Teens and Indoor Tanning: A Cancer Prevention Opportunity for Pediatricians

abstract

FREE

In October 2011, California became the first US state to ban indoor tanning for minors under age 18 years. Vermont followed in May 2012. Increasingly, scientific evidence shows that artificial tanning raises the risk of skin cancer, including melanoma, a common cancer in adolescents and young adults and the type most likely to result in death. The World Health Organization, the American Academy of Pediatrics, the American Academy of Dermatology, the American Medical Association, and other organizations strongly recommend legislation to ban minors under age 18 from indoor tanning. Several nations have banned teen tanning. Yet, tanning in salons is still a prevalent practice in the United States, especially among teen girls, where rates for the oldest teens approach 40%. There is no federal legislation to restrict minors from salon tanning. More than 60% of states have some kind of legislation regarding minors' use of tanning salons, but only California and Vermont have passed complete bans of indoor tanning for minors. The Indoor Tanning Association, an industry advocacy group, has vigorously opposed legislative efforts. Pediatricians can play key roles in counseling families and with legislative efforts. In this update, we review the prevalence of salon tanning, association with skin cancer risk, tanning addiction, the roles of the federal and state governments in regulation and legislation, and responses to arguments created by industry to oppose legislation. Preventing exposure to artificial tanning may save lives, including young lives, and is a key cancer prevention opportunity for pediatricians. *Pediatrics* 2013;131:772–785

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KEY WORDS

indoor tanning, artificial tanning, teenagers, skin cancer, melanoma, prevention, tanning addiction, tanning legislation

ABBREVIATIONS

BCC—basal cell carcinoma
FDA—US Food and Drug Administration
FTC—US Federal Trade Commission
ITA—Indoor Tanning Association
NMSC—nonmelanoma skin cancer
POMC—pro-opiomelanocortin
SCC—squamous cell carcinoma
USPSTF—US Preventive Services Task Force
UVR—UV radiation

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BACKGROUND

Prevalence

People may be exposed to artificial sources of UV radiation (UVR) for treatment of certain medical conditions, in occupational settings, and for cosmetic purposes. Sunlamps and tanning beds are the main sources of artificial UVR used for deliberate purposes.[1] Indoor tanning started in the 1970s and has grown rapidly. Now >1 million people in the United States tan in tanning salons each day.[2] Many of those who visit tanning salons are adolescent girls and young women. According to the 2009 Youth Risk Behavior Survey, a nationally representative sample of high school students in grades 9 through 12, 15.6% of all students used an indoor tanning device ≥1 times during the 12 months before the survey. Among students who reported using devices within the past year, 49.1% reported doing so ≥10 times. Female students and white students were more likely to use tanning devices ≥10 times. More than one-quarter (25.4%) of girls reported using a tanning device in the past year.[3] The rate of artificial tanning among white girls increases with age, doubling from ages 14 to 15 (7% to 15%), and doubling again at age 17 (35%).[4] Tanning salons are ubiquitous. The average US city has 41 salons, outnumbering the number of Starbucks or McDonalds.[5] Access is easy. Salons are inexpensive and often offer "unlimited" tanning packages.[6] Adolescents are specifically targeted through advertising strategies that include promoting purported cosmetic and health benefits.[6]

Young adults and some adolescents have opportunities to access indoor tanning in nonsalon locations, including apartments, beauty salons, and fitness centers. Regulations governing minors' access to tanning salons do not affect these sites, and there is little scientific information available about them.

Radiation Emitted by Tanning Devices

Tanning devices emit primarily UV-A radiation.[7] UV-B radiation is much more potent than UV-A in causing sunburn, but high fluxes of UV-A can cause erythema in people who are sensitive to sunlight. In people who tan easily, exposure to tanning devices results in immediate pigment darkening caused by oxidation of existing melanin. A more permanent tan occurs with additional exposure, depending on the individual's tanning ability and the amount of UV-B in the lamps.[7] UV-B exposure results in greater tanning; newer tanning lamps may emit a greater proportion of UV-B.

The doses of UV-A emitted by high-pressure tanning units may be up to 10 to 15 times higher than that of the midday sun, an intense exposure not found in nature.[8,9] Frequent indoor tanners may receive 1.2 to 4.7 times the yearly dose of UV-A received from sunlight, in addition to doses from sun exposure.[1]

Skin Cancer Incidence

The incidence of skin cancer has reached epidemic proportions. Skin cancer (including basal cell carcinoma [BCC], squamous cell carcinoma [SCC], and melanoma) is by far the most common cancer. Approximately 3.5 million BCCs and SCCs in >2 million Americans are diagnosed each year.[10,11] BCC and SCC (grouped together as nonmelanoma skin cancer [NMSC]) are less likely to result in fatality compared with melanoma. Nonetheless, the American Cancer Society estimates that ~2000 people die each year of NMSC.[10] There is considerable morbidity and cost associated with treating NMSC. The American Cancer Society estimates that 76 690 new melanomas will be diagnosed in 2013; ~9480 people are expected to die of melanoma in 2013. US incidence rates for melanoma have been rising in all age groups since first recorded in 1973.[12]

Melanoma is more likely to occur in males and at older ages but also occurs in teenagers and in young adults. Melanoma is the second most common cancer in women in their 20s and the third most common cancer in men in their 20s.[13] Data from the SEER (Surveillance, Epidemiology, and End Results) Program show that the age-adjusted annual incidence rate for women aged 15 to 39 years more than doubled from 5.5 per 100 000 (range: 4.5–6.6) in 1973 to 13.9 per 100 000 (12.7–15.2) in 2004. The rise in the incidence rate for women has been sharpest since 1992 (Fig 1). Melanoma incidence increased for both thin and thick tumors and was greater for regional and distant tumors compared with localized lesions.[14] In Olmstead County, Minnesota, melanoma incidence increased 4-fold in young men but 8-fold in young women over a 30-year period: among men ages 18 to 39 years, the incidence rose from 4.3 per 100 000 between 1970 and 1979 to 18.6 per 100 000 between 2000 and 2009; among women ages 18 to 39 years, the incidence rose from 5.4 per 100 000 between 1970 and 1979 to 43.5 per 100 000 between 2000 and 2009.[15] Experts believe that 1 reason for this dramatic increase is the increasing popularity of artificial tanning,[15] especially among young women.

The incidence of NMSC also is increasing in young adults. Between 1976 and 2003, the incidence of BCC increased significantly among young women (<40 years of age), and the incidence of SCC increased significantly among men and women.[16] A trend toward a greater number of BCC cases occurring on the torso in younger patients has been reported.[16–18] This change in location supports the possibility that excessive outdoor tanning, use of tanning booths, or both give rise to BCC. The use of tanning beds has been shown

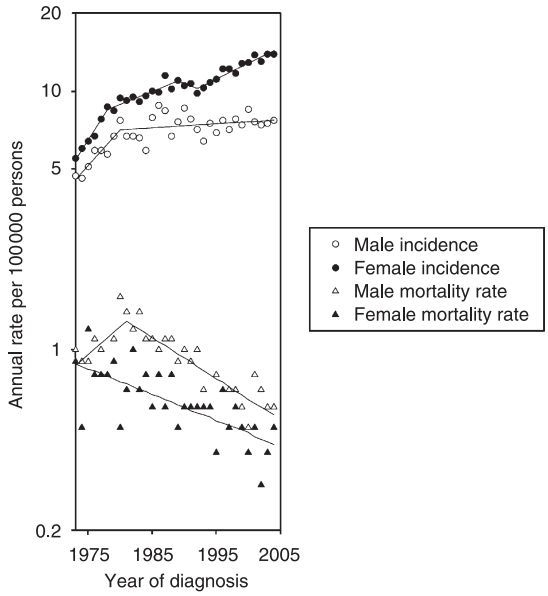

FIGURE 1

Trends in melanoma incidence and mortality among young adults. Age-adjusted (to 2000 US population) annual cutaneous melanoma incidence and mortality rates among Caucasian males and females aged 15–39 years in the Surveillance, Epidemiology, and End Results Program areas from 1973 through 2004. The segments of uniform trend from the best-fitting Joinpoint models are also shown. (Reprinted with permission from Purdue MP, Beane Freeman LE, Anderson WF, Tucker MA. Recent trends in incidence of cutaneous melanoma among US Caucasian young adults. *J Invest Dermatol.* 2008;128:2906.)

to be a risk factor for NMSC in young women.[19]

TANNING RESULTS IN DNA DAMAGE

The skin is composed of the epidermis, dermis, and subcutaneous layer. The top layer, the epidermis, includes basal cells, squamous cells (together known as keratinocytes), and melanocytes. Keratinocytes produce keratin, which is a structural and protective protein. Melanocytes produce melanin, a family of pigments spanning brown-black to blond-red colors. After their synthesis in melanocytes, melanin-containing vesicles are transported to overlying keratinocytes, where they traffic selectively to the sun-exposed side of nuclei. Darker melanins appear to protect the skin by absorbing UVR and reactive oxygen species.

Recent evidence indicates that the tanning response is mediated, in significant part, by signals emanating directly from damage to DNA. Exposure to UVR triggers DNA damage in the nuclei of keratinocytes, activating the p53 tumor-suppressor protein, a transcription factor that plays a pivotal role in the cellular response to genotoxic stressors such as UV- and chemically induced DNA damage.[20] p53 directly activates transcription of numerous genes such as those that regulate cell-cycle progression and apoptotic cellular pathways. p53 function is critical for the retention of tissue integrity after UV irradiation of skin. Loss of function of p53 leads to aberrant cell growth and survival responses; dysfunction of p53 plays an integral part in human cancer development.[20]

p53 activation in the skin leads to upregulation of the gene that encodes pro-opiomelanocortin (POMC), a polypeptide precursor present throughout the central nervous system and skin. POMC is then processed to produce α-melanocyte–stimulating hormone, which after secretion, stimulates its receptor, the melanocortin 1 receptor on the surface of melanocytes, to induce the synthesis, maturation, trafficking, and secretion of melanin. After the uptake of melanin by overlying keratinocytes, skin takes on a darker appearance, which results in tanning (Fig 2).[21] Thus, tanning occurs as a response to DNA damage and appears to be a component of the p53-induced stress response. Any wavelength of UV (ie, UV-A or UV-B) that is capable of inducing tanning (thus elevating carcinogenic risk) appears to do so via damage to DNA as a first step because the DNA damage response factor p53 is a key mediator of the tanning pathway.[20]

ACUTE AND LONG-TERM EFFECTS OF EXPOSURE TO ARTIFICIAL TANNING

Exposure to artificial UVR often results in erythema and sunburn. Erythema or burning was reported in 18% to 55% of users of indoor tanning equipment in North America and Europe.[1] A large US study of teen tanning-bed use revealed that 57% experienced at least 1 sunburn during a salon visit.[22] Other reported effects include skin dryness, pruritus, nausea, photodrug reactions, disease exacerbation (eg, systemic lupus erythematosus), and disease induction (eg, polymorphous light eruption). Long-term health effects include skin aging, effects on the eye (eg, cataract formation), and carcinogenesis.[7]

ARTIFICIAL TANNING IS CARCINOGENIC

In 2006, the International Agency for Research on Cancer (a branch of the World Health Organization) issued a report[1] based on meta-analysis of 19 studies of associations between tanning-bed use and skin cancer risk. On the basis of these data, in 2009 the International Agency for Research on Cancer declared that UVR from salons was a group 1 carcinogen (ie, known to cause cancer in humans).[23] These findings were criticized by some because of the weak association and inability to

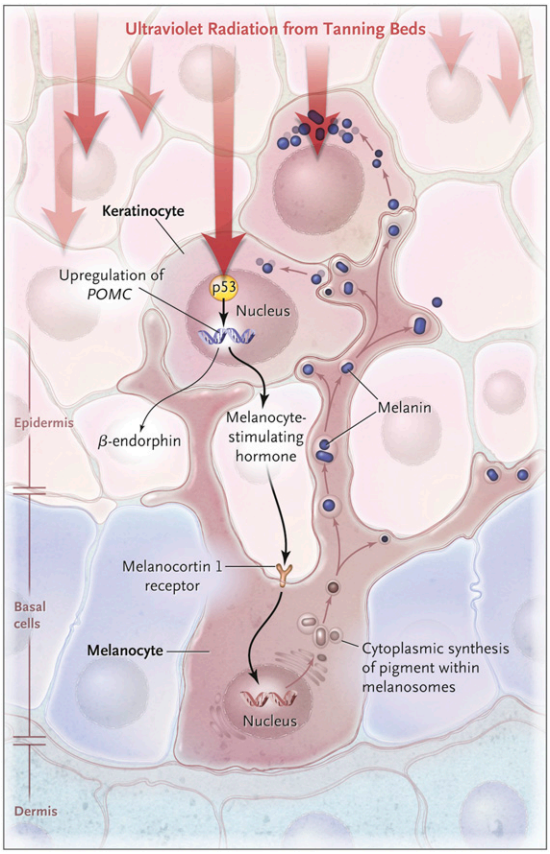

FIGURE 2

Molecular Mechanism of Skin Pigmentation Induced by UV Radiation. Ultraviolet light triggers DNA damage in the nucleus of keratinocytes, resulting in the activation of p53, which transcriptionally up-regulates the expression of the gene encoding proopiomelanocortin (POMC). POMC is post-translationally processed to produce melanocyte-stimulating hormone (MSH) and β-endorphin. After secretion, MSH acts on its receptor, the melanocortin 1 receptor, located on melanocytes at the basal layer of the epidermis, thereby inducing the production of pigment, which is subsequently transported out of melanocytes to overlying keratinocytes, where the pigment vesicles coalesce over the sun-exposed side of the nucleus, resulting in tanning. (Reprinted with permission from Fisher DE, James WD. Indoor tanning—science, behavior, and policy. *N Engl J Med.* 2010;363:902.)

confirm a dose-response relationship or examine exposure to specific tanning devices. Since then, new studies have strengthened the association of tanning-bed use with increased melanoma risk (Table 1). In 2012, a meta-analysis of 27 observational studies showed that for users of indoor tanning devices the risk of melanoma increased 20%, which doubled if tanning started when users were younger than 35 years.[9]

WHY PEOPLE TAN

Despite evidence that UVR exposure increases skin cancer risk, people continue to intentionally tan. Knowledge about the dangers of UVR often does not change tanning behavior.[24,25] These practices may persist because many people believe that a tanned appearance is attractive and healthy. In 1 study, 67.8% of youth agreed with the statement "I look better when I have a tan" and 55% agreed with the statement "I feel healthy when I have a nice tan."[26] In addition to the desire for improved appearance, motivations in some tanners include relaxation and a better mood. In view of potentially severe consequences, it has been postulated that continued and frequent use of tanning beds shares characteristics with addictive disorders,[27] and that for some individuals, tanning behavior may be motivated, at least in part, by a type of UV light substance-related disorder.

To characterize possible tanning addiction, researchers have used surveys that included tanning-specific modifications of 2 established instruments. The CAGE (Cut down, Annoyed, Guilty, Eye-opener) Questionnaire screens for alcohol abuse or dependence. Modifications include questions about whether tanners wanted to cut down but nevertheless continued and whether tanners felt annoyed when others advised them not to tan. The second instrument uses a modification of the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*, criteria for substance-related disorders. Questions include tolerance to tanning (ie, need for increased amounts of tanning to achieve a desired effect), withdrawal symptoms, and loss of control such as use despite a desire to cut down. Table 2 describes some studies of tanning addiction.

A small study found increased plasma concentrations of β-endorphin after UVR exposure in frequent tanners.[28] Other studies have not observed such elevations.[29,30] Blood endorphin concentrations appear to fluctuate through the day, so these studies might be limited, and more research is needed. It is interesting to consider whether an endorphin-mediated addictive mechanism might have conferred an advantage to human survival. UVR exposure results in conversion of vitamin D precursors in skin to vitamin D; adequate vitamin D is needed to ensure human survival.[31] Among the cleavage products of POMC are the glucocorticoid precursor adrenocorticotropic hormone (ACTH) and β-endorphin, an endogenous ligand of the μ-opioid receptor. Endogenous β-endorphin exerts analgesic

TABLE 1 Studies of Tanning-Bed Use and Melanoma Risk

Name	Study Type	Study Population, Methods	Main Findings	Other Findings	Comment
The association of use of sunbeds with cutaneous malignant melanoma and other skin cancers: a systematic review (2006)[1]	Meta-analysis of 19 studies that examined associations between use of an artificial tanning device ("sunbed") and skin cancer risk.		A 15% increase in melanoma risk (95% CI: 1.00, 1.31) for those who ever used a sunbed compared with those who never did; no consistent evidence of a dose-response relationship.	RR of melanoma greater with first use before age 35 (summary RR based on 7 studies: 1.75; 95% CI: 1.35, 2.26).	Based on findings, the IARC declared that artificial UVR is a group A carcinogen.
Australian Melanoma Family Study (2011)[64]	Population-based, case-control family study of early-onset melanoma.	604 cases diagnosed between ages 18 and 39; 479 controls.	Compared with never using, OR for melanoma associated with ever using sunbed = 1.41 (95% CI: 1.01, 1.96) and 2.01 (95% CI: 1.22, 3.31) for >10 lifetime sessions (P_{trend} = .01 with cumulative use).	Stronger association for earlier age at first use (P_{trend} = .02), also for melanoma diagnosed at 18–29 y (OR for >10 lifetime sessions: 6.57; 95% CI: 1.41, 30.49) than for melanoma diagnosed at 30–39 y (OR: 1.60; 95% CI: 0.92, 2.77; $P_{interaction}$ = .01).	Among those who ever used a sunbed and were diagnosed between 18 and 29 y, 76% of melanomas attributable to sunbed use.
Indoor tanning and risk of melanoma: a case-control study in a highly exposed population (2010) [65]	Case-control study in Minnesota.	1167 melanoma cases, 1101 controls ages 25–59 y.	63% of cases and 51% of controls ever indoor tanned (adjusted OR: 1.74; 95% CI: 1.42, 2.14). Risk increased in both users of UV-B–enhanced (adjusted OR: 2.86; 95% CI: 2.03, 4.03) and primarily UV-A–emitting devices (adjusted OR: 4.44; 95% CI: 2.45, 8.02). Greater risk associated with greater use when examined with regard to years of exposure (P < .006), hours (P < .0001), or sessions (P = .0002).	ORs elevated within each initiation age category; years of use among indoor tanners was more relevant for melanoma development.	Authors concluded that frequent indoor tanning increased melanoma risk independent of outdoor sun exposure and regardless of age when tanning began.
Norwegian-Swedish Women's Lifestyle and Health Cohort study (2010)[66]	Prospective cohort study established 1991–1992. Subjects in Norway came from nationwide random sample of 100 000 women born 1943–1957. Subjects in Sweden were 96 000 randomly selected women born 1943–1962.	Researchers examined subjects' responses about host factors sun exposure and solarium (ie, sunbed or sunlamp) use through 5 age decades (<10, 10–19, 20–29, 30–39, 40–49 y).	Among 106 366 women with complete follow-up through 2005, 412 melanoma cases were diagnosed. Risk increased with the number of sunburns and bathing vacations in the first 3 age decades ($P_{trend} \leq .04$).	Compared with "no use" of a solarium in the 3 decades from 10 to 39 y, RRs increased from 1.24 for "rarely use" in any decade to 1.38 for "use 1 or more times per month in 1 of 3 decades" to 2.37 for "use 1 or more times per month in 2 or 3 decades" (P_{trend} = .003).	Authors concluded that melanoma risk seems to continue to increase with accumulating intermittent sun exposure and solarium use in early adulthood. People with nevi and red hair were at particular risk for developing melanoma.
Cutaneous melanoma attributable to sunbed use: systematic review and meta-analysis (2012)[9]	Meta-analysis of 27 observational studies of sunbed use.		Ever use of sunbeds associated with summary RR of 1.20 (95% CI: 1.08, 1.34).	Calculations for dose-response showed a 1.8% (95% CI: 0%, 3.8%) increase in risk of melanoma for each additional session of sunbed use per year.	Study confirms doubling of melanoma risk when first use at a young age (<35 y) Dose-response relationship found between amount of use and melanoma risk. In Europe each year, 3438 estimated new cases of melanoma due to sunbed use, most among women.

CI, confidence interval; IARC, International Agency for Research on Cancer; OR, odds ratio; RR, relative risk; UVR, UV radiation.

TABLE 2 Studies of Tanning Addiction

Name	Study Type	Study Population, Methods	Main Findings	Other Findings	Comment
UV light tanning as a type of substance-related disorder. (2005)[25]	Convenience sample.	In Galveston, TX, 145 beachgoers ≥18 y interviewed with the use of modifications of the CAGE (mCAGE) and DSM-IV (mDSM-IV-TR) instruments. Two or more affirmative responses to questions on mCAGE and ≥3 affirmative responses to mDSM-IV-TR during the same 12-mo period were, respectively, tabulated as evidence for UVL tanning dependence.	26 of 145 (18%) screened positive on both measures; 63 (43%) screened positive on 1 measure. Positive mDSM-IV-TR subjects 2.2 times more likely than negative mDSM-IV-TR subjects to go to the beach to tan ($P = .05$).	Subjects screening positive on mCAGE were 2.2 times more likely than negative mCAGE subjects to go to the beach to tan ($P = .08$). Women were 5.5 times more likely than men ($P < .001$), and young people (ages 18–25 y) were 3.1 times more likely than older people (age ≥36 y) ($P = .04$) to go to the beach to tan.	Authors concluded that those who chronically and repeatedly exposed themselves to UVR to tan may have a UVR substance-related disorder.
Addiction to indoor tanning: relation to anxiety, depression, and substance use (2010) [67]	Survey of 229 college students who had tanned indoors.	CAGE and DSM-IV-TR questionnaires modified to assess the prevalence of tanning addiction and its association with substance use and symptoms of anxiety and depression.	70 of 229 (31%) met CAGE criteria and 90 of 229 (39%) met DSM-IV-TR criteria for addiction to indoor tanning.	Tanners who met modified DSM-IV-TR and CAGE criteria for addiction to indoor tanning reported significantly greater symptoms of anxiety and greater use of alcohol, marijuana, and other substances than respondents not meeting the criteria.	Authors suggested that for some individuals, interventions to reduce skin cancer risk should address addictive qualities of indoor tanning and the relationship of indoor tanning to other addictions and affective disturbances.
Addictive-like behaviours to ultraviolet light among frequent indoor tanners (2010). [27]	In Dallas, TX, survey of 100 frequent (≥3 times weekly) indoor tanners.	Modifications of CAGE and DSM-IV-TR instruments.	41% met criteria consistent with "tanning addictive disorder" and another 33% met criteria for "problematic tanning behavior."	Female gender and early age of tanning onset were associated with meeting tanning addiction criteria.	Authors suggested that findings are similar to studies showing that early age at first alcohol, nicotine, and cannabis use is a risk factor for subsequent development of the respective substance-related disorder.
Ultraviolet exposure is a reinforcing stimulus in frequent indoor tanners (2004). [68]	Double-blind controlled design to determine whether there was a physiologic preference for UVL compared with non-UVL.	14 frequent adult tanners exposed to either a commercially available tanning bed or to identically appearing bed with acrylic filter that prevented the transmission of UVL (ie, "sham light").	Frequent tanners exhibited overwhelming preference (95%) for UV-emitting tanning beds.	Subjects reported a more relaxed and less tense mood after UVR exposure compared with after non-UVR exposure.	Results suggest that UV tanning might have reinforcing properties.
Induction of withdrawal-like symptoms in a small randomized, controlled trial of opioid blockade in frequent tanners (2006). [69]	Randomized controlled trial comparing reactions to opioid antagonist nalaxone given to frequent and infrequent salon tanners.	Naloxone given to 8 frequent salon tanners and 8 people who were infrequent tanners.	Withdrawal-like symptoms induced in 4 of 8 frequent salon tanners; no symptoms occurred in 8 infrequent tanners.		Authors discussed possibility that cutaneous endorphin release resulting from UVL exposure may be involved in reinforcing property of tanning, leading some individuals to seek tanning.

TABLE 2 Continued

Name	Study Type	Study Population, Methods	Main Findings	Other Findings	Comment
Activation of the mesostriatal reward pathway with exposure to UV radiation (UVR) vs. sham UVR in frequent tanners: a pilot study (2012).[70]	Small study assessing effects of commercially available tanning bed on regional cerebral blood flow (a measure of brain activity) by using single-photon emission computed tomography.	7 frequent salon tanners placed under a UV-A/UV-B tanning light during 2 sessions: 1 session with UVR and other with sham UVR. Before turning on tanning lamps, subjects asked to rate "How much you feel like tanning right now" from "Not at all" to "More than I ever have." Order of sessions randomized and subjects blinded to study order.	During UVR session, relative to sham UVR session, subjects showed relative increase in regional cerebral blood flow of dorsal striatum, anterior insula, and medial orbitofrontal cortex, brain regions associated with experience of reward.	These changes accompanied by decrease in subjective desire to tan after UVR exposure but not after sham UVR. When asked which bed was preferred, most subjects selected the UVR session rather than sham session.	Authors discussed associations between some dermatologic and psychiatric disorders and suggested that UVR may have centrally rewarding properties that encourage excessive tanning.

CAGE, Cut down, Annoyed, Guilty, Eye-opener Questionnaire (see text); DSM-IV-TR, American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*; mCage, modified CAGE questionnaire; mDSM-IV-TR, American Psychiatric Association's modified *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*; UVL, UV light.

effects and promotes feelings of relaxation and well-being, similar to exogenous opiates such as morphine. It is thought that selection for fair skin and poor tanning ability was associated with migration of human populations to high-latitude geographic locations (with limited UV exposure, especially during winter months). It is possible that endorphin release may have evolved to reward behaviors that augment UV exposure and vitamin D acquisition.[32]

HOW TANNING DEVICES ARE REGULATED

The US Food and Drug Administration (FDA) is the agency responsible for ensuring the safety and efficacy of medical devices and products that emit radiation, and thus regulates the manufacturers of tanning equipment.[2] The FDA established classifications for ~1700 different generic types of devices, each of which is assigned to 1 of 3 regulatory classes on the basis of the level of control necessary to ensure that the device is safe and effective. The class to which a device is assigned determines, among other things, the type of premarketing submission and application required for FDA clearance to market. Classification is also based on the risk posed to the patient and/or user.[33] Table 3 summarizes FDA regulatory classes.

Concerns have been expressed that tanning beds are misclassified and need stronger regulation and scrutiny. On March 25, 2010, the General and Plastic Surgery Devices Panel of the FDA Center for Devices and Radiologic Health Medical Devices Advisory Committee convened a public meeting to discuss tanning devices. Scientific information was presented about the risks posed from intentional UVR exposure through tanning lamps. Medical organizations urged the FDA to reclassify indoor tanning devices and to pass federal restrictions concerning their use. The Indoor Tanning Association (ITA; an industry advocacy group) presented counterarguments. The FDA continues to deliberate about possible reclassification.

Manufacturers of indoor tanning equipment are required to adhere to FDA requirements for sunlamp specifications, posting of warning labels,[34] and provision of eye protection.[6] The standard requires manufacturers to provide an exposure schedule in the product warning label.[34] The FDA recommends that the exposure schedule for users depends on the user's skin type.[34] The FDA recommends, but does not require or enforce,[35] an exposure schedule not exceeding a 0.75 minimal erythemal dose (defined as a dose resulting in minimal pinkness) 3 times during the first week of tanning, gradually increasing exposure after the first week, then gradually increasing exposure the following weeks until maximum tanning has occurred (~4 weeks total) and then providing for maintenance of a tan by biweekly or weekly exposures of up to 4 minimal erythemal doses.[34] There are limitations on the amount of UV-C emitted, but no regulation on the amount of UV-A and UV-B. Because the proportion varies, consumers may not be able to predict the outcome of a particular tanning session.[6]

THE TANNING INDUSTRY

The indoor tanning industry has grown substantially over several decades and comprises 19 000 businesses employing 160 000 individuals, according to industry information.[36] According to the ITA, ~10% of the American public visits an indoor tanning facility each year.[36] This percentage is dramatically higher for female teens and young women. The mission of the ITA is "to protect the freedom of individuals to acquire a suntan, via natural or artificial light."[37] The ITA claims that melanoma is

TABLE 3 FDA Classification of Medical Devices

FDA Class	Examples	Requirements	Comment
I	Tongue depressors, elastic bandages, indoor tanning devices.[46]	Class I devices present minimal potential for harm. Subject to general controls to ensure safety and effectiveness, including registering with FDA, proper branding and labeling, and notifying FDA before marketing. Subject to "good manufacturing practice" requirements: FDA requires manufacturers to consistently meet applicable requirements for their safety and efficacy.	Tanning beds used for cosmetic purposes are categorized as class I with exemption 510(k). Manufacturers of devices with this exemption not required to give premarket notification to show safety and efficacy and substantial equivalence to other devices already in the market. Tanning beds also exempt from design controls that require manufacturers to establish and validate a development process through which the design control documentation must be available for FDA review during a site inspection.
II	X-ray machines, UV lamps used for dermatologic disorders, laser equipment used in surgery and dermatology.[46]	Require special controls that may include special labeling requirements, mandatory performance standards, postmarket surveillance, patient registries, and development and dissemination of guidance documents.	
III	Replacement heart valves, silicone gel–filled breast implants, and implantable cerebellar stimulators. [46]	Require additional information regarding safety and effectiveness and require premarket approval and scientific review.	

not a problem of the young and that tanning at an early age does not increase melanoma risk and makes other claims of purported benefits. Table 4 lists some of these claims and the evidence-based arguments used by child health advocates to counter them.

TANNING INDUSTRY FALSE CLAIMS AND DECEPTIVE PRACTICES

The US Federal Trade Commission (FTC) investigates false and deceptive advertising claims, such as the claim that tanning in salons is safer than tanning outdoors. The commission files a complaint when it has "reason to believe" that the law has been or is being violated. The FTC has the power to issue consent orders to ban further deception.[38] The FTC issued a complaint against the ITA alleging that, in March 2008, the ITA launched an advertising campaign portraying indoor tanning as safe and beneficial. The campaign included 2 national newspaper ads, television and video advertising, 2 Web sites, a communications guide, and point-of-sale materials that were provided to ITA members. The ITA claimed that indoor tanning was safer than outdoor tanning because the amount of UVR is monitored and controlled and that it neither increased skin cancer risk nor posed a danger to consumers. The ITA also claimed that research showed that vitamin D supplements may harm the body's ability to fight disease, and that a study from the National Academy of Sciences determined that "the risks of not getting enough ultraviolet light far outweigh the hypothetical risk of skin cancer." The ITA stated that indoor tanning is approved by the government, misrepresenting the nature of FDA approval. In January 2010, the FTC issued a consent order and the ITA agreed to a settlement barring it from any further deception.[38,39]

In 2012, a minority investigative report commissioned by 4 Democratic members of the US House of Representatives Committee on Energy and Commerce described results of "sting" telephone calls made by congressional staff to 300 tanning salons nationwide. Congressional staff posed as 16-year-old women wanting to tan for the first time. On the basis of answers given by salon workers, the report concluded that salons target teenage girls with advertising and promotions, deny known risks of indoor tanning, provide false information on benefits of tanning, and fail to follow FDA recommendations on tanning frequency.[40] The tanning industry questioned the veracity of the study and conclusions but acknowledged that they could improve on giving accurate and consistent information to customers.[41]

FEDERAL LEGISLATION

Regulation of the tanning industry has been lax.[2] As of February 2013, there is as yet no federal legislation prohibiting minors from tanning in salons.

As of July 1, 2010, under the Affordable Care Act, indoor tanning services were levied with a 10% excise tax (the so-called tanning tax or tan tax). Tanning salons are required to receive a payment for indoor tanning services, report the tax quarterly and remit the tax to the Internal Revenue Service. Sunless tanning options such as spray tans and tanning lotions are not included. The "tanning tax," a part of President Obama's administration's health care overhaul plan, is expected to raise 2.7 billion dollars over the next 10 years. The indoor tanning industry expressed vigorous opposition to the tanning tax.[42]

TABLE 4 Tanning Industry Claims and Responses

Industry Claim	Response by Child Health Advocates
People using tanning beds are less likely to sunburn.[36] The ITA contends that tanning bed users are less likely to spend time in the sun compared with people practicing "total abstinence," which "ultimately encourages abuse," and that tanning bed users are taught sun protection by tanning salon personnel. [36]	On the contrary, strong tan-promoting attitudes drive teens to sunbathe intentionally and use tanning beds. Teens using tanning beds are more likely than those who do not use tanning beds to experience sunburns (76% vs 68%).[44] People who use tanning beds are more likely to spend more time outdoors [71] and less likely to use sunscreen.[4,72] Older teens who used tanning beds ≥10 times in the past year were more likely to have ≥3 sunburns compared with teens who did not use tanning beds (28% vs 20%; $P = .001$).[4]
Burning, not tanning, at an early age could increase skin cancer risk later in life.	Although individuals who burn before tanning are at greater risk of melanoma, people who do not burn but tan also are at risk. Case studies and case-control studies from all geographic areas of the US show that melanoma occurs in people without established risk factors (such as light skin that has a tendency to burn [type I and II] and high sun sensitivity) known to increase melanoma risk. Twenty-one percent of melanomas in women occurred in those reporting no blistering sunburns between the ages of 15 and 20 y. [73] In Iowa, 64% of melanomas occurred among individuals reporting no or mild sunburn.[74] In Washington State, 85% of melanoma cases reported that they had either a deep tan, moderate tan, or mild tan in response to chronic sun exposure. [75] In Connecticut, 30% of melanoma cases had medium skin as objectively measured by examination of the inner aspect of the upper arm; [76] 56% of cases in California and Michigan reported non–sun-sensitive skin. [77]
Tanned skin is protective.	Abundant evidence suggests that melanoma risk is lower in darkly pigmented individuals (from birth) than in lightly pigmented ones. However, as described in the text, UV-induced tanning can enhance melanoma risk, because of the use of a known carcinogen (UVR) as the means to achieve pigmentation.
A "prevacation" tan is protective.	People may visit a tanning salon to prepare the skin for a sunny vacation, the "prevacation tan", thinking that a "base tan" will protect against subsequent skin damage during the vacation. This leads to extra radiation before the vacation and also afterward, because people may use fewer sun-protection precautions during the vacation because of a mistaken belief that the tan will protect them.[2] The prevacation tan results in minimal protection (an estimated SPF of 3)[8] and provides virtually no protection against sun-induced DNA damage.[2]
Salon tanning is a good way to raise concentrations of vitamin D: the ITA states "There is a growing body of well-conducted, validated scientific research demonstrating that the production of the activated form of vitamin D is one of the most effective ways the body controls abnormal cell growth." [36]	In fact, in 2012 the US Preventive Services Task Force concluded that "the current evidence is insufficient to assess the balance of the benefits and harms of vitamin D supplementation, with or without calcium, for the primary prevention of cancer in adults."[78] Given the enormous variables of geographic UV intensity, daytime UV intensity variability, skin pigmentation (darkness), and skin surface area exposed to sunlight, it is virtually impossible to predict UV dose-responses capable of maintaining plasma vitamin D concentrations. In contrast, oral supplementation provides a reproducible and verifiable means.
Tanning is a parents' rights issue and government should not interfere.	Laws to limit minors' access to tanning parlors should be considered in the same way as laws that limit youth access to tobacco.[79,80] Every state prohibits the purchase of tobacco products by those younger than 18 y; some prohibit sales to those under 19.[79] Tanning and tobacco are carcinogenic and both are preventable exposures. Therefore, governments should act to protect young people from these known carcinogens.

The Tanning Accountability and Notification (TAN) Act (HR 4767) was included in FDA Amendments Act of 2007. The TAN Act requires the FDA to conduct consumer testing to determine if warning labels on commercial tanning beds are positioned correctly and provide sufficient information pertaining to skin cancer risk.[6,27]

STATE AND LOCAL LEGISLATION

In 2009, Howard County, Maryland, was the first US jurisdiction to ban tanning for minors under age 18. On October 8, 2011, California's Governor Brown signed the first state law banning under-18 salon tanning, effective January 1, 2012. Vermont passed an under-18 ban in May 2012. The City of Chicago did so in June 2012 and Springfield, IL did so in September 2012. Currently, 33 states have at least minimal legislation regarding tanning by minors.[43]

Despite the existence of state laws, researchers and advocates have noted that current laws appear to have limited effectiveness, perhaps because most states' policies permit use with parental consent and no states had bans on minors tanning when the study was conducted. It has been suggested that multipronged approaches are needed to reduce teens' use of tanning salons.[44]

ENFORCEMENT OF LEGISLATION

Researchers conducted a telephone survey of informants in states with indoor tanning legislation to assess enforcement practices. At the time of the survey, 28 states had teen tanning regulations. One respondent from the most populous city in each state was interviewed. Licensure was required in 22 of 28 cities. Slightly less than half of cities gave citations to facilities that

violated state law. Approximately 32% did not inspect tanning facilities for compliance with state law; another 32% conducted inspections less than annually. Of the 21 cities in states that had youth access laws, approximately half penalized those salons with known violations. The authors expressed concern about relatively low rates of annual inspections and citations. They recommended that future studies assess whether legislation, enforcement practices, or both affect indoor tanning practices.[45]

LEGISLATION IN OTHER COUNTRIES

Several nations have strong antitanning legislation. In 2009, Brazil imposed a total ban on the use and sale of tanning devices for cosmetic purposes for the entire population.[46]

In 2012, the state of New South Wales (population >5 million) in Australia announced a total ban by 2014.[47] France, Germany, Austria, and the United Kingdom banned under-18 indoor tanning. South Australia imposed a ban for those younger than 18 and for anyone with type I skin, the type most susceptible to skin cancer. Finland allows only certain types of devices for indoor tanning use and requires inspections to ensure that regulations are upheld.[46]

RECOMMENDATIONS ABOUT TANNING LEGISLATION

The World Health Organization,[48] the American Academy of Pediatrics,[49] the American Academy of Dermatology,[50] the American Medical Association,[51] the Canadian Pediatric Society,[52] and others recommend legislation to ban minors younger than 18 years from tanning in salons.

PARENT INFLUENCES

Mothers' behaviors and attitudes may influence teen tanning practices. A population-based survey found that indoor tanning in the year before the survey was 30% among 12- to 18-year-olds whose caregiver also reported tanning indoors.[44] Investigators in Minnesota and Massachusetts conducted telephone surveys of adolescents aged 14 to 17 years and their female parents or guardians to determine their role in teen tanning attitudes and practices. Female parents' behavior, concern about children's indoor tanning practices, and permissiveness were significant independent contributors to teen tanning.[53] In another study, researchers sent questionnaires to female college students to investigate whether first-time indoor tanning with one's mother would influence the frequency of tanning later in life and whether it was associated with age of initiation. Participants who reported tanning with mothers during their initial experience were >4 times more likely to be heavy current tanners than those who initiated tanning alone or with someone other than their mother (odds ratio: 4.64; $P < .001$). Participants who tanned for the first time with mothers started tanning at a significantly earlier age than those who started tanning without mothers.[54] Additional research from national studies is needed to determine the prevalence of artificial tanning in mothers of teens.

PARALLELS BETWEEN SMOKING AND TANNING

Researchers and advocates from the disciplines of tobacco control and indoor tanning met in November 2011 to discuss common challenges and lessons. By consensus, participants agreed that legislative remedies must be sought as part of comprehensive programs, including the following: higher taxes; education for parents, pediatricians, and policymakers; and counteradvertising to refute tanning industry claims.

ROLE OF PEDIATRICIANS AND OTHER CLINICIANS

Indoor tanning is practiced by as many as 35% to 40% of white adolescent girls. It is estimated that 25% of melanomas observed in young women might be attributable to using tanning beds.[55] It therefore stands to reason that pediatricians have an obligation to discuss this potentially life-threatening practice with families. Although pediatricians are often considered trusted advisors to families, sometimes over years and decades, many do not take opportunities to discuss indoor tanning.[56] This may be due, in part, to a general view that skin cancer prevention is primarily an issue for dermatologists. Yet, skin cancer prevention, a lifelong effort, is clearly a pediatric issue as well as a dermatology issue. By the time a teen or young adult arrives in a dermatologist's office to evaluate a suspicious skin lesion (one that may be melanoma) the opportunity for prevention may have been lost.

Counseling by pediatricians to reduce UVR exposure is likely to result in behavior change in some teens and families. In July 2012, the US Preventive Services Task Force (USPSTF) published an update of their 2003 recommendation regarding the effectiveness of behavioral counseling to prevent skin cancer. The USPSTF stated that there was adequate evidence in the scientific literature to conclude that counseling delivered in the primary care setting can moderately increase the use of protective behaviors for fair-skinned people between the ages of 10 and 24 years. Successful counseling interventions used messages about skin cancer or about the effects of UVR exposure on appearance. Appearance-focused messages succeeded in reducing intent to use indoor tanning among late-adolescent women. Behavioral interventions were not associated with any known risks or harms. The USPSTF thus recommended counseling fair-skinned children, adolescents, and young adults about minimizing their exposure to UVR. Evidence was not sufficient to conclude

that counseling resulted in behavior change in girls younger than age 10 or women older than 24 years.[57] Under the Affordable Care Act, the health insurance reform legislation passed by Congress and signed into law by President Obama on March 23, 2010, counseling patients to avoid tanning beds (a recommendation receiving a "B" rating from the USPSTF) is a covered service and thus is fully reimbursable.[58] The American Academy of Pediatrics and other organizations interested in pediatric health should consider interventions for the best methods in training pediatricians in tanning-bed avoidance counseling as well as informing them of the new covered service.

Because teens begin to take up tanning at 13 to 14 years of age, pediatricians may adopt a strategy of discussing indoor tanning at the 12-year-old well-child visit. Most parents state that they do not want their children to use tanning devices but most have not discussed tanning with their child.[59] Pediatricians may influence tanning practices by inquiring about the mother's tanning practices and asking her if she has started discussions with her child.[59] Interventions directed at the mother may reduce her practices and lead to reduced tanning initiation and frequency of the child's tanning.[54] It should be noted that although parents may not approve of tanning indoors, they may have adopted a "pick your battles" strategy, feeling it to be more important to enforce rules on issues such as smoking or dating rather than focusing on tanning. For some teens and their families, this decision may have major health consequences. Table 5 lists some recommendations for integrating questions into practice.

Considering the teen's perspective about tanning benefits may be helpful.[60] She may be an "event tanner" preparing for a wedding or prom or may tan regularly as a mood enhancer or to relieve stress.[61] Physicians may use open-ended questions, such as "How does having a tan make you feel?," to gain insight and provide appropriate interventions. For "event tanners," pediatricians may suggest substituting spray tanning or self-applied lotion to give a tanned appearance. An event tanner interested in appearance may also be receptive to information about indoor tanning as a cause of premature skin aging. For regular tanners who do so to relax and improve mood, physicians may suggest substituting running, dancing, or other aerobic activities.

Pediatricians have important roles in advocating for state laws to prevent minors from accessing tanning salons. Legislators who are parents and grandparents may be receptive to a pediatrician's voice, particularly if the pediatrician is the family's doctor. State-specific legislation should conform to FDA recommendations. Pediatricians also have a role at the federal level, working to change FDA classification of indoor tanning devices to class II or III and advocating for federal legislation to ban under-18 access.

Resources to help pediatricians address indoor tanning (akin to those that help clinicians discuss smoking cessation and secondhand smoke exposure) need to be developed. One model is the CEASE (Clinical Effort Against Secondhand Tobacco Exposure) Program developed to help clinicians counsel about smoking cessation and harm reduction by using written and video materials.[62] Another is the American Academy of Pediatrics' Julius B Richmond Center, which provides an array of education, training, and tools for clinicians.[63] Resources are needed in academic settings, especially in pediatric settings, to train medical students and residents. Funding will be needed for all these efforts.

TABLE 5 Recommendations for Pediatricians Regarding Tanning Beds

Recommendation
• Aim to integrate discussions about exposure to UVR, including tanning beds, into annual well-child and well-adolescent visits
• Discuss risks of artificial tanning with parents as well as teens
• Discuss prevention of sunburn and artificial tanning during "teachable moments" such as when a teen (or her parent) presents with a tan or sunburn
• Be aware that many teens will tan before special events such as a prom; suggest spray tanning as an alternative if the teen is committed to looking darker
• Add a question about indoor tanning if using forms that are filled out by parents and/or teens; add a prompt about discussing tanning-bed use in "adolescent risk factor" section when designing or modifying electronic medical records for preteens and teens
• Advocate for state legislation banning under-18 salon tanning
• Advocate for changes in federal legislation regarding classification of tanning salons and for banning minors' access to tanning salons

Research needs with regard to indoor tanning have been identified. Table 6 lists some of these areas.

CONCLUSIONS

Engaging families in discussions about tanning beds represents a unique and one of few cancer prevention opportunities

TABLE 6 Next Research Tasks

Research Task
• Investigate the possibility that tanning is addictive in some individuals and whether early-life exposure to artificial UVR raised the risk of addiction
• Determine revenues raised by the "tanning tax" and their allocation and explore redistribution to an educational fund
• Track tanning industry claims and effect of the FTC consent order, particularly on industry Web sites
• Establish the prevalence of teens tanning with their mothers
• Establish where young women obtain indoor tanning most often, whether from indoor tanning salons, nonsalon sites such as beauty salons and fitness centers, or places of residence
• Determine best ways for pediatricians to discuss salon tanning with teens and parents, including best ways to use electronic medical record technology to do so

for pediatricians. Evidence reveals that counseling is effective for youth and young persons aged 10 to 24 years. Discussions about UVR exposure, including artificial tanning, need to be integrated into health maintenance visits and should also occur at times when a teen arrives in the office with a tanned appearance or sunburn. A reasonable message is to "love the skin you're in." Pediatricians and dermatologists should work together, using their knowledge and perspectives to advocate for banning salon tanning for all minors. It is difficult to justify recreational exposure to a known carcinogen in any human population. Thus, child health advocates are working to encourage both state and federal governments to ban minors from indoor tanning. A long-term goal is banning indoor tanning for adults as well as teens, as has been done in Brazil and parts of Australia.

REFERENCES

1. International Agency for Research on Cancer Working Group on Artificial Ultraviolet (UV) Light and Skin cancer. The association of use of sunbeds with cutaneous malignant melanoma and other skin cancers: a systematic review. *Int J Cancer*. 2007;120(5):1116–1122
2. Levine JA, Sorace M, Spencer J, Siegel DM. The indoor UV tanning industry: a review of skin cancer risk, health benefit claims, and regulation. *J Am Acad Dermatol*. 2005;53(6):1038–1044
3. Guy GP Jr, Tai E, Richardson LC. Use of indoor tanning devices by high school students in the United States, 2009. *Prev Chronic Dis*. 2011;8(5):A116. Available at: www.cdc.gov/pcd/issues/2011/sep/10_0261.htm. Accessed February 12, 2012
4. Geller AC, Colditz G, Oliveria S, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10 000 US children and adolescents. *Pediatrics*. 2002;109(6):1009–1014
5. Hoerster KD, Garrow RL, Mayer JA, et al. Density of indoor tanning facilities in 116 large U.S. cities. *Am J Prev Med*. 2009;36(3):243–246
6. Suarez A, Dellavalle RP, Robinson JK. Indoor tanning regulation, enforcement, taxation and policy. In: Heckman CJ, Manne SJ, eds. Shedding Light on Indoor Tanning. Springer Netherlands; 2012
7. Balk SJ; Council on Environmental Health; Section on Dermatology. Ultraviolet radiation: a hazard to children and adolescents. *Pediatrics*. 2011;127(3). Available at: www.pediatrics.org/cgi/content/full/127/3e791
8. Autier P. Perspectives in melanoma prevention: the case of sunbeds. Eur J Cancer. 2004;40(16):2367–2376
9. Boniol M, Autier P, Boyle P, Gandini S. Cutaneous melanoma attributable to sunbed use: systematic review and meta-analysis. *BMJ*. 2012;345:e4757. Available at: www.bmj.com/content/345/bmj.e4757.full?rss=1&utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%253A+bmj%252Frecent+%28Latest+from+BMJ%29. Accessed July 29, 2012
10. American Cancer Society. What are the key statistics about basal and squamous cell skin cancers? Available at: www.cancer.org/Cancer/SkinCancer-basalandSquamousCell/DetailedGuide/skin-cancer-basal-and-squamous-cell-key-statistics. Accessed February 4, 2013
11. Rogers HW, Weinstock MA, Harris AR, et al. Incidence estimate of nonmelanoma skin cancer in the United States, 2006. *Arch Dermatol*. 2010;146(3):283–287
12. American Cancer Society. What are the key statistics about melanoma? Available at: www.cancer.org/Cancer/SkinCancer-Melanoma/DetailedGuide/melanoma-skin-cancer-key-statistics. Accessed February 4, 2013
13. Wu X, Groves FD, McLaughlin CC, Jemal A, Martin J, Chen VW. Cancer incidence patterns among adolescents and young adults in the United States. *Cancer Causes Control*. 2005;16(3):309–320
14. Purdue MP, Freeman LE, Anderson WF, Tucker MA. Recent trends in incidence of cutaneous melanoma among US Caucasian young adults. *J Invest Dermatol*. 2008;128(12):2905–2908
15. Reed KB, Brewer JD, Lohse CM, Bringe KE, Pruitt CN, Gibson LE. Increasing incidence of melanoma among young adults: an epidemiological study in Olmsted County, Minnesota. *Mayo Clin Proc*. 2012;87(4):328–334
16. Christenson LJ, Borrowman TA, Vachon CM, et al. Incidence of basal cell and squamous cell carcinomas in a population younger than 40 years. *JAMA*. 2005;294(6):681–690
17. Emmett AJ. Surgical analysis and biological behaviour of 2277 basal cell carcinomas. *Aust N Z J Surg*. 1990;60(11):855–863
18. Scrivener Y, Grosshans E, Cribier B. Variations of basal cell carcinomas according to gender, age, location and histopathological subtype. *Br J Dermatol*. 2002;147(1):41–47
19. Boyd AS, Shyr Y, King LE Jr. Basal cell carcinoma in young women: an evaluation of the association of tanning bed use and smoking. *J Am Acad Dermatol*. 2002;46(5):706–709
20. Cui R, Widlund HR, Feige E, et al. Central role of p53 in the suntan response and pathologic hyperpigmentation. *Cell*. 2007;128(5):853–864
21. Fisher DE, James WD. Indoor tanning—science, behavior, and policy. *N Engl J Med*. 2010;363(10):901–903
22. Cokkinides V, Weinstock M, Lazovich D, Ward E, Thun M. Indoor tanning use among adolescents in the US, 1998 to 2004. *Cancer*. 2009;115(1):190–198
23. The International Agency for Research on Cancer. Sunbeds and UV radiation. Available at: www.iarc.fr/en/media-centre/iarcnews/2009/sunbeds_uvradiation.php. Accessed January 15, 2012
24. Monfrecola G, Fabbrocini G, Posteraro G, Pini D. What do young people think about the dangers of sunbathing, skin cancer and sunbeds? A questionnaire survey among Italians. *Photodermatol Photoimmunol Photomed*. 2000;16(1):15–18
25. Warthan MM, Uchida T, Wagner RF Jr. UV light tanning as a type of substance-related disorder. *Arch Dermatol*. 2005;141(8):963–966
26. Cokkinides V, Weinstock M, Glanz K, Albano J, Ward E, Thun M. Trends in sunburns, sun protection practices, and attitudes toward sun exposure protection and tanning among US adolescents, 1998-2004. *Pediatrics*. 2006;118(3):853–864
27. Harrington CR, Beswick TC, Leitenberger J, Minhajuddin A, Jacobe HT, Adinoff B. Addictive-like behaviours to ultraviolet light among frequent indoor tanners. *Clin Exp Dermatol*. 2011;36(1):33–38
28. Kaur M, Liguori A, Fleischer AB Jr, Feldman SR. Plasma beta-endorphin levels in frequent and infrequent tanners before and after ultraviolet and non-ultraviolet stimuli. *J Am Acad Dermatol*. 2006;54(5):919–920
29. Gambichler T, Bader A, Vojvodic M, et al. Plasma levels of opioid peptides after sunbed

exposures. *Br J Dermatol*. 2002;147(6):1207–1211
30. Wintzen M, Ostijn DM, Polderman MC, le Cessie S, Burbach JP, Vermeer BJ. Total body exposure to ultraviolet radiation does not influence plasma levels of immunoreactive beta-endorphin in man. *Photodermatol Photoimmunol Photomed*. 2001;17(6):256–260
31. Jablonski NG, Chaplin G. The evolution of human skin coloration. *J Hum Evol*. 2000;39(1):57–106
32. Kourosh AS, Harrington CR, Adinoff B. Tanning as a behavioral addiction. *Am J Drug Alcohol Abuse*. 2010;36(5):284–290
33. US Food and Drug Administration. Medical devices. Available at: www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/Overview/ClassifyYourDevice/default.htm. Accessed February 6, 2013
34. US Food and Drug Administration. Policy on maximum timer interval and exposure schedule for sunlamp products, August 1986. Available at: www.fda.gov/downloads/Radiation-EmittingProducts/RadiationEmitting-ProductsandProcedures/HomeBusinessandEntertainment/UCM192707.pdf. Accessed February 6, 2013
35. Pichon LC, Mayer JA, Hoerster KD, et al. Youth access to artificial UV radiation exposure: practices of 3647 US indoor tanning facilities. *Arch Dermatol*. 2009;145(9):997–1002
36. Indoor Tanning Association. Frequently asked questions. Available at: www.theita.com/?page=FAQs. Accessed May 7, 2012
37. Indoor Tanning Association. Mission statement. Available at: www.theita.com/?page=Mission_Statement. Accessed March 28, 2012
38. US Federal Trade Commission. Indoor Tanning Association settles FTC charges that it deceived consumers about skin cancer risks from tanning. Available at: www.ftc.gov/opa/2010/01/tanning.shtm. Accessed June 8, 2012
39. US Federal Register; Federal Trade Commission. [File No. 082 3159]. Federal Trade Commission [File No. 082 3159] Indoor Tanning Association; Analysis of Proposed Consent Order to Aid Public Comment. Available at: www.ftc.gov/os/fedreg/2010/february/100202indoortanninganal.pdf. Accessed February 4, 2013
40. US House of Representatives Committee on Energy and Commerce. New Report Reveals Indoor Tanning Industry's False and Misleading Practices. February 1, 2012. Available at http://democrats.energycommerce.house.gov/index.php?q=news/new-report-reveals-indoor-tanning-industry-s-false-and-misleading-practices. Accessed February 4, 2013
41. International Smart Tan Network Inc. Report misleads about salon claims. Available at: https://smarttan.com/news/index.php/report-misleads-about-salon-claims. Accessed February 12, 2012
42. CNN. Tanning salons burned by health care bill. Available at: http://money.cnn.com/2010/03/24/news/economy/tanning_tax. Accessed July 1, 2012
43. National Conference of State Legislatures. Indoor Tanning Restrictions for Minors - A State-by-State Comparison. http://www.ncsl.org/issues-research/health/indoor-tanning-restrictions.aspx. Accessed February 5, 2013
44. Cokkinides VE, Weinstock MA, O'Connell MC, Thun MJ. Use of indoor tanning sunlamps by US youth, ages 11-18 years, and by their parent or guardian caregivers: prevalence and correlates. *Pediatrics*. 2002;109(6):1124–1130
45. Mayer JA, Hoerster KD, Pichon LC, Rubio DA, Woodruff SI, Forster JL. Enforcement of state indoor tanning laws in the United States. *Prev Chronic Dis*. 2008;5(4):A125
46. Lim HW, James WD, Rigel DS, Maloney ME, Spencer JM, Bhushan R. Adverse effects of ultraviolet radiation from the use of indoor tanning equipment: time to ban the tan. *J Am Acad Dermatol*. 2011;64(5):893–902
47. New South Wales Office of Environment and Heritage. State government bans commercial tanning units. Available at: www.environment.nsw.gov.au/resources/MinMedia/MinMedia12020301.pdf. Accessed February 20, 2012
48. World Health Organization. Sunbeds, tanning and UV exposure. Available at: www.who.int/mediacentre/factsheets/fs287/en. Accessed July 29, 2012
49. Balk SJ; Section on Dermatology; Council on Environmental Health. Ultraviolet radiation: a hazard to children and adolescents. *Pediatrics*. 2011;127(3):588–597
50. American Academy of Dermatology. Indoor tanning. Available at: www.aad.org/media-resources/stats-and-facts/prevention-and-care/indoor-tanning. Accessed March 28, 2012
51. American Medical Association. D-440.960. Prohibiting the sale of tanning parlor ultraviolet rays to those under 18 years of age. Available at: https://ssl3.ama-assn.org/apps/ecomm/PolicyFinderForm.pl?site=www.ama-assn.org&uri=%2fresources%2fdoc%2fPolicyFinder%2fpolicyfiles%2fDIR%2fD-440.960.HTM. Accessed February 4, 2013
52. Canadian Pediatric Society. Banning children and youth under the age of 18 years from commercial tanning facilities. Available at: www.cps.ca/English/statements/AM/AH12-01.htm. Accessed February 5, 2012
53. Stryker JE, Lazovich D, Forster JL, Emmons KM, Sorensen G, Demierre M. Maternal/female caregiver influences on adolescent indoor tanning. J Adolesc Health 2004;35:528.e1–528.e9
54. Baker MK, Hillhouse JJ, Liu X. The effect of initial indoor tanning with mother on current tanning patterns. *Arch Dermatol*. 2010;146(12):1427–1428
55. Diffey B. Sunbeds, beauty and melanoma. *Br J Dermatol*. 2007;157(2):215–216
56. Balk SJ, O'Connor KG, Saraiya M. Counseling parents and children on sun protection: a national survey of pediatricians. *Pediatrics*. 2004;114(4):1056–1064
57. Moyer VA; US Preventive Services Task Force. Behavioral counseling to prevent skin cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2012;157(1):59–65
58. The Henry J Kaiser Family Foundation. Summary of new health reform law. Available at: www.krr.org/healthreform/upload/8061.pdf. Accessed September 24, 2012
59. Magee KH, Poorsattar S, Seidel KD, Hornung RL. Tanning device usage: what are parents thinking? *Pediatr Dermatol*. 2007;24:216–221
60. Robinson JK. Consider tanning motivations and counsel accordingly. *JAMA*. 2010;303(20):2074–2075
61. Hillhouse J, Turrisi R, Shields AL. Patterns of indoor tanning use: implications for clinical interventions. *Arch Dermatol*. 2007;143(12):1530–1535
62. Massachusetts General Hospital. CEASE PediaLink. Available at: http://www2.massgeneral.org/ceasetobacco/clinicians.htm. Accessed July 29, 2012
63. American Academy of Pediatrics Julius B Richmond Center of Excellence Web site. Available at: http://www2.aap.org/richmondcenter/AboutTheRichmondCenter.html. Accessed July 29, 2012
64. Cust AE, Armstrong BK, Goumas C, et al. Sunbed use during adolescence and early adulthood is associated with increased risk of early-onset melanoma. *Int J Cancer*. 2011;128(10):2425–2435
65. Lazovich D, Vogel RI, Berwick M, Weinstock MA, Anderson KE, Warshaw EM. Indoor tanning and risk of melanoma: a case-control study in a highly exposed population. *Cancer Epidemiol Biomarkers Prev*. 2010;19(6):1557–1568
66. Veierød MB, Adami HO, Lund E, Armstrong BK, Weiderpass E. Sun and solarium exposure and melanoma risk: effects of age, pigmentary characteristics, and nevi. *Cancer*

Epidemiol Biomarkers Prev. 2010;19(1):111–120

67. Mosher CE, Danoff-Burg S. Addiction to indoor tanning: relation to anxiety, depression, and substance use. *Arch Dermatol*. 2010;146(4):412–417
68. Feldman SR, Liguori A, Kucenic M, et al. Ultraviolet exposure is a reinforcing stimulus in frequent indoor tanners. *J Am Acad Dermatol*. 2004;51(1):45–51
69. Kaur M, Liguori A, Lang W, Rapp SR, Fleischer AB Jr, Feldman SR. Induction of withdrawal-like symptoms in a small randomized, controlled trial of opioid blockade in frequent tanners. *J Am Acad Dermatol*. 2006;54(4):709–711
70. Harrington CR, Beswick TC, Graves M, et al. Activation of the mesostriatal reward pathway with exposure to ultraviolet radiation (UVR) vs. sham UVR in frequent tanners: a pilot study. *Addict Biol*. 2012;17(3):680–686
71. Westerdahl J, Ingvar C, Måsbäck A, Jonsson N, Olsson H. Risk of cutaneous malignant melanoma in relation to use of sunbeds: further evidence for UV-A carcinogenicity. *Br J Cancer*. 2000;82(9):1593–1599
72. Lazovich D, Forster J, Sorensen G, et al. Characteristics associated with use or intention to use indoor tanning among adolescents. *Arch Pediatr Adolesc Med*. 2004;158(9):918–924
73. Weinstock MA, Colditz GA, Willett WC, et al. Nonfamilial cutaneous melanoma incidence in women associated with sun exposure before 20 years of age. *Pediatrics*. 1989;84(2):199–204
74. Dennis LK, Lowe JB, Lynch CF, Alavanja MC. Cutaneous melanoma and obesity in the Agricultural Health Study. *Ann Epidemiol*. 2008;18(3):214–221
75. White E, Kirkpatrick CS, Lee JA. Case-control study of malignant melanoma in Washington State. I. Constitutional factors and sun exposure. *Am J Epidemiol*. 1994;139(9):857–868
76. Berwick M, Begg CB, Fine JA, Roush GC, Barnhill RL. Screening for cutaneous melanoma by skin self-examination. *J Natl Cancer Inst*. 1996;88(1):17–23
77. Swetter SM, Johnson TM, Miller DR, Layton CJ, Brooks KR, Geller AC. Melanoma in middle-aged and older men: a multi-institutional survey study of factors related to tumor thickness. *Arch Dermatol*. 2009;145(4):397–404
78. US Preventive Services Task Force. Vitamin D and calcium supplementation to prevent cancer and osteoporotic fractures in adults: U.S. Preventive Services Task Force recommendation statement. Draft. Available at: www.uspreventiveservicestaskforce.org/draftrec3.htm. Accessed July 1, 2012
79. Dellavalle RP, Parker ER, Cersonsky N, et al. Youth access laws: in the dark at the tanning parlor? *Arch Dermatol*. 2003;139(4):443–448
80. Balk SJ, Geller AC. Teenagers and artificial tanning. *Pediatrics*. 2008;121(5):1040–1042

PREDICTING THE FUTURE: *I was having a conversation with a colleague of mine and asked, "Do you think you have changed?" She replied that she regretted some of her past decisions, but was now quite stable, had returned to her core values and interests, and was unlikely to make poor life decisions again. I thought her response interesting, but somewhat unsatisfying — after all, she was still a young woman and had most of her life in front of her. According to research reported in* The New York Times *(Science: January 3, 2013), however, my friend was not alone in her beliefs. Adults at all ages suffer from a syndrome dubbed "end of history illusion" in which they underestimate how much they will change in the future. Investigators measured the personalities, values, and preferences of more than 19,000 adults between the ages of 18 and 68, asking them to state how much they had changed over the past decade and predict how much they would change over the next 10 years. In all age groups, participants reported they had changed a lot over the past decade, but predicted much less change in the future. Seemingly, at each age point (and contrary to their own past experience), adults concluded that they have reached a stable era and are unlikely to undergo further change. Failing to take this inclination into account could potentially have financial ramifications, as adults expect currently highly valued items to retain that value over time, when in fact they do not. For example, adults knew that musical groups from the past had lost their appeal, but thought current favorite music groups were unlikely to do so. When researchers asked participants to report how much they would be willing to pay to attend a concert today by a favorite musical group of a decade ago, and how much they would pay to attend a concert of their current favorite musical group in 10 years' time, respondents were willing to pay $80 to see a past favorite now, but $129 for a current favorite in the future. Why adults suffer from "end of history illusion" is not known. One theory is that we have a tendency to overestimate how wonderful we currently are. Another is that predicting the future takes more effort and insight than recalling the past. As for me, I look back aghast at some of the things I have done and wonder, just a bit, what I am doing now that will be viewed with similar chagrin in a decade.*

Noted by WVR, MD

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