World Health Organization

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ISBN 978-92-4-151259-6

Suggested citation. Artificial tanning devices: public health interventions to manage sunbeds. Geneva: World Health Organization; 2017. Licence: CC BY-NC-SA 3.0 IGO.

Cataloguing-in-Publication (CIP) data. CIP data are available at http://apps.who.int/iris.

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Design and layout by L'IV Com Sàrl, Villars-sous-Yens, Switzerland.

Printed by the WHO Document Production Services, Geneva, Switzerland.

Contents

Foreword

Artificial tanning is a recent phenomenon. Sunbeds and other tanning devices emitting artificial ultraviolet radiation (UVR) were developed in the 1960s but it was not until the 1980s that people began to use tanning beds in large numbers. During the 1990s, the artificial tanning industry grew rapidly in Northern Europe, Australia and the Americas. With increasing exposure by young people, often women, to artificial ultraviolet radiation, the health risks soon became apparent. Artificial tanning is now seen as a public health issue accounting for about half a million new cancer diagnoses each year in the United States of America, Europe and Australia. Evidence of an association between artificial tanning and risk of skin cancer clearly shows that the risk is highest in those exposed to artificial tanning in early life.

In 2003, the World Health Organization (WHO) responded to this growing public health challenge by publishing a guidance document on sunbed legislation, *Artificial Tanning Sunbeds, Risks and Guidance*. In addition, WHO's International Agency for Research on Cancer (IARC) classified exposure to UV-emitting tanning devices (sunbeds) as carcinogenic to humans in 2009. Since then, momentum has been building among policy-makers to regulate sunbed use and now more than 40 national or provincial authorities around the world have implemented outright bans or restrictions on the use of sunbeds.

In line with the United Nations Sustainable Development Goal (SDG) on good health and well-being, WHO is strongly committed to reducing premature mortality from noncommunicable diseases, including cancer, through various prevention and control strategies (SDG indicator 3.4). This booklet is intended to provide policy-makers with information on the health risks from sunbed use, and how some countries have tackled this challenge through a number of public health interventions. Governments and other stakeholders have a key role to play in addressing and challenging the myths and behaviours related to sunbed use, often by youth, which contributes to increasing morbidity and mortality while providing no clear benefit beyond cosmetic outcomes.

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Acknowledgements

This document was prepared by Emilie van Deventer (WHO Department of Public Health, Environmental and Social Determinants of Health) and Craig Sinclair (Cancer Council Victoria, WHO Collaborating Centre for UV radiation).

WHO thanks the following WHO collaborating centres for their technical assistance and support: Australian Radiation Protection and Nuclear Safety Agency, Australia (P. Gies, R. Tinker); Cancer Council Victoria, Australia (K. Dunstone, A. Nicholson, C. Sinclair); Universidad Mayor de San Andres, Bolivia (L. Blacutt); Association Sécurité Solaire, France (M. Boniol, JP. Césarini, P. Césarini, JF. Doré); Federal Office of Radiation Protection, Germany (C. Baldermann, D. Weiskopf); Federal Office of Public Health, Switzerland (D. Storch) and Public Health England, United Kingdom of Great Britain and Northern Ireland (M. Khazova, J. O'Hagan).

Contributions to the report were provided through consultation with external experts within the framework of the WHO INTERSUN programme. The inputs received from Member State agencies are greatly appreciated. These included the Federal Ministry of Health and Women's Affairs, Austria (N. Leitgeb, M. Renhardt); the National Centre of Public Health and Analyses, Bulgaria (M. Israel); Health Canada (J. McNamee, S. Qutob), the Office of the Chief Medical Officer of Health of New Brunswick (S. Hamel), Canada; the Danish Health Authority, Denmark (P. Søgaard Thygesen); the Radiation and Nuclear Safety Authority, Finland (R. Visuri); the Agency for Food, Environmental and Occupational Health and Safety, France (J. Fite); the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Germany (B. Keller); the Greek Atomic Energy Commission, Greece (E. Karabetsos), the Department of Health, Hong Kong Special Administrative Region, China (YK. Wan); the Radiation Safety Authority, Iceland (S. Magnússon); the Department of Health, Ireland (G. Connolly); the Environmental Protection Agency, Ireland (B. Rafferty); the Israeli National Information Centre for Non-Ionizing Radiation, Israel (S. Sadetzki); Tuscany region, Italy (I. Pinto); the Ministry of Health, Italy (P. Rossi); the Ministry of Health, New Zealand (M. Gledhill); the Norwegian Radiation Protection Authority, Norway (LT. Nilsen, TM. Sjømoen); the Swedish Radiation Safety Authority, Sweden (J. Gulliksson); the Ministry of Health, Turkey (E. Hacikamiloğlu); the Department of Health of Northern Ireland (N. McMahon), the Population Health Directorate of the Scottish Government (M. Stewart), United Kingdom of Great Britain and Northern Ireland; the Food and Drug Administration, United States of America (S. Miller); the Centers for Disease Control and Prevention, United States of America (M. Watson).

Input is also acknowledged from the following non-governmental organizations: EUROSKIN (R. Greinert), the International Commission on Non-Ionizing Radiation Protection (A. Green) and the Association of European Cancer Leagues which collated replies from the Cyprus Association of Cancer Patients and Friends, Cyprus (D. Constantinides); the Danish Cancer Society, Denmark (P. Dalum); the Icelandic Cancer Society, Iceland (L. Sigurðardóttir); the Irish Cancer Society, Ireland (E. Browne); the Israel Cancer Association, Israel (M. Ziv); Cancer Focus, Northern Ireland (G. McElwee); the League against cancer, Slovakia (E. Siracka); and the Swiss Cancer League, Switzerland (N. Gerber).

Support was also provided by WHO colleagues, including from the Public Health Ethics Consultative Group (A. Croisier, R. Johnson, MP. Preziosi, A. Reis); the Department of Essential Medicines and Health Products (J. Hansen); the Department of Gender, Equity and Human Rights (R. Thomas Bosco); the Department of Prevention of Noncommunicable Diseases (K. Schotte); the Department for Management of Noncommunicable Diseases, Disability, Violence and Injury Prevention (A. Ilbawi), the Department of Public Health, Environmental and Social Determinants of Health (MN. Bruné-Drisse, M. Perez, A. Prüss-Ustün) and the International Agency for Research on Cancer (B. Lauby-Secretan).

The project was supported by the French Ministry of Health and funded by the French Agency for Food, Environmental and Occupational Health and Safety (ANSES) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).


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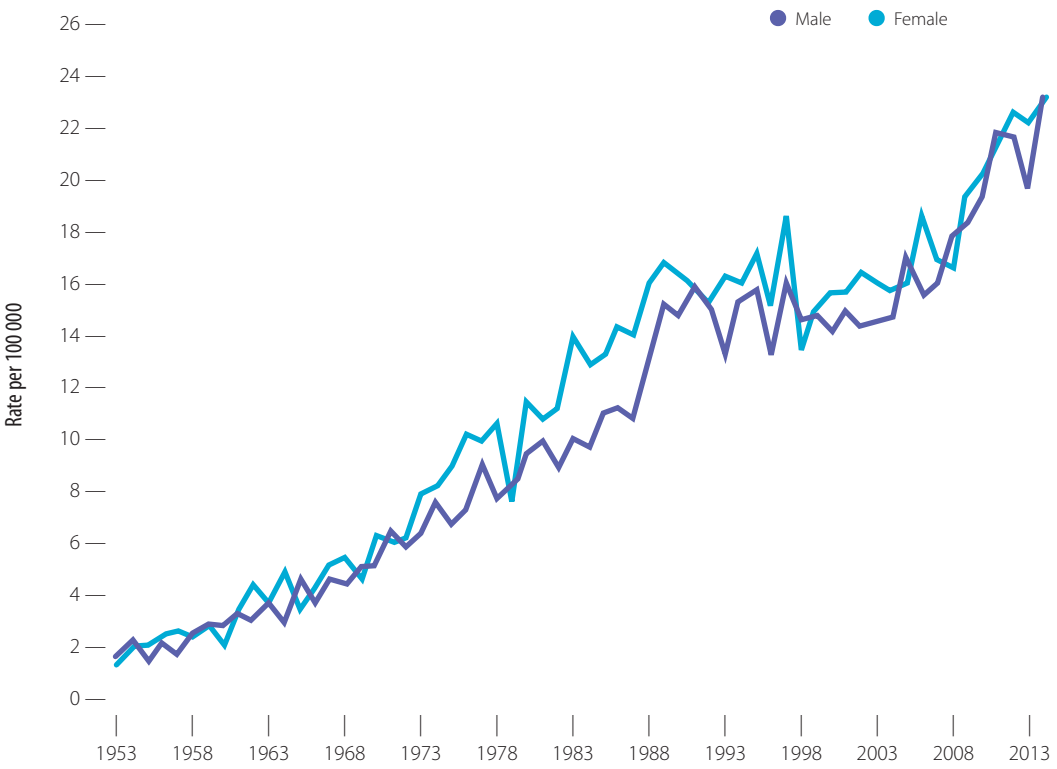
1. Introduction

SKIN CANCER IS THE MOST COMMON FORM OF CANCER AMONG LIGHT-SKINNED POPULATIONS. The incidence of melanoma, the least common but most lethal type of skin cancer, has increased alarmingly in the past several decades (see example from Norway in Fig. 1). As of 2012, there were over 230 000 new cases of melanoma worldwide, causing an estimated 55 500 deaths *(1)*. Keratinocyte cancers (also known as non-melanoma skin cancers) are much more common, and in the United States of America alone accounted for over 5.4 million incident cases in 2012 *(2)*. The chief environmental cause of skin cancer is ultraviolet radiation (UVR) *(3)*.

UVR exposure comes mainly from the sun, but over the past three decades there has been an increase in the use of artificial sources of UVR in the form of artificial tanning devices, such as sunbeds, stand up booths and facial tanners (all referred to as sunbeds in this document). This deliberate exposure to UVR for cosmetic purposes is increasing the incidence of the major types of skin cancer and driving down the age of first appearance *(4, 5, 6)*.

Figure 1. **Rising melanoma incidence rates in Norway over six decades**



Source: Norway Association of the Nordic Cancer Registries (7).

1.1. THE PURPOSE OF THIS DOCUMENT

The purpose of this document is to provide information to assist with the introduction of interventions relevant to the use and management of sunbeds. The document provides a summary of health effects as well as a catalogue of interventions that have been used to reduce risks associated with artificial tanning. It is supplemented by a WHO database on sunbed regulations *(8)*.

The main target audience is policy makers at the national or state level in countries that are considering the development or revision of regulations relating to sunbed use. The document addresses artificial tanning sunbeds used for cosmetic purposes only, and is not intended to cover UV-therapy devices when used for medical purposes under the guidance of a medically trained practitioner.

1.2. THE USE OF SUNBEDS

Few people had ever used a sunbed before 1980, but by the end of the 2000s surveys found that in Northern Europe 60% of individuals aged 15–59 had used a sunbed at least once *(9)*. Today, sunbeds are mostly found in countries where there is little sun to naturally tan and in sunny areas where individuals wear more revealing clothes and may be more body image-conscious. Though artificial tanning facilities have spread to wide geographical regions, there are limited data on the extent of sunbed use in middle-income and low-income countries.

The largest proportion of sunbed users are women, particularly young women.

There is a large amount of data characterizing sunbed users, primarily in North America, Europe and Australia, from which there are three principal findings: 1) the largest portion of users are women; 2) young adults utilize artificial tanning more than other adults; and 3) the rate of usage in all age groups has risen over the past years *(4, 10, 11)*. Notably, even though adolescents are barred from artificial tanning facilities in a number of countries and constitute the smallest fraction of users overall, they still report surprisingly common use, with between 7 and 24% of adolescents in the United States of America having used sunbeds *(4, 12)*. A Danish survey from 2008 found that some 2% of children aged 8 to 11 years had used a sunbed within the past 12 months *(13)*.

1.3. THE TYPE OF RADIATION EMITTED BY SUNBEDS

The UVR from a sunbed is divided into two bands based on wavelength – UV-A (315–400 nanometres, nm) and UV-B (280–315 nm) and has the same physical characteristics as the UVR reaching the earth from the sun, though it is composed of different ratios of UV-A and UV-B depending on the lamp type. Many sunbeds emit mostly UV-A with much higher irradiance compared to the sun, as well as some UV-B *(14, 15)*.

Sunbeds are designed to provide a tan rapidly and, to achieve this, emit UVR at high intensity. Most tanning beds in Europe emit UVR at levels equivalent to midday tropical sun *(14, 15)*, but some of the more powerful tanning beds may emit UVR with an intensity equivalent to an "extreme" UV index (>11), and with UVA intensities well above anything experienced in nature *(15, 17, 18, 19)*.

2. Health consequences from sunbed use

THERE ARE A NUMBER OF HEALTH CONSEQUENCES FROM EXPOSURE TO BOTH NATURAL AND ARTIFICIAL UVR. The adverse health effects associated with sunbed use are now well-documented and the body of evidence continues to grow. Cancer, sunburns, accelerated skin ageing, eye inflammation and transient immunosuppression are all associated with sunbed use. Of these, cancer is by far the most serious and will be the focus of this section (see Annex 1 for a summary of non-cancer health risks). Vitamin D production from UVR is also discussed.

2.1. CANCER RISK

The incidence of skin cancer, which is caused by UVR exposure, has risen dramatically among light-skinned populations in the last few decades. Even though natural sun exposure accounts for most cases, sunbed use is responsible for an increasing number of skin cancers. Artificial tanning induces DNA damage in skin cells, similar to that induced by exposure to solar UVR *(20)*. DNA damage can occur even with UV doses too low to cause sunburn *(21)* and the risk of skin cancer is increased with each exposure *(22)*.

UV-A radiation, which predominates in most sunbeds, penetrates the skin more deeply than UV-B and is linked to photo-ageing but is actually less effective at generating melanin pigment and vitamin D. UV-B radiation causes skin reddening and sunburn and contributes to tanning. Most importantly, both UV-A and UV-B contribute to DNA damage, and therefore IARC has classified the whole spectrum of ultraviolet radiation and the use of UV-emitting tanning devices (sunbeds) as carcinogenic to humans *(23)*.

Sunbeds are classified as carcinogenic to humans by the International Agency for Research on Cancer.

The risk of developing skin cancer varies greatly with skin type, and the majority of skin cancers are found in light-skinned people, especially those with a low tanning response to UVR. The three major types of skin cancer are listed below in order of increasing severity and decreasing frequency.

- Basal cell carcinoma (BCC) arises from skin epithelial cells and does not usually spread to other parts of the body but may form a deep sore if not removed.

- Squamous cell carcinoma (SCC) also forms in the epithelial cells of the skin and can spread in the body if not detected early and removed surgically.

- Melanoma is the least common but the most deadly skin cancer, accounting for the majority of skin cancer deaths. This cancer, which develops in pigmented cells (melanocytes), may occur early in life and is one of the most common malignancies in young adult Caucasian women (15 to 49 years of age) *(24)*.

Melanoma risk increases with younger age of first sunbed use and with greater lifetime use of sunbeds *(6, 25)*. A systematic review showed that people who have used a sunbed at least once at any stage in their life have a 20% higher risk of developing melanoma than people who have never used a sunbed, and the first use of sunbeds before the age of 35 increases the risk of developing melanoma by 59% *(6)*. The risk of melanoma was calculated to increase by 1.8% with each additional sunbed session per year. The added risk of early sunbed use was confirmed in a recent large prospective cohort study of over 140 000 Norwegian women *(26)*. Sunbeds have been found to pose a specific risk for melanoma, independent of skin type and of solar exposure *(6, 21, 25, 26)*.

It is estimated that sunbed use is responsible for over 450 000 non-melanoma skin cancer cases and more than 10 000 melanomas in the United States, Europe and Australia.

Sunbed use is also associated with keratinocyte cancers *(27, 28)*. For both SCC and BCC, early use is an important risk factor. A systematic review estimated the risk of SCC to increase by 102% and BCC by 40% when first exposure to sunbeds started before the age of 25 *(5)*.

It is estimated that sunbed use is responsible for over 450 000 non-melanoma skin cancer cases and more than 10 000 melanoma cases per year in the combined populations of the United States of America, Europe and Australia *(4, 29)*. As populations in these countries age, melanoma rates, including those from sunbed exposure, are predicted to continue to rise for at least the coming decade *(30)*.

Ocular melanoma is much less common than skin melanoma, but is also life-threatening and often requires surgical removal of the eye *(31)*. Epidemiological studies have found an increased risk of ocular melanoma with sunbed use, especially for those who started artificial tanning before 20 years of age *(23)*.

Because of the strong evidence of skin cancer induction following sunbed exposure with no indications for threshold, the Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) of the European Commission concluded that there is no safe limit for exposure to UV radiation from sunbed *(10)*.

2.2. VITAMIN D PRODUCTION

Vitamin D is a hormone that is important in musculoskeletal health. Vitamin D synthesis is triggered in the skin through exposure to UVB, including from sunbeds *(32, 33, 34, 35)*. While optimal vitamin D concentrations in blood are a matter of scientific debate *(36, 37)*, low vitamin D levels, which have been found in patients with a wide range of diseases, are suggested to be a marker rather than a cause of ill-health. Interventions to increase vitamin D levels have not generally improved non-musculoskeletal health outcomes *(38)*.

Maximal vitamin D synthesis is triggered by sub-erythemal doses of UVR *(39)*, and longer exposures cause a linear increase in DNA damage while adding nothing to the vitamin D level *(40)*. Scientific organizations and national health agencies in several countries, and more recently the EC SCHEER, advise against the use of sunbeds to enhance vitamin D levels because any beneficial effect of increased vitamin D synthesis is outweighed by adverse effects *(10)*. Alternative sources of vitamin D (dietary vitamin D and supplements) are readily available.

It is not recommended to use sunbeds to enhance vitamin D levels.

2.3. POPULATIONS MOST AT RISK FROM SUNBED USE

While all sunbed users are at risk of adverse health effects, studies on UVR exposure from the sun or sunbeds indicate that certain people are at increased risk of harm, including those who:

- tend to freckle
- have skin that burns easily
- have a history of childhood sunburn
- have a large number of naevi (moles)
- are taking medication which has the potential to increase photosensitivity
- are wearing cosmetics
- have a weakened immune system
- have a family history of skin cancer
- have ever been treated for actinic keratosis or skin cancer
- have pre-malignant or malignant skin lesions
- have had sun or sunbed exposure within the past 48 hours.

People with freckles

Freckles, lightly pigmented spots, are more apparent after exposure to UVR, but may be permanent, particularly in red- haired people. Having freckles is a sign of strong natural sensitivity to UVR and also a strong risk factor for skin melanoma *(41, 42)*. People who have permanent freckles or who freckle after UVR exposure are at higher risk when using sunbeds.

People with sun-sensitive skins

People with natural solar sensitivity – individuals with fair skin who are easily sunburned (skin phototypes I and II in Table 1) – are at higher risk of skin cancer and of eye melanoma *(27, 43)*. However, cancer risk from sunbed exposure is not limited to populations with UV-sensitive skin and increases even in people who never experienced sunburns *(21)*.

Table 1. **Skin phototypes: typical features and tanning ability**

I	II	III	IV	V	VI
Pale white skin; blond or red hair; blue or grey eyes; very frequent freckles	White, fair skin; blond to brown hair; blue, grey, green, or hazel eyes; frequent freckles	Light skin; dark blond to brown hair; grey or brown eyes; rare freckles	Light brown to olive skin; dark brown hair; brown to dark brown eyes; no freckles	Dark brown skin; dark brown to black hair; dark brown eyes; no freckles	Deeply pigmented dark brown to black skin; black hair; dark brown eyes; no freckles
ALWAYS BURNS, NEVER TANS	USUALLY BURNS, TANS MINIMALLY	BURNS MODERATELY, TANS UNIFORMLY	BURNS MINIMALLY, ALWAYS TANS	RARELY BURNS, TANS VERY EASILY	NEVER BURNS, NEVER TANS

Source: Adapted from *(44)*.

Young individuals

Epidemiological studies have shown that UVR exposure in childhood and adolescence leads to a higher risk of adult melanoma *(45, 46, 47, 48)*, and that artificial tanning during youth poses a specific additional risk *(4, 49)*. One study estimated that one in six melanoma cases diagnosed in Australians aged 18–29 could be prevented by avoiding sunbeds *(50)*.

People with a high number of skin naevi

The number of skin naevi (moles) is an important marker of melanoma risk *(51, 52, 53, 54)*, including from the use of sunbeds *(55)*.

People taking medication or wearing cosmetics

Numerous drugs and cosmetics have the potential to stimulate photosensitive (phototoxic and/or photoallergic) reactions of skin *(56)*. Exposure to UVR after taking or touching photosensitizing substances may cause an acute skin toxic/allergic reaction which can be serious and life-threatening. Tanning accelerators, particularly those containing psoralen compounds, may cause severe sunburn in people using sunbeds *(57)*. Psoralen use during UVR exposure is mutagenic and carcinogenic.

3. Policy options to decrease health risks from sunbeds

POLICY-MAKERS HAVE A NUMBER OF OPTIONS, FROM VOLUNTARY TO LEGISLATIVE, TO MANAGE HEALTH RISKS FROM SUNBEDS. The selection of approaches should balance the particularities of the population (e.g. degree of risk currently posed, political and societal acceptability of restrictions and other mandated solutions), the cost and feasibility of implementation, and the likelihood of success. Some of these approaches may not be appropriate or relevant for certain countries.

The following represents some of the policy options that may be considered by legislators and regulatory authorities. In each case, the intervention has been implemented in at least one country or Member State. Further information can be found on the WHO database on sunbed regulations *(8)*.

3.1. PROMOTING EDUCATION STRATEGIES

Public health campaigns are most effective when directed towards groups most affected by the harm in question. In the case of artificial tanning, campaigns have been often directed towards women and younger age groups who are more likely to be early adopters of sunbeds (see examples in Fig. 2). Some countries, e.g. Canada, Denmark and the United States of America, have used social media effectively to target young people. A public awareness campaign in Denmark was followed by a marked reduction in sunbed use *(9)*. An Italian study showed that sunbed use by parents influenced the desire of teenagers to use a sunbed more than participation in educational interventions, highlighting the importance of educational interventions involving families *(58)*. Evidence has shown that counselling by general practitioners and paediatricians can moderately result in behaviour change of youth *(59)*.

Policy makers can take advantage of influential and diverse stakeholder groups, including cancer societies, professional associations and even religious leaders, to develop innovative and impactful messages. In the United Kingdom of Great Britain and Northern Ireland, for example, modelling agencies united in a 2012 campaign to highlight the dangers of using sunbeds. Activism from sunbed users who developed skin cancer has also been a powerful factor driving policy change.

To be effective, public awareness campaigns need to acknowledge the arguments advanced in favour of sunbed use and employ evidence-informed arguments to counter them. Table 2 compiles some examples of the claims made about the benefits of sunbed use and scientific evidence that can be used as counterargument.

Figure 2. **Examples of public awareness campaigns**

1

2

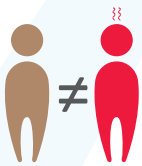
3

4

5

(1) United States of America Centers for Disease Control and Prevention;
(2) and (3) Cancer Research UK;
(4) Slovenian Institute of Non-Ionizing Radiation (INIS);
(5) Greek Atomic Energy Commission.

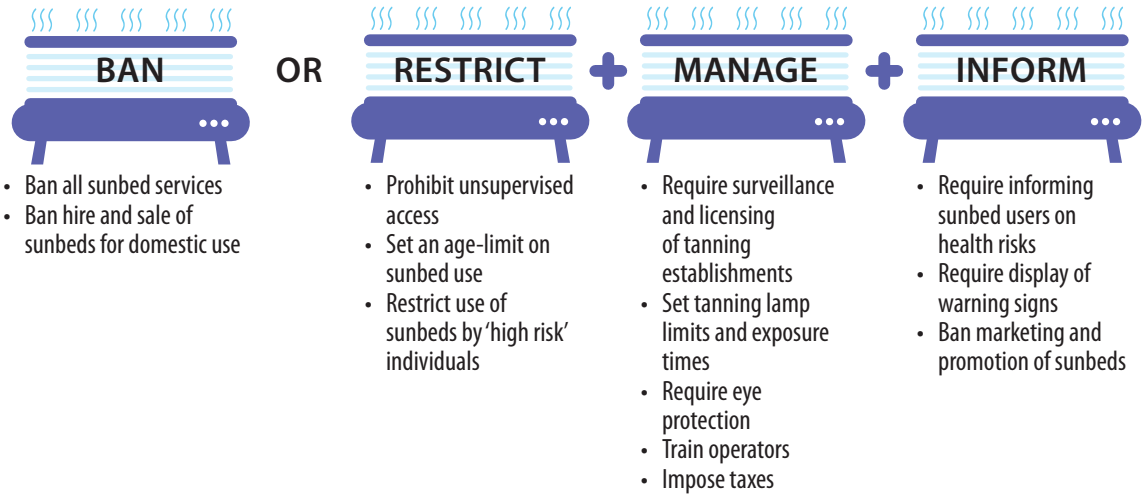
Table 2. **Claims about the benefits of sunbed use and effective counterarguments**

CLAIMS		THE FACTS
VITAMIN D *« Using a sunbed helps people generate vitamin D which is essential for bone and muscle health »*		Using a sunbed is not an efficient way to generate Vitamin D *(10, 60)*. In most latitudes, only very brief exposure to sunlight is needed for synthesizing adequate vitamin D levels. For people at high risk of vitamin D deficiency and very limited solar exposure, taking oral supplements is an effective, non-carcinogenic way to increase vitamin D levels.
CONTROLLED TANNING *« Sunbeds are safer than going out into the sun because it uses mostly UV-A radiation and is more controllable »*		This claim was also used in the days when UV-A was believed to be so-called safe UVR. This is now known to be untrue *(23)*. Sunbed users can be exposed to higher UVR doses than anticipated because a large number of devices emit UVR above safety limits *(14, 15, 16)*.
SO-CALLED PRE-VACATION TANNING *« Using a sunbed is a controlled way to develop a tan that will protect against sunburn during uncontrolled exposure to sunlight during vacation »*		The tan induced by artificial UVR tanning devices provides little protection against sunburn and solar UVR-induced DNA damage *(61)*. Human laboratory tests have shown it to be equivalent to a sunscreen with sun protection factor (SPF) of only about 3 *(62)*. Research has shown that a sunbed tan does not reduce the risk of sunburn from solar exposure and may even increase it by giving a false sense of protection *(63, 64)*.
IMMEDIATE COSMETIC BENEFITS *« Sunbed use gives a healthy-looking tan right away »*		The immediate skin pigment darkening that follows sunbed UVR exposure may indeed hide existing optical imperfections such as small wrinkles, telangiectasia (commonly referred to as spider veins) and other blemishes for a few hours *(65)*. The immediate, but not necessarily uniform, darkening soon fades and the skin imperfections are visible again, motivating users to use the sunbed again. This may lead to "all year tanning" raising the risk of premature ageing and skin cancers *(21)*.
PSYCHOLOGICAL WELL-BEING *« Sunbed use enhances well-being and has a positive role in the treatment of seasonal affective disorder (SAD) »*		This claim is the most difficult to counter because the sense of well-being felt by sunbed users after a tanning session may be genuine and is regularly reported in surveys as their main reason for repeatedly using sunbeds. This may be linked to feeling more attractive or "healthy looking" *(66)*. It may also be that endogenous brain opioids are created during the tanning session, leading to a sense of well-being and the possibility of tanning addiction *(67)*. Visible light exposure, rather than UV, is a common therapy for SAD.
TANNING NOT SUN-BURNING *« My skin is only damaged if I get sunburned »*		A tan is a sign that the skin has been damaged from UVR and is not a sign of good health. Tanning without a sunburn can still cause premature skin ageing and increase the risk of skin cancer through irreparable DNA damage *(21)*. Each time skin is exposed to UVR from the sun or from a sunbed, the risk of developing skin cancer is increased *(61)*.

3.2. REGULATING SUNBED USE

There are essentially two options for consideration in the application of public health regulations relating to sunbeds: either to ban them outright as some countries have done, or to restrict and manage their use and inform customers. These interventions are shown in Fig. 3 and discussed further below.

Figure 3. **Regulatory options to reduce health risks from sunbeds**



Authorities in an increasing number of countries are imposing regulations to discourage sunbed use in general and for young adults in particular. Regulation alone, including self-regulation by the sunbed operators using an industry-developed code of practice, has proved to be inefficient and has failed to prevent high-risk people from using sunbeds *(68, 69, 70)*. To be effective, regulation needs comprehensive enforcement involving training, licensing and inspection together with public education.

3.2.1. Regulatory frameworks

As most countries characterize sunbeds as consumer products rather than medical devices, specific legislation may be required to regulate their sale or use. Artificial tanning devices fall under two separate industries: the tanning equipment industry (sale and manufacture of sunbeds), and the commercial provision of tanning services (access to sunbeds in tanning establishments, fitness studios, hotels). These are served in some countries by two separate regulatory frameworks. For example, in the United States and Canada the federal government requires tanning equipment to have numerous engineering features, labelling and information disclosures (i.e. emergency stop switch, timer, warning labels, recommended exposure time) before being manufactured, sold or imported into the country. It is the responsibility of governments of states, provinces and territories to regulate the personal services industry (that comprise tanning salons among other services).

Given the strong evidence linking sunbed use and the risk of skin cancer, some countries have implemented an outright ban of sunbed use for cosmetic purposes.

3.2.2. Banning sunbeds

3.2.2.1. Banning all artificial tanning services

Given the strong evidence linking sunbed use and the risk of skin cancer, some countries have implemented an outright ban of sunbed use for cosmetic purposes. Where governments opt to ban sunbeds, public education and strong enforcement of the ban need to be part of the package of interventions. Consideration needs to be given to unintended consequences, including increased sale of domestic devices and use of unsupervised tanning services.

In November 2009, Brazil became the first country in the world to ban the trade and use of artificial tanning sunbeds. The only UV-therapy devices legitimately allowed to operate in Brazil are those used for medical purposes *(71)*. As of January 2016, all Australian states have also legislated an outright ban on commercial sunbeds; as a result of strong enforcement and incentives for businesses, adherence has been very high *(72)*.

3.2.2.2. Banning the hire and sale of sunbeds for domestic use

Banning domestic use has been considered as a supplementary measure whenever bans or heavy restrictions are placed on salons and other tanning centres. Ireland, and Scotland outlaw the hire or sale of sunbeds to individuals under the age of 18. Several countries, including France, Italy and Spain, have complemented a ban on unsupervised sunbed services by prohibiting the sale of sunbeds for domestic use.

With the legislation to ban sunbeds in a number of states and territories in Australia, some included a financial incentive for owners to dispose of artificial tanning units through government-approved recyclers rather than sell them to the general public. This significantly reduced the number of sunbeds being available for private use. While a ban of commercial use of sunbeds could result in a transfer of risk from commercial salons to private use, a study following the ban in Victoria, Australia showed that this did not occur *(72)*.

3.2.3. Restricting access to sunbeds

3.2.3.1. Prohibiting unsupervised artificial tanning services

Unsupervised sunbeds are most commonly found in student apartment buildings, fitness centres, indoor swimming pools, hotels, and other service establishments where the sunbed operations are an added service. Unsupervised sunbeds are more likely used by minors, compared to adults. Several countries, including Austria, Belgium, Chile, Finland, Latvia and Slovakia, have banned unsupervised operations at the same time as restricting access by age. Otherwise age limitations may well drive more under-age clients to unsupervised sunbeds, as has been observed in Germany *(73)*.

3.2.3.2. Setting an age-limit on sunbed use

As mentioned earlier, sunbed use at a young age increases the risk of melanoma *(6)*. The evidence suggests that the older the age limit is set for banning access, the greater the public health benefit will be in terms of reducing melanoma risk.

Eighteen years represents the age of majority in many countries and is therefore a legally convenient cut-off point to restrict access to sunbeds. In addition the United Nations Convention on the Rights of the Child requests special protection for those under the age of 18 *(74)*. However, there are no scientific data to support the age of 18 as being an absolute point where the risk of melanoma drops significantly following sunbed use.

Many countries, including Austria, Belgium, France, Germany, Iceland, Ireland, Italy, Israel, Norway, Portugal and Spain now prohibit people under the age of 18 from using sunbeds. In Australia, prior to the total ban, awareness campaigns on the dangers of sunbed use, when combined with new legislative controls that included banning all those under the age of 18, led to a 51% decrease in the number of sunbed operators *(75)*. Some states in the United States of America have established lower age restrictions. Requiring minors to be accompanied by a parent or to obtain parental written consent are alternative approaches to restricting access to indoor tanning facilities. Such legal measures may have limited impact among families where one or more parent is a sunbed user *(58, 76)*.

3.2.3.3. Preventing use of sunbeds by high-risk individuals

The risk of melanoma from sunbed use is not limited to skin-sensitive populations *(21)*; sunbed use is particularly unsafe for certain categories of people who are at higher risk of developing skin cancer or other adverse effects of UVR. In Italy, legislative controls have been introduced that put the onus on the sunbed operator to prohibit access to all people with skin type 1 (see Table 1) and pregnant women from using sunbeds.

3.2.4. Managing sunbed operations

3.2.4.1. Surveillance and licensing of tanning establishments

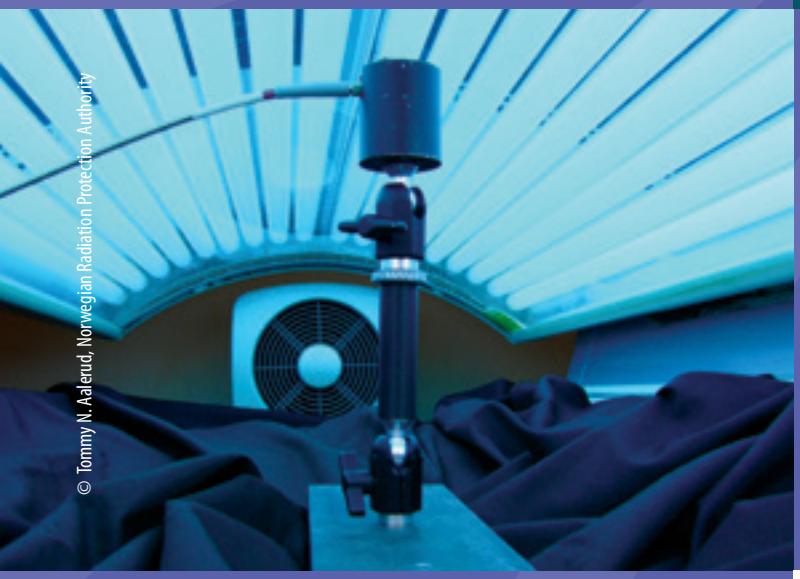
A number of countries regulate sunbed operators through licensing. In France and in some states of the United States of America, sunbed establishments are required to be licensed. This provides authorities with a list of the number of sunbeds in operation, and gives them the power to revoke licences when operators fail to follow appropriate procedures and regulations. Further regulation has been implemented in France – the initial inspection of tanning equipment must now be carried out before making it available to the public (previously there was only a technical control every two years) *(77)*. In Germany, a general trade licence for sunbed establishments serves as notification, and the commercial operation of sunbeds (i.e. standards for the UV-emitting appliances, the operation of these appliances, attendance of qualified staff, qualification of staff, as well as the obligatory offer of customer consulting) is regulated by statutory decree *(78)*.

3.2.4.2. Controlling UV exposure

The amount of exposure to UVR from sunbeds depends on both the UV irradiance of the device and the duration of exposure (or tanning schedule). Different countries have used various approaches to regulate the devices and their use in order to control exposure and reduce both acute and long term adverse effects.

Restrict age limit

Prevent eye damage



Monitor and inspect sunbeds

Train sunbed operators

The International Electrotechnical Commission (IEC) has published a standard for UV-emitting devices (60335-2-27:2009+AMD1:2012+AMD2:2015) which provides an upper limit of the erythema-weighted irradiance for a total UV of 0.7 W/m^2 (equivalent to a UV index of 28) *(79)*. Tanning schedules suggesting the duration of exposure on first and later sessions are also provided. These are designed to avoid erythema from overexposure (e.g. sunburn) but will only do so if the erythema-weighted irradiance for total UV is known and the lamps are compliant with specifications, which is often not the case (see section Ensuring compliance and enforcement below). The impact of the standard is limited both by its voluntary nature, and the impracticability of its implementation (for example, at an intensity of 0.7 W/m^2, an untanned individual would reach exposure limits for a first session in 2.4 minutes). As a result, excessive exposure in many settings is common.

The European standard for tanning devices (EN 60335-2-27:2013) (80) is more stringent, prescribing a maximum total erythemal UV irradiance limit of 0.3 W/m2 (equivalent to a UV index of 12). In addition, all sunbeds must be classified into UV type 1 to 4 according to the UV-A and UV-B irradiances, and requirements for user instructions and tanning schedules depending on the sunbed's UV irradiance are given. Most European countries are members of the European Committee for Electrotechnical Standardization (CENELEC) and are therefore bound to comply with this standard. Some European countries have adapted further restrictions into their legislation, for example allowing only UV type 3 sunbeds (maximum UV-A and UV-B erythema-weighted irradiance of no more than 0.15 W/m^2 in each band).

In the United States of America, the Food and Drug Administration (FDA) regulations do not control device irradiance, but rather have recommended limitations on the maximum allowable exposure (i.e. irradiance multiplied by exposure duration or "dose") and provide guidance on how the exposure schedule should be designed *(81)*. The FDA requires manufacturers to provide operators and users with exposure schedules based on the tanning device lamp characteristics and tanners' skin type. In December 2015, the FDA proposed to amend its 1985 Performance Standard to bring it into closer alignment with IEC 60335-2-27 clauses *(82)*.

3.2.4.3. Requiring eye protection

Countries that have implemented sunbed controls usually make UVR-protective eyewear a mandatory condition of use. Sunbed operators are required to ensure that every user wears protective eyewear whenever a sun-tanning unit is operating. The eyewear needs to have a secure attachment over the eyes forming a light tight seal against the skin. The eye protection should not transmit more than 1% of UV-A (320–400 nm) and 0.1% of UV-B, according to the limits set by IEC 60335-2-27:2009+AMD1:2012+AMD2:2015 *(79, 83)*, and EN 60335-2-27:2013 in Europe *(80)*, AS/NZS 60335.2.27:2010 in Australia and New Zealand *(84)*, and the 21 CFR 1040.20 standards in the United States of America *(81)*.

While appropriately designed protective eyewear can effectively block visible light and UVR from reaching the eyes, many models of goggles do not achieve such protection. Furthermore, surveys of sunbed users have repeatedly shown that eye protection is often neither proposed nor used during tanning sessions *(85,86)*.

3.2.4.4. Training sunbed supervisors

The role of a sunbed supervisor is to assess each client and control exposure times. An appropriate assessment includes identifying individual risk factors, such as the client's age, skin type, UV exposure within the past 48 hours, past adverse reactions to sun exposure and medical conditions that may increase the client's risk of getting sunburned. Such supervision also provides the opportunity to ensure that eyewear is used and that exposure times are suitably limited.

A European standard entitled "Professional Indoor UV Exposure Services" (EN 16489-1:2014, EN 16489-2:2014 and EN 16489-3:2014) sets out requirements for training courses of indoor UV exposure consultants which can be used as a basis for more detailed legally binding national regulations *(87)*. Countries such as France, Germany and Norway have introduced certified training for sunbed operators into their legal framework. For example, the German statutory decree concerning UV emitting devices used for cosmetic purposes requires that only accredited centres train sunbed staff.

3.2.4.5. Taxing tanning sessions

Taxing unhealthy products (e.g. tobacco, alcohol and sugary beverages) or services is part of the toolkit for the prevention of noncommunicable diseases. Increasing taxation on tobacco and alcohol products has proven an effective deterrent, so it is likely that a tax on income derived from sunbed services might have a similar effect *(88)*. For example, the United States Internal Revenue Service has put a 10% excise tax on indoor tanning services since 1 July 2010 under the Patient Protection and Affordable Care Act, 2010. Taxing sunbed use alone, however, may not be sufficient if other measures are not taken to improve operating practices and reduce sunbed use.

3.2.5. Prescribing risk communication

3.2.5.1. Requiring information provision

In some countries, clients must complete and sign a form before beginning a tanning course of one or more exposure sessions. These forms are designed to provide information on the health risks associated with sunbed use. An example of a client information form from Ireland is given in Annex 2.

3.2.5.2. Banning marketing and promotion of sunbeds

In some countries, sunbed operators are not permitted to make unsubstantiated or false health claims to consumers, both under consumer protection law (for services) and/or drugs/medical devices legislation. Countries like Canada, Chile, Colombia, Slovenia and the United States of America have implemented controls to restrict sunbed operators from advertising non-cosmetic health benefits.

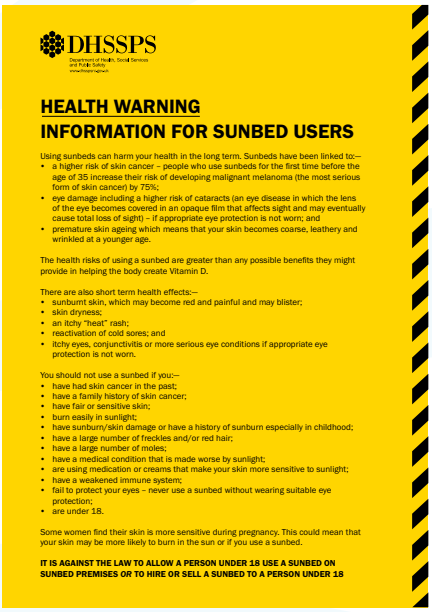
There is also a concern that promotional offers, such as unlimited tanning for a set price, are likely to lead to excessive use. In this regard, Ireland has introduced regulations banning certain marketing practices that encourage additional use of sunbeds such as free use, happy hours, reduced prices and other types of promotions and advertising.

3.2.5.3. Requiring display of warning notices

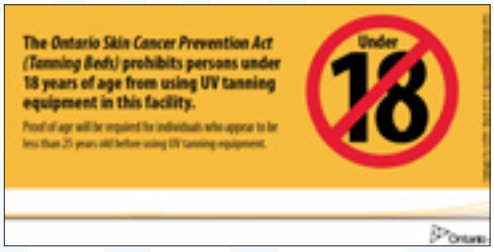
Some countries require that all commercial tanning establishments display warning notices, either in conspicuous places on the premises (e.g. point-of-sale, entry way) or on the equipment, informing users of the risks they are taking when using artificial tanning services. Such warnings are also of particular relevance for domestic devices. Fig. 4 provides examples of warning notices that are a statutory requirement in their respective jurisdictions. For example, the Canadian province of Ontario

Figure 4. **Examples of warning notices about the use of sunbeds**

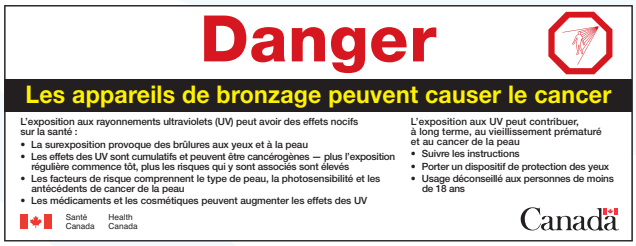
1



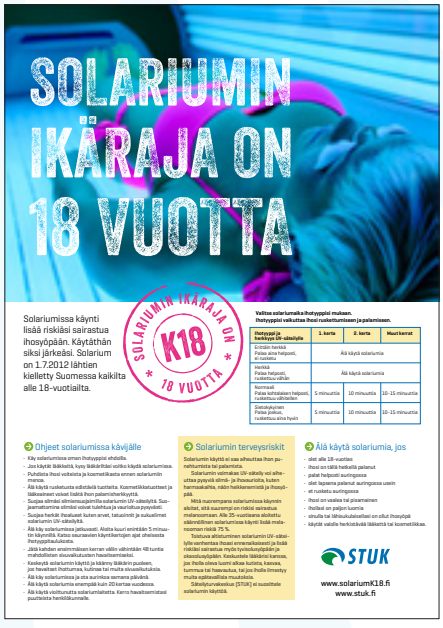
2



3



4



5

6

(1) Scottish Government, United Kingdom of Great Britain and Northern Ireland; (2) the Department of Health of Northern Ireland, United Kingdom of Great Britain and Northern Ireland; (3) the Ontario Ministry of Health and Long-Term Care, Canada; (4) Health Canada, Canada; (5) the Radiation and Nuclear Safety Authority, Finland; (6) the Norwegian Radiation Protection Authority, Norway.

requires all tanning bed operators to display four different types of signs under the Skin Cancer Prevention Act (Tanning Beds), 2013: a point-of-sale warning sign, a health warning sign, an age restriction and identification decal, and an employee reminder decal *(89)*. A French study reported that, while information is necessary, it is not necessarily very effective *(90)*.

3.2.6. Ensuring compliance and enforcement

The experience with public health measures associated with alcohol and tobacco control indicates that effective and sustained enforcement is crucial to achieving good compliance with national, state or local regulations. Legislation may not have the desired effect if there is no provision for adequate monitoring and enforcement of compliance, and if it is not accompanied by public awareness *(76)*. It is important to include not only the roles but also the associated costs of enforcement in the legal framework. In some countries where licensing of sunbed operators is mandatory, the licence fee enables the employment of compliance and enforcement officers.

Effective and sustained enforcement is crucial to achieving good compliance with national, state or local regulations.

Surveys in Europe, Australia and the United States of America have shown generally poor compliance by sunbed operators with either their own codes of practice or legislation where it has been put in place *(91,92,93,94)*. For example, in one Australian review of self-regulations it was found that 90% of people with skin type I were allowed access to sunbeds even though the code of practice required restricted use for such skin types *(92)*. In another Australian study, 4 out of 5 adolescents were permitted access to a sunbed – contrary to state law – when they attempted to conceal their age *(95)*. Part of the problem may be the low rate of inspections and application of penalties by regulating authorities. A recent survey conducted in 2010 among the French population showed that 3.5% of those aged under 18 years had used a sunbed at least once in their lifetime, even though minors have been legally banned from using commercial sunbeds since 1997 *(90)*.

In a number of countries, national authorities may perform UV measurements as part of their regular inspections or after reported skin burns. A joint market surveillance project was carried out in several European countries in order to harmonize sunbed inspections and regulations. The inspection surveys showed poor compliance *(68)*. Measurement campaigns on commercial artificial tanning services were conducted to assess compliance with the 0.3 W/m^2 erythema effective irradiance limit. A recent systematic review of UV measurement studies has shown very poor compliance with the European limits *(15)*. For example, in Greece, sunbeds exceeded irradiance limits in 64% of the sunbeds *(96)*, while in England measurements performed showed that 9 of 10 sunbeds exceeded limits *(14)*.

4. Discussion

SKIN CANCER IS THE GREATEST HEALTH RISK POSED BY EXPOSURE TO UVR; A CLEAR CAUSAL RELATIONSHIP HAS BEEN ESTABLISHED. The science is now also clear that artificial tanning is responsible for a portion of those skin cancers and, as such, offers an excellent opportunity for primary prevention.

The sustained long-term goal is to enable a change in culture in fair-skinned people regarding exposure to artificial tanning through regulation, education and awareness. Meanwhile, there are various actions that governments have taken to mitigate health risks from artificial tanning. As discussed above, these actions include a mixture of policy instruments, such as voluntary, legislative and financial tools, to ensure the best use of health expenditures (economic considerations) while acknowledging the protection of individual rights from an ethical perspective. Designing and implementing policies and programmes to enable health lifestyle choices are critical to reducing the non-communicable disease burden and achieving the United Nations Sustainable Development Goal (SDG) target 3.4 *(97)*.

4.1. PUBLIC HEALTH FINANCING CONSIDERATIONS

In selecting an intervention, policy-makers will have to consider both the impact on health and the financial implications. The increased incidence of skin cancer, combined with limited health care resources and constrained budgetary conditions, has intensified the importance of understanding the economic impact of skin cancer. Both direct costs associated with the management of skin cancer (from diagnosis, treatment to follow-up) and indirect costs (associated with morbidity and premature mortality) need to be considered. Such estimates performed in a few countries, e.g. Sweden *(98)* and Australia *(99)*, have provided policy-makers with information of the monetary savings that may arise from efforts to reduce the incidence of skin cancer. A recent publication estimated that the cost of direct medical care for skin cancers caused by sunbeds in the United States of America was over US$ 340 million annually, leading to a total economic loss of over US$ 127 billion over the lifetime of the individuals affected *(29)*. A Belgian study has determined that a total ban on sunbed use in Belgium would be more cost-effective than other primary prevention efforts *(100)* . In addition, given the relatively young age of many melanoma patients, the total health impact as measured in disability-adjusted life years (DALYs) may be sizeable in some countries.

The evidence is clear that artificial tanning is responsible for a portion of skin cancers and therefore offers an excellent opportunity for primary prevention.

4.2. COMMERCIAL CONSIDERATIONS

Private sector financial consequences – especially economic and job losses – is an issue that is often raised as an argument against sunbed regulations by sunbed operators and policy-makers. To address this issue, the State Government of Victoria in Australia gave up to 2000 Australian dollars per sunbed to support sunbed operators in making a transition to other services. Many firms that provide artificial tanning services through UV tanning beds now diversify their services to include sunless spray-on tan booths and airbrush systems, as well as merchandise such as suntan lotions, cosmetics and other skin-care products. A regulatory impact statement compiled by an Australian State Government suggested that because sunbed use largely constitutes discretionary spending by the consumer, any reduction of spending in the area of sunbeds as a result of new legislative controls would likely result in a transfer of spending to other discretionary items rather than a withdrawal from the economy as a whole *(101)*.

The economic benefits of regulation would be significant.

4.3 HUMAN RIGHTS IMPLICATIONS AND ETHICAL CONSIDERATIONS

There are many factors leading people to use sunbeds that stem from gender norms, roles and behaviours, such as those that perpetuate idealized standards of physical appearance, and commercial marketing strategies. As well as gender, the extent to which sunbed use is linked to

equity considerations such as socio-economic status, age, education, geographic location and other factors also needs to be further understood. Some research has provided context-specific profiles of sunbed users that suggest patterns across socio-economic groups *(10)*. These trends need to be identified and explored further to better target regulation and awareness to these users.

> The tanning culture influences preferentially girls and women to the risk of skin cancer and therefore has a bearing on health outcomes they experience throughout the life-course.

While the protection and respect for individual consumer choice is important, human rights law around the right to health places a responsibility on the state to ensure that consumers are adequately informed and that protections exist to safeguard against over-exposure to health risks such as those involved in sunbed use. This is particularly relevant with regards to children, as described in the UN Convention on the Rights of the Child.

In developing strategies to eliminate or restrict exposure to harmful sunbed use, states may want to:

- consider how local gender norms may affect sunbed usage and drive sunbed marketing strategies that target women and young girls;
- compile or review qualitative information on the determinants of sunbed use across different population groups;
- involve the target populations in the development of prevention and awareness campaigns and policy decisions on sunbed use.

An additional consideration is the discrimination or stigmatization that can accompany a life-threatening diagnosis such as melanoma. The many patients with melanoma who survive after therapy often find themselves having to declare their prior disease in order to secure financing (e.g. health insurance, life insurance and home loans) *(102)*. Recent legislation in France that excuses cancer survivors from declaring their previous cancers after a certain number of years may serve as a model to address this issue *(103, 104)*.

4.4. PRIORITY AREAS FOR RESEARCH

While the scientific evidence linking increased risk of skin cancer to the use of artificial tanning devices is strong, further research is needed to understand the different pathways to melanoma, and to indicate which interventions to reduce this risk are likely to be most effective over time. Particular interest will be paid to the efficacy of total bans of commercial tanning sunbeds, which has been proposed by several national agencies and professional associations and implemented in two countries to date. Countries considering new policy changes should therefore consider investing in studies to document the effectiveness and cost of the interventions.

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Abbreviations

BCC	Basal cell carcinoma
CENELEC	European Committee for Electrotechnical Standardization
DALY	Disability-adjusted life year
FDA	United States Food and Drug Administration
IARC	International Agency for Research on Cancer
IEC	International Electrotechnical Commission
nm	nanometre
SAD	Seasonal affective disorder
SCC	Squamous cell carcinoma
SDG	Sustainable Development Goal
SPF	Sun protection factor
UV	Ultraviolet
UVR	Ultraviolet radiation
W/m²	Watt per square metre
WHO	World Health Organization

Glossary

Actinic keratosis – rough, scaly, pink or white growth that occurs on the surface of the skin in areas (such as the face, neck, and back of the hands) frequently exposed to UV radiation and that may develop into squamous cell carcinoma.

Artificial tanning – using a device that emits ultraviolet (UV) radiation to produce a cosmetic tan.

Basal cell carcinoma – a skin cancer derived from and preserving the form of the basal cells of the skin.

Carcinogen – a substance or agent that is capable of causing cancer in living tissue.

Cataract – opacity of the lens of the eye or its capsule.

Dose – the product of irradiance and exposure duration, usually expressed in joule per square metre (J/m^2).

Erythema – redness of skin, including that due to an inflammatory response caused by solar or artificial ultraviolet (UV) radiation.

Gender – behavioral, cultural, or psychological traits typically associated with one sex.

Health – state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

Irradiance – UV radiant power received by a surface per unit area, usually expressed in watts per square metre (W/m^2).

Melanoma – the most serious type of skin cancer, arising from atypical melanocytes (cells that produce melanin) in the skin.

Melanocytes – epidermal cells that produce melanin.

Non-melanoma skin cancers – all types of skin cancers that are not melanoma, such as basal cell carcinoma and squamous cell carcinoma.

Ocular melanoma – a type of cancer that develops in or around the eye in the cells that produce pigment.

Photosensitivity – adverse cutaneous reaction that results when a certain chemical or drug is applied topically or taken systemically while a person is exposed to UVR or visible light.

Seasonal affective disorder (SAD) – a type of depression related to change in season, which usually begins and ends at about the same time every year.

Squamous cell carcinoma – a carcinoma that is made up of or arises from squamous cells.

Sunbed – an electrically powered appliance or installation emitting UV radiation, intended to produce tanning for cosmetic purposes.

Ultraviolet (UV) radiation – a type of radiation that is produced by the sun and some artificial sources, such as sunbeds. UV radiation covers the wavelength range 100–400 nm and is divided into three bands: UVA (315–400 nm), UVB (280–315 nm); and UVC (100–280 nm). All three bands are classified as carcinogenic to humans.

UV index – The UVI is a measure of the level of UV radiation. The values of the index range from zero upward – the higher the UVI, the greater the potential for damage to the skin and eye, and the less time it takes for harm to occur.

Vitamin D – a fat-soluble vitamin that is naturally present in some foods and available as a dietary supplement. It is also produced endogenously from exposure to UVB radiation.

Wavelength – distance between identical points on two successive crests of an electromagnetic wave.

Annex 1. Summary of health risks other than cancer

A.1. SKIN

UVR exposure is associated with a variety of skin disorders and causes both short-term and permanent skin damage.

Accelerated skin ageing
Extensive laboratory experiments in humans and animals have shown that chronic or excessive exposure to UVR from the sun or sunbeds causes accelerated photo-ageing of the exposed skin, characterized by a leathery, wrinkled appearance and loss of elasticity (A1, A2, A3).

Sunburns
"Sunburn", an acute injury caused by excessive exposure to UVR, is also common after artificial tanning sessions (A4, A5). It is characterized by erythema (skin reddening resulting from vasodilation) and oedema (swelling), both of which may be severe. Sunburn is an early indicator of melanoma risk, because it is a biological marker of excessive UVR exposure (A6, A7).

Phototoxic and photoallergic reactions
Two types of drug-induced acute photosensitivity skin reactions to UVR have been described – phototoxic and photoallergic reactions. Both occur in people taking specific medications or food or touching certain plants which contain photoreactive agents, while being simultaneously exposed to UVR or visible light. Phototoxic reactions, which may be seen within minutes to hours after exposure, typically cause an exaggerated sunburn. In photoallergic reactions, UVR elicits an immune response, causing a skin reaction usually seen several days after exposure and often on non-sun-exposed areas of the body.

Other skin disorders
Due to immune effects of UV exposure, solar and artificial tanning may induce other skin acute lesions such as polymorphic light eruptions, as well as reactivation of herpes (A8, A9). These conditions are benign and disappear after termination of exposure.

A.2. EYES

Exposure to UVR is associated with a variety of eye disorders, including damage to the eyelids, cornea and lens (A10). Repeated exposure of the eyes to UVR causes both short-term eye complaints and permanent eye damage. The eye is structured to block most UVR from reaching and damaging the retina. However, UV-A and blue light, both from the sun and artificial UVR tanning devices, can reach the retina and may cause acute and chronic conditions.

Cataracts
Chronic, low-dose exposure to UV-B similar to levels emitted by sunbeds can lead to premature formation of cataracts (A11).

Eye inflammation

Eye inflammation or photokeratitis, popularly known as snow blindness or welder's flash, occurs when an unprotected eye is exposed to excessive UVR leading to so-called sunburn of the cornea. As with sunburn of the skin, the symptoms are delayed for several hours, starting with a feeling of itchiness ("sand in the eye" sensation) then increased tearing, followed by severe pain and photophobia (extreme light sensitivity). This is caused by an inflammatory reaction in the cornea and conjunctiva, which leads to a swelling and loss of outer corneal and conjunctival cells. Photokeratitis usually resolves within a few days due to regeneration of the outer cells of the cornea.

Retinal phototoxicity

The intense UV-A and visible light emitted by some lamps used in tanning beds can produce direct retinal phototoxicity (A12, A13). Appropriate protective eyewear can block a significant portion of UV and visible light.

A.3. OTHER HEALTH EFFECTS

Addiction

Studies of frequent tanners have suggested possible links between tanning behaviour and dependence and addiction (A14, A15, A16, A17). There is evidence that frequent tanners develop withdrawal symptoms and have difficulty controlling their use, leading to compulsive tanning. Recent studies suggest biochemical mechanisms may reinforce UVR-seeking behaviour. Many tanners report relaxation and mood-enhancement as their motivation for tanning, suggesting the possibility of a psychological dependence (A18).

Immunosuppression

UV-A and UV-B have been shown to affect skin and organ immunity, via mechanisms that appear to depend on the amount of UV-A and UV-B present (A19, A20, A21). This means that humans may have a different immunological response to an event such as a viral infection or vaccination depending upon the intensity of UVR exposure at the time.

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Annex 2. Example of Client Information Form (Ireland)

Public Health (Sunbeds) (Health Information) Regulations 2015
(http://www.irishstatutebook.ie/eli/2015/si/50/made/en/pdf)

HEALTH WARNING
INFORMATION FOR SUNBED USERS

Using sunbeds can seriously harm your health and lead to melanoma skin cancer. Sunbeds have been linked to:

- a higher risk of skin cancer — people who use sunbeds for the first time before the age of 35 years increase their risk of developing malignant melanoma (the most serious form of skin cancer) by 75 per cent;
- anyone who has ever used a sunbed is at least 20 per cent more likely to develop malignant melanoma;
- eye damage including melanoma of the eye and a higher risk of cataracts; and
- premature skin ageing which means that your skin becomes coarse, leathery and wrinkled at a younger age.

Your risk of developing skin cancer increases each time you use a sunbed.

There are also short term health effects:

- sunburnt skin, which may become red, painful and blister;
- skin dryness;
- an itchy "heat" rash; and
- itchy eyes, conjunctivitis or more serious eye conditions if appropriate eye protection is not worn.

You should never use a sunbed if you:

- have had skin cancer in the past;
- have a family history of skin cancer;
- have sunburn/skin damage or have a history of sunburn especially in childhood;
- burn easily in sunlight;
- have skin that never tans or does so with difficulty;
- have fair or sensitive skin;
- have a large number of freckles and/or red hair;
- have a large number of moles;
- are using medication or creams that make your skin more sensitive to sunlight;
- have a medical condition that is made worse by sunlight;
- have a suppressed or weakened immune system;
- fail to protect your eyes — never use a sunbed without wearing eye protection that meets the required standard; or
- are under 18 years (no person under 18 years may use a sunbed on these premises or purchase or hire a sunbed).

Skin is more sensitive to UV rays during pregnancy and sunburn is more common. Therefore, the risk of skin cancer is increased. Sunbeds should never be used during pregnancy.

IT IS AGAINST THE LAW TO ALLOW A PERSON UNDER 18 YEARS USE A SUNBED ON SUNBED PREMISES OR TO HIRE OR SELL A SUNBED TO A PERSON UNDER 18 YEARS

This form must be signed each time by the potential client before a sunbed can be used, hired or purchased.

I confirm that I have been provided with a copy of the prescribed information and have had an opportunity to read and consider that information.

Signed: . . . . . Date: . . . . . .

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ISBN 978 92 4 151259 6