Health Disparities in Skin Cancer Prevention in the Age of Artificial Intelligence

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Disclosure

• Former member, American Academy of Dermatology (AAD) Augmented Intelligence Task Force

• Member, AAD Skin of Color and Skin Cancer Work Group
Skin cancer prevention in skin of color is challenging

1. Incidence is much, much lower in darker skin types.

2. When skin cancer develops it is often later, and clinical outcomes much worse.

How can we approach prevention? Can AI Help?
Epidemiology of Skin Cancer in Skin of Color

Basal Cell Carcinoma (BCC)
Squamous Cell Carcinoma (SCC)
Melanoma
BCC incidence rates vary by racial group

• Rate per 100,000 population:

• 1-2 Black

• 5-6 Chinese

• 15-17 Japanese (residents of Hawaii/Okinawa 30/26)

• 50-90 Hispanic

• 1500-2000 Non-Hispanic White

SCC incidence rates vary by racial group

- Rate per 100,000 population:
  - 3 Black
  - 18-19 Chinese
  - 23 Japanese (Hawaii)
  - 15-30 Hispanic
  - 1000-1500 Non-Hispanic White

Melanoma incidence rates vary by racial group

- Rate per 100,000 population:
  - 1 Black
  - 1.6 Asian/Pacific Islander
  - 4.9 Hispanic
  - 7 Indian/Alaskan Native
  - 37 Non-Hispanic White

Non-white race is associated with later detection

**Table II.** Primary cutaneous melanoma: relative risk for stages I through IV at presentation for white versus black patients

<table>
<thead>
<tr>
<th>Stage</th>
<th>Blacks RR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0.69</td>
<td>0.62-0.77</td>
</tr>
<tr>
<td>II</td>
<td>1.76</td>
<td>1.43-2.18</td>
</tr>
<tr>
<td>III</td>
<td>2.02</td>
<td>1.51-2.70</td>
</tr>
<tr>
<td>IV</td>
<td>2.49</td>
<td>1.80-3.44</td>
</tr>
</tbody>
</table>

*C1, Confidence interval; RR, relative risk.*
Non-white race is associated with lower survival

Could Artificial Intelligence help with these melanoma disparities?
Dermatologist-level classification of skin cancer with deep neural networks

Andre Esteva¹*, Brett Kuprel¹*, Roberto A. Novoa²,³, Justin Ko², Susan M. Swetter²,⁴, Helen M. Blau⁵ & Sebastian Thrun⁶

Nature 2017
Skin cancer classification performance of the CNN and dermatologists

Lack of diversity of skin types

Study excluded acral lesions which are most melanomas in darker skin types

Esteva et al. Nature 2017
But skin cancer really isn’t a big deal in darker skin types!!!
Disparities may worsen for inflammatory disorders
Google has unveiled a tool that uses artificial intelligence to help spot skin, hair and nail conditions, based on images uploaded by patients.
A deep learning system for differential diagnosis of skin diseases

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Development set</th>
<th>Validation set A</th>
<th>Validation set B (enriched subset of 'A')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitzpatrick skin types (6 types)&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type I (%)</td>
<td>46 (0.3%)</td>
<td>9 (0.2%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Type II (%)</td>
<td>2,807 (17.4%)</td>
<td>383 (10.2%)</td>
<td>104 (10.8%)</td>
</tr>
<tr>
<td>Type III (%)</td>
<td>6,641 (41.2%)</td>
<td>2,412 (64.2%)</td>
<td>607 (63.0%)</td>
</tr>
<tr>
<td>Type IV (%)</td>
<td>5,040 (31.3%)</td>
<td>724 (19.3%)</td>
<td>195 (20.2%)</td>
</tr>
<tr>
<td>Type V (%)</td>
<td>510 (3.2%)</td>
<td>101 (2.7%)</td>
<td>24 (2.5%)</td>
</tr>
<tr>
<td>Type VI (%)</td>
<td>46 (0.3%)</td>
<td>1 (0.0%)</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Unknown (%)</td>
<td>1,024 (10.2%)</td>
<td>126 (3.4%)</td>
<td>33 (3.4%)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Liu, Y et al. Nat Med 2020.
Lack of Transparency and Potential Bias in Artificial Intelligence Data Sets and Algorithms
A Scoping Review

Table 1. Summary of Key Findings

<table>
<thead>
<tr>
<th>Description</th>
<th>No./total No. of studies (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developed a novel algorithm</td>
<td>57/70 (81.4)</td>
</tr>
<tr>
<td>With novel algorithms that tested on an external test set</td>
<td>14/57 (24.6)</td>
</tr>
<tr>
<td>With tasks involving cutaneous malignant neoplasms</td>
<td>56/70 (80.0)</td>
</tr>
<tr>
<td>Involved cutaneous malignant neoplasms and reported biopsy-proven labels for all cutaneous malignant neoplasms</td>
<td>36/56 (64.3)</td>
</tr>
<tr>
<td>Reported any race or ethnicity information for ≥1 data set</td>
<td>14/70 (20.0)</td>
</tr>
<tr>
<td>Reported any Fitzpatrick skin tone information for ≥1 data set</td>
<td>7/70 (10.0)</td>
</tr>
<tr>
<td>Stated that the AI model developed or used was publicly accessible</td>
<td>21/70 (30.0)</td>
</tr>
</tbody>
</table>

Abbreviation: AI, artificial intelligence.
Characteristics of publicly available skin cancer image datasets: a systematic review

Problems with AI in dermatology

• ML algorithms are only as good as the inputs used to train them.

• Without representative inputs, we are at risk of worsening disparities in health care outcomes.

• We have a chance to intervene before a health care disparity potentially widens.
Solutions for AI in darker skin

• Oversample skin lesions in skin of color.

• Design a separate algorithm for darker skin tones (less ideal).

• Find digital solutions using image manipulation techniques to mimic dark skin.
Thank you

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