Childhood and Adolescent Melanoma—Where Do We Stand Today?

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Abstract

The purpose of this review is to update physicians on recent advances in the prevention, diagnosis, and treatment of pediatric melanoma. The incidence of melanoma is rapidly increasing, creating a serious public health concern. Recent advances in understanding the mutational landscape of pediatric melanoma has demonstrated that the majority of conventional melanoma seen in adolescents is caused by Ultraviolet (UV)-induced DNA damage. Fostering effective strategies among individuals, physicians, communities, schools, and policy makers to reduce UV exposure in children is pivotal to reducing their future risk of melanoma. Furthermore, a national multidisciplinary collaborative effort is needed to collect data, promote biological studies, and develop diagnostic and therapeutic recommendations for this rare disease.

Section 1 "Epidemiology"

Melanoma is the most deadly form of skin cancer and represents a serious public health threat. In 2013, 71,943 people were diagnosed with melanoma and over 9,000 people died from melanoma. The incidence of melanoma in adults doubled from 1982 to 2011 and is projected to continue to increase (Guy et al., 2015). While melanoma in children and adolescents represents less than 1% of all melanoma cases, it is the second leading cause of cancer in adolescents and young adults ages 15-29 years old (Bleyer, O'Leary, Barr, & Ries, 2006). The incidence sharply increases with age from 1.1 per million in 1-4 year olds to 10.4 per million in 15-19 year olds ("United States Cancer Statistics: 2009-2013 Incidence and Mortality Web-based Report," 2016). Adolescents represent 73% of pediatric melanoma cases followed by 10 to 14 year olds (17%), 5 to 9 year olds (6%), and 1 to 4 year olds (4%) (Lange, Palis, Chang, Soong, & Balch, 2007).

Similar to adults, the incidence of pediatric melanoma increased an average annual percent change (APC) of 2-2.9% from 1973-2009 (Austin, Xing, Hayes-Jordan, Lally, & Cormier, 2013; Lange et al., 2007; Strouse, Fears, Tucker, & Wayne, 2005; Wong, Harris, Rodriguez-Galindo, & Johnson, 2013). However, more recent studies suggest that melanoma incidence among children and adolescents has significantly decreased over the past decade (Barr et al., 2016; Campbell et al., 2015; Siegel et al., 2014). A study by Campbell et al. (2015) using the Surveillance, Epidemiology, and End Results cancer registry found that the incidence among children <20 years decreased 11.58% per year from 2004-20010, most notably among adolescents ages 15-19 years old (-11.08% per year from 2003-2010) and among female adolescents (-10.9.% per year from 2003-2010). Similarly, a study using 2001–2009 National Program of Cancer Registries (NPCR) and SEER data demonstrated an APC of -5.1 % among adolescents with melanoma while another SEER study from 2000-2011 demonstrated an APC of -1.2% among adolescents and young adults ages 15-39 years old (Barr et al., 2016; Siegel et al., 2014).

Section 2 "Diagnosis/Detection"

The rarity of the disease contributes to decreased perception of risk among parents and physicians. Delays in diagnosis or misdiagnosis have been reported to occur in 50-60% of patients and contribute to a thicker

tumor, advanced disease at presentation, and increased mortality risk (Cordoro, Gupta, Frieden, McCalmont, & Kashani-Sabet, 2013; Ferrari et al., 2005; Rajput et al., 2014; Saenz et al., 1999). Pediatric melanoma often does not follow the traditional ABCDE (*A*symmetry, *B*order irregularity, *C*olor variegation, *D*iameter >6mm, *E*volution) criteria used among adults with melanotic lesions. Melanomas in children, especially pre-pubertal, are more often nodular amelanotic lesions that are red or pink and can resemble benign lesions such as pyogenic granulomas and warts (Cordoro et al., 2013; Ferrari et al., 2005). In a study by Cordoro et al. (2013), 60% of children <10 years old and 40% of patients ages 11-19 presented with lesions that were lacking conventional ABCDE criteria. Cordoro therefore proposed new ABCD criteria: amelanotic; bleeding, bump; color uniformity; de novo, any diameter (Cordoro et al., 2013). A heightened awareness is needed when examining skin lesions in children and applying both sets of criteria may improve detection of melanoma (Cordoro et al., 2013).

Section 3 "Management"

When a suspicious lesion is identified, is in important to obtain a full thickness biopsy. Shave biopsies and small punch biopsies provide inadequate assessment of the depth of the primary lesion. Excisional biopsies with 1-3mm are the preferred method of biopsy, although a full-thickness incisional or punch biopsy is acceptable for very large lesions or in certain anatomic areas such as the palm/sole, finger, face, or ear (NCCN Guidelines Version 3.2016 Panel Members Melanoma, 2016). A dermatopathologist with experience in diagnosing pediatric melanoma should review the biopsy results.

When melanoma is identified in a pediatric patient, it is important to refer the patient to a center with expertise in melanoma management. Melanocytic lesions in pediatric patients can be divided into three major categories: Spitz tumors including Spitz nevi and Spitz tumors with atypical features, conventional melanomas, and melanoma arising in congenital nevi (Pappo, 2014). Each has their own unique clinical behavior, pathological characteristics, and molecular profiles which may influence the surgical management and choice of therapies (Lu et al., 2015). Because the rarity of the disease has made it impossible to conduct prospective clinical trials, pediatric patients with melanoma are managed using adult guidelines. However, the controversy surrounding atypical melanocytic lesions and

the diagnosis and prognosis of pediatric melanoma has led to almost uniform exclusion of these patients from clinical trials for adults with melanoma offering novel immune and targeted therapies (Ascierto et al., 2012; Lu et al., 2015; Page, Postow, Callahan, & Wolchok, 2013; Pappo, 2014). Recent advances in genomic sequencing of pediatric melanoma has demonstrated that pediatric conventional melanoma and adult melanoma are essentially the same disease. These findings support the inclusion of these patients in clinical trials that offer novel immunotherapy, targeted therapy, or combination therapies for treatment of advanced melanoma in adults. Furthermore, pediatric melanoma arising in congenital nevi and spitzoid melanoma have distinctive molecular profiles that may be suitable for novel molecular treatments that target specific tumor-related genes (Davar, Lin, & Kirkwood, 2015; Lu et al., 2015; Pappo, 2014).

Section 4 "Prevention Strategies"

While a number of genetic and environmental risk factors are associated with the development of pediatric melanoma, the majority of pediatric melanoma cases are sporadic and attributed to UV radiation (Cordoro et al., 2013; Lu et al., 2015; Pappo, 2003, 2014). A review of over 8 single institutional studies comprising 322 children and adolescents with melanoma found only 22% of patients had predisposing conditions such as dysplastic or numerous melanocytic nevi, large/giant congenital melanocytic naevi, family history of melanoma, xeroderma pigmentosum, inherited immunodeficiency disorder, prior malignancy, or history of irradiation (Pappo, 2003). Growing molecular evidence supports that pediatric melanoma is the result of sequential acquisitions of multiple mutations from UV exposure (Lu et al., 2015; Pappo, 2014). Genomic analysis of pediatric melanoma showed that that pediatric conventional melanoma had the highest somatic mutation rate of any sequenced pediatric cancer, most of which are single nucleotide mutations reflective of UV-induced DNA damage (Lu et al., 2015). Fostering effective strategies to reduce UV exposure in children is pivotal to reducing their future risk of melanoma.

Over 55% of high school students grades 9-12 reported having a sunburn in the past year (Centers for Disease Control and Prevention, 2015). The highest prevalence of sunburns was among white female students (77.7%) indicating that many are not following primary preventative strategies that

can protect their skin from UV exposure. In 2014, the US Surgeon General released *The Surgeon General's Call to Action to Prevent Skin Cancer* (Watson, Garnett, Guy, & Holman, 2015). Five goals were outlined as effective prevention strategies and called on government, healthcare, education, business, and community partners

1. Increase opportunities for sun protection in the outdoor settings

2. Provide individuals with the information they need to make informed, healthy choices about UV exposure

3. Promote policies that advance the national goal of preventing skin cancer

4. Reduce harms from indoor tanning

6. Strengthen research, surveillance, monitoring, and evaluation related to skin cancer prevention (Watson et al., 2015)

UV radiation from indoor tanning is a completely avoidable carcinogen. More than 450,000 non-melanoma skin cancers and over 10,000 melanoma cases are attributed to indoor tanning each year in the US, Europe, and Australia (Wehner et al., 2014). Indoor tanning confers a 6-fold increased risk of developing melanoma among women younger than 30, and first exposure typically starts in adolescents (Cust et al., 2011; G. P. Guy et al., 2014; Lazovich et al., 2016). Public health efforts have significantly impacted the use of indoor tanning among adolescents. In 2014, the FDA issued a black-box warning label for indoor tanning devices stating "This sunlamp product should not be used on persons under the age of 18 years'' (Department of Health and Human Services Food and Drug Administration., 2014). At the same time, multiple states passed legislation banning tanning among all minors less than 18 years. As of August 2015, thirteen states and the District of Columbia have passed similar laws banning indoor tanning among anyone under the age of 18 (Hanson, 2016). A significant linear decrease occurred overall in the prevalence of indoor tanning use among high school students from 15.6% in 2009 to 7.3% in 2015 which may be due in part to the passing of these regulations (Centers for Disease Control and Prevention, 2015). The greatest decrease was among 12th grade females from 34% to 16% (Centers for Disease Control and Prevention, 2015).

Increasing sun protective behaviors (using sunscreen, staying in the shade, wearing wide brim hats, and wearing protective clothing) and decreasing the

prevalence of sunburns are key components to preventing future cases of melanoma. Only 10% of high school students wear sunscreen always or most of the time when outdoors for more than 1 hour (Guy et al., 2014). Furthermore, only 4.7% of blacks and 7.9% of Hispanics high school students routinely wear sunscreen (Guy et al., 2014). Individuals with darker skin may not perceive themselves at risk and are less likely to follow primary prevention strategies (Andreeva et al., 2009; Harvey, Patel, & Sandhu, 2014; Pipitone, Robinson, Camara, Chittineni, & Fisher, 2002). These groups tend to be diagnosed with melanoma at later stages and have worse overall outcomes in part due to this perception of low risk and lack of awareness (Cormier et al., 2006; Friedman et al., 1994; Hu, Soza-Vento, Parker, & Kirsner, 2006; Pipitone et al., 2002; Pollitt et al., 2011). These findings highlight the need for improved education among individuals of all skin types about sun protective behavior.

While the US Preventive Services Task Force recommends clinicians to counsel fair skinned patients ages 10-24 years on sun protective behaviors, previous studies have demonstrated that physician counseling of children and their parents is not associated with the use of sun protection (Cohen, Brown, Haukness, Walsh, & Robinson, 2013; Wu et al., 2016). However, studies using multicomponent interventions incorporating printed materials, interactive multimedia, and distribution of sun protective products demonstrated significant improvements in reported sun protective behaviors (Crane et al., 2012; Gritz et al., 2013; Ho et al., 2016).

Community-based and school-based interventions have also been implemented throughout the US. *Practice Safe Skin* is a program launched by The Melanoma Foundation of New England that provides free sunscreen dispensers throughout the Boston area in public parks and recreational areas (Melanoma Foundation of New England, 2016). School based programs can foster and establish a lifetime of sun safe behaviors starting at early age. The *SunWise* Program was developed by the Environmental Protection Agency to educate K-8th grade students and their parents about the health risks of UV radiation and to promote sun safe behaviors. As of 2015, the program was offered in over 34,000 and is estimated to have potentially prevented more than 11,000 cases of skin cancer and 50 premature deaths (Kyle et al., 2008; "The History of the SunWise Program at EPA," 2016).

Section 5 "Future Work"

The recent decline in incidence of melanoma among adolescents and young adults may be because of public campaigns initiated in the 1990s to reduce UV exposure. Comprehensive skin cancer prevention programs are projected to prevent over 230,000 melanoma cases among adults from 2020 to 2030 (Guy et al., 2015). However, in the absence of new interventions, the burden of melanoma is expected to more than double and the annual cost of treating melanoma is expected to increase from $457 million to $1.6 billion over the next 15 years (Guy et al., 2015). *The Surgeon General's Call to Action to Prevent Skin Cancer* outlines a clear strategy for individuals, parents, communities, health care professionals, and policy makers to reverse the increasing burden of melanoma.

While many schools include education about sun safety and skin cancer prevention, the majority of schools do not have policies that promote sun safety practices and some have policies that pose a barrier to sun protection. Less than half of schools (47.6%) allow students time to put on sunscreen, 13% provide sunscreen for students to use, 28% of teachers remind students to apply sunscreen before going outside, 15% avoid outdoor activities during peak UV intensity, and 7.5% prevent students from wearing hats when in the sun (*Skin Cancer Prevention: Progress Report of 2016*, 2016). Promoting and improving sun protective policies among schools are important for establishing effective and sustainable sun-safe habits among children.

Comprehensive community and school wide programs started in the 1980s in Australia have been effective in raising awareness, changing attitudes about tanning, and promoting sun-protective behaviors (Dobbinson, Volkov, & Wakefield, 2015; Jones, Beckmann, & Rayner, 2008; Reeder, Mcnoe, & Iosua, 2016). Moreover, there have been declines in the incidence in invasive melanoma among children, adolescents, and young adults in Australia attributed in part to these sun awareness campaigns (Baade et al., 2010; Iannacone, Youlden, Baade, Aitken, & Green, 2015). Future studies are needed to determine the most effective interventions and policies that can change social norms regarding tanned skin and promote lifelong sun protective behaviors starting in early childhood.

Although preventative strategies to reduce UV exposure remain the mainstay of decreasing melanoma incidence, understanding the molecular pathogenesis of the distinct variants of pediatric melanoma is

crucial for improving the diagnosis, prognosis, and treatment of this rare entity. A national registry and committee of pediatric oncologist, surgeons, pathologists, and other experts is needed to collect data, promote biological studies, develop diagnostic recommendations, promote prospective studies, and initiate clinical trials with novel therapies targeted for the three categories of pediatric melanoma. A better understanding of the clinical behavior and molecular profiles of pediatric melanoma may lead to development of improved diagnostic and therapeutic guidelines.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Andreeva, V. A., Unger, J. B., Yaroch, A. L., Cockburn, M. G., Baezconde-Garbanati, L., & Reynolds, K. D. (2009). Acculturation and sun-safe behaviors among US Latinos: Findings from the 2005 Health Information National Trends Survey. *American Journal of Public Health*, *99*(4), 734–741. http://doi.org/10.2105/AJPH.2007.122796

Ascierto, P. A., Simeone, E., Giannarelli, D., Grimaldi, A. M., Romano, A., & Mozzillo, N. (2012). Sequencing of BRAF inhibitors and ipilimumab in patients with metastatic melanoma: a possible algorithm for clinical use. *Journal of Translational Medicine*, *10*, 107. http://doi.org/10.1186/1479-5876-10-107

Austin, M. T., Xing, Y., Hayes-Jordan, A. A., Lally, K. P., & Cormier, J. N. (2013). Melanoma incidence rises for children and adolescents: An epidemiologic review of pediatric melanoma in the United States. *Journal of Pediatric Surgery*, *48*(11), 2207–2213. http://doi.org/http://dx.doi.org.ezproxyhost.library.tmc.edu/10.1016/j.jpedsurg.2013.06.002

Baade, P. D., Youlden, D. R., Valery, P. C., Hassall, T., Ward, L., Green, a C., & Aitken, J. F. (2010). Trends in incidence of childhood cancer in Australia, 1983-2006. *British Journal of Cancer*, *102*(3), 620–626. http://doi.org/10.1038/sj.bjc.6605503

Barr, R. D., Ries, L. A. G., Lewis, D. R., Harlan, L. C., Keegan, T. H. M., Pollock, B. H., & Bleyer, W. A. (2016). Incidence and incidence trends of the most frequent cancers in adolescent and young adult Americans, including "nonmalignant/noninvasive" tumors. *Cancer*, *122*(7), 1000–1008. http://doi.org/10.1002/cncr.29867

Bleyer, A., O'Leary, M., Barr, R., & Ries, L. (2006). SEER Cancer Epidemiology in Older Adolescents and Young Adults 15-29 Years of Age. In *National Cancer Institute, NIH Pub. No. 06-5767* (pp. 53–64). Bethesda, MD.

Campbell, L. B., Kreicher, K. L., Gittleman, H. R., Strodtbeck, K., Barnholtz-Sloan, J., & Bordeaux, J. S. (2015). Melanoma Incidence in Children and Adolescents: Decreasing Trends in the United States. *The Journal of Pediatrics*, *166*(6), 1505–

1513. http://doi.org/10.1016/j.jpeds.2015.02.050

Centers for Disease Control and Prevention. (2015). Youth risk behavior surveillance — United States, 2015. *Morbidity and Mortality Weekly Report*, *65*(6).

Cohen, L., Brown, J., Haukness, H., Walsh, L., & Robinson, J. K. (2013). Sun protection counseling by pediatricians has little effect on parent and child sun protection behavior. *Journal of Pediatrics*, *162*(2), 381–386. http://doi.org/10.1016/j.jpeds.2012.07.045

Cordoro, K. M., Gupta, D., Frieden, I. J., McCalmont, T., & Kashani-Sabet, M. (2013). Pediatric melanoma: Results of a large cohort study and proposal for modified ABCD detection criteria for children. *Journal of the American Academy of Dermatology*, *68*(6), 913–925. http://doi.org/10.1016/j.jaad.2012.12.953

Cormier, J. N., Xing, Y., Ding, M., Lee, J. E., Mansfield, P. F., Gershenwald, J. E., … Du, X. L. (2006). Ethnic differences among patients with cutaneous melanoma. *Archives of Internal Medicine*, *166*(17), 1907–1914. http://doi.org/10.1001/archinte.166.17.1907

Crane, L. A., Asdigian, N. L., Barón, A. E., Aalborg, J., Marcus, A. C., Mokrohisky, S. T., … Morelli, J. G. (2012). Mailed intervention to promote sun protection of children: A randomized controlled trial. *American Journal of Preventive Medicine*, *43*(4), 399–410. http://doi.org/10.1016/j.amepre.2012.06.022

Cust, A. E., Armstrong, B. K., Goumas, C., Jenkins, M. A., Schmid, H., Hopper, J. L., … Mann, G. J. (2011). Sunbed use during adolescence and early adulthood is associated with increased risk of early-onset melanoma. *International Journal of Cancer. Journal International Du Cancer*, *128*(10), 2425–35. http://doi.org/10.1002/ijc.25576

Davar, D., Lin, Y., & Kirkwood, J. M. (2015). Unfolding the mutational landscape of human melanoma. *The Journal of Investigative Dermatology*, *135*(3), 659–62. http://doi.org/10.1038/jid.2014.467

Department of Health and Human Services Food and Drug Administration. (2014). *21 CFR Part 878. [Docket No. FDA-*

2013-N- 0461]. General and plastic surgery devices: reclassification of ultraviolet lamps for tanning, henceforth to be known as sunlamp products and u (Vol. 79).

Dobbinson, S. J., Volkov, A., & Wakefield, M. A. (2015). Continued Impact of SunSmart Advertising on Youth and Adults' Behaviors. *American Journal of Preventive Medicine*, *49*(1), 20–28. http://doi.org/10.1016/j.amepre.2015.01.011

Ferrari, A., Bono, A., Baldi, M., Collini, P., Casanova, M., Pennacchioli, E., … Bartoli, C. (2005). Does melanoma behave differently in younger children than in adults? A retrospective study of 33 cases of childhood melanoma from a single institution. *Pediatrics*, *115*(3), 649–654. http://doi.org/10.1542/peds.2004-0471

Friedman, L. C., Bruce, S., Weinberg, A. D., Cooper, H. P., Yen, A. H., & Hill, M. (1994). Early detection of skin cancer: racial/ethnic differences in behaviors and attitudes. *Journal of Cancer Education : The Official Journal of the American Association for Cancer Education*, *9*(2), 105–10. http://doi.org/10.1080/08858199409528281

Glanz, K., Escoffery, C., Elliott, T., & Nehl, E. J. (2015). Randomized trial of two dissemination strategies for a skin cancer prevention program in aquatic settings. *American Journal of Public Health*, *105*(7), 1415–1423. http://doi.org/10.2105/AJPH.2014.302224

Gritz, E. R., Tripp, M. K., Peterson, S. K., Prokhorov, A. V, Shete, S. S., Urbauer, D. L., … Gershenwald, J. E. (2013). Randomized Controlled Trial of a Sun Protection Intervention for Children of Melanoma Survivors. *Cancer Epidemiol Biomarkers*, *22*(10), 1813–1824. http://doi.org/10.1158/1055-9965.EPI-13-0249.Randomized

Guy, G. P., Berkowitz, Z., Tai, E., Holman, D. M., Everett Jones, S., & Richardson, L. C. (2014). Indoor Tanning Among High School Students in the United States, 2009 and 2011. *JAMA Dermatology*, *30341*(5), 1–11. http://doi.org/10.1001/jamadermatol.2013.7124

Guy, G. P. J., Thomas, C. C., Thompson, T., Watson, M., Massetti, G. M., &

Richardson, L. C. (2015). Vital Signs : Melanoma Incidence and Mortality Trends and Projections — United States , 1982 – 2030. *MMWR Morb Mortal Wkly Rep*, *64*(21), 591–596.

Hanson, K. (2016). Indoor Tanning Restrictions for Minors:A State-by-State Comparison. Retrieved August 1, 2016, from http://www.ncsl.org/research/health/indoor-tanning-restrictions.aspx

Harvey, V. M., Patel, H., & Sandhu, S. (2014). Social Determinants of Racial and Ethnic Disparities in Cutaneous Melanoma Outcomes. *Cancer Control*, *21*(4), 343–349.

Ho, B. K., Reidy, K., Huerta, I., Dilley, K., Crawford, S., Hultgren, B. A., … Robinson, J. K. (2016). Effectiveness of a Multicomponent Sun Protection for Young Children. *JAMA Pediatrics*, *60611*, 1–9. http://doi.org/10.1001/jamapediatrics.2015.4373

Hu, S., Soza-Vento, R. M., Parker, D. F., & Kirsner, R. S. (2006). Comparison of stage at diagnosis of melanoma among Hispanic, black, and white patients in Miami-Dade County, Florida. *Archives of Dermatology*, *142*(6), 704–708. http://doi.org/10.1001/archderm.142.6.704

Iannacone, M. R., Youlden, D. R., Baade, P. D., Aitken, J. F., & Green, A. C. (2015). Melanoma incidence trends and survival in adolescents and young adults in Queensland, Australia. *International Journal of Cancer*, *136*(3), 603–609. http://doi.org/10.1002/ijc.28956

Jones, S. B. W., Beckmann, K., & Rayner, J. (2008). Australian primary schools' sun protection policy and practice: evaluating the impact of the National SunSmart Schools Program. *Health Promotion Journal of Australia : Official Journal of Australian Association of Health Promotion Professionals*, *19*(2), 86–90. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18647119

Kyle, J. W., Hammitt, J. K., Lim, H. W., Geller, A. C., Hall-Jordan, L. H., Maibach, E. W., … Wagner, M. C. (2008). Economic evaluation of the US Environmental Protection Agency's SunWise program: sun protection education for young children. *Pediatrics*, *121*(5), e1074–84.

http://doi.org/http://dx.doi.org/10.1542/peds.2007-1400

Lange, J. R., Palis, B. E., Chang, D. C., Soong, S.-J., & Balch, C. M. (2007). Melanoma in children and teenagers: an analysis of patients from the National Cancer Data Base. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *25*(11), 1363–1368. http://doi.org/10.1200/JCO.2006.08.8310

Lazovich, D., Isaksson Vogel, R., Weinstock, M. A., Nelson, H. H., Ahmed, R. L., & Berwick, M. (2016). Association Between Indoor Tanning and Melanoma in Younger Men and Women. *JAMA Dermatology*, *152*(3), 268–75. http://doi.org/10.1001/jamadermatol.2015.2938

Lu, C., Zhang, J., Nagahawatte, P., Easton, J., Lee, S., Liu, Z., … Bahrami, A. (2015). The genomic landscape of childhood and adolescent melanoma. *The Journal of Investigative Dermatology*, *135*(3), 816–23. http://doi.org/10.1038/jid.2014.425

Melanoma Foundation of New England. (2016). Practice Safe Skin: Skin Cancer Prevention Project. Retrieved August 1, 2016, from http://mfne.org/practice-safe-skin/

NCCN Guidelines Version 3.2016 Panel Members Melanoma. (2016). NCCN Clinical Practice Guidelines in Oncology (NCCN Guidelines®)Melanoma, Version 3.2016. Retrieved from https://www.nccn.org/professionals/physician_gls/f_guidelines.asp#site

Page, D. B., Postow, M. A., Callahan, M. K., & Wolchok, J. D. (2013). Checkpoint modulation in melanoma: An update on ipilimumab and future directions. *Current Oncology Reports*, *15*(5), 500–508. http://doi.org/10.1007/s11912-013-0337-1

Pappo, A. S. (2003). Melanoma in children and adolescents. *European Journal of Cancer*, *39*, 2651–2661. http://doi.org/10.1016/j.mpdhp.2007.11.004

Pappo, A. S. (2014). Pediatric melanoma: the whole (genome) story. *American Society of Clinical Oncology Educational Book / ASCO. American Society of Clinical Oncology. Meeting*, (Table 1), e432–5. http://doi.org/10.14694/EdBook_AM.2014.34.e432

Pipitone, M., Robinson, J. K., Camara, C.,

Chittineni, B., & Fisher, S. G. (2002). Skin cancer awareness in suburban employees: A Hispanic perspective. *Journal of the American Academy of Dermatology*, *47*(1), 118–123. http://doi.org/10.1067/mjd.2002.120450

Pollitt, R. A., Clarke, C. A., Swetter, S. M., Peng, D. H., Zadnick, J., & Cockburn, M. (2011). The expanding melanoma burden in California Hispanics:Importance of socioeconomic distribution, histologic subtype and anatomic location. *Cancer*, *117*(1), 152–161. http://doi.org/10.1002/cncr.25355

Rajput, A., Faizi, S. A., Nir, I., Morris, K. T., Fahy, B., Russell, J., & Wiggins, C. (2014). Pediatric melanoma in New Mexico American Indians, Hispanics, and non-Hispanic whites, 1981-2009. *American Journal of Surgery*, *207*(3), 412–416. http://doi.org/10.1016/j.amjsurg.2013.10.015

Reeder, A. I., Mcnoe, B. M., & Iosua, E. E. (2016). Sun protection practices in New Zealand secondary schools : a 2014 baseline study. *Pmedr*, *3*, 257–263. http://doi.org/10.1016/j.pmedr.2016.03.001

Saenz, N. C., Saenz-Badillos, J., Busam, K., LaQuaglia, M. P., Corbally, M., & Brady, M. S. (1999). Childhood melanoma survival. *Cancer*, *85*(3), 750–754.

Siegel, D. a., King, J., Tai, E., Buchanan, N., Ajani, U. a., & Li, J. (2014). Cancer Incidence Rates and Trends Among Children and Adolescents in the United States, 2001-2009. *Pediatrics*, *134*(4), e945–e955. http://doi.org/10.1542/peds.2013-3926

Skin Cancer Prevention: Progress Report of 2016. (2016). *Centres for Disease Control and Prevention, US Dept of Health and Human Services*. Atlanta, GA. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=rzh&AN=107347780&site=ehost-live

Strouse, J. J., Fears, T. R., Tucker, M. A., & Wayne, A. S. (2005). Pediatric melanoma: Risk factor and survival analysis of the Surveillance, Epidemiology and End Results database. *Journal of Clinical Oncology*, *23*(21), 4735–4741. http://doi.org/10.1200/JCO.2005.02.899

The History of the SunWise Program at EPA.

(2016). Retrieved August 6, 2016, from https://www.epa.gov/sunsafety/history-sunwise-program-epa

United States Cancer Statistics: 2009-2013 Incidence and Mortality Web-based Report. (2016). Retrieved August 1, 2016, from https://nccd.cdc.gov/uscs/Index.aspx

Watson, M., Garnett, E., Guy, G. P., & Holman, D. M. (2015). The surgeon general's call to action to prevent skin cancer: facts for consumers. *International Journal of Cancer Research and Prevention*, *8*(1), 55–161.

Wehner, M. R., Chren, M.-M., Nameth, D., Choudhry, A., Gaskins, M., Nead, K. T., … Linos, E. (2014). International Prevalence of Indoor Tanning. *JAMA Dermatology*, *150*(4), 390. http://doi.org/10.1001/jamadermatol.2013.6896

Wong, J. R., Harris, J. K., Rodriguez-Galindo, C., & Johnson, K. J. (2013). Incidence of childhood and adolescent melanoma in the United States: 1973-2009. *Pediatrics*, *131*(5), 846–854. http://doi.org/10.1542/peds.2012-2520

Wu, Y. P., Aspinwall, L. G., Conn, B. M., Stump, T., Grahmann, B., & Leachman, S. A. (2016). A systematic review of interventions to improve adherence to melanoma preventive behaviors for individuals at elevated risk. *Preventive Medicine*, *88*, 153–167. http://doi.org/10.1016/j.ypmed.2016.04.010