection behaviours, and those receiving the enhanced intervention reported lower rates of sunburn compared to those that received the standard intervention.[96]

<u>Go SunSmart, USA & Canada, 2004–2007</u>

- A comprehensive intervention targeting sun safety for outdoor workers across 53 ski resorts in the USA and Canada was evaluated over a 5-7 year period. This was a large study of ski area employees (n=2,940) and ran for 4 years.[91]

The purpose of the study was to evaluate the sustainability of an occupational skin cancer prevention program, where a controlled randomised dissemination trial compared an enhanced versus a basic dissemination strategy at ski areas enrolled in the trial, whereby resorts were provided with up to 23 program dissemination items (for example, posters, decals, magnets, newsletter articles, and training).[91] The follow up study that was conducted 5-7 years later found that ski staff reported using more sun protection practices in the resorts still implementing the enhanced approach to delivering sun protection messages.[117] Those ski areas where more Go SunSmart items were displayed (i.e. in the enhanced condition) also reported fewer sunburns.[91]

- Significant differences for all sun protection practices were identified at ski areas that displayed 9 or more Go Sun Smart materials or a combined total of 9 or more materials and other sun safety messages.[117]
- The project identified that strong partnerships with industry associations can facilitate sustainable program uptake and dissemination,[82] and that personal contact with workplace managers is an important factor influencing the adoption of sun safety amongst their staff. [82]
- There was also evidence of intervention effects relating to sun protection behaviours that ran over into summer months, when the seasonal employees in the ski industry worked elsewhere, many at other outdoor occupations.[113]
- Similar to 'Pool Cool Plus', this study demonstrated that an enhanced program delivery strategy consisting of personalised support and exposing workers to more sun safety communication materials (e.g., posters, magnets, website content, newsletter snippets or training programs for managers) resulted in increasing their awareness and adoption of sun safe behaviours.[91]

The findings from the 'Go SunSmart' and 'Pool Cool Plus' interventions highlight that the 'dose' of the sun safe message matters. Providing educational content with repeat reminders was found to be effective in sustaining behaviour.

‘Outdoor Worker Sun Safety Project’, 2010-2013, Australia

- This Outdoor Worker Sun Safety Project focused on 14 workplaces across the construction, farming, local government and public sector industries in Queensland over a four-year period.[101]
- Funded by the Queensland government and led by a research team at the Queensland University of Technology (QUT), this study involved an intensive participatory-action-research approach, with QUT staff supporting designated workplace champions to plan and deliver interventions tailored to the needs of their workplaces. Interventions included six domains, consisting of: policy; structural and environmental strategies; personal protective equipment (PPE); education and awareness raising strategies; role modelling; and skin examinations.
- Alongside improved sun protection and reduced sunburn in workers, the results demonstrated that strong relationships between QUT staff and participants can lead to positive outcomes. Additionally, the study found that the dissemination of highly visual resources with limited wording were preferred by workplaces.

There was no set combination of strategies that suited all workplaces; rather the combination depended on workplace size, industry and workplace culture, and therefore benefited from a flexible approach that could be tailored to suit the individual needs and priorities of each of the businesses.[81,121]

Sun Safe Workplaces, 2010-ongoing, USA

- The Sun Safe Workplaces study focused on workers within public works, public safety and parks and recreation from 98 local councils in Colorado, USA.[102]
- This extensive study was led by the same research group as those working on the Go SunSmart study and showed that education sessions should be considered as a key part of a comprehensive intervention.
- A two-year follow up of this study found that workplaces exposed to the intervention reported higher levels of sun safety procedures, communication to workers, use of shade and accessibility to sunscreen compared to those local government areas that did not receive the intervention.
- These findings highlight that when workplaces adopt multi-component sun safety approaches, they are more likely to report sustained sun safe practices and procedures.
- An additional follow-up study designed to investigate the feasibility of scaling up this intervention by comparing an online approach (i.e. downloadable resources, information and online meetings) with the original in-person approach highlighted that workplace leaders are open to digitized workplace sun safety interventions but they need to remain affordable and uncomplicated.[84]
- As part of this scale up, the authors investigated sun safety policies in a sample of 21 state departments of transportation (DoT) participating in the intervention.[80] This study found that 95% of DoTs surveyed had a policy that included at least one sun protection strategy, however, less than half of the policies explicitly mentioned sun protection as its purpose. PPE measures were the most common strategies, with administrative controls lacking in most policies.
- The authors note there was a strong association between having a policy in place and the implementation of controls, making a formal policy beneficial for influencing workplaces to implement sun safety as a long-term strategy.[80] These findings echo the findings from the Queensland University of Technology, where a sun safe policy was found to be a foundational piece for workplace sun protection.[133]
- Unpublished data regarding subsequent phases of this project has highlighted that providing digitised information that guides workplace leaders through a dedicated process of reviewing their policy with sun safety training implementation has been well received. The impact of COVID was a catalyst for this scalable approach to service delivery, and results thus far indicate the high useability of the online support and high rating of the online training. A randomised trial is currently underway to explore these findings further.[134]

This iterative and ongoing intervention highlights the important foundational role of a policy in enabling implementation of sun safety strategies and controls.

‘Sun Solutions’, 2012-2013, USA

- This study involved a 6-month trial with 357 operating engineers in Michigan, USA. The study evaluated the efficacy of four different combinations of communication and sunscreen provision strategies on worker sunscreen use and sunburn.[115,116]
- While the study demonstrated a significant increase in sunscreen use and a decrease in reported sunburns for all intervention groups, the greatest decrease in sunburn was for workers who received the most comprehensive intervention that included all of the communication and sunscreen strategies.
- These enhanced strategies and improved outcomes align with the results of Go SunSmart,[117] highlighting that a greater number of dissemination strategies can lead to improved sun safety outcomes for workers.

Sun Safety at Work Canada 2015-2016, Canada

- This 'Sun Safety at Work' project focused on 12 workplaces from the electrical, utility and local government sectors over a two-year period in Canada.[76]
- The project was led by a research team at Toronto Metropolitan University where workplace support was provided to enhance sun safety practices amongst outdoor workers. Key strategies included personalised support, training and resources tailored to suit workplace needs.
- This research resulted in the development of a dedicated program website with 70 evidence-based, Canadian-centric resources. These resources are publicly available on the Sun Safety at Work website, designed to sustain sun safety implementation across workplaces.
- Through personal communication with the lead author, Cancer Council NSW learned that the main focus for the research team was the development of workplace-focused resources, not academic papers, therefore limiting access to published evaluations. However, as part of our discussions with the authors, we learned that the personalised support provided to workplaces by 'knowledge brokers' was identified as the strongest facilitator driving improvements in sun safe practice adoption. The knowledge brokers helped keep sun safety on the agenda and provided tailored support strategies that met the needs of workplaces.
- A key challenge identified by the authors related to the unsustainable nature of this type of resourcing, particularly if the project was to be scaled up. The authors recommended that businesses demonstrate their buy-in to the project by resourcing knowledge brokers from within the organisation, rather than relying on external research funding.
- Unfortunately, the intervention only ran for one full Canadian summer (~4 months), due to the length of time required to recruit workplaces.

This intervention highlighted that 'management buy-in' and 'workplace champions' are critical to ensuring sun safety is prioritised, and that sufficient momentum is maintained within organisations to support progress.

Outdoor worker intervention, 2019, United Kingdom (UK)

- This cross-sectional study involved an intervention targeting ~60 construction workers who were studied over 3 seasonal timepoints. Intervention components included wearable UV dosimeters, sun safety text message reminders, a sun safety App, sunscreen and vitamin D supplements.[98]
- Unfortunately, the study found that those workers exposed to the intervention actually increased their UV exposure. The authors noted that the deeply entrenched perceived benefits of sunlight and tanning amongst the British population may have contributed to this unintended consequence.

Outdoor worker follow up study, 2020, Denmark

- This follow up study was undertaken with 237 outdoor workers in Denmark who had previously participated in a multi-component intervention during a European summer four years earlier.[107] The intervention consisted of sun protection information, access to sunscreen, a wearable UV dosimeter (i.e. measuring real-time UV exposure), and skin cancer examinations.
- Study findings demonstrated a significant and sustained increase in awareness of outdoor worker skin cancer risk, and the perceived importance and use of sun protection (particularly sunscreen) at work.
- The provision of a wearable UV dosimeter in this intervention contributed to positive outcomes, which is in contrast to the results from the UK intervention with construction workers described above, highlighting the importance of understanding the social context in which strategies are being delivered.

Outdoor worker pilot 2022, Egypt

- A 6-month pilot intervention was undertaken with 139 farmers in Egypt. The intervention consisted of education sessions, provision of PPE and information provided to workers.[111]
- The study resulted in significant improvement in workers' sun safety knowledge, some behaviours including use of protective clothing and hats, rotating jobs and checking their own skin, and a significant reduction in their perceived barriers to sun protection.[111]
- The authors noted the importance of developing industry-specific messages to help overcome barriers to sun protection. These findings align with 2023 research from the Canadian study, where the objective to develop evidence-based messaging needed to be tailored to the worker, employer and occupation and should include infographics and short, sharp key messaging framed in 'occupational safety' language.[112]

Table 11. Highlights of single strategy interventions targeting outdoor workers

Single component interventions				
Intervention	**Location and Year**	**Target Group**	**Key Components**	**Outcomes and Insights**
'Sun Solutions' module to reduce sun exposure and decrease risk of skin cancer	USA, 2014	Operating engineers	Education module incorporated into safety training; tailored information on skin cancer risks	High participant agreement on helpfulness; increased understanding and intent to use sunscreen; slight increase in perceived barriers
DVD-based sun safety educational intervention	UK, 2016	Construction workers	DVD-based intervention shown post-baseline survey; comparison group emerged	Positive behavioural change; no significant knowledge change; education alone may be insufficient
Determine the effect of an education intervention based on health belief model and social support among farmers	Iran, 2019	Farmers	Eight weekly training sessions with lectures, discussions, and multimedia	Significant improvement in sun safety behaviours and self-efficacy; reduced perceived barriers
Smart sunscreen station in a regional outdoor workplace	Australia, 2020	Miners	Smart sunscreen station deployed in common areas; continuous data collection	High usability and connectivity; potential tool for optimizing sunscreen use
Develop a patient counselling approach for individual sun protection for outdoor workers	Germany, 2020	Outdoor workers	Guided interviews; tailored counselling modules; development of personal sun protection plans	Highly rated individual focus; interest in workplace prevention programs
Effective methods for communicating the risks of sun exposure to outdoor workers	USA, 2021	Outdoor workers	Randomised messaging styles (generic, targeted, tailored) with/without financial info	Targeted and financial messages more effective; tailored not significantly better than targeted
Evaluate shading structures and T-shirts used by lifeguards for UV protection	Italy, 2022	Lifeguards	UV measurements under different shade structures; UPF testing of T-shirts	Significant UV reduction under shade
Develop practical harm-	Canada, 2023	Outdoor workers	Stakeholder workshops;	Importance of occupation-specific, concise

Single component interventions				
reducing sun safety messages for outdoor workers			tailored messaging; qualitative interviews	messaging; practical challenges acknowledged
Knowledge of sun safety and impact of educational measures	USA, 2023	Outdoor workers	Pre/post interactive lecture with survey	Improved awareness and agreement with photoprotection practices

Noting that workplace-based interventions are often complex and challenging to implement,[76] single component strategies can appear attractive to sun safety practitioners, based on the fact that they can seem easier to deliver. The challenge is that single component interventions can be harder to sustain. For example, interventions consisting of education sessions alone have demonstrated improved understanding of skin cancer, efficacy and sun protection behaviours,[83,87,114,118] but their impact has not been sustained.

Two pilot studies investigated the impact of a 'sunscreen only' intervention with miners at a work site in Queensland Australia for 12 days during summer,[95] and with 67 construction workers in the Netherlands for 4 months.[106]

- These studies found that whilst increasing sunscreen access was acceptable to workers, it should not be a stand-alone intervention.[95,106]
- These findings echo the conclusions reached by the researchers leading on the multicomponent Danish sun safety pilot,[107] who stress the importance of including additional strategies to sunscreen.