

# The potential impact of reducing indoor tanning on melanoma prevention and treatment costs in the United States: An economic analysis

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**Background:** Indoor tanning is associated with an increased risk of melanoma. The US Food and Drug Administration proposed prohibiting indoor tanning among minors younger than 18 years.

**Objective:** We sought to estimate the health and economic benefits of reducing indoor tanning in the United States.

**Methods:** We used a Markov model to estimate the expected number of melanoma cases and deaths averted, life-years saved, and melanoma treatment costs saved by reducing indoor tanning. We examined 5 scenarios: restricting indoor tanning among minors younger than 18 years, and reducing the prevalence by 20%, 50%, 80%, and 100%.

**Results:** Restricting indoor tanning among minors younger than 18 years was estimated to prevent 61,839 melanoma cases, prevent 6735 melanoma deaths, and save \$342.9 million in treatment costs over the lifetime of the 61.2 million youth age 14 years or younger in the United States. The estimated health and economic benefits increased as indoor tanning was further reduced.

**Limitations:** Limitations include the reliance on available data and not examining compliance to indoor tanning laws.

**Conclusions:** Reducing indoor tanning has the potential to reduce melanoma incidence, mortality, and treatment costs. These findings help quantify and underscore the importance of continued efforts to reduce indoor tanning and prevent melanoma. (J Am Acad Dermatol <http://dx.doi.org/10.1016/j.jaad.2016.09.029>.)

**Key words:** indoor tanning; melanoma; prevention; skin cancer.

Indoor tanning is partially responsible for the increase in melanoma incidence rates, especially among young women.<sup>1</sup> The World Health Organization and the US Department of Health and Human Services has classified the ultraviolet radiation from indoor tanning devices as carcinogenic to human beings.<sup>2,3</sup> A recent meta-analysis estimated

that more than 6000 melanomas are attributable to indoor tanning each year in the United States.<sup>1</sup> The risk of melanoma is higher among frequent tanners and those initiating indoor tanning at a younger age.<sup>4,5</sup>

Despite its risks, indoor tanning remains common in the United States.<sup>6,7</sup> An estimated 11.3 million

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Americans engaged in indoor tanning in 2013, 1.6 million of whom are younger than 18 years. Among high school students, 5% of boys and 20% of girls engaged in indoor tanning in 2013.<sup>6,7</sup> Among this population, frequent use is common, with over half of indoor tanners doing so more than 10 times per year.<sup>6</sup> The US Surgeon General has highlighted the importance of reducing the harms from indoor tanning.<sup>8</sup> In addition, the US Food and Drug Administration has announced important proposed steps to protect public health by prohibiting the use of indoor tanning among minors, younger than 18 years.<sup>9</sup>

An earlier study conducted in Australia examining the impact of indoor tanning laws, particularly age restrictions, found that such laws could prevent a substantial number of melanoma cases and result in significant reductions in melanoma treatment costs.<sup>10</sup> A similar study has not been conducted in the United States. The purpose of this study is to estimate the health benefits of reducing indoor tanning and the associated melanoma treatment cost-savings in the United States. Specifically, this study examines the impact of reducing indoor tanning under various scenarios on: (1) the expected number of melanoma cases averted, (2) the expected number of melanoma deaths averted, (3) the expected life-years (LYs) saved, and (4) the expected treatment costs saved.

## METHODS

Health benefits and melanoma treatment cost-savings were estimated using a Markov model. The model follows the current cohort of 61.2 million individuals aged 14 years or younger in the United States<sup>11</sup> through their lifetime (until death from melanoma or from other causes) in 1-year cycles. At the end of each 1-year cycle, individuals could be in 1 of the following mutually exclusive health states: (1) never indoor tanned and no melanoma, (2) ever indoor tanned and no melanoma, (3) given a diagnosis of melanoma, (4) death from melanoma, and (5) death from other causes (Fig 1). During each 1-year cycle individuals face probabilities of outcomes given their current state and being 1 year older. For each health state or transition an outcome is assigned (eg, a diagnosis of melanoma and associated treatment costs). The aggregation of these outcomes over the life of the model is expected to

vary between individuals based on the use of indoor tanning and its increased melanoma risk. The differences between these groups are the primary outputs of the model.

## Model parameters and sources

Models inputs were obtained from existing data sources and the published literature. We estimated the current probability of ever indoor tanning by age using annual prevalence data among individuals age 15 through 18 years from the 2013 Youth Risk Behavior Survey,<sup>12</sup> and the prevalence of ever indoor tanning in the United States from a recent meta-analysis.<sup>1</sup> We fit an exponential equation using these values (Table 1), and imputed the probability of ever indoor tanning among individuals age 19 through

76 years. We used a constant probability of ever indoor tanning after age 77 years, as suggested by the 2010 and 2013 National Health Interview Surveys.<sup>13</sup>

We obtained the age-specific invasive melanoma incidence rates from the 2007 to 2011 US Cancer Statistics data set.<sup>14</sup> Only invasive melanoma was considered, given that in situ cases are not generally associated with increased mortality and are likely to be underreported in central cancer registries.<sup>15</sup> Individuals initiating indoor tanning before age 35 years had a 59% higher risk of developing melanoma and individuals initiating use after age 35 years had a 20% higher risk, based on results from a systematic review and meta-analysis.<sup>4,5</sup>

We calculate the age-specific probabilities of death from melanoma from the reduced probabilities of surviving based on melanoma relative survival. Given the stabilization of relative survival 10 years after a melanoma diagnosis,<sup>16</sup> a melanoma diagnosis only increased an individual's mortality for the first 10 years after diagnosis. The age-specific probabilities of death from other causes were derived by subtracting melanoma mortality from all-cause mortality using 2011 US life tables.<sup>17,18</sup>

Melanoma treatment costs were obtained from the published literature.<sup>19</sup> Treatment costs were stratified by age at diagnosis (<65 and ≥65 years) and phase of care. The phase of care included the initial phase (the first 12 months after diagnosis), continuing phase (all years in between the initial phase and the last year of life), and the last year of life

## CAPSULE SUMMARY

- Reducing indoor tanning can reduce melanoma incidence, mortality, and treatment costs.
- Prohibiting indoor tanning among minors can prevent 61,839 melanoma cases among youth. The benefits of reducing indoor tanning increase as its prevalence is further reduced.
- These findings underscore the importance of efforts to reduce indoor tanning.

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