Objectives

- Learn UVA, UVB, and UVC wavelengths
- Review of sunburn and learn pathogenesis of sunburn
- Review of skin cancer
- Learn types of individuals most susceptible to damaging effects of the sun
- Learn and recommend the most appropriate sunburn prevention methods
- Learn new FDA guidelines for labeling sun protection products
- Identify common medications that cause photosensitivity reactions
- Learn treatment options for sunburn

We LOVE being outside!
Anatomy of the skin

- The skin is the body’s largest organ, covering the entire body.
- Also protects against heat, light, injury, and infection.
- The skin also:
  - regulates body temperature.
  - stores water and fat.
  - is a sensory organ.
  - prevents water loss.
  - prevents entry of bacteria.

Sunscreen use in the U.S.

- Apply Sunscreen: 40%
- Do Not Apply Sunscreen: 60%

Radiation from the Sun

- Sun radiates UVA, UVB, and ultraviolet UVC rays.
- Well known that UV radiation causes complications such as:
  - aging
  - photosensitivity
  - photodermatoses
  - erythema
  - skin cancer
UVA Radiation
- Longer wavelength (320-400nm)
  - Results in deeper penetration into the dermal layer
  - Results in darkening or tanning of the skin
  - Causes skin aging
  - Prolonged pigmentation
  - Wrinkles
- Recent further classification:
  - UVA-I: longer wavelength (340-400nm)
    - Deeper penetration results in skin damage and increases risk of tumors.
  - UVA-II: slightly shorter wavelength (320-340nm)
    - Similar penetration to UVB radiation
    - Causes sunburn

UVB Radiation
- Shorter wavelength (290-320nm)
  - Does not penetrate the dermis layer as deeply as UVA.
  - Penetration is mainly limited to the epidermal layer.
  - Result is more significant sunburn.
    - Shorter length UV-A-II (320-340) also results in significant sunburn as it acts similar to UVB radiation due to shorter wavelength.
    - Much of this wavelength is absorbed by the ozone layer.

UVC Radiation
- Short wave radiation (200-290nm)
  - 100% absorbed by the ozone layer
  - This type of radiation results in SIGNIFICANT burning and is the reason we are concerned with the ozone layer.
  - Recent evidence that the “hole in the ozone layer is expanding and moving”.
Epidemiology of Sunburn

- 39% of adults reported having a sunburn in the previous year.
- 18.5% of adults experience 1 episode of sunburn per year, where 8% had 3 or more events.
- Highest occurrences of sunburn are found in ages 11-18.
- Excessive alcohol consumption is associated with increased risk of sunburn.
- Importance not only derives from acute discomfort caused, but excessive exposure is a marker for skin cancer.

Pathogenesis

- Exposure to UV light at molecular level (particularly UVB) is known to induce irreversible DNA damage.
  - Inflammatory reaction of the skin in response to damage caused by overexposure of UV light.
  - Dermal vasodilatation is thought to be responsible for visible erythema.
  - UV light has been shown to cause the formation of pyrimidine dimers, via induction of the p53 pathway.
  - Formation of these dimers can cause mutations in the DNA which in turn leads to cell apoptosis and can lead to development of skin cancers.
  - UV exposure can also deplete Langerhans cells and induce thickening of the stratum, corneum, epidermis, dermis, and responsible for dermal edema.

Skin Cancer

- Three most common forms are:
  - Basal Cell Carcinoma
  - Squamous Cell Carcinoma
  - Melanoma
Basal Cell Cancer
- Commonly occurs on sun damaged areas of the skin.
- Very common in light skin individuals with a long history of sun exposure.
- Treatments following biopsy:
  - Freezing
  - Electrodesiccation
  - Surgical excision
  - Mohs Surgery
  - Radiation
- Generally non-invasive and typically does not metastasize.

Squamous Cell Cancer
- Second most common form of skin cancer
- Occurs on sun-damaged skin of light skin individuals with a long history of sun exposure.
- Requires treatment to prevent it from becoming invasive.
- If neglected, causes tissue damage and can progress to death.
- Treatment after biopsy:
  - Cryosurgery
  - Electrodesiccation and curettage
  - Excision
  - Mohs Surgery
  - Radiation

Basal Cell and Squamous Cell Carcinoma
- Each year more than a million new cases of basal cell or squamous cell (non-melanoma forms) skin cancer are reported.
- 40-50% of Americans who live to age 65 will develop one of these two types of skin cancer at least once.
- These types of skin cancers involve only the epidermis and dermis with rare metastasis to other organs.
- Most new cancer types in the US are skin cancer.
- Incidence of skin cancer is rising.
- Other types of cancers have remained stable or show declining numbers.
- Most cases of skin cancer are preventable.
- Most important avoidable cause we know is exposure to UV radiation.
Melanoma

- Asymmetry: one half doesn’t match the appearance of the other half.
- Border irregularity: the edges are ragged, notched, or blurred.
- Color: the color (pigmentation) is not uniform. Shades of tan, brown, and black are present. Dashes of red, white, and blue add to a mottled appearance.
- Diameter: The size of the mole is greater than 1/4 inch (6 mm), about the size of a pencil eraser.

Between 1975 and 2004 the number of new cases of melanoma had risen.
- It is estimated that 60,000 new cases occurred in 2007.
- UVB radiation primarily and also UVA radiation have been shown to cause DNA damage.
- UVA and UVB radiation also cause immunosuppression leading to formation of melanomas.

Skin Cancer...risk factors

- Light natural skin color
- Family and personal history of skin cancer
- Blue or green eyes
- Certain types and a large number of moles
- **EXPOSURE to the SUN!**
- Damage to DNA has been linked to UVB radiation
- UVA also has been linked to damaging DNA and causing immunosuppression, leaving you more susceptible to disease including skin cancer(s).
- Indoor Tanning...
Indoor Tanning

- Evidence of association between indoor tanning and both squamous cell cancer and melanoma.
- Evidence between UV-emitting devises and ocular melanoma.
- Risk of melanoma increased by 75% when tanning bed use started before the age of 35.
- Tanning causes premature aging resulting in wrinkles from loss of skin elasticity.

Her story...

- Former Miss Maryland and Washington Redskins Cheerleader
  - Began tanning at age 17
  - Stopped at age 20 when diagnosed with melanoma
  - Surgeries have left her with 25 scars
  - Gets a head-to-toe exam every 3 months
  - Now a national advocate against indoor tanning.

The scars of Melanoma
Groups at risk for sun damage

- Men and younger adults...less likely to use sun protection
- Adults with less education and lower income are less likely to use a product or any method
- At present only 56% of adults protect themselves from solar exposure
- Goal is to increase use of sunscreen (w a SPF of 30 or greater), wear protective clothing, or seek shade while we are in the outdoors to 75%

Individuals most susceptible to sunburn

- Fair skin individuals
- Light colored hair
- History of sunburn with limited exposure to sunlight
  (Notable examples of Fitzpatrick skin phototypes I & II)
- Use of photosensitizing medications:
  - NSAIDs’s
  - Tetracyclines (incl. minocycline, doxycycline)
  - Thiazide type diuretics
  - Furosemide
  - Amiodarone
  - Phenothiazines (prochlorperazine, promethazine, etc)

Skin type and susceptibility to sunburn

<table>
<thead>
<tr>
<th>Skin Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Usually bright white or pale skin, blue or green eyes, red hair and many freckles. This skin type always burns outdoors, never tans. NOTE: A person who is a true Skin Type I should avoid tanning indoors and outdoors.</td>
</tr>
<tr>
<td>Type II</td>
<td>Beige skin, blue or grey eyes, blonde or light brown hair and some freckles. This skin type has a strong tendency to sunburn outdoors, but sometimes tans.</td>
</tr>
<tr>
<td>Type III</td>
<td>Light brown skin, brown eyes and hair. This skin type sometimes burns outdoors but never tans.</td>
</tr>
<tr>
<td>Type IV</td>
<td>Light brown or olive skin, dark brown eyes and hair. This skin type sometimes burns outdoors and tans readily.</td>
</tr>
<tr>
<td>Type V</td>
<td>Brown skin, dark brown hair and eyes. This skin type rarely burns outdoors and has difficulty tan.</td>
</tr>
<tr>
<td>Type VI</td>
<td>Black skin, black brown eyes and hair. This skin type rarely sunburns outdoors.</td>
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</table>
Sunburn prevention methods

- Use of sunscreen
- Wears protective clothing
  - Visors
  - Long-sleeve shirts
  - Sun protective hats (not baseball caps)
    - Fully protect the face, neck, and ears
- Seeks shade

Sunburn prevention methods and recommendations

- FDA and AAD (American Academy of Dermatology) recommend a combination of nonpharmacologic and pharmacologic interventions.
- Long considered to be the Gold Standard in preventing sunburn complications:
  - Protective clothing
  - Sunscreen applications
  - Wide-brim headgear to fully protect the face, nose, neck, and ears

How Sunscreen’s Work

Blocking the sun

- Products that protect against both UVA and UVB: Broad spectrum
- Sunscreens that only protect against UVA: UVA protect
- Sunscreens that only protect against UVB: UVB protect
- Sunscreen effectiveness based on broad-spectrum protection

- UVA rays: Penetrate deep, weaken tissue, cause cancer
- UVB rays: Only penetrate skin’s top layer; cause sunburn

Sunscreen protects against both UVA and UVB rays.
Facts about sunscreen products.

- SPF = MED of sunscreen protected skin ÷ MED of un-protected skin
- Creams/lotions are best for dry skin, gels are best for hairy areas, stick applications are best for nose and around the eyes
- Creams are a thicker base and are best for the face.
- Product availability for sensitive skin and use on young children

More facts about sunscreen products

- UVB rays can not penetrate windows, but UVA can
- Can be applied under makeup or vice versa
- On cloudy days 80% of UV rays pass through. Sand reflect 25% of UV rays and snow reflects 80%.
- Apply 15-30 minutes before anticipated exposure and re-apply about 20 minutes after exposure.
- Apply liberally...1oz. is considered the amount needed to adequately cover exposed areas
- Re-application every 2 hours or after swimming or perspiring heavily

Waterproof? Sweat-proof?

- Manufacturers CANNOT Claim:
  - Products are waterproof, sweat-proof
  - Identify their product as a sunblock
  - Claim immediate protection
Sunscreen Products.

- Two classes, Organic and Inorganic
- Inorganic agents are also referred to as physical blockers:
  - Zinc Oxide
  - Titanium Dioxide
  - Red Petrolatum
- These agents scatter and reflect radiation
- Well tolerated, but somewhat unpleasant as they are very opaque
- Often times, they leave a white residue
- Micronized forms help to reduce the residue, but they scatter less light. They only block UVB radiation
- Un-micronized forms are able to block long wavelengths such as UVA.

Organic agents do not scatter & reflect radiation, but rather absorb it
- Absorb UV radiation and convert it to heat energy by means of electron excitation.
- Can be classified as to whether they protect against UVA or UVB.
- Your best products protect against both UVA and UVB.

Initial FDA proposal of Re-labeling of Sunscreen Products

- SPF measures the time it will take to produce minimal erythema.
- This pertains to UVB radiation which is mostly responsible for sunburn.
- The bottle on the left is what consumers are most familiar with.
- SPF factor only reflects the lotion’s effectiveness in blocking UVB rays.
Initial FDA proposal of Re-labeling of Sunscreen Products

- FDA will classifying products as offering Low, Medium, High, and Highest protection against UVA radiation.
- The second bottle is showing what the proposed labeling will look like.
- FDA was to issue a final opinion in October, 2010

Other initial proposed changes

- The FDA is also proposing changes to the SPF (sun protection factor) ratings.
  - Currently 30+ is the maximum assigned rating.
  - Proposal to increase this number to 50+ for sun sensitive individuals
    - This will prevent manufacturers from claiming SPF of more than 50+
    - Companies will have 18 months after the new rules are enacted to make label changes or provide evidence to justify a higher SPF rating.
  - Proposal to change SPF from “sun protection factor” to “sunburn protection factor”

SPF rating scale

- SPF stands for “sun protection factor” or to be re-classified as “sunburn protection factor”
- SPF presently range from 2 to greater than 50 with pending re-classification
- Dermatologists recommend a broad spectrum product (UVA & UVB protection) of 30+ for year-round protection
- Does a SPF 30 product have twice as much protection as a 15 product?
SPF rating scale

- UVB protection does not increase proportionately with designated SPF number.
  - SPF 30 screens 97% of UVB rays
  - SPF 15 screens 93% of UVB rays
  - SPF 2 screens 50% of UVB rays
- No one product provides 100% protection
**Photosensitivity**

- The way in which medications modify a person’s response to solar radiation.
- Skin manifestations that result from an interaction of a chemical and exposure to light.
- Both systemic and topical medications can cause this to occur.
- Most common photosensitivity reactions are phototoxic and photoallergic reactions.

**Common medications that can cause phototoxic & photoallergic reactions**

<table>
<thead>
<tr>
<th>Phototoxic Reaction</th>
<th>Photoallergic Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetrascyclines</td>
<td>Ketoprofen</td>
</tr>
<tr>
<td>Fluoroquinolones</td>
<td>Celecoxib</td>
</tr>
<tr>
<td>Sulfonamides</td>
<td>HCTZ</td>
</tr>
<tr>
<td>Diclofenac</td>
<td>Sulfapyridine (pamidronate)</td>
</tr>
<tr>
<td>Naproxen</td>
<td>PABA</td>
</tr>
<tr>
<td>Furosemide</td>
<td>5-FU</td>
</tr>
<tr>
<td>HCTZ</td>
<td>Quinidine</td>
</tr>
<tr>
<td>Isosorbide</td>
<td>Dapsone</td>
</tr>
<tr>
<td>Phenothiazines</td>
<td>Oral Contraceptives</td>
</tr>
<tr>
<td>Amiodarone</td>
<td>PABA</td>
</tr>
<tr>
<td>Diltiazem</td>
<td>Cinnamates</td>
</tr>
<tr>
<td>Lisinopril</td>
<td>Benzophenones</td>
</tr>
<tr>
<td>PABA</td>
<td>Salicylates</td>
</tr>
</tbody>
</table>

**Treatment options**

- Number of options have been explored
- Some with favorable results
- Not sufficiently studied and results have not been consistently reproducible or of significant clinical benefit
- Use of some therapies may be of use in relieving symptoms of sunburn.
NSAID’s

- Potential treatment of sunburn due to inhibitory effect on prostaglandins.
- Aspirin, ibuprofen, and indomethacin have been shown not only to relieve pain, but also reduction in swelling.
- Pain and erythema were significantly decreased during the initial 48 hours following initial application of diclofenac gel.
- Generally speaking, the need decreases beyond 24-36 hours.

Topical Corticosteroids

- Use has been noted in the literature since the 1950's.
- Some studies show benefit, lack of a placebo control bring doubt into their benefit.
- Use of a moderate potency corticosteroid may be of benefit in reducing erythema and pain.
- Combination of topical corticosteroid with an oral NSAID may be of benefit.
- Generally benefits are limited to the first 24-36 hours.

Other agents

- Topical antihistamines: lack of efficacy in reviewed studies to justify use.
- Emollient creams: may be useful in helping with pain.
- Aloe Vera Gel: may be useful in helping with pain.
- Topical anesthetics: little evidence to support use.
- Acetaminophen: may be useful in reducing pain.
- Cool soaks and cold compresses: may be useful in reducing discomfort.
What can we all do for our patients?

- When choosing a sunscreen, consideration of duration in the sun is important.
- American Academy of Dermatology recommends a SPF rating of at least 15 and labeled as broad spectrum.
- Those who burn easily, a sunscreen of SPF 30+ is a reasonable choice.
- People of color (African Americans, Hispanic, Native American, etc.) have more melanin in their skin which imparts some level of protection, but they still burn and will need some level of protection.
- Those who work in the sun or are exposed to long periods of sun during 10am to 4pm, should use a higher rated SPF sunscreen.
- “Rule of Thumb”: if your shadow cast is shorter than your actual height, the sun’s rays are at their maximum intensity.
- There is no longer ANY SUCH THING as “all day protection” or “instant protection” upon application.
- Re-apply frequently as it is suspected that sunscreens begin to breakdown in the sun.
  - Recommendation is every 1 & 1/2 to 2 hours.

What can we all do for our patients?

- Sunscreen failure occurs because often times not enough is applied.
  - About 1oz is needed to cover the skin adequately.
- Chemical sunscreens must bind to skin before they are effective.
- Best to apply 15-30 minutes before anticipated exposure.
- Sunscreen’s cannot no longer claim they are “waterproof”
  - Best to reapply as you are in and out of the water.
  - Depending on approval, sunscreens can only be labeled as waterproof for 40 min or 80 min.
- Use in children less than 6 months of age is not recommended. Use barrier coverings or stick to the shade.

Questions about sunscreen expiration dates and effectiveness?

- Consistent with other pharmaceutical products, exposure to extreme temperatures, direct sunlight, or humidity may reduce the shelf life of the product.
- Most products have a 3-5 year expiration, so it is NOT NECESSARY to discard them after one season.
  - FDA requires that all sunscreens be stable and at original strength for at least 3 years.
- Many products are labeled with the expiration date, but if not they are coded with manufacture date.
Opinion from two experts...

"Going about your normal daily business, going to the grocery store, going to the cleaners, going to work, driving in your car, you are cumulatively getting lots of UV exposure without necessarily getting a tan or a burn. This cumulative or incidental exposure really adds up over time with great damage."

Derek Jones MD, Board Certified Dermatologist

Sunlight has a profound effect on the skin causing premature skin aging, skin cancer, and a host of skin changes. Exposure to ultraviolet light, UVA or UVB, from sunlight accounts for 90% of the symptoms of premature skin aging. Many skin changes that were commonly believed to be due to aging, such as easy bruising, are actually a result of prolonged exposure to UV Radiation.

Heather Brannon, MD

References:

- SunWise Program, US EPA Website.
Thank You for attending and supporting UPhA!

- Enjoy your time outdoors, but do it smartly.
- Pay attention to your shadow...It can tell you a lot.
- Reapply sunscreen LIBERALLY and OFTEN.
- Most of all, inspect your skin and look for bumps, dry scaly areas, and areas of discoloration. REPORT ANY suspicions to your doctor.

Learning Assessment

1. What is the largest organ system in the human body?
   a. Skin
   b. Skeletal System
   c. Circulatory System
   d. Nervous System
   e. Digestive System.

2. Exposure to this light does not penetrate the skin as deep but produces significant burning.
   a. UVA
   b. UVB
   c. UVC
   d. UVA-II
   e. Both UVB and UVA-II
3. Melanoma is the deadliest form of skin cancer and can metastasize to other parts of the body.
   a. True
   b. False

4. When is it best to apply sunscreen?
   a. 15-30 after exposure
   b. 15-30 minutes prior to exposure with reapplication 20 minutes after exposure
   c. No need to apply; I do not sunburn.
   d. None of the above

5. Sunburn Protection Factor (SPF) will be the FDA’s new/re-classified meaning of SPF.
   a. True
   b. False
6. You are asked for a recommendation for a sunscreen product. Which one will you recommend?
   a. Brand X Broad Spectrum 10
   b. Brand X SPF 30
   c. Brand X Broad Spectrum 15
   d. Zinc Oxide