Implementation of AI in Dermatology

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CEO, MetaOptima Technology
Disclosure: CEO and Co-Founder, MetaOptima

- 5.7M Images
- 1.5M Patients
- 2000 Providers
- 1000 Medical Centers
My Journey

- Iran
- BSc in Computer Engineering

- Canada
- PhD in Computing Science:
  - SFU, Medical Imaging
  - CHIR Scholar, UBC Skin Care Center,
  - BC Cancer Agency
- CEO and Co-founder, MetaOptima
First Focus: Skin Cancer

- Skin Cancer is the most common cancer
  - 2 in 3 Australians
  - 1 in 5 Americans
  - 1 in 7 Canadians

- Doubles every 10 years

- Early diagnosis saves life and cost

<table>
<thead>
<tr>
<th></th>
<th>Early Stage</th>
<th>Late Stage</th>
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<tbody>
<tr>
<td>Survival Rate</td>
<td>98%</td>
<td>15%</td>
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<tr>
<td>Cost</td>
<td>$200</td>
<td>$150,000</td>
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</table>
Skin cancer and melanoma

- Skin cancer:
  most common of all cancers
- Melanoma:
  leading cause of mortality (75%)
- Early detection:
  significantly reduces mortality

[Images courtesy of "Dermoscopy of pigmented skin lesions"]
Dermoscopy

globules

black blotch

dots

veil

globules
Skin Cancer

Skin Cancers

- Basal Cell Carcinoma (BCC)
- Squamous Cell Carcinoma (SCC)
- Melanoma

Melanoma
Dermoscopy

- Colors
- Structures

Images from: Introduction to Dermoscopy, Dr. Kittler
Clinical Diagnostic Methods

- **ABCD** (Asymmetry, Border, Color, Dermoscopy Structures)
- **CASH** (Color, Architecture, Symmetry, Homogeneity)
- Pattern Analysis (7 point, 3 point check list, Menzie’s,…)

Melanoma $\geq 2$

<table>
<thead>
<tr>
<th>ELM Criterion</th>
<th>Score</th>
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<tbody>
<tr>
<td>Major criteria</td>
<td></td>
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<tr>
<td>1. Atypical pigment network</td>
<td>2 ✔</td>
</tr>
<tr>
<td>2. Blue-whitish veil</td>
<td>2 ✔</td>
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<tr>
<td>3. Atypical vascular pattern</td>
<td>2</td>
</tr>
<tr>
<td>Minor criteria</td>
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<tr>
<td>4. Irregular streaks</td>
<td>1</td>
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<tr>
<td>5. Irregular pigmentation</td>
<td>1</td>
</tr>
<tr>
<td>6. Irregular dots/globules</td>
<td>1</td>
</tr>
<tr>
<td>7. Regression structures</td>
<td>1 ✔</td>
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</tbody>
</table>

Melanoma $\geq 3$
Digital Dermoscopes

- 3Gen DermLite Dermoscopes
- 3M Dino-Lite with USB
- FotoFinder HandyScope with iPhone 4
- Canfield DermScope with iPhone 4
“Machine Vision” 21 Century Update on Computer-Assisted Diagnosis of Melanoma

- Harold S. Rabinovitz MD
- Dina Gutkowicz-Krusin PhD
- Margaret Oliviero ARNP
Potential Computer Systems to Aid in the Diagnosis of Melanoma
Dermoscopic images of small (< 6 mm) lesions
49 MM (21 invasive, 28 in situ)
50 non-MM (matched to MM by gender, age, location) selected randomly from the database
9 independent readers (dermoscopists)
Questions: Melanoma or not melanoma? To biopsy or not to biopsy?

Friedman RJ, Gutkowicz-Krusin D, Farber MJ; et al. The diagnostic performance of expert dermoscopists vs a computer-vision system on small-diameter melanomas. 
*Arch Dermatol.* 2008;144(4):476-482.
Case # 8

Melanoma, in situ
Diameter: 5.59 mm
Male, 81
Right Lower Back

<table>
<thead>
<tr>
<th>Reviewer</th>
<th>Melanoma?</th>
<th>Biopsy?</th>
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<tbody>
<tr>
<td>A</td>
<td>No</td>
<td>No</td>
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<td>B</td>
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<td>J</td>
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**Computer**

Yes | Yes
Case # 32

Melanoma, in situ
Diameter: 3.44 mm
Male, 13
Left Dorsal Foot

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<th>Biopsy?</th>
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Pattern Matching
My Fun PhD Journey

SFU's Dean Medal

CIPPRS Doctoral Award

Microsoft ACM Silver Medal

World Congress of Dermatology Gold Medal

CMIG Journal
Solution: DermEngine AI

- Improves accuracy
- It is Secure, Scalable and Accessible
- Saving life, cost and time
Solution: AI in Dermatology

- Built the digital platform
- Built the best AI algorithms
- Implement and validate in clinical settings
- Iterate, improve and expand

ENGINE

Better Product and AI

More Users

More Data
Connected
Implementation of AI in Healthcare

- **AI and Bias**
  - User Bias (Specialists, PCPs, mid-levels, etc.)
  - Patient Bias (Skin colour, age, gender, etc.)
  - Data Bias (imaging sensors, artifacts, etc.)

- Regulatory Challenges: continuous improvements vs. frozen algorithms

- Legal vs. Ethical - AI in Good Hands vs. Bad Hands

- Explainable AI
DermEngine Deep Diagnostics
DermEngine
Deep Diagnostics
An independent reader study (June 2019), DermEngine AI outperformed the majority of 511 human experts. 27 human experts with more than 10 years of experience achieved an accuracy of 62%, compared with 87.3% for DermEngineAI.

Experts Worldwide

International ISIC Challenge winner.

Top 3 AI models among 140 algorithms from 77 international teams.

THE LANCET
Oncology

An independent reader study (June 2019), DermEngine AI outperformed the majority of 511 human experts. 27 human experts with more than 10 years of experience achieved an accuracy of 62%, compared with 87.3% for DermEngineAI.
Comparison of the accuracy of human readers versus machine-learning algorithms for pigmented skin lesion classification: an open, web-based, international, diagnostic study

Philipp Tschandl, PhD • Noel Codella, PhD • Bengü Nisa Akay, MD • Prof Giuseppe Argenziano, PhD • Ralph P Braun, MD • Prof Horacio Cabo, MD • et al. Show all authors
Recent Publications on AI vs Human

Human–computer collaboration for skin cancer recognition, Tschandl et. al., Nature Medicine, 2020
AI In General Dermatology

A deep learning system for differential diagnosis of skin diseases, Liu et. al., published in Nature Medicine, 2020
Vertical Integration of Artificial Intelligence
AI Implementation in Healthcare Systems
Your DermDrone - Your Intelligent Assistant

- DermDrone Platform
  - Intelligent and autonomous total body exams
  - The world’s first drone in intelligent medical applications
Your DermDrone - Your Intelligent Assistant
Your DermDrone - Your Intelligent Assistant

Marker Detection
Contact

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CEO, Co-founder

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The Engine

The Platform
- Clinical Decision Support Diagnostics & Therapeutics
- In-Office and Telemedicine
- Mobile App
- Web App

DB

DermSync APIs Migration & Integration

EMR/EHR
- Lab Diagnostic Systems
- Other Systems

Data Acquisition
- MoleScope
- Other Data Modalities
  - Imaging Data – 2D and 3D
  - Text Data
  - Epidermal Genetic Data– RNA and DNA
  - Nano and micro-needling biopsies

Structured Integrated Multimodality Data for Noninvasive and Minimally Invasive Diagnostics