

Implementation of

AI in Dermatology

Maryam Sadeghi, PhD

CEO, MetaOptima Technology

Disclosure: CEO and Co-Founder, MetaOptima



5.7M
Images

1.5M
Patients

2000
Providers

1000
Medical
Centers

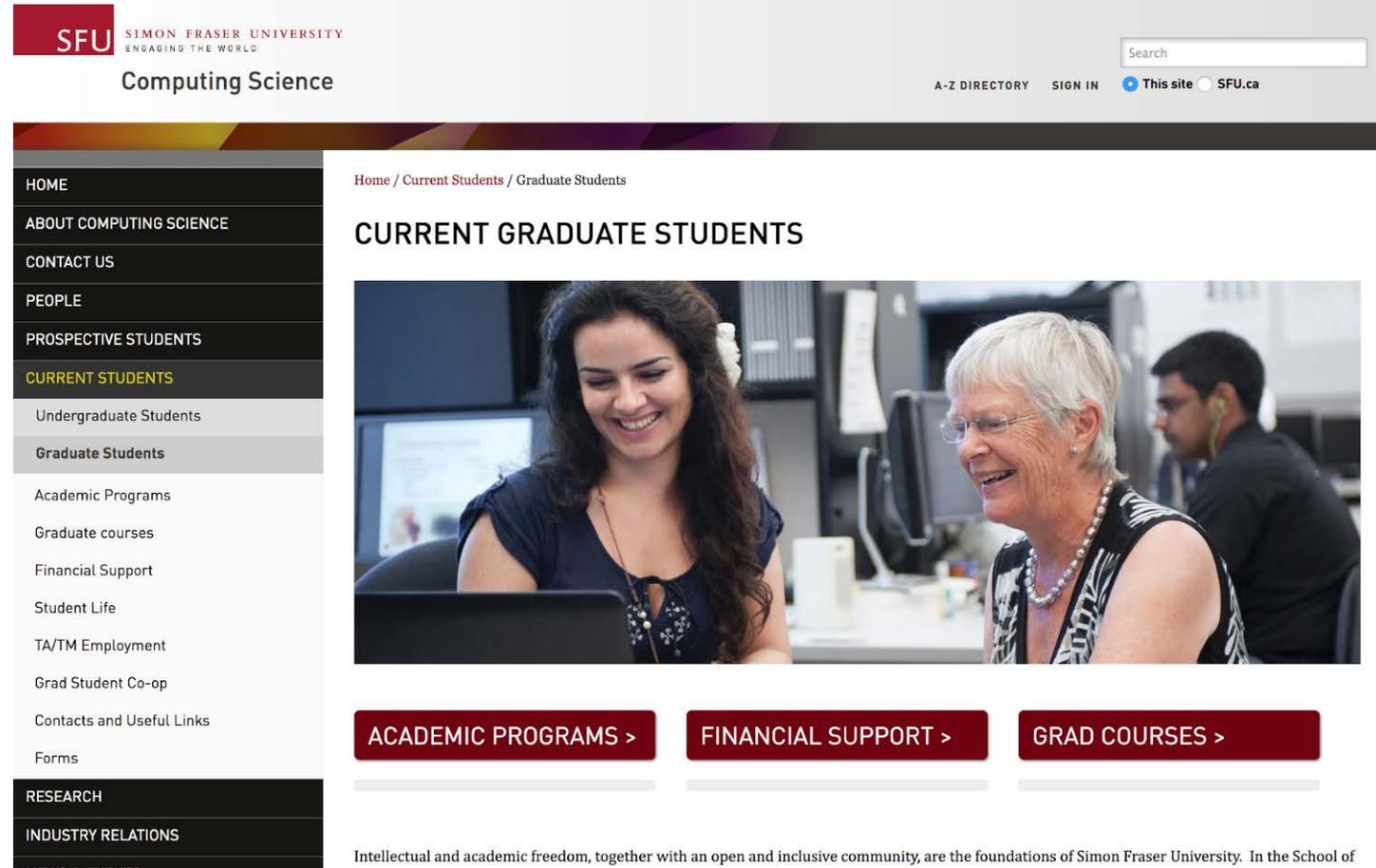
My Journey

Iran

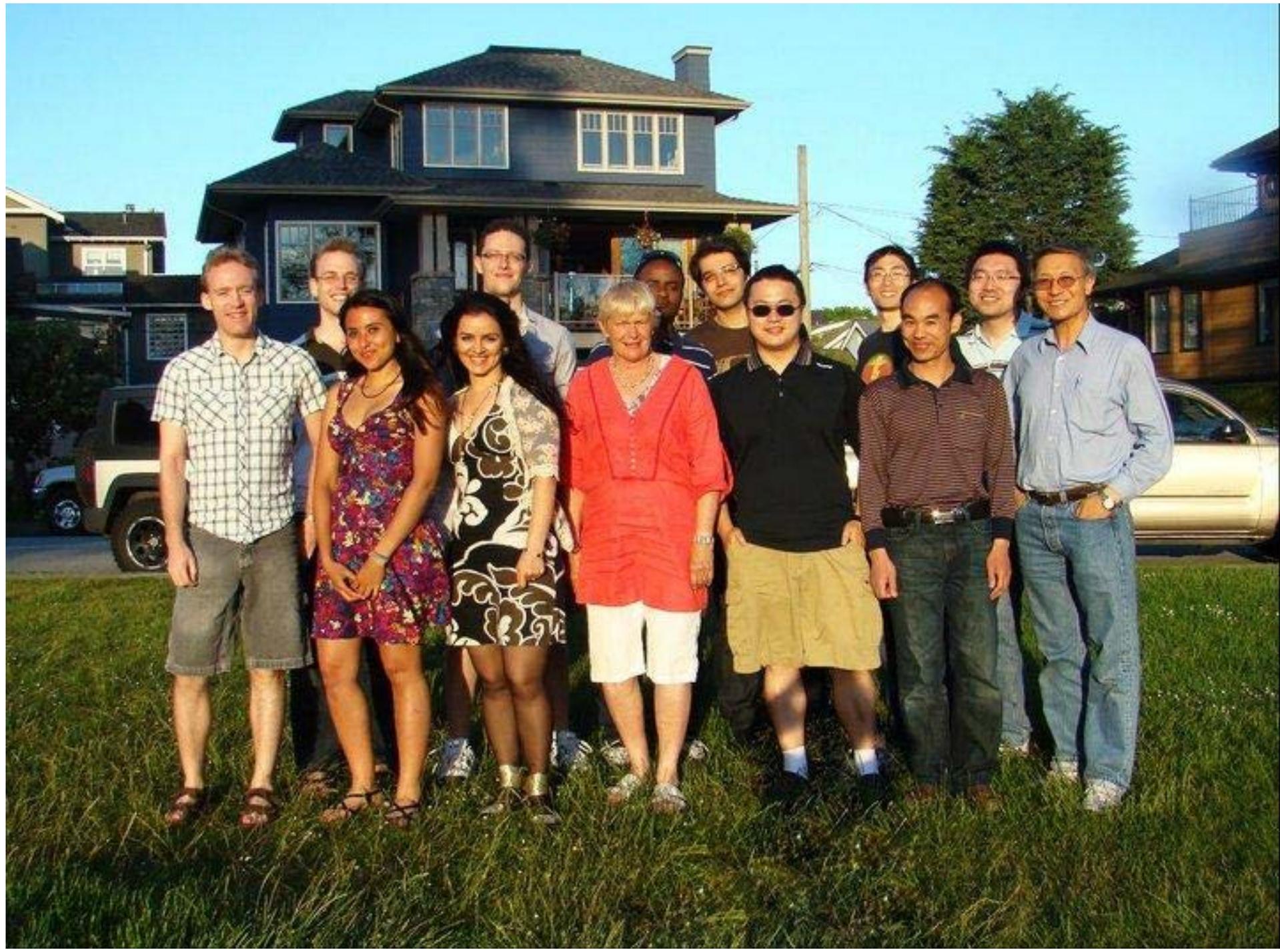
- BSc in Computer Engineering

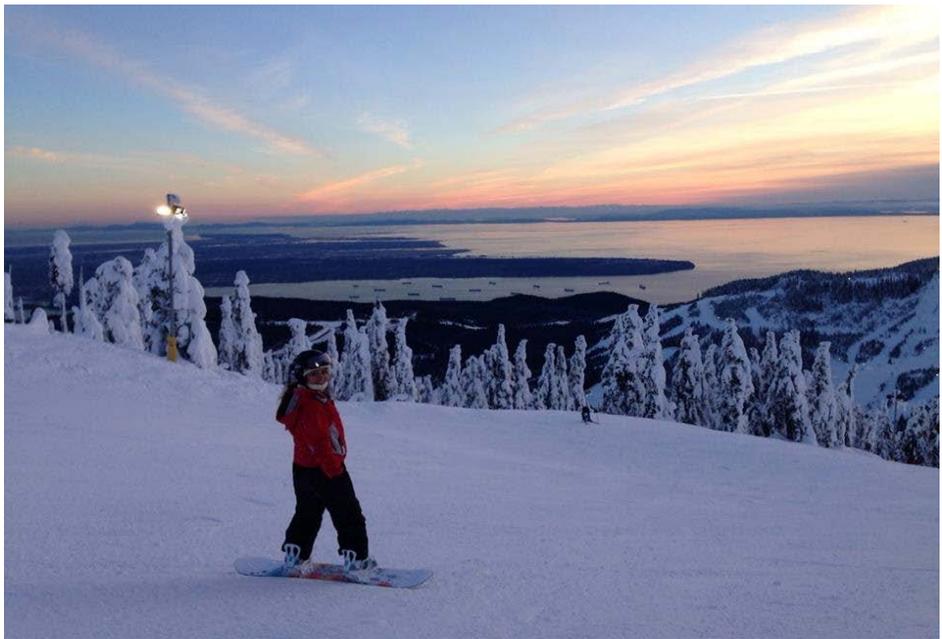
Canada

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



The screenshot shows the SFU website header with the logo and tagline 'SIMON FRASER UNIVERSITY ENGAGING THE WORLD'. The page title is 'Computing Science'. A search bar is located in the top right corner. Below the header, there is a navigation menu on the left with options: HOME, ABOUT COMPUTING SCIENCE, CONTACT US, PEOPLE, PROSPECTIVE STUDENTS, CURRENT STUDENTS (highlighted), Undergraduate Students, Graduate Students (highlighted), Academic Programs, Graduate courses, Financial Support, Student Life, TA/TM Employment, Grad Student Co-op, Contacts and Useful Links, Forms, RESEARCH, INDUSTRY RELATIONS, and NEWS & EVENTS. The main content area displays the breadcrumb 'Home / Current Students / Graduate Students' and the heading 'CURRENT GRADUATE STUDENTS'. Below this is a photograph of two women, one younger and one older, smiling while looking at a laptop. At the bottom of the page, there are three red buttons with white text: 'ACADEMIC PROGRAMS >', 'FINANCIAL SUPPORT >', and 'GRAD COURSES >'. The footer text reads: 'Intellectual and academic freedom, together with an open and inclusive community, are the foundations of Simon Fraser University. In the School of

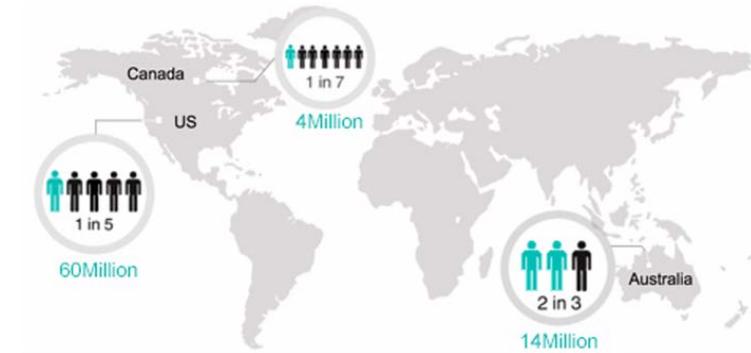




First Focus: Skin Cancer

- Skin Cancer is the most common cancer

- 2 in 3 Australians
- 1 in 5 Americans
- 1 in 7 Canadians



150,000,000 Patients Worldwide

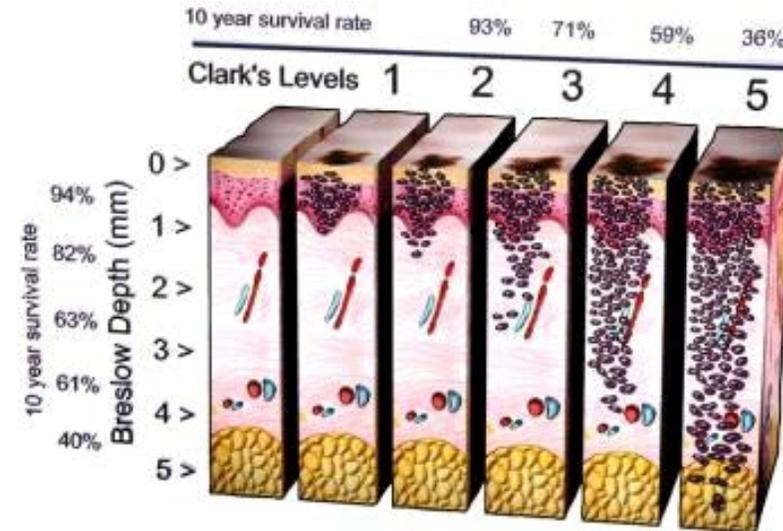
- Doubles every 10 years

- Early diagnosis saves life and cost

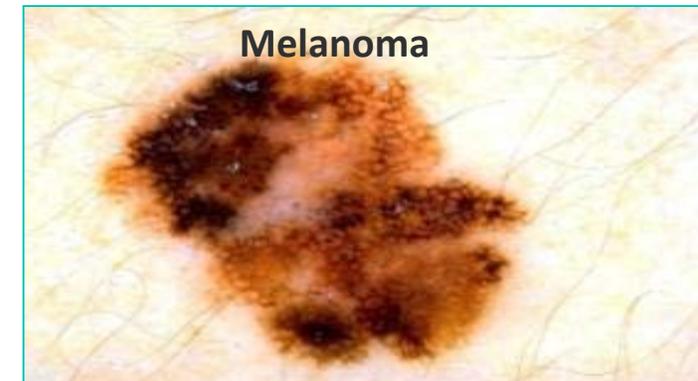
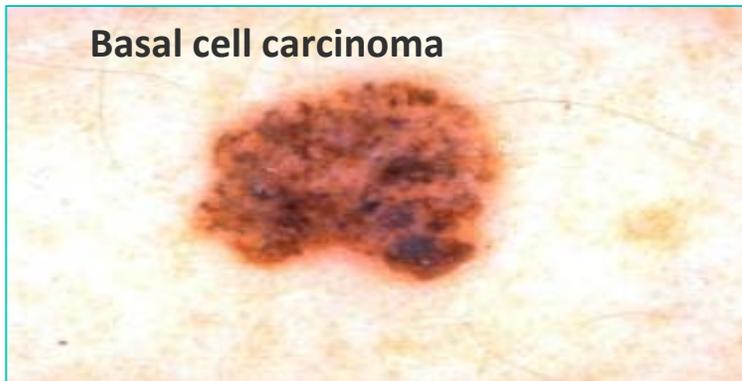
	Early Stage	Late Stage
Survival Rate	98%	15%
Cost	\$200	\$150,000

Skin cancer and melanoma

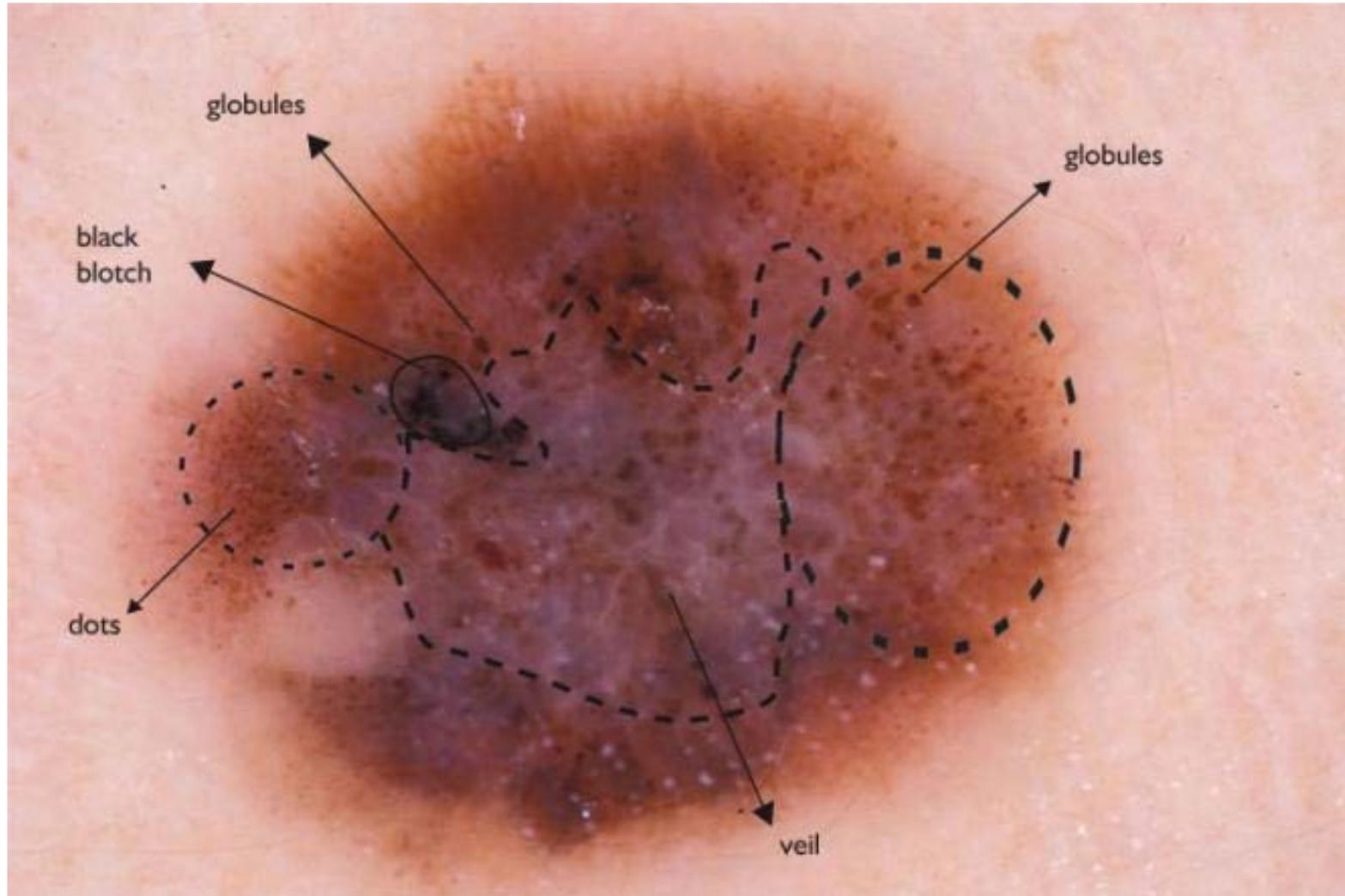
- Skin cancer :
most common of all cancers
- Melanoma :
leading cause of mortality (75%)
- Early detection:
significantly reduces mortality



2011 Image by Med-Art - <http://www.med-art.nl>



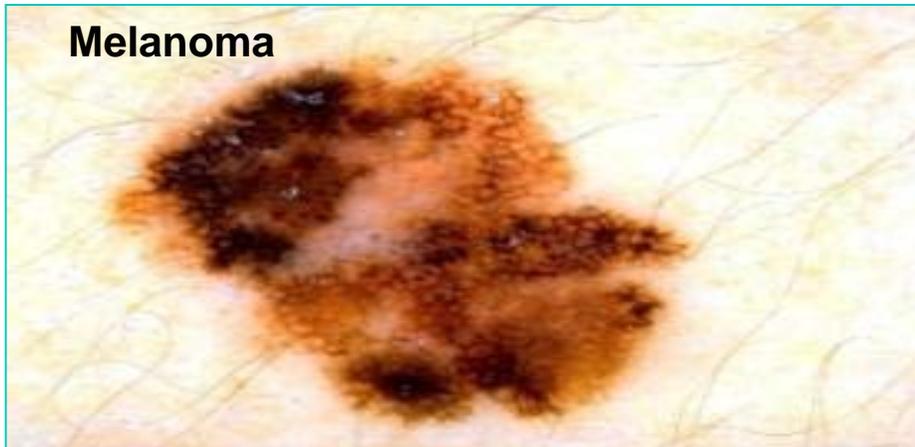
Dermoscopy



Skin Cancer

■ Skin Cancers

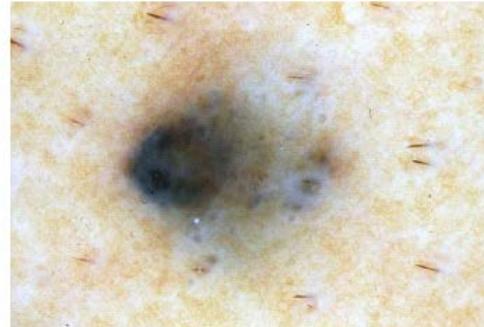
- Basal Cell Carcinoma (BCC)
- Squamous Cell Carcinoma (SCC)
- Melanoma



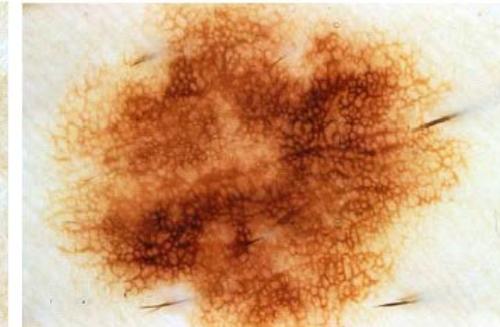
(a) Freckles



(b) Lentigo (Solar)



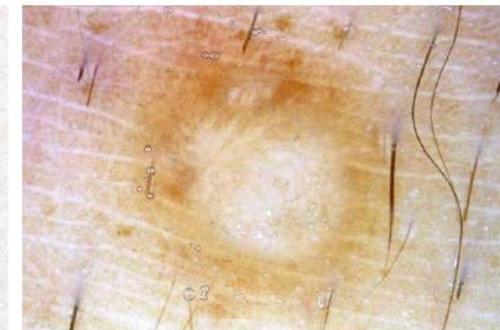
(c) Melanocytic Nevus (Blue Nevus)



(d) Atypical Nevus (Clark Nevus)



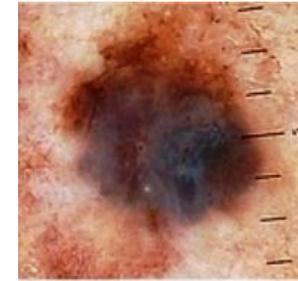
(e) Seborrheic Keratosis



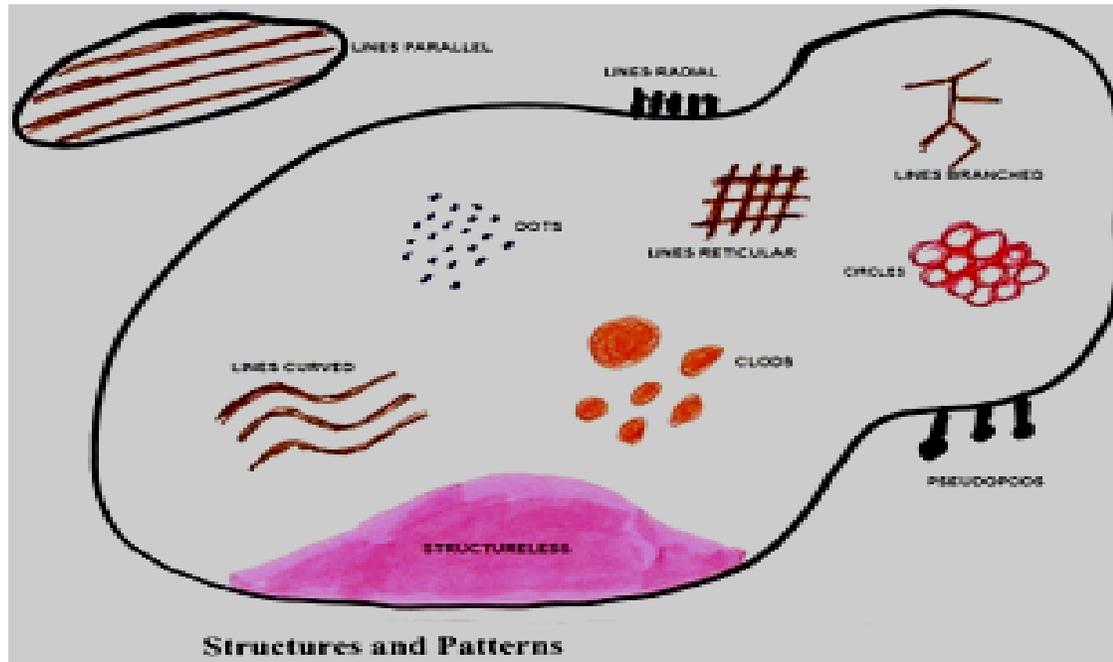
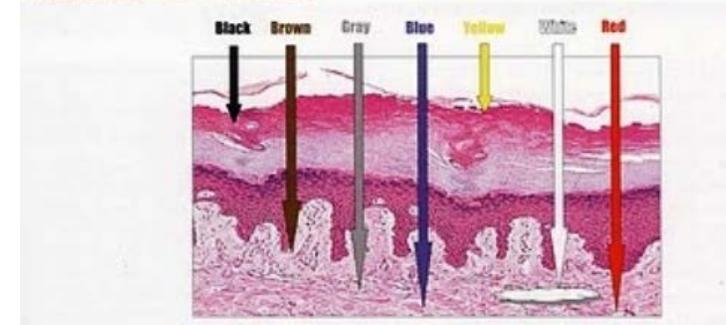
(f) Dermatofibroma

Dermoscopy

- Colors
- Structures



Because melanin appears as different colours at different depths in the skin dermatoscopy provides information in both the horizontal and vertical planes. It provides a 3-dimensional view



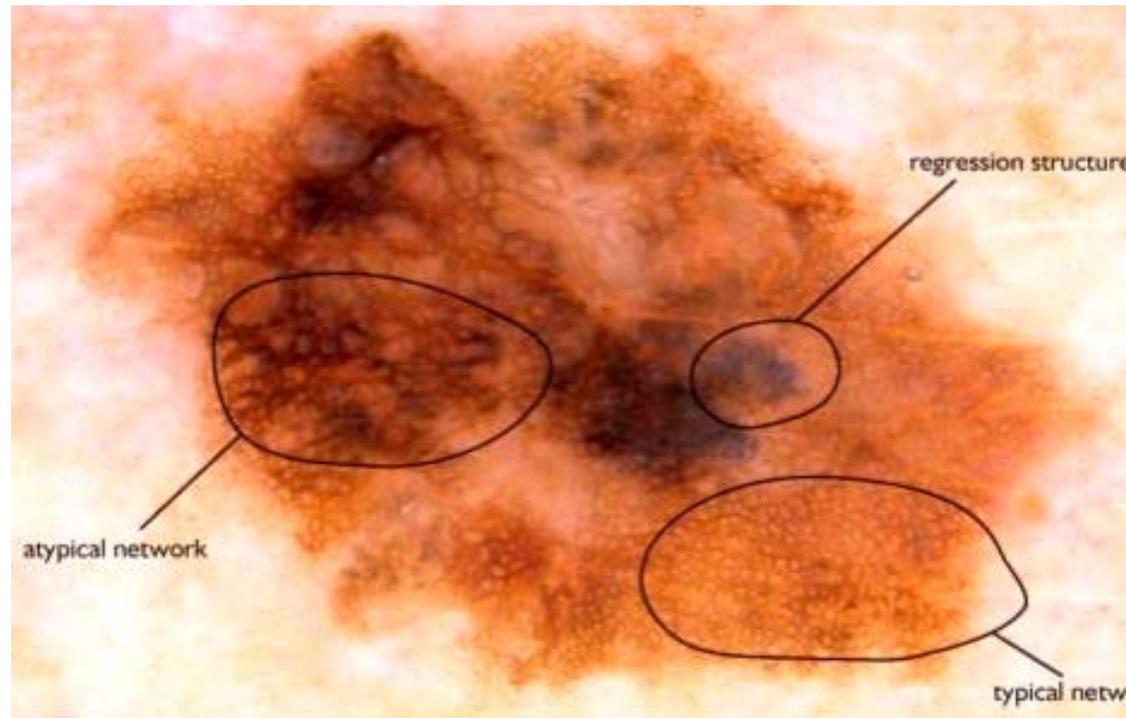
Images from: Introduction to Dermoscopy, Dr. Kittler



Clinical Diagnostic Methods

- ABCD (A)symmetry, (B)order, (C)olor, (D)ermoscopy Structures)
- CASH (C)olor, (A)rchitecture, (S)ymmetry, (H)omogeneity)
- Pattern Analysis(7 point, 3 point check list, Menzie's,...)

3-POINT CHECKLIST	
Asymmetry	<input checked="" type="checkbox"/>
Atypical network	<input checked="" type="checkbox"/>
Blue-white structures	<input checked="" type="checkbox"/>
Total score	3
Melanoma ≥ 2	



Tab. I: The criteria of the 7-point checklist

ELM Criterion	Score
<i>Major criteria</i>	
1. Atypical pigment network	2 <input checked="" type="checkbox"/>
2. Blue-whitish veil	2 <input checked="" type="checkbox"/>
3. Atypical vascular pattern	2
<i>Minor criteria</i>	
4. Irregular streaks	1
5. Irregular pigmentation	1
6. Irregular dots/globules	1
7. Regression structures	1 <input checked="" type="checkbox"/>
Melanoma ≥ 3	5

Digital Dermoscopes

- 3Gen DermLite Dermoscopes
- 3M Dino-Lite with USB
- FotoFinder HandyScope with iPhone 4
- Canfield DermScope with iPhone 4



(a) Heine10®



(b) Heine20®



(c) DermLite III DL3®



(d) DermLite(TM) DL100®



(e) DermLite II Pro®



(f) DinoLite



(g) Handyscope

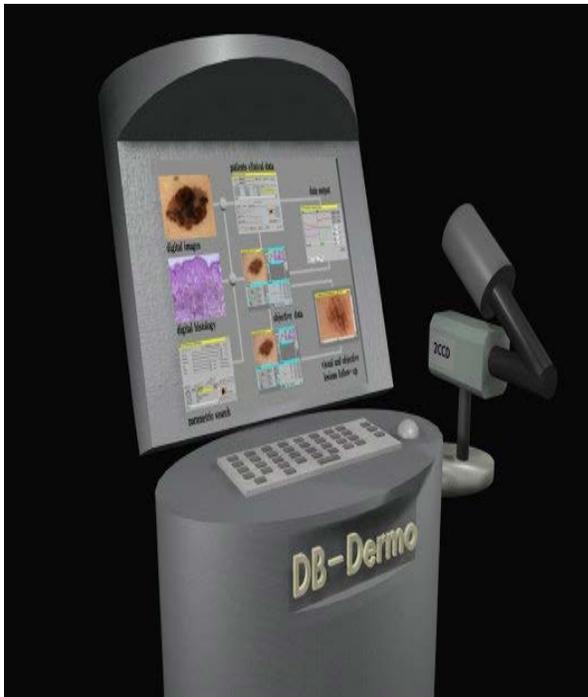
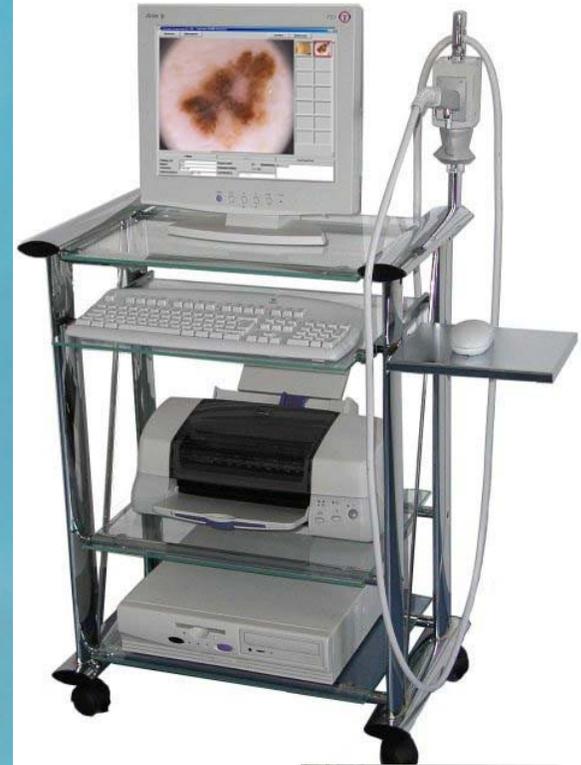


(h) DermScopeCanfield

“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*

Small Pigmented Lesion Study Experts vs Computer

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

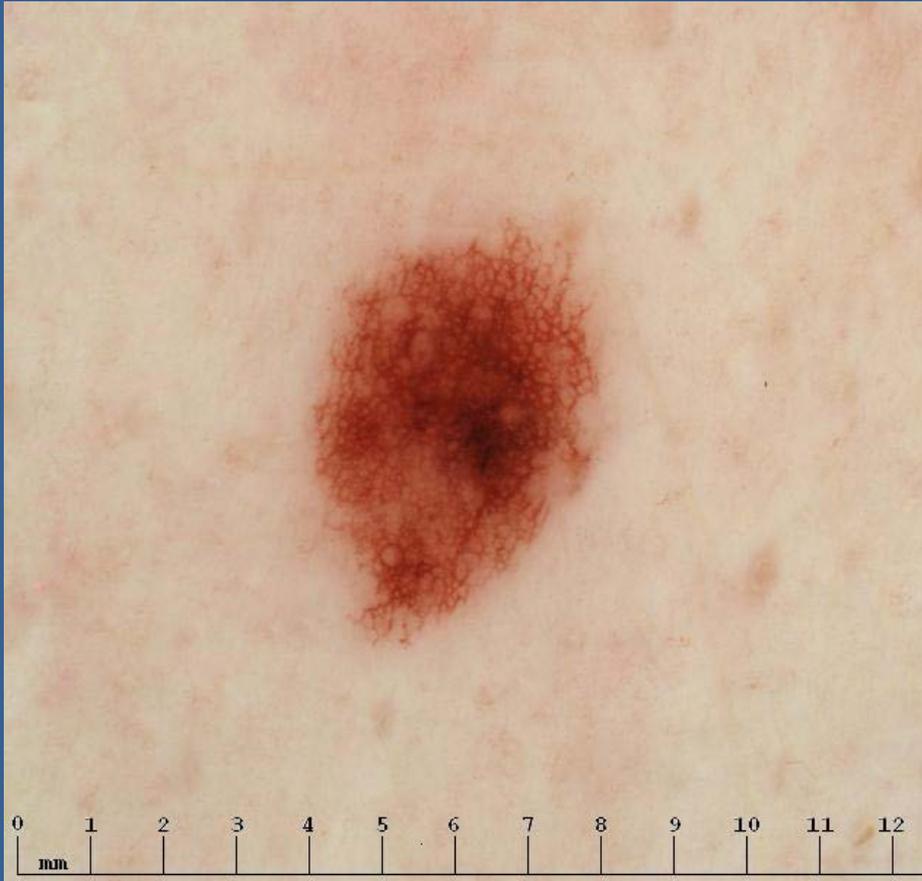
9 independent readers (dermoscopists)

Questions: Melanoma or not melanoma? To
biopsy or not to biopsy?

Friedman RJ, Gutkowitz-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.

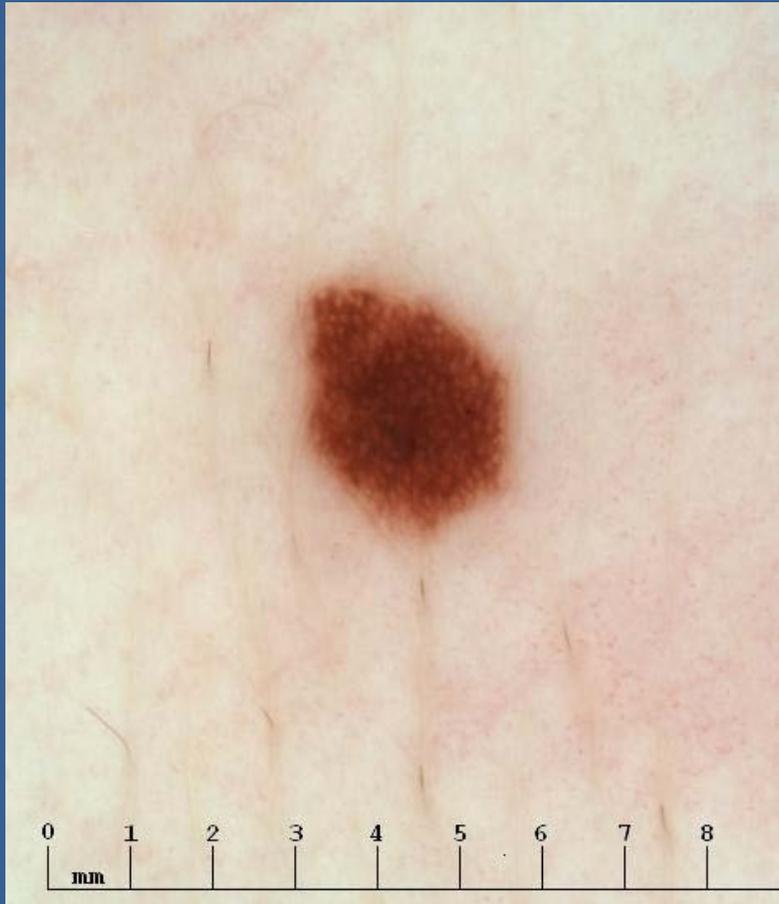
Case # 8



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

Reviewer	Melanoma?	Biopsy?
A	No	No
B	No	No
C	No	No
D	No	No
E	No	No
F	No	No
H	No	No
I	No	No
J	No	No
Computer	Yes	Yes

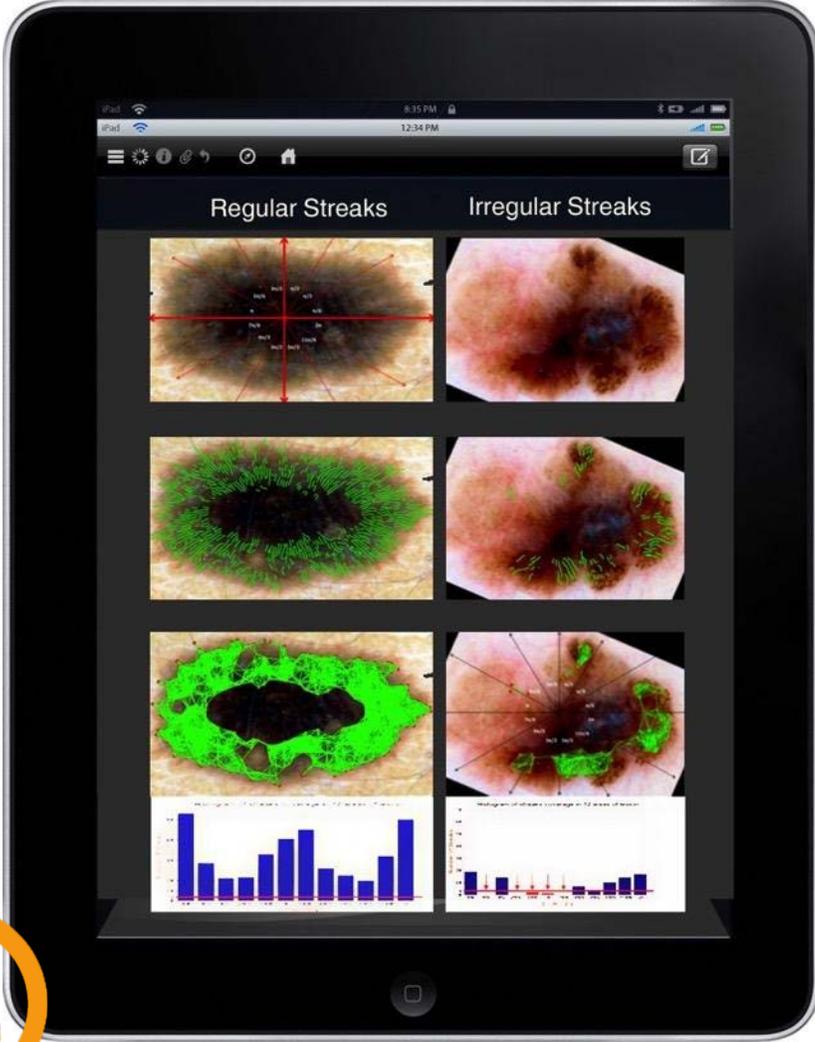
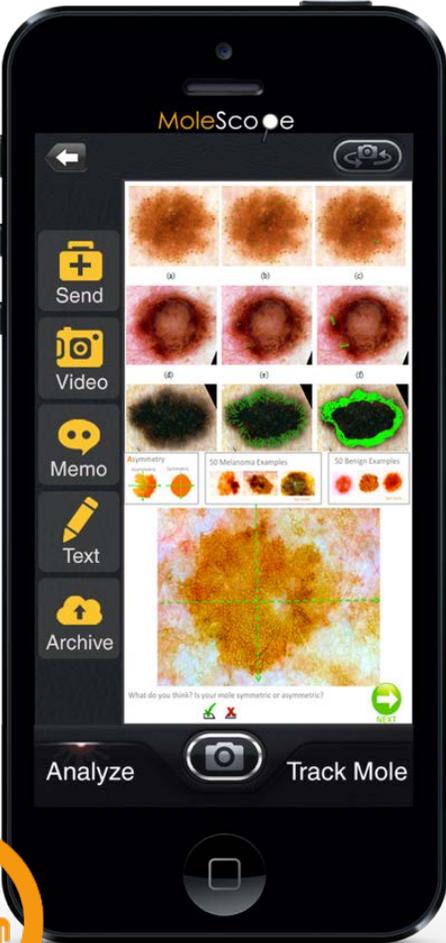
Case # 32



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

Reviewer	Melanoma?	Biopsy?
A	No	No
B	No	No
C	No	No
D	No	No
E	No	No
F	No	No
H	No	No
I	No	No
J	No	No
Computer	Yes	Yes

Pattern Matching



My Fun PhD Journey



SFU's Dean Medal



CIPPRS Doctoral Award



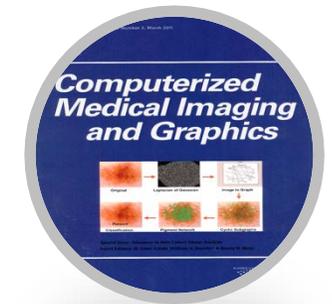
Microsoft ACM Silver Medal

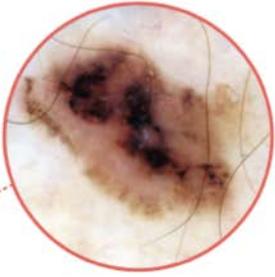


World Congress of Dermatology Gold Medal



CMIG Journal





DermEngine™
Smart Skin Analytics



MetaOptima

Jan 2014

Solution: DermEngine AI



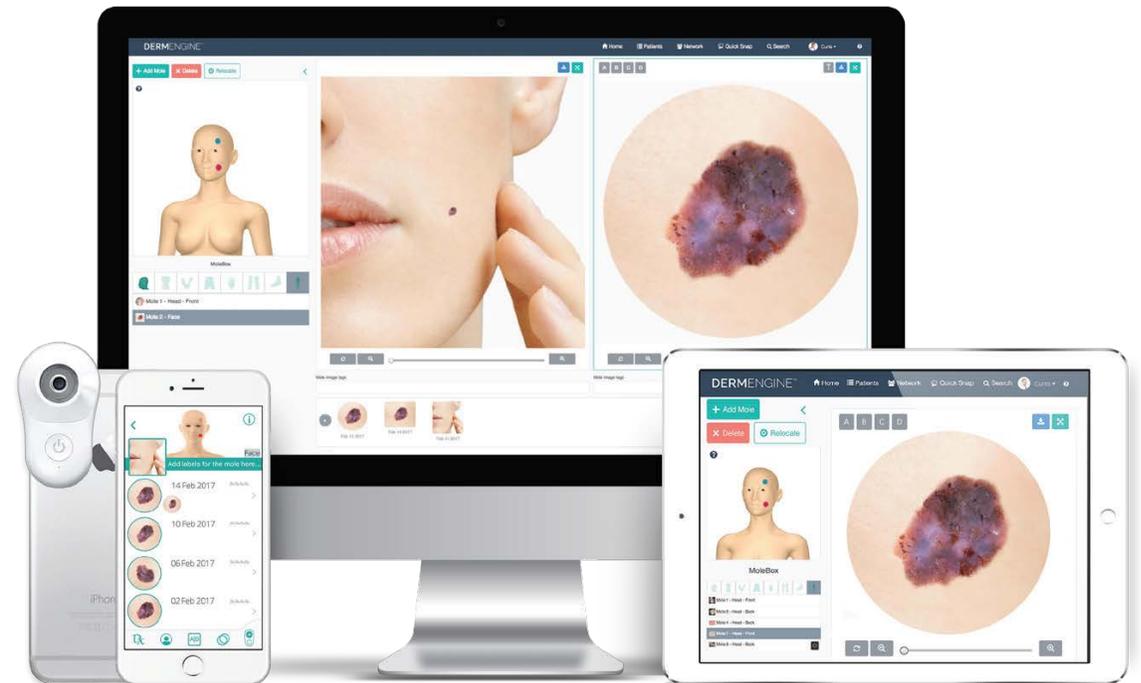
Improves accuracy



It is Secure, Scalable and Accessible

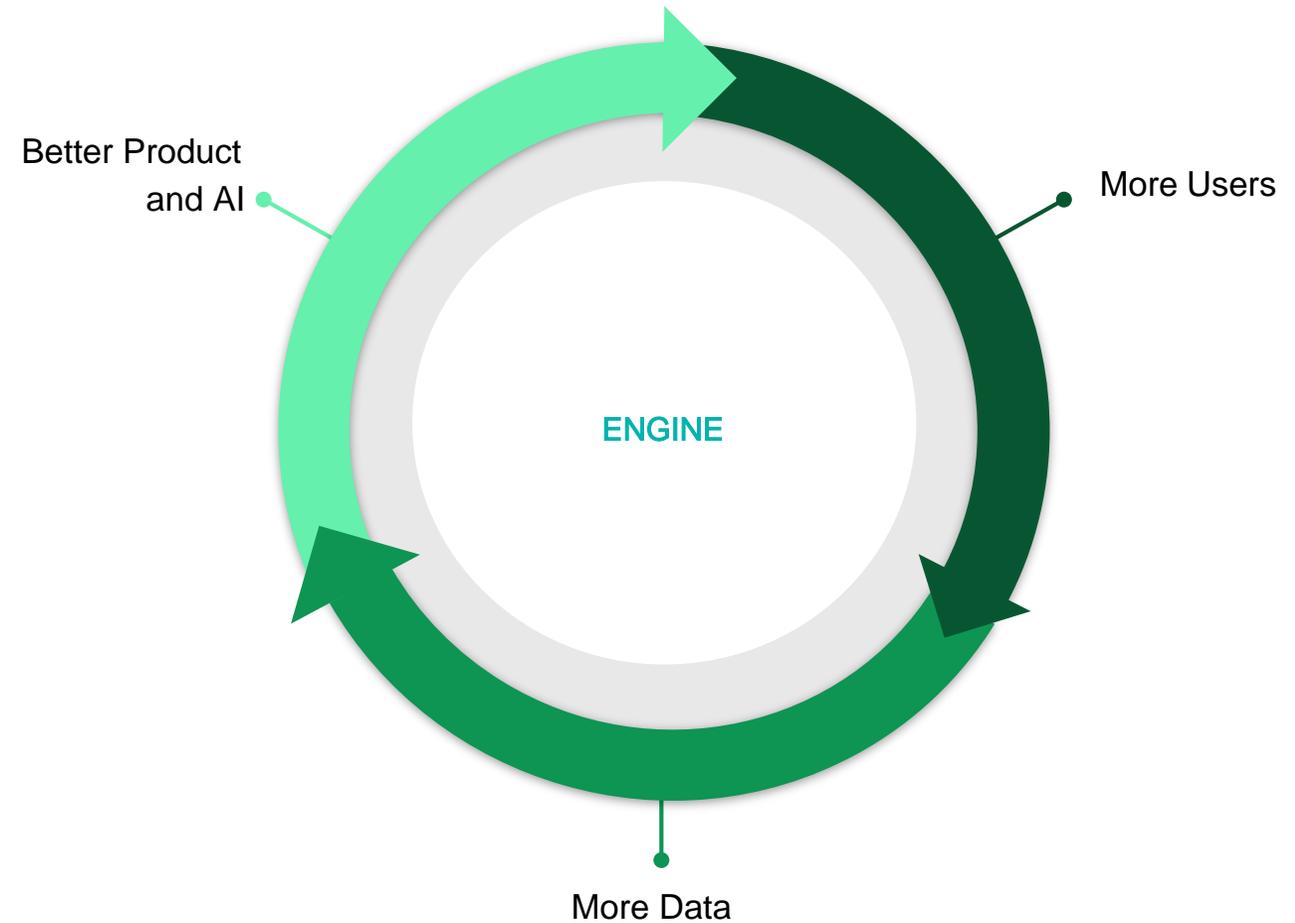


Saving **life**, cost and time



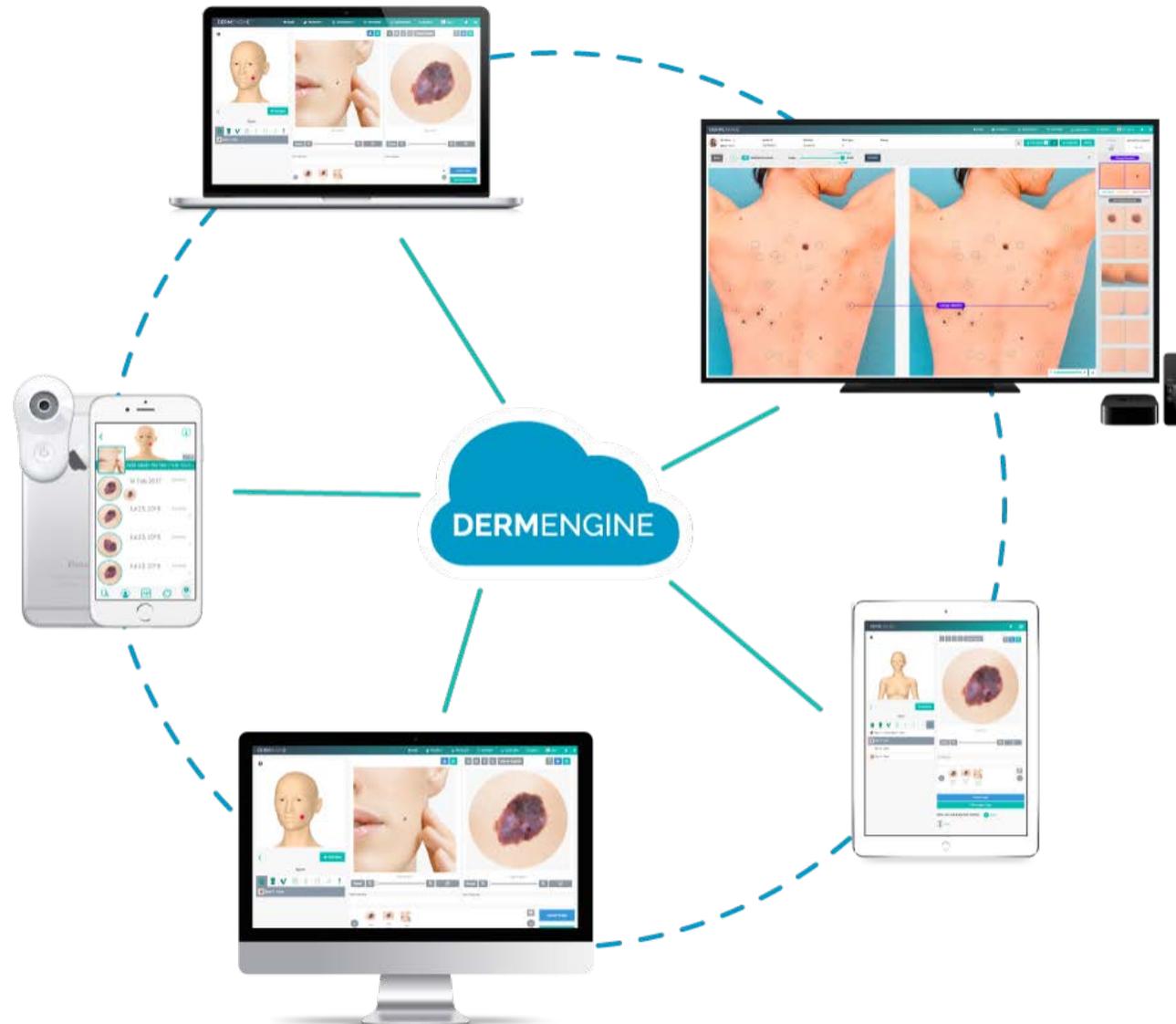
Solution: AI in Dermatology

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





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

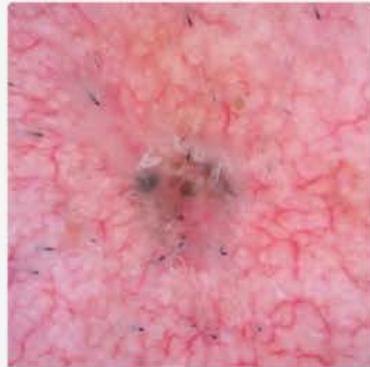
DermEngine Deep Diagnostics

Back

Algorithm 1

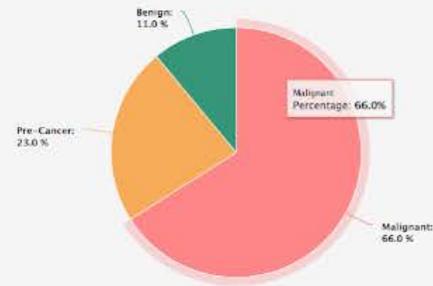
Algorithm 2

Selected Image

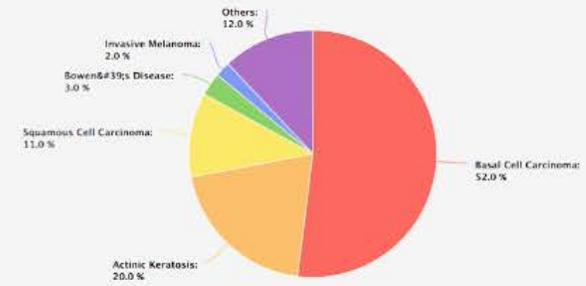


Basal Cell Carcinoma

Malignant vs Pre-cancer vs Benign Ratio



Top Diagnosis



Similar Images



Basal Cell Carcinoma

Similar Images



Basal Cell Carcinoma

Similar Images



Actinic Keratosis

Similar Images



Basal Cell Carcinoma

Similar Images



Nodular Basal Cell Carcinoma

Similar Images



Basal Cell Carcinoma

Similar Images



Basal Cell Carcinoma

Similar Images



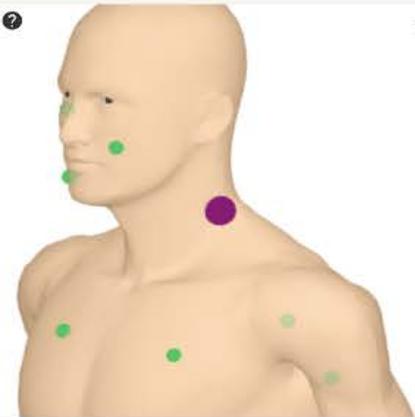
Squamous Cell Carcinoma

Similar Images



3D BODY MAP

TBP IMAGES



+ Add Spot

Spots



Spot 1 - Back

Spot 2 - Right Forearm - Posterior

Spot 3 - Face

Spot 4 - Face

Spot 5 - Left Leg - Posterior

Spot 6 - Neck - Anterior

Spot 7 - Face

Spot 8 - Right Thigh - Anterior

Spot 10 - Left Thigh - Anterior

Spot 11 - Chest

DATE USER ACTION DETAILS

Aug 13, 2020 You Visit Notes @Dr.Alex Doe book for surgery

Aug 13, 2020 You Clinical Dx Dx: BCC. Action: Biopsy/Excision. Notes: We recommend that you book an appointment with your doctor to examine this cas...

Jul 17, 2020 Dr.A. Hersh Tele-consult Dx Dx: Basal cell carcinoma. Recommendation: Biopsy/Excision. Notes: Lesions consistent with BCC. Extensional biopsy recom...

View All



Add Tags

Jun 18, 2019



Add Tags

Jul 03, 2019



Jul 03, 2019 Jun 18, 2019

Tile View

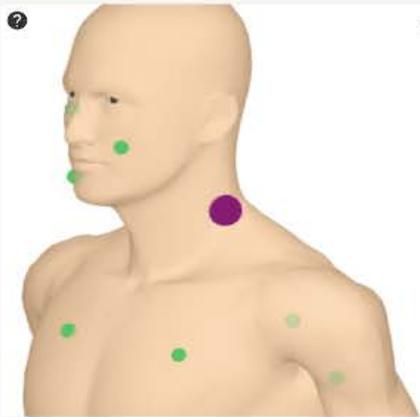
UPLOAD IMAGES



TAKE IMAGE ON APP

3D BODY MAP

TBP IMAGES



+ Add Spot

Spots



Spot 1 - Back

Spot 2 - Right Forearm - Posterior

Spot 3 - Face

Spot 4 - Face

Spot 5 - Left Leg - Posterior

Spot 6 - Neck - Anterior

Spot 7 - Face

Spot 8 - Right Thigh - Anterior

Spot 10 - Left Thigh - Anterior

Spot 11 - Chest

DATE USER ACTION DETAILS

Aug 13, 2020	You	Visit Notes	@Dr.Alex Doe book for surgery
Aug 13, 2020	You	Clinical Dx	Dx: BCC. Action: Biopsy/Excision. Notes: We recommend that you book an appointment with your doctor to examine this cas...
Jul 17, 2020	Dr.A. Hersh	Tele-consult Dx	Dx: Basal cell carcinoma. Recommendation: Biopsy/Excision. Notes: Lesions consistent with BCC. Extensional biopsy recom...

View All



Jun 18, 2019



Jul 03, 2019



Jun 18, 2019



Jul 03, 2019



Tile View

UPLOAD IMAGES



TAKE IMAGE ON APP

DermEngine Deep Diagnostics

Visual Search

Selected Image

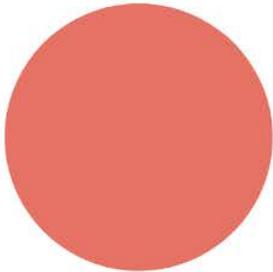


Region Search

Statistics of Most Similar Images

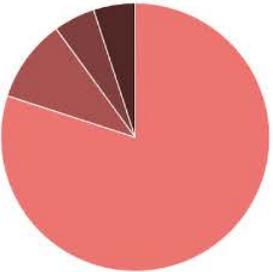
Not a diagnostic tool

Malignancy for Similar Images



Malignant

Diagnoses for Similar Images



- Basal Cell Carcinoma
- Nodular Basal Cell Car...
- Actinic Keratosis
- Actinic Keratosis / Intr...

Similar Images Select an image below to compare with your image.



Basal Cell Carcinoma

Basal Cell Carcinoma

Basal Cell Carcinoma

Nodular Basal Cell C...

Actinic Keratosis

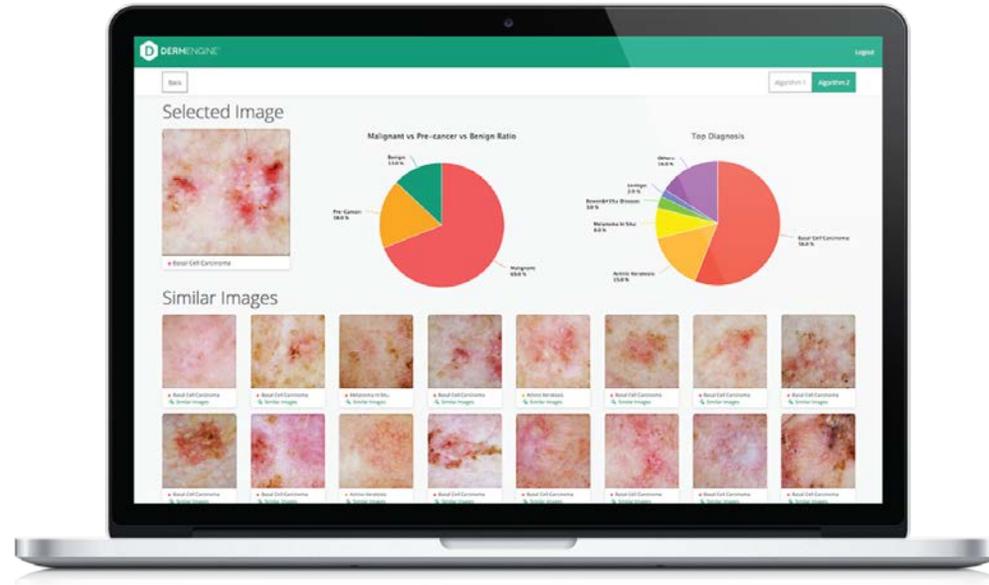
Basal Cell Carcinoma

Basal Cell Carcinoma

Basal Cell Carcinoma

Basal Cell Carcinoma

Nodular Basal Cell C...



AI Models

International ISIC Challenge winner.
 Top 3 AI models among 140 algorithms from 77 international teams.



Experts Worldwide

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 DermEngine AI.

AI vs human Performance

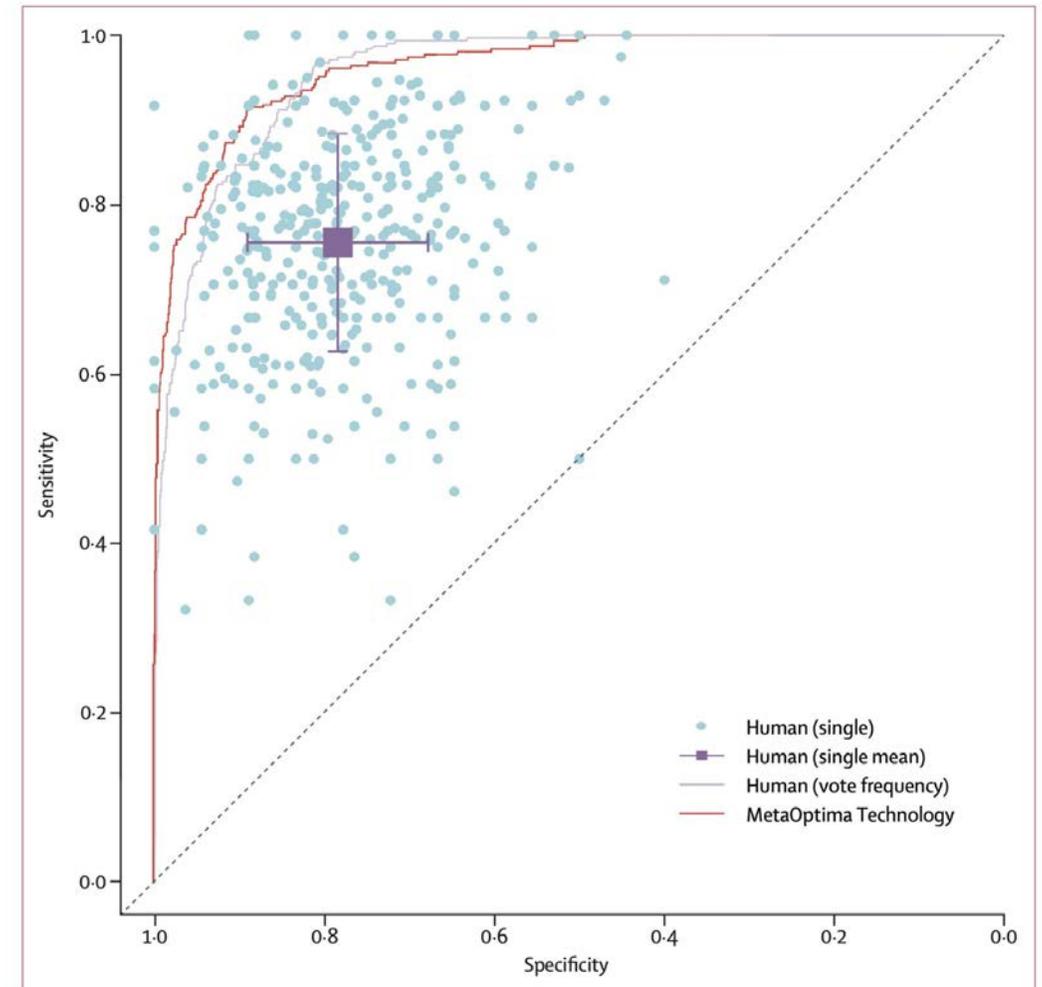
THE LANCET
Oncology

ARTICLES | VOLUME 20, ISSUE 7, P938-947, JULY 01, 2019

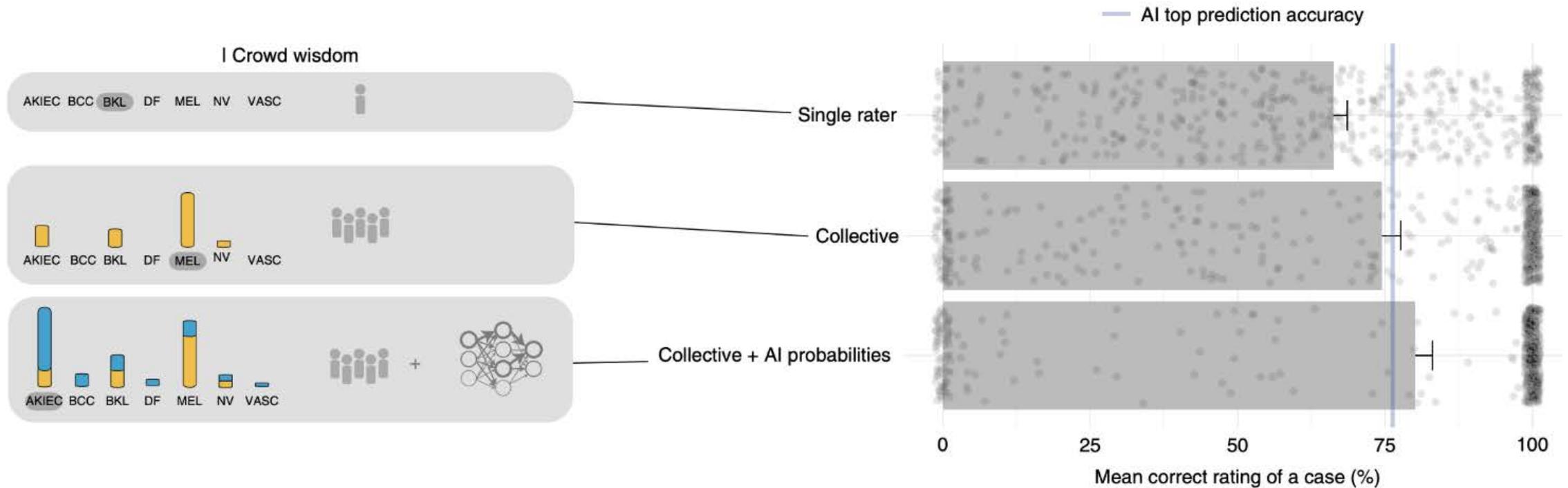
Comparison of the accuracy of human readers versus machine-learning algorithms for pigmented skin lesion classification: an open, web-based, international, diagnostic study

Philipp Tschandl, PhD • Noel Codella, PhD • Bengü Nisa Akay, MD • Prof Giuseppe Argenziano, PhD •

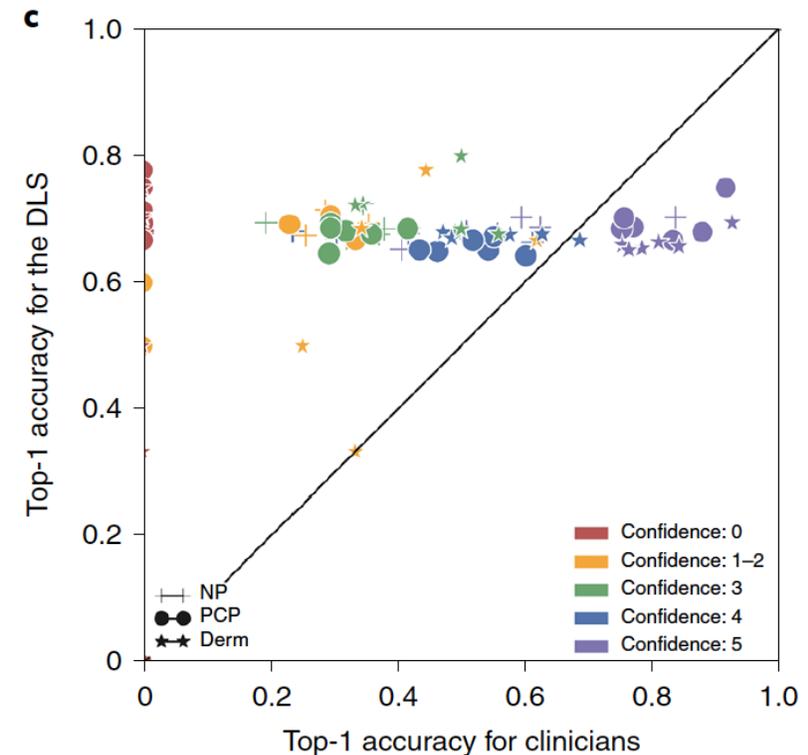
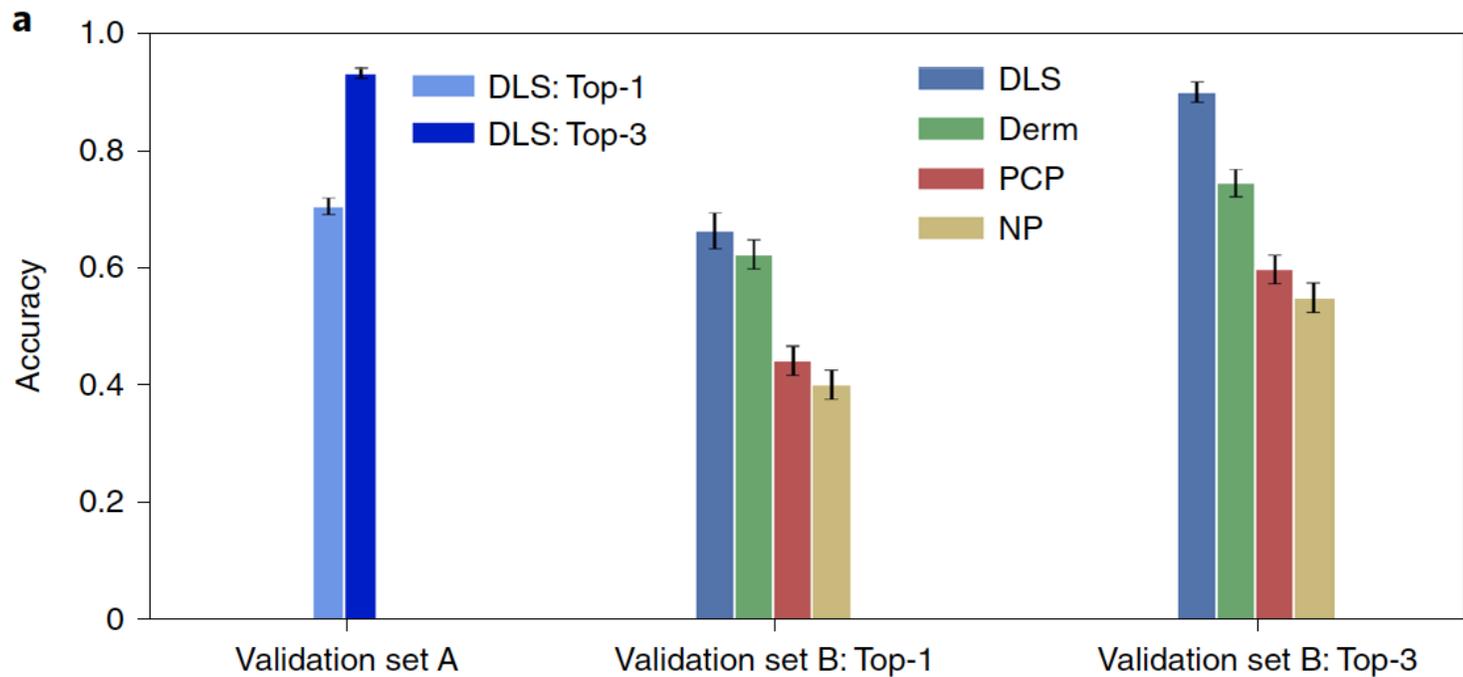
Ralph P Braun, MD • Prof Horacio Cabo, MD • et al. [Show all authors](#)

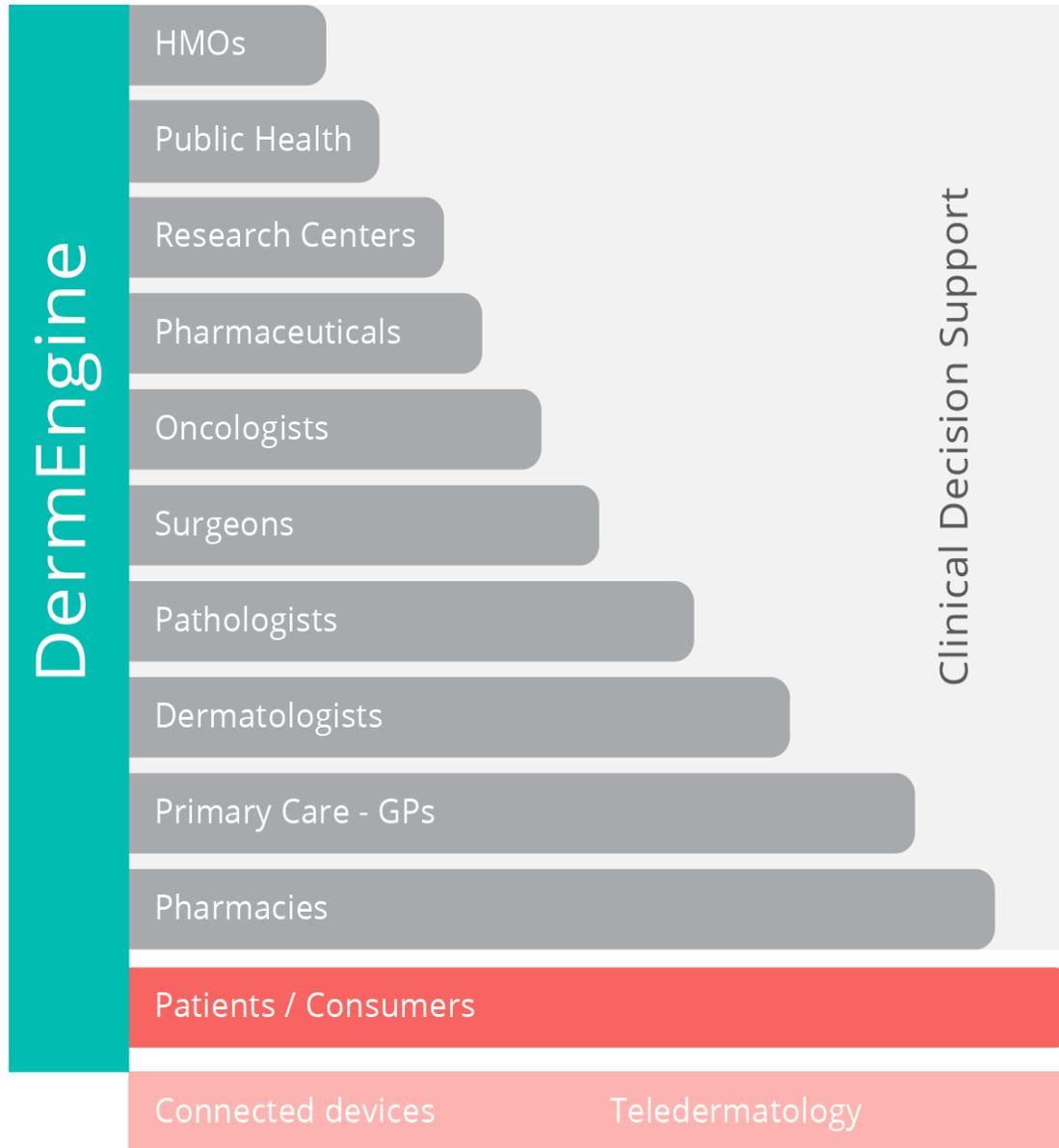


Recent Publications on AI vs Human



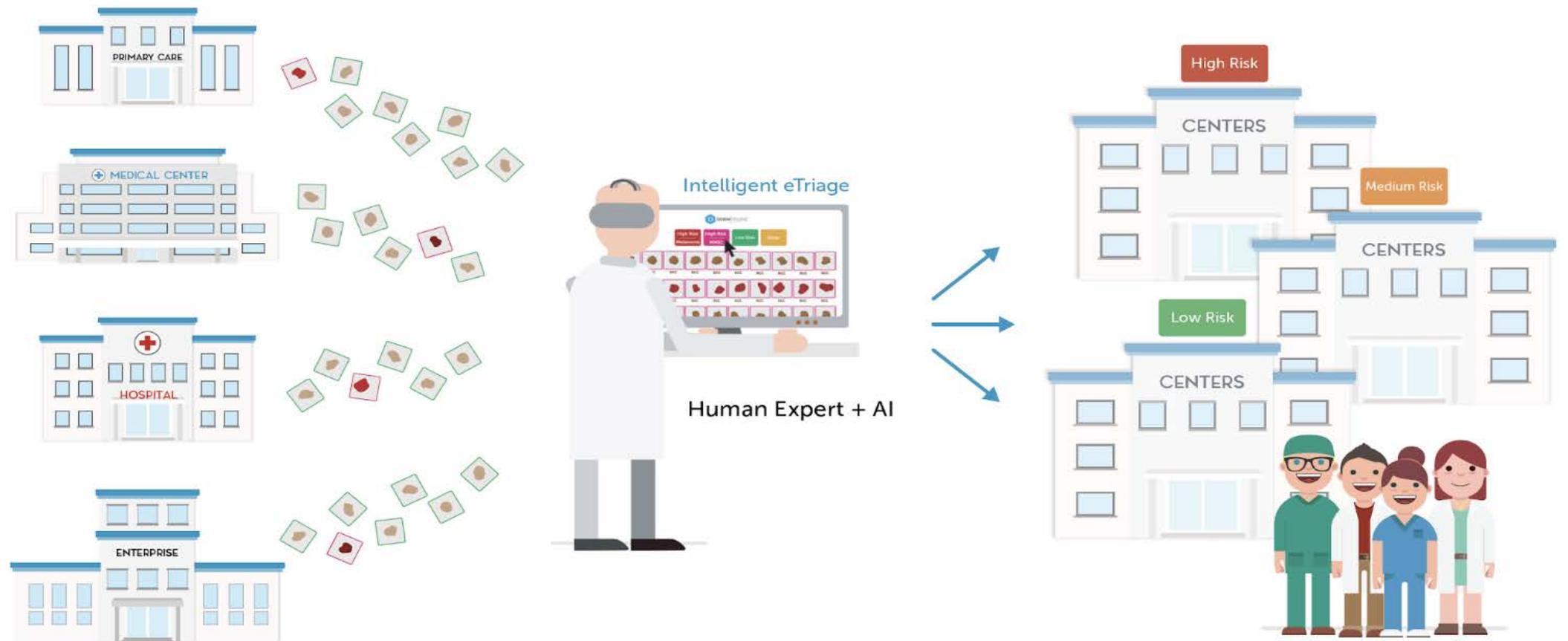
AI In General Dermatology





Vertical Integration of Artificial Intelligence

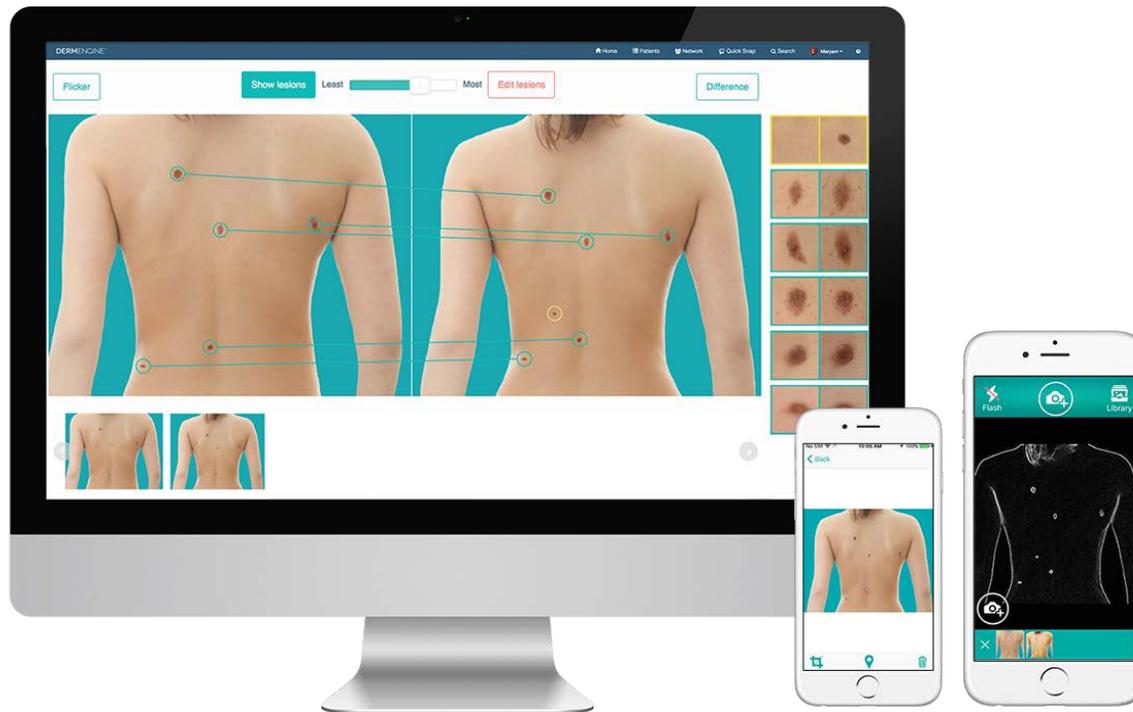
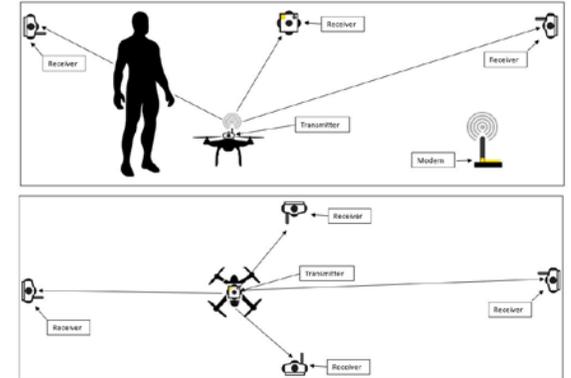
AI Implementation in Healthcare Systems



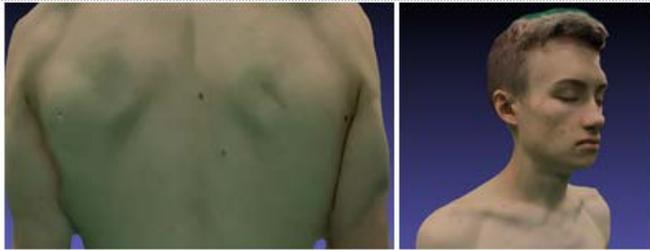
Your DermDrone - Your Intelligent Assistant

- DermDrone Platform

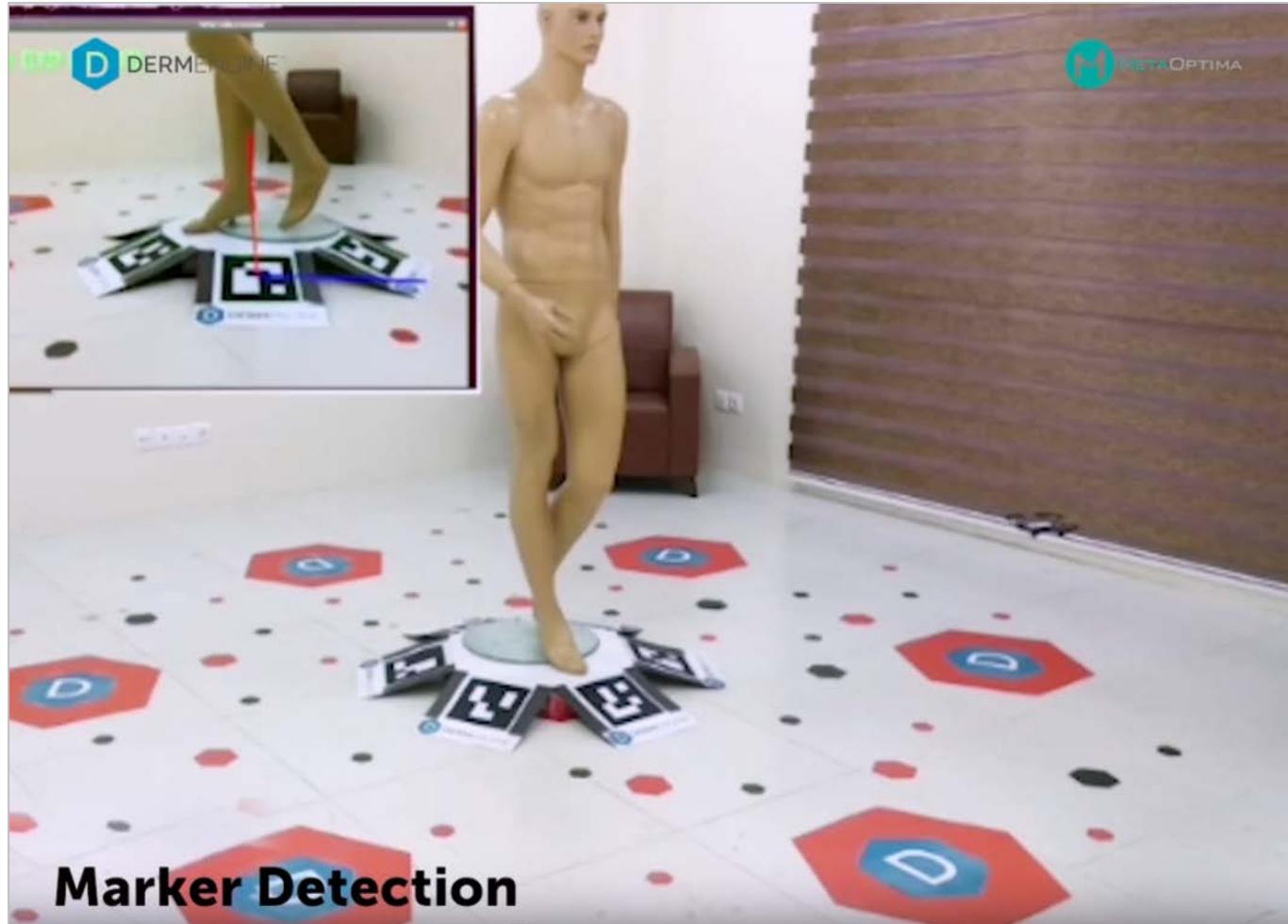
- Intelligent and autonomous total body exams
- The world's first drone in intelligent medical applications



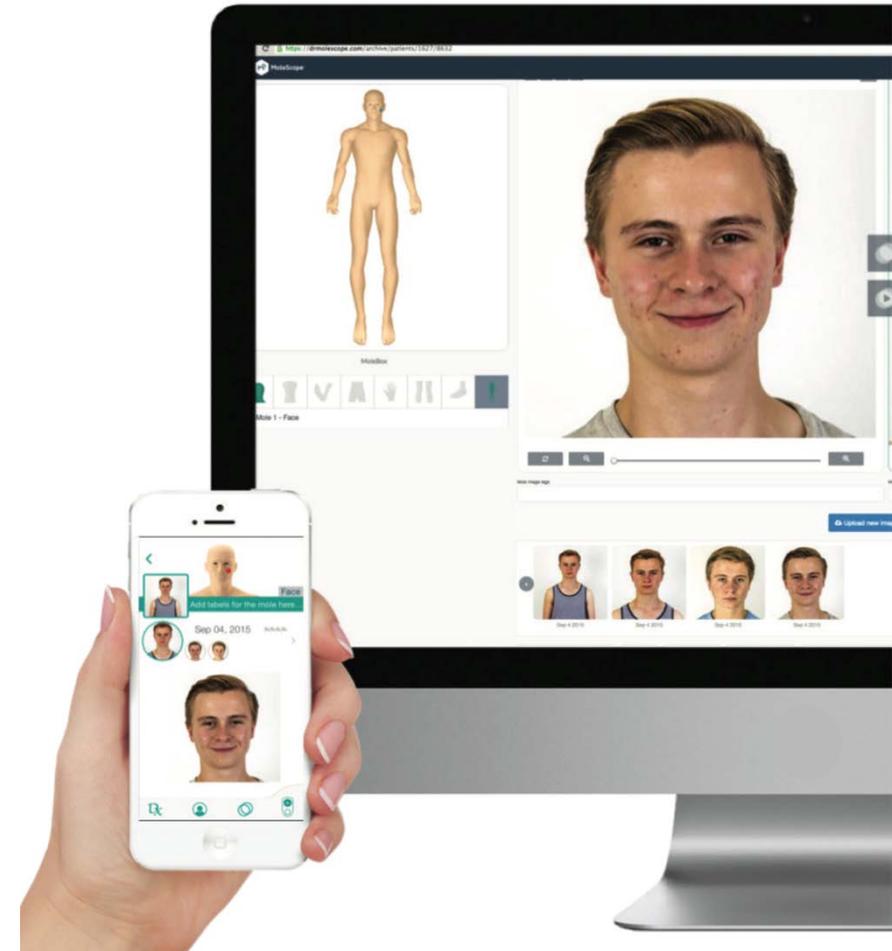
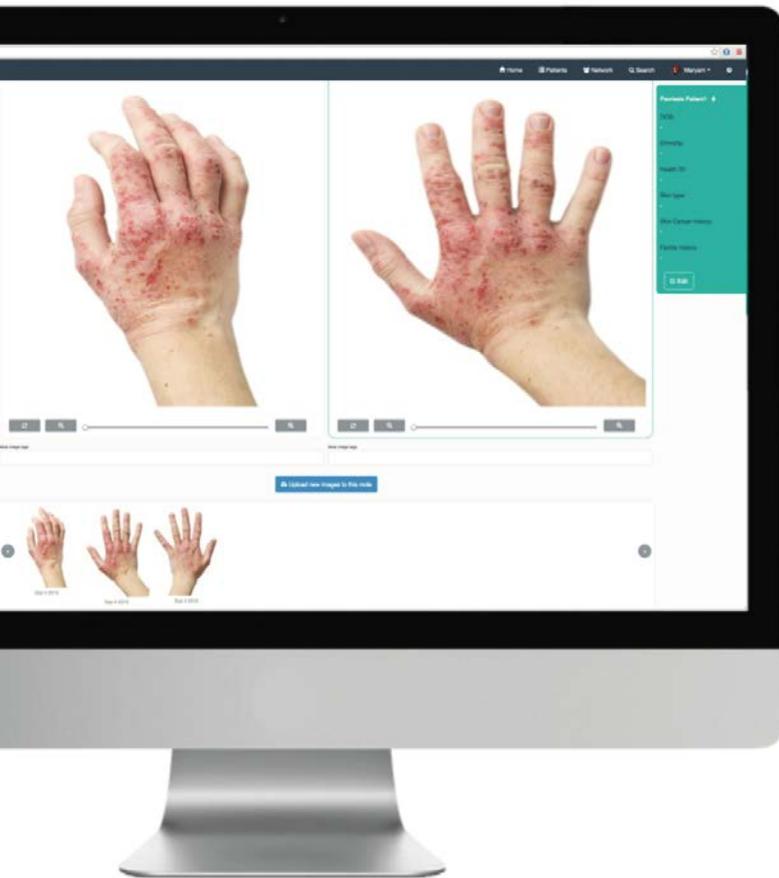
Your DermDrone- Your Intelligent Assistant



Your DermDrone - Your Intelligent Assistant



AI in General Dermatology





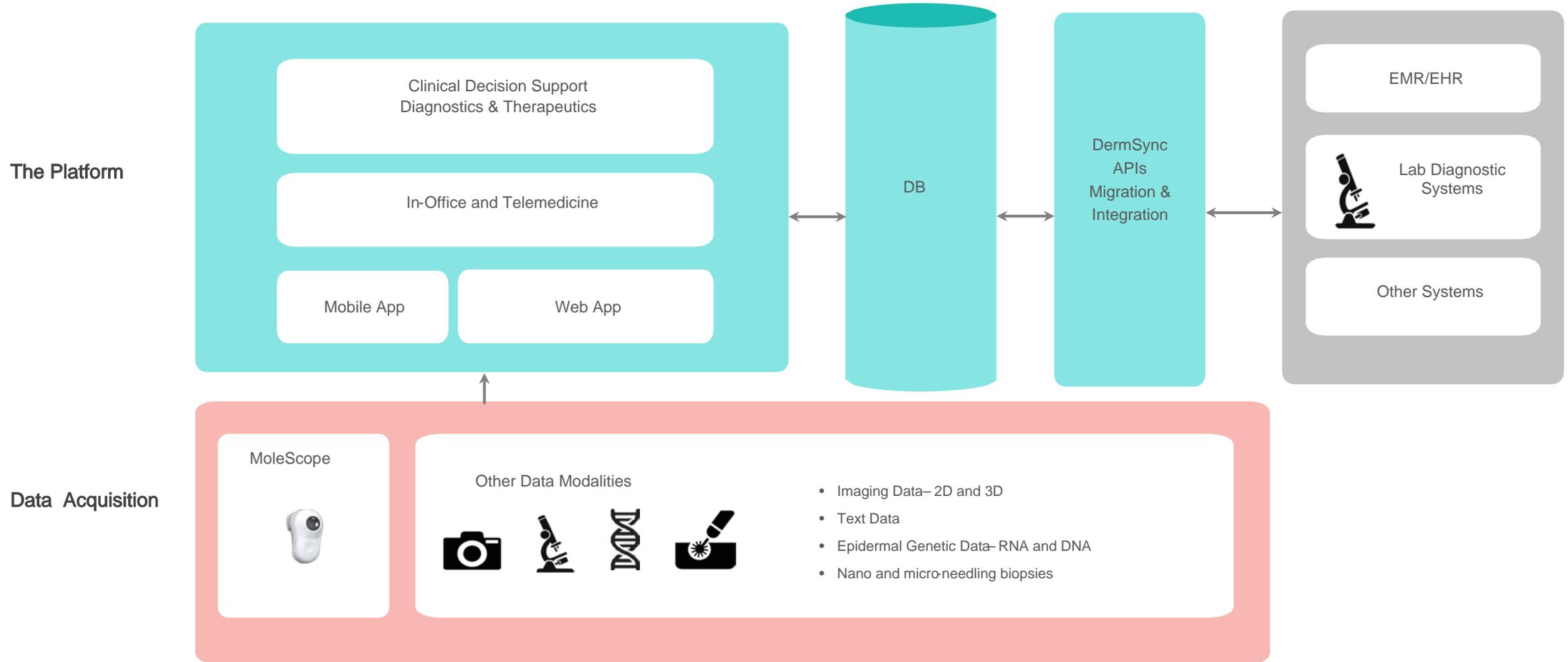


Contact

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CEO, Co-founder

maryam@metaoptima.com
+1 (778) 892-0248

The Engine



Structured Integrated Multimodality Data for Noninvasive and Minimally Invasive Diagnostics