From the Biology of Tanning to Indoor Tanning

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Outline of Presentation

• Solar radiation
• Ultraviolet (UV) light definition and effects
  – Sunburn
  – Tanning
  – Photoaging
• Indoor tanning industry
• Indoor tanning: health consequences
• Indoor tanning: public health issues
• Indoor tanning: UV light addiction
Solar Radiation

- Mood Improvement
- Photosynthesis
- Vitamin D Synthesis
- Warmth
- Phototherapy
- Vision
- Cataracts
- Photokeratitis
- Sunburn
- Premature Skin Aging
- Skin Cancer
- Phototoxicity/Allergy
- Immunosuppresion
Solar Radiation: Electromagnetic Waves

- **Infrared**: 760 - 3000 nm
- **Visible**: 400 - 760 nm
- **UV**: 200 - 400 nm

![Diagram of electromagnetic spectrum showing X-rays, Gamma rays, Vacuum UV, UV, Visible, Infrared, and Radio waves. UVC, UVB, and UVA regions are highlighted.](image-url)
UV Exposure: Penetration

Longer Wavelength = Lower Energy

UVC/B filtered out by glass

Stratum corneum
Epidermis
Dermis
Subcutaneous fat

UVC 250 nm
UVB 300 nm
UVA 350 nm
UV Exposure: Definitions

Chromophore
molecules that absorb photons
DNA, amino acids, Hb, melanin, drugs

Absorption spectrum
wavelengths absorbed by chromophore

Action spectrum
wavelengths that cause a reaction
(eg., erythema)
UV Exposure: Effects

• Early effects:
  - Vitamin D synthesis
  - Sunburn (erythema)
  - Tanning (hyperpigmentation)
  - Immunologic alterations
  - Skin thickening (hyperplasia)

• Late effects:
  - Photoaging
  - Photocarcinogenesis
Sunburn (Erythema)

- Redness, swelling, pain, blistering of the skin
- Histologically, see “sunburn cells” or necrotic keratinocytes in the epidermis
- Vasodilation and vasopermeability
- UVB erythema peaks 12 – 24 hrs later, UVA peak is biphasic: peaks immediately, decreases around 4 hrs, then peaks 6 – 24 hrs
Sunburn Cells
Tanning

• Hyperpigmentation: biphasic response
• Thought to be triggered by UV-induced DNA damage and/or repair:

• Immediate tanning (greyish) – UVA
  – photo-oxidation of existing melanin
  – melanin re-distribution

• Delayed tanning (2-3 days) – UVA, B, C
  – new melanin formed
  – melanocyte proliferation
Chronic Effects of UV: Skin Cancer
The Indoor Tanning Industry

• According to the Indoor Tanning Association (ITA) there are over 25,000 professional indoor tanning businesses across America

• Each year > 30 million people (>10% of American public) visit a tanning facility

• Industry employs >140,000 Americans, total economic impact exceeds $5 billion annually

http://www.theita.com
The Indoor Tanning Industry

- Tanning beds are commonly used by children/adolescents
- Two surveys from 1998 and 2004 found consistent rates of usage in adolescents aged 11-18 yrs: 10% and 11%
- Another very large survey showed use of tanning beds in 1999 was 9.5% among adolescents, usage rate increased from 7% among 14 yr old girls to 16% by age 15 to 35% by age 17

History of Regulation

• Federal regulation is primarily through the Code of Federal Regulations (CFR) 1040.20

• The CFR details requirements for sunlamp manufacturers on:
  – lamp specifications
  – posting of warning labels
  – provision of suitable eye protection
  – limiting amount of UVR wavelengths 200-260 nm

History of Regulation

• The CFR (21 CFR 878.4635) also classifies UV lamps for tanning as a class I device (class I devices require very little FDA oversight and include items like bandages, gauze, tongue depressors)

• UV lamps for dermatologic disorders are classified as class II medical devices

DHHS/FDA (21 CFR 878.4635) Fed Reg 1990
Health Consequences: Burns

• In a large survey of adolescents (ages 11-18 years) 58% reported getting burns from indoor tanning
• Burns were associated with frequent use of indoor tanning (≥6 sessions within past year)
• 3% reported ever getting a skin rash or infection
• In a large UK Burn/Plastic Surgery practice seen a rise in the number of patients presenting with burns related to sunbed use over the last several years

Health Consequences: Skin Cancer

• Clear link between UVR from indoor tanning and melanoma skin cancer:
  – IARC meta-analysis of 19 studies conducted over 25 years showed increase risk of MM and SCC
  – Minimal exposure to UVR from tanning beds before age 35 increases risk of MM by 75%
  – More recent case-control study showed adjusted OR 1.74; risk increased as the number of hours and years of tanning increased

Int J Cancer 2007;120:1116
Health Consequences: Skin Cancer

• Clear link between UVR from indoor tanning and non-melanoma skin cancer:
  – Studies show tanning bed users are 2.5x and 1.5x more likely to develop SCC and BCC

Health Consequences: Skin Cancer

- There is an alarming trend in new melanoma diagnoses among girls and women aged 15 – 39
- SEER results show an annual increase of 2.7% in this group (1992-2004)
- Incidence of thicker melanomas (>1 mm) has increased
- Incidence of regional and distant tumors also increased at an annual rate 9.2%

Public Health Issues

• Considerable data points to childhood and adolescence as the key periods for initiation and development of melanoma in adulthood
Public Health Issues

• In Washington state, 70% of the parents surveyed said they never wanted their children to use tanning devices
• We found children as young as 5 years old were currently using tanning beds
• On average children were using them 4 years younger than their parents

Magee KH et al, Pediatr Dermatol 2007;24:216
Public Health Issues: Compliance with Regulations

• 50 NC tanning facilities evaluated during state inspections:
  – Were patrons complying with the FDA recommended “safe” exposure schedules outlined on the tanning beds?
  – Established guidelines are based on getting no more than 0.75 minimal erythemal dose (MED) 3 times the first week, gradually increasing the exposure thereafter

Public Health Issues: Compliance with Regulations

- 95% of patrons were not following the safe exposure guidelines
- ~1/3rd actually started at the maximum levels (>4 MED)
- Average length of tanning on the first visit was >14 minutes
- Primary tanning facilities where the sole business was for tanning, the patrons had significantly shorter tanning times

Public Health Issues: Compliance with Regulations

• We also studied the amount of UV radiation emitted by tanning beds
  – The tanning beds emitted 4x more UVA and 2x more UVB when compared to radiation emitted by the noon-day sun in Washington D.C.
  – In high-pressure sunlamps radiation can reach doses 10-15x that of the sun

Gerber B et al, Photochem Photobiol 2002;76:664
Public Health Issues: Compliance with Regulations

• In San Diego a study utilized phone interviews to assess compliance with recommended exposure schedules:
  – Compliance was measured as the weekly frequency of visits
  – Only 6.8% in compliance with the FDA recommended exposure guidelines

Kwon HT et al, J Am Acad Derm 2002;46:700
Public Health Issues: Knowledge And Training

- Survey of tanning operators in Michigan: 63% did not believe that tanning beds can cause cancer
- Survey of tanning operators in New York: 80% said one could not get skin cancer from artificial tanning, 75% said one could not get a sunburn from artificial tanning

Public Health Issues: Knowledge And Training

• 400 facilities in 4 states, 87% of operators advised patrons of the potential risk of sunburn
• < 50% facility operators in Colorado, Texas and Wisconsin informed patrons about the risk of skin cancer vs 81% in Illinois

UV Light Addiction

• More and more data suggesting UV light may be addictive
• Frequent tanners exhibit signs of both physical and psychological dependence
  – Physical dependency: repeated use of substance causes symptoms of increased tolerance, craving and withdrawal
  – Psychological dependence: a substance's effect on the brain’s reward system, the production of pleasure or well-being encourages repeated use
UV Addiction: Physical Dependency

• 2006 study used naltrexone, an opiate antagonist, in frequent vs infrequent tanners before they got UV exposure

• 50% of frequent tanners exhibited withdrawal symptoms including jitteriness and nausea, infrequent tanners did not

UV Addiction: Physical Dependency

• Another study found frequent tanners able to distinguish between identical UV-light emitting beds and non-UV placebo beds
• Tanners showed an overwhelming preference (95%) to tan in the UV-light emitting bed
• They suggested UV light created a more relaxed mood and even relieved pain, possibly due to endorphin release

UV Addiction: Psychological Dependency

• Many frequent tanners report relaxation and mood-enhancing effects as their motivation for tanning

• One study showed 21% of 14-17 year old indoor tanners reported difficulty quitting

• Quitting was most difficult for those who started tanning at age 13 or younger, and in those who tanned more frequently

UV Addiction

- CAGE is a clinical tool to diagnose substance related disorders
- The CAGE tool was modified to measure tanning addiction:
  - Have you ever felt you needed to Cut down on your tanning?
  - Have people Annoyed you by criticizing your tanning?
  - Have you ever felt Guilty about tanning?
  - Have you ever felt you needed to tan first thing in the morning (Eye-opener)?

Warthan MM et al. Arch Dermatol 2005;141:963
UV Addiction

- Our study showed 18% of undergraduates at the UW who acknowledged purposely tanning their skin scored positive on the CAGE.
- They continued high-risk tanning behavior despite adverse personal experiences such as blistering sunburns of FH of skin cancer.
- A survey of Texas beachgoers found 26% of sunbathers scored positive.

Warthan MM et al. Arch Dermatol 2005;141:963
UV Addiction: What Can We do?

- Indoor tanning is associated with other high-risk behaviors such as smoking, alcohol, recreational drug use, and eating disorders.
- Preventing an addiction is far better than trying to treat one.
- Early primary prevention/public education directed to children, adolescents, parents.
- Banning indoor tanning among children.
- For addiction consider behavioral models such as Stages of Change.

Recent Federal/National Efforts

- March 2010: FDA’s Medical Devices Advisory Committee conducted a hearing:
  - Reclassify tanning devices from a Class I device to a Class II or III (Class I devices require very little FDA oversight and include items like bandages, gauze, tongue depressors)
  - Proposed more prominent posting of warnings
  - Proposed an age restriction for tanning
The Future: What can we do?

- Talk to your friends/relatives/patients (examples):
  - Would you allow your child to start smoking? If not why would you allow tanning? They are both known carcinogens
  - On average in tanning beds UVA is 4X and UVB 2X the amount compared to noon day summer sun in D.C.
- Continue public education through skin cancer screenings, symposia, etc.
- Get involved at the state or national level with legislative activities