

Recommending the Best Sun Protection

Clinical Pearls:

- Recommend a “broad-spectrum” sunscreen – one that covers UVB, UVA1, and UVA2.
- Recommend SPF 30-50
- Advise on non-pharmacological sun protection methods
- Emphasize proper sunscreen application technique
- Emphasize skin protection when taking drugs known to cause photosensitivity. Familiarize yourself with known implicated drugs by referring to appendix 2.

Background¹⁻⁴

The sun emits 3 types of ultraviolet (UV) radiation: UVC (100-290 nm), UVB (290-320 nm), and UVA (320-400 nm). UVA rays can be further divided into the shorter UVA2 rays and the longer UVA1 rays. UVC rays, the shortest rays, are completely absorbed by the ozone layer, whereas UVB rays penetrate the epidermis and UVA rays, the longest rays, penetrate into the dermis. The main consequence of UVB irradiation is sunburn, but can also include immunosuppression and skin cancer. Consequences of UVA radiation include: phototoxicity (i.e. involvement in drug-induced sun sensitivity reactions), photo-aging, immunosuppression, and skin cancer.

What is SPF?^{2,5,6,7}

It is easy to be misled by Sun Protection Factors (SPF). SPF is assessed through a standardized test by finding the ratio of the minimal dose of solar radiation that produces perceptible erythema (i.e., minimal erythema dose) on sunscreen-protected skin compared with unprotected skin. Sunburn is caused primarily by UVB rays (and shorter UVA2 rays), and thus SPF indicates mostly UVB protection. However, UVA protection is equally important since it is responsible for photo-aging and cancer.

Therefore, it is important to look for the phrase “broad spectrum” when choosing a sunscreen as broad spectrum indicates both UVB and UVA protection. Unfortunately, there is no rating system in Canada yet, like there is in Europe that describes the quality of UVA protection.

Refer to Appendix 1 for a list of sunscreen ingredients, and the UV radiation spectrum against which they protect.

Nonpharmacological Sun Protection Recommendations¹⁻³

- Check the UV index daily, and adjust activities (0-2: not a big problem; 3-7: take care – sunscreen, hats; 8+: don’t stay too long in the sun) (UV index can be checked at <https://weather.gc.ca>). Avoid outdoor activity especially between 10 am and 4 pm, when the sun’s UV rays are strongest.
- Seek shade from trees, buildings etc. A single tree may provide an SPF of 2-50.
- Wear protective clothing (long pants, long sleeved shirts), including broad brimmed (≥ 7.5 cm) hats of tightly woven fabric. Regular use of hats reduces the lifetime risk of skin cancer by 40%.

- Avoid indoor tanning as this damages cells. Self- tanners are safe to use since they tan the skin through a chemical reaction between its constituent dihydroxyacetone and amino acids on your skin – but sunscreen is still required.
- Use umbrellas – they may reduce UV radiation by about 70%, but realize they do not protect against reflected radiation.
- Avoid alcohol since it decreases the antioxidants in the skin that neutralize free radicals.

Pharmacological Sun Protection Recommendations^{1,2,5}

There are two broad types of sunscreen ingredients: inorganic (sometimes referred to as physical) and organic (sometimes referred to as chemical). See Table 1 for the major differences between these categories. Very few ingredients provide protection against the entire UVA and UVB spectrums. In fact, the only ingredients that have adequate UVA1 protection are avobenzone and zinc oxide. Refer to *Appendix 1* for a list of ingredients found in available products and the spectrum of UV protection they provide.

Table 1: Common Active Ingredients Found in Sunscreens

| Inorganic/ Physical Sunscreens | Organic/ Chemical Sunscreens |
|---|--|
| <p>Contain ingredients such as:</p> <ul style="list-style-type: none"> • titanium dioxide • zinc oxide • others: kaolin, talc, ferric chloride, melanin | <p>Contain >1 active ingredient such as:</p> <ul style="list-style-type: none"> • avobenzone • octisalate • octocrylene |
| <p>MOA: absorb?, reflect and scatter light</p> | <p>MOA: absorb radiation and convert it to heat</p> |
| <p>Advantages: less risk of sensitization; protection against UVB and UVA</p> | <p>Advantages: more cosmetically appealing</p> |
| <p>Disadvantages: thicker and less cosmetically elegant than chemical sunscreens (nanoparticle technology improves cosmetic appearance); may rub off easily or melt with the sun’s heat.</p> | <p>Disadvantages: can cause sensitivity; no one agent protects against the broad spectrum of UV rays; many different ingredients must be combined to get full protection.</p> |

In order for a sunscreen to be labeled as broad spectrum, it must protect against a critical wavelength of at least 370 nm. This means that the UVA protection level is at least 90% at 370 nm; that is to say that there is adequate UVA1 (and therefore UVA 2) protection. See Table 2 for an explanation of what claims on sunscreen products mean.

Recommend a formulation of sunscreen that best suits the patient. *Creams* are good for dry skin, *gels* for oily or acne prone skin, *sticks* are good for the face (i.e. they will not drip into the eyes), *sprays* are good for hard to reach areas or for athletes (although they could result in inconsistent distributions), and *lotions* are good for applying sunscreen to large areas.

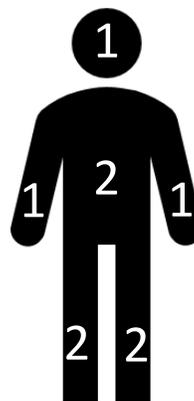
Table 2: Sunscreen Claims^{1,4,5}

| Sunscreen Characteristics | Claims the Product can Make |
|--|---|
| No broad spectrum coverage OR have an SPF <15 must add the following to their label: | Skin Cancer/ Skin Aging Alert: Spending time in the sun increases your risk of skin cancer and early skin aging. This product has been shown only to help prevent sunburn, not skin cancer or early skin aging. |
| Protects against UVA and UVB rays with a critical wavelength protection of at least 370 nm | “Broad Spectrum” |
| Broad spectrum (covers UVA and UVB rays; critical wavelength protection of at least 370 nm) AND SPF ≥ 15 | “The sun may cause sunburn, premature aging of the skin and skin cancer. Avoiding the sun, wearing protective clothing and regular use of sunscreens over the years reduces the chance of these harmful effects.” |
| Sunscreens maintain their SPF after either 40 or 80 minutes of swimming or sweating, respectively | “Water resistant” / “Sweat resistant” |

Proper Application of Sunscreen: Teaspoon Rule^{1, 2, 5, 6, 9}

~ 1 teaspoon (total) to the face and the neck, as well as to each arm
 ~ 2 teaspoons (total) to the back and front torso, and to each leg
 ~30-45 mL (or 6-9 teaspoons) total of sunscreen used per application

*** using only half of the proper amount (1 mg/cm² instead of 2 mg/cm²) would provide approximately one third of the SPF. We usually do apply less than we should (0.5 mg/cm²), thus it is best to use an SPF of at least 30.*



Wait 15 minutes before sun exposure to allow formation of protective film on skin

Reapply every 2 hours, after swimming or after towel drying

Don't forget to apply to the lips and reapply after eating or drinking

Which SPF should I be recommending?^{2,5,7}

When applied in a sufficient amount (i.e. ≥30 ml for the whole body), the amount of UVB radiation absorbed by:

- SPF 15 sunscreen = 93%
- SPF 30 sunscreen =97%
- SPF 50 sunscreen =98%
- Products with SPF >50 don't provide much more protection from UV radiation. (9) (As such, products with SPF >50 should be labelled only as SPF 50+)

There is a nonlinear relationship between effective SPF and the amount of sunscreen applied, and using only half of the proper amount (1 mg/cm²) would provide approximately one third of the labelled SPF. Since it is known that people don't usually apply as much sunscreen as they should (i.e. they apply 0.5 mg/cm² instead of the 2 mg/cm² used in SPF testing), SPF 30 or greater sunscreens should be recommended - even though SPF 15 provides adequate protection- to compensate, especially for higher risk individuals such as those working outdoors.

Sun Protection and Infants^{1,2}

- <6 months old, avoid sun exposure
 - Create shade using stroller, hoods, umbrella, etc.
- Dress infant in wide brimmed hats, lightweight loose-fitting clothing
- If sun exposure is unavoidable:
 - Apply broad spectrum SPF 30 sunscreen for babies to small areas of exposed skin
 - No data indicate toxicity from absorption of sunscreen ingredients in infants; there have been reports of dermatitis from organic sunscreens
 - Inorganic (physical) sunscreen are minimally absorbed and less likely to cause sensitization

Does sunscreen application affect Vitamin D synthesis?^{2,6-11}

Aggressive photo-protection does reduce skin production of vitamin D; however, normal usage (which is inadvertently less than recommended) has not shown to decrease skin synthesis of vitamin D drastically.⁶ To obtain 1000 IU of vitamin D3 from UVB radiation, a young white person needs 4 minutes' exposure to 25% of the body's surface (e.g. arms and most of the legs). An older person or those with darker skin tones may need as long as 18 minutes.⁸ Unfortunately, this would result in a significant amount of UVB (and therefore UVA) radiation over a summer, increasing the risks of skin damage. Importantly, the Canadian recommended dietary allowance (RDA) for vitamin D were based on minimal sun exposure. Therefore, as the photo-protection review by Kannan and Lim concludes "*Oral intake with vitamin D-enriched foods or vitamin D supplements is recommended over prolonged ultraviolet exposure to maintain proper serum levels*".⁶

Thus, it is also important to remember to recommend vitamin D supplementation to your patients, due to its known benefits in bone health and general absence from dietary intake. Health Canada recommends an RDA between 400 and 800 IU and an upper limit of between 1000 and 4000 IU per day, depending on age.¹¹

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Appendix 1: Sunscreen Ingredients and UV Protection* ^{2,5,11,12}

| <i>Ingredient</i> <i>Common name (alternative name)</i> | <i>UV Spectrum</i> | | |
|--|--------------------|-------------|-------------|
| | <i>UVB</i> | <i>UVA1</i> | <i>UVA2</i> |
| Organic Sunscreens | | | |
| Para-aminobenzoic acid (PABA) and its derivatives | | | |
| PABA | √ | | |
| Padimate-O (octyl dimethyl PABA) | √ | | |
| Cinnamates | | | |
| Cinoxate (2-ethoxyethyl <i>p</i> -methoxycinnamate) | √ | | √ |
| DEA methoxycinnamate (Diethanolaminemethoxycinnamate) | √ | | |
| Octinoxate (octyl methoxycinnamate) | √ | | |
| Salicylates | | | |
| Homosalate (homomenthyl salicylate) | √ | | |
| Octisalate (octyl salicylate) | √ | | |
| Triethanolamine salicylate (trolamine salicylate) | √ | | |
| Benzophenones | | | |
| Dioxybenzone (benzophenone-8) | √ | | √ |
| Oxybenzone (benzophenone-3) | √ | | √ |
| Sulisobenzone (benzophenone-4) | √ | | √ |
| Miscellaneous | | | |
| Avobenzone (butyl- methoxydibenzoylmethane) | | √ | √ |
| Bemotrizinol (bis-ethylhexyloxyphenol methoxyphenol triazine, Tinsorb S) | √ | | √ |
| Bisotrizole | √ | | √ |
| Drometrizoletrisiloxane (Mexoryl XL) | √ | | √ |
| Ecamsule (terephthalylidene dicamphor sulfonic acid, Mexoryl SX) | √ | | √ |
| Ensulizole (phenylbenzimidazole sulphonic acid) | √ | | |
| Enzacamene (methyl benzylidene camphor) | √ | | |
| Meradimate (menthyl anthranilate) | √ | | √ |
| Octocrylene (2-ethylhexyl alpha-cyano-beta-phenylcinnamate; octocrileno) | √ | | √ |
| Inorganic Sunscreens | | | |
| Titanium dioxide | √ | | √ |
| Zinc oxide | √ | √ | √ |

*There is not complete agreeance among the references for all ingredients; where information is divergent, the most spectrum with the most support was chosen.

Appendix 2: Drugs that may Cause Photosensitivity¹³⁻¹⁵

| Antibiotics | NSAIDs | Statins | Retinoids |
|----------------------|----------------------------|------------------------|-----------------------|
| Tetracyclines | celecoxib | atorvastatin | acitretin |
| doxycycline | diclofenac | fluvastatin | adapalene |
| tetracycline | ibuprofen | lovastatin | alitretinoin |
| Fluoroquinolones | indomethacin | pravastatin | isotretinoin |
| ciprofloxacin | ketoprofen | rosuvastatin | tazarotene |
| levofloxacin | naproxen | simvastatin | tretinoin |
| norfloxacin | piroxicam | Neuroleptics | Miscellaneous |
| ofloxacin | sulindac | chlorthalidone | 5-fluorouracil |
| Sulfonamides | tiaprofenic acid | chlorpromazine | alprazolam |
| Trimethoprim | EGF Inhibitors | fluphenazine | amiodarone |
| Antifungals | cetuximab | perphenazine | coal tar |
| itraconazole | erlotinib | prochlorperazine | dapsone |
| terbinafine | gefitinib | thiothixene | desipramine |
| voriconazole | lapatinib | trifluoperazine | hydroxychloroquine |
| Antihypertensives | panitumumab | Photodynamic Therapy | imipramine |
| diltiazem | vandetanib | aminolevulinic acid | oral contraceptives |
| enalapril | Diuretics | methyl aminolevulinate | paclitaxel |
| Hypoglycemics | bumetanide | methoxsalen | quinidine |
| glyburide | furosemide | porfimer | quinine |
| tolbutamide | hydrochlorothiazide | verteporfin | vinblastine |

EGF=epidermal growth factor; NSAIDs= nonsteroidal anti-inflammatory drugs; SMX/TMP= sulfamethoxazole/trimethoprim
BOLDED agents are more likely to cause photosensitivity

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