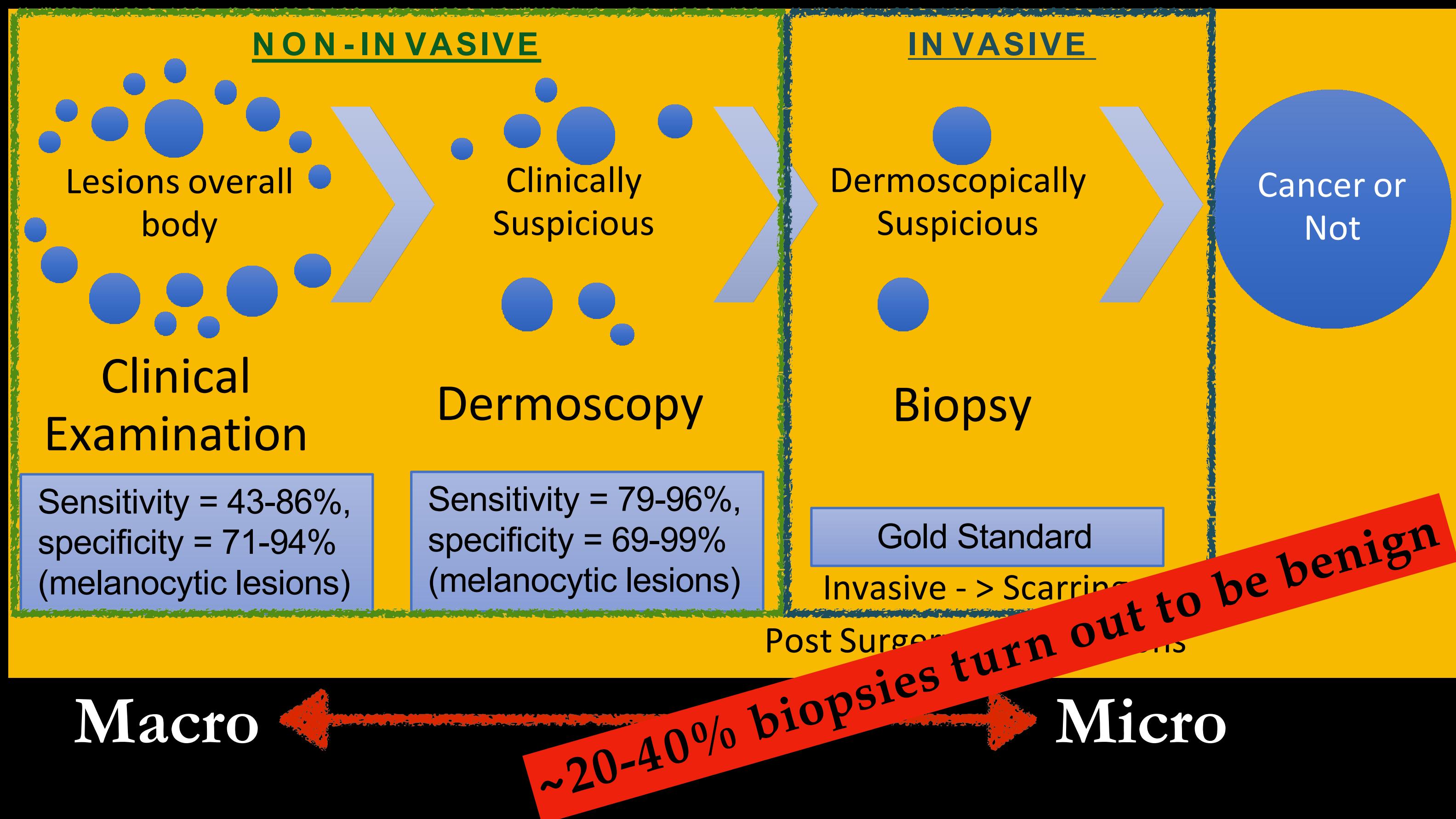


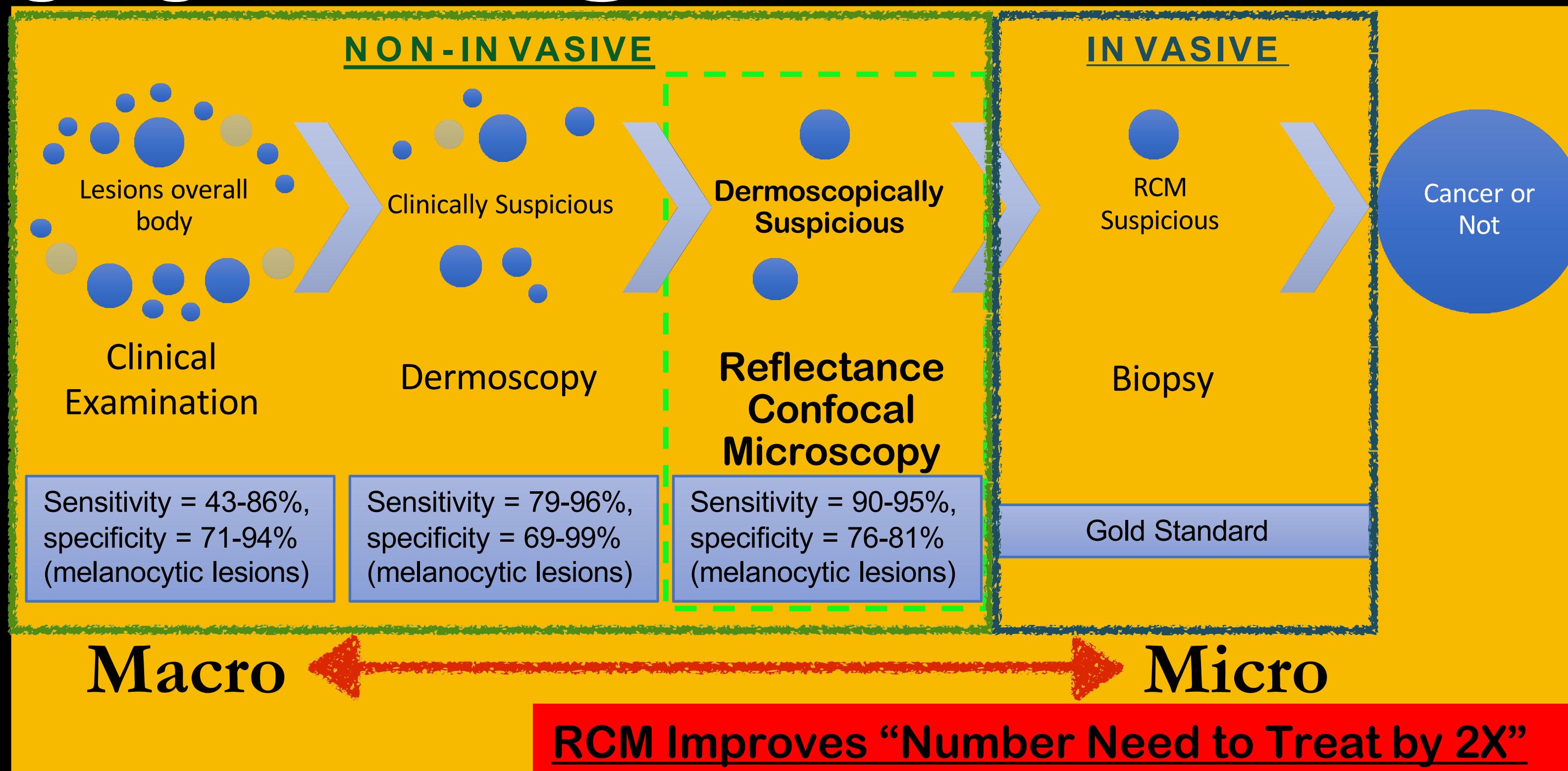
# Tools for clinician-AI collaboration and dermatology AI research

Veronica Rotemberg, MD, PhD  
Memorial Sloan Kettering Cancer Center  
Dermatology Service  
ECCV 2022

# Imaging in Derm@MSKCC



# Imaging in Derm@MSKCC



# Where are we standing?

## Dermatology Service at MSKCC

### Optical Imaging Group

#### **Developing Optical Imaging Technologies**

*Reflectance Confocal Microscopy*

*Optical Coherence Tomography*

*Widefield Imaging*

### Image Informatic Group

#### **International Skin Imaging Collaboration (ISIC)**

*Ingestion of Data from Collaborators*

*AI Challenges*

#### **Developing Computer Vision and AI for These Techniques**

*Dermal Epidermal Junction Detection*

*Morphology Segmentation*

*Videomosaicking*

#### **Integration of Imaging and AI In the Clinic**

*Dermoscopy*

*Reflectance Confocal Microscopy*



### Multimodal-ISIC (M-ISIC)



Ingestion, Integration and Archival of Multimodal Data in an organized way

# ISIC Archive → M-ISIC

Enabling the next frontier in multimodal dermatology AI/ML research

Search by filters  Search by name



Search images

Select All on the Page for Download

Shown images: 1-54. Total amount of images: 238416.

Automatic width compilation



APPLIED FILTERS

[Clear applied filters](#)

## DIAGNOSTIC ATTRIBUTES

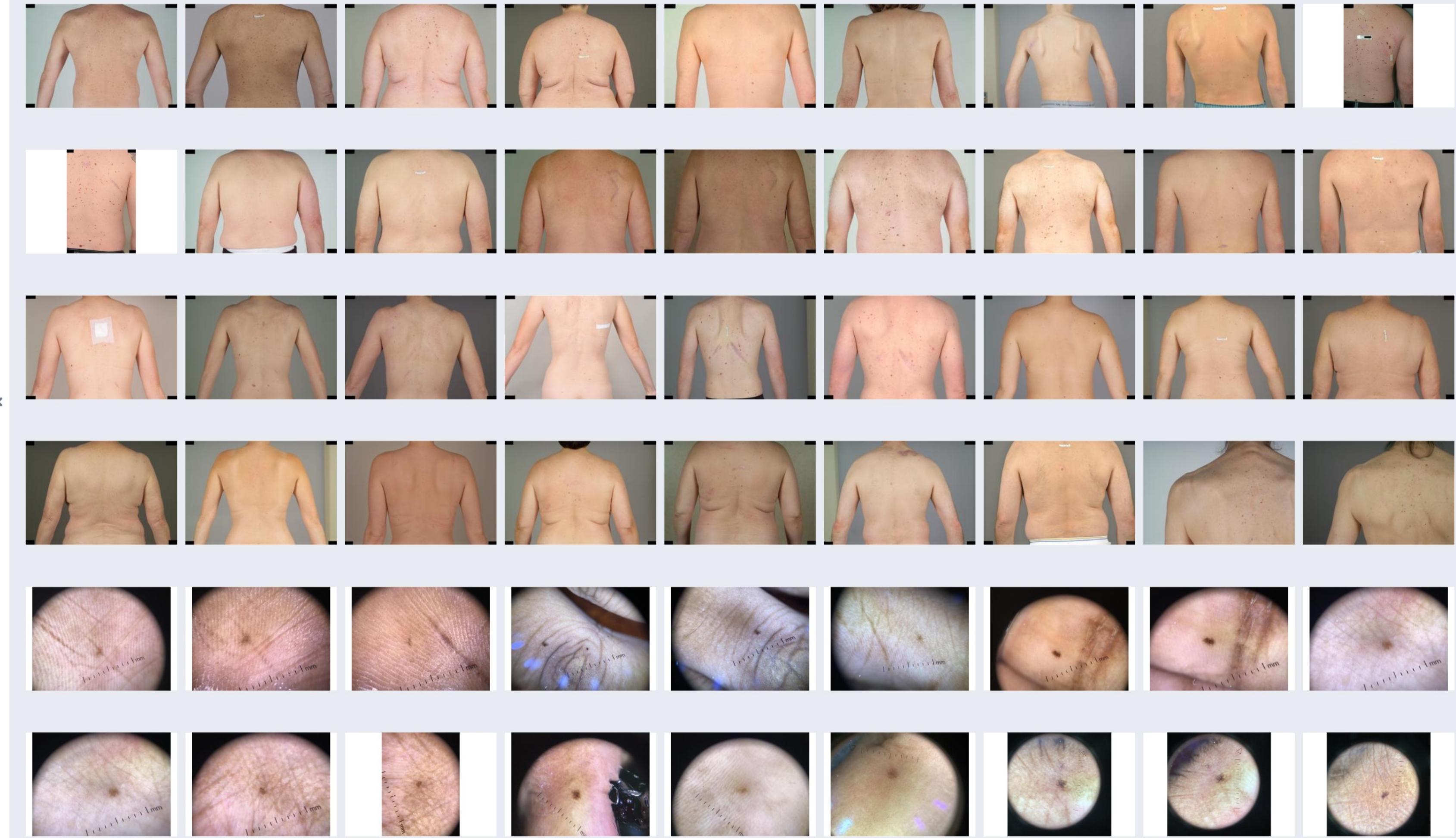
- ▶ BENIGN OR MALIGNANT
- ▶ LESION DIAGNOSIS

## CLINICAL ATTRIBUTES

- ▶ APPROXIMATE AGE
- ▶ GENERAL ANATOMIC SITE
- ▶ CLINICAL SIZE - LONGEST DIAMETER (MM)
- ▶ TYPE OF DIAGNOSIS
- ▶ FAMILY HISTORY OF MELANOMA
- ▶ MELANOMA CLASS
- ▶ MELANOMA MITOTIC INDEX
- ▶ MELANOMA THICKNESS (MM)
- ▶ MELANOMA TYPE
- ▶ MELANOMA ULCERATION
- ▶ MELANOCYTIC
- ▶ NEVUS TYPE
- ▶ PERSONAL HISTORY OF MELANOMA
- ▶ SEX

## TECHNOLOGICAL ATTRIBUTES

- ▶ DERMOSCOPIC TYPE
- ▶ IMAGE TYPE

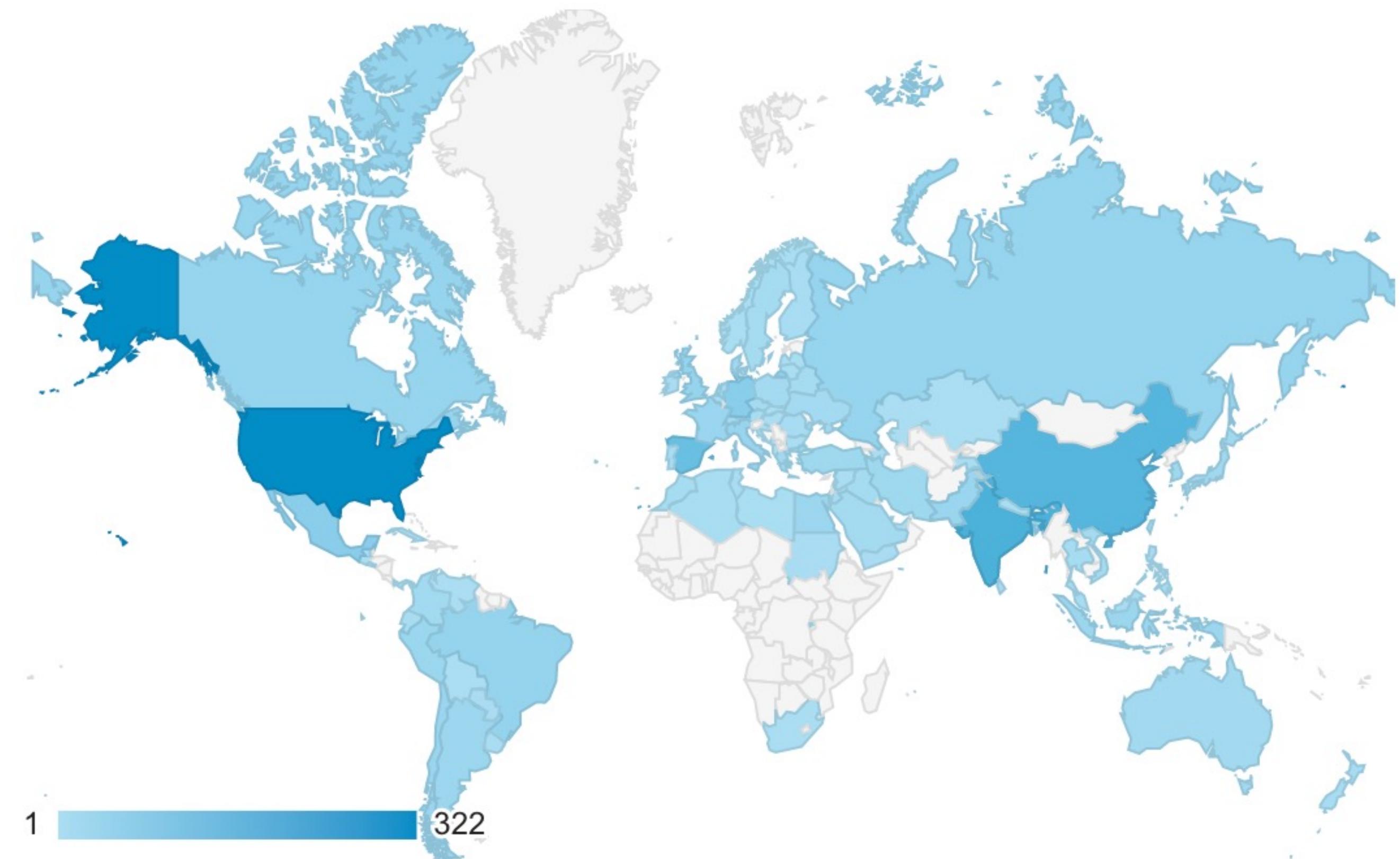


# Map Overlay

# Explorer

Summary Site Usage Ecommerce

Users ▾



Primary Dimension: **Country** City Continent Sub Continent

# ISIC Grand Challenges for Melanoma Detection

Year	Conference	Number of Diagnoses	Training	Test	Participants
			(N images)	(N images)	
2016	ISBI	2 (melanoma, nevi)	1,000	400	24
2017	ISBI	3 (melanoma, nevi, SK)	2,000	600	23
2018	MICCAI	7 (melanoma, nevi, SK, BCC, SCC, angioma, DF)	10,000	1,500	160
2019	MICCAI & CVPR	8 + 1 (melanoma, nevi, BKL, BCC, SCC, angioma, AK, DF)	30,000	8,,239	200
2020	MICCAI & CVPR	2: Benign and Melanoma + Patient-level contextual images and Patient ID	33,126	10,982	3300

# 2020 Grand Challenge

- Partnership with:
  - The University of Queensland
  - Memorial Sloan Kettering Cancer Center
  - University of Athens
  - Medical University of Vienna
  - Hospital Clinic Barcelona
  - Melanoma Institute Australia and Sydney Melanoma Diagnostic Center
- Cohost: Society for Imaging Informatics in Medicine (SIIM)
- Hosted on Kaggle for the first time
- 3,314 teams participated

kaggle

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Featured Prediction Competition

## SIIM-ISIC Melanoma Classification

Identify melanoma in lesion images

SIIM & ISIC · 3,314 teams · 2 months ago

\$30,000 Prize Money

Overview Data Notebooks Discussion Leaderboard Rules Team Host My Submissions New Topic

870 topics Following Sort by Hotness

Recently Viewed Search Topics

All Owned Upvoted

Rank	User	Topic	Last comment	Upvotes
2	Julia Elliott	Call for Manuscripts!	3d ago by Girdhari	6
5	Julia Elliott	Call for Submissions: With/Without Context Special Prizes!	2mo ago by Julia Elliott	11
22	Anna Zawacki	Join SIIM AI Conference Virtually on 9/13-14	2mo ago by Guilherme Maia	6
62	Jochen Weber	True duplicates in this dataset	4mo ago by Markin	19
15	Phil Culliton	Welcome!	5mo ago by Julia Elliott	34
29	Julia Elliott	Join me in congratulating the TPU Stars!	1mo ago by Ronaldo S.A. Batista	6
10	TeYang Lau	AUROC vs AUC of Precision-Recall Curve as Evaluation Metric	3mo ago by Anthony Leo	3
652	Chris Deotte	Thank you Kagglers - 1st Place Datasets, 1st Notebooks, 1st Discussions	2mo ago by ROHAN SAHANA	313
1	Amritvir Singh	How to combine meta features with Images?	1mo ago by Ali Abdin	2
-3		H5 File ?????	Last comment 1mo ago	2

# Comparison of Algorithm to Human Raters

**DermaChallenge**  
L: 23 - Round: 1 - 3/10 - T: 2 sec.

The main image shows a skin surface with several dark brown, irregular spots. Three callout lines point from the top right towards specific features: one to a small dark speck, one to a larger dark brown spot, and one to a thin, dark, curved line. Below the main image is a 2x4 grid of smaller lesion images. The first image in the top row is highlighted with a blue border. The bottom row contains four solid gray squares.

Melanoma			Benign

Diagnose this lesion without any other information

**DermaChallenge**  
L: 23 - Round: 1 - 4/10 - T: 1 sec.

The main image shows a skin surface with several dark brown, irregular spots. Three callout lines point from the top right towards specific features: one to a small dark speck, one to a larger dark brown spot, and one to a thin, dark, curved line. Below the main image is a 2x4 grid of smaller lesion images. Each image in the grid has a magnifying glass icon in the top right corner. The first image in the top row is highlighted with a blue border. The bottom row contains four solid gray squares.

Melanoma			Benign

Diagnose the lesion again, but now with other lesions of the patient

# Context does not improve human performance as compared to AI

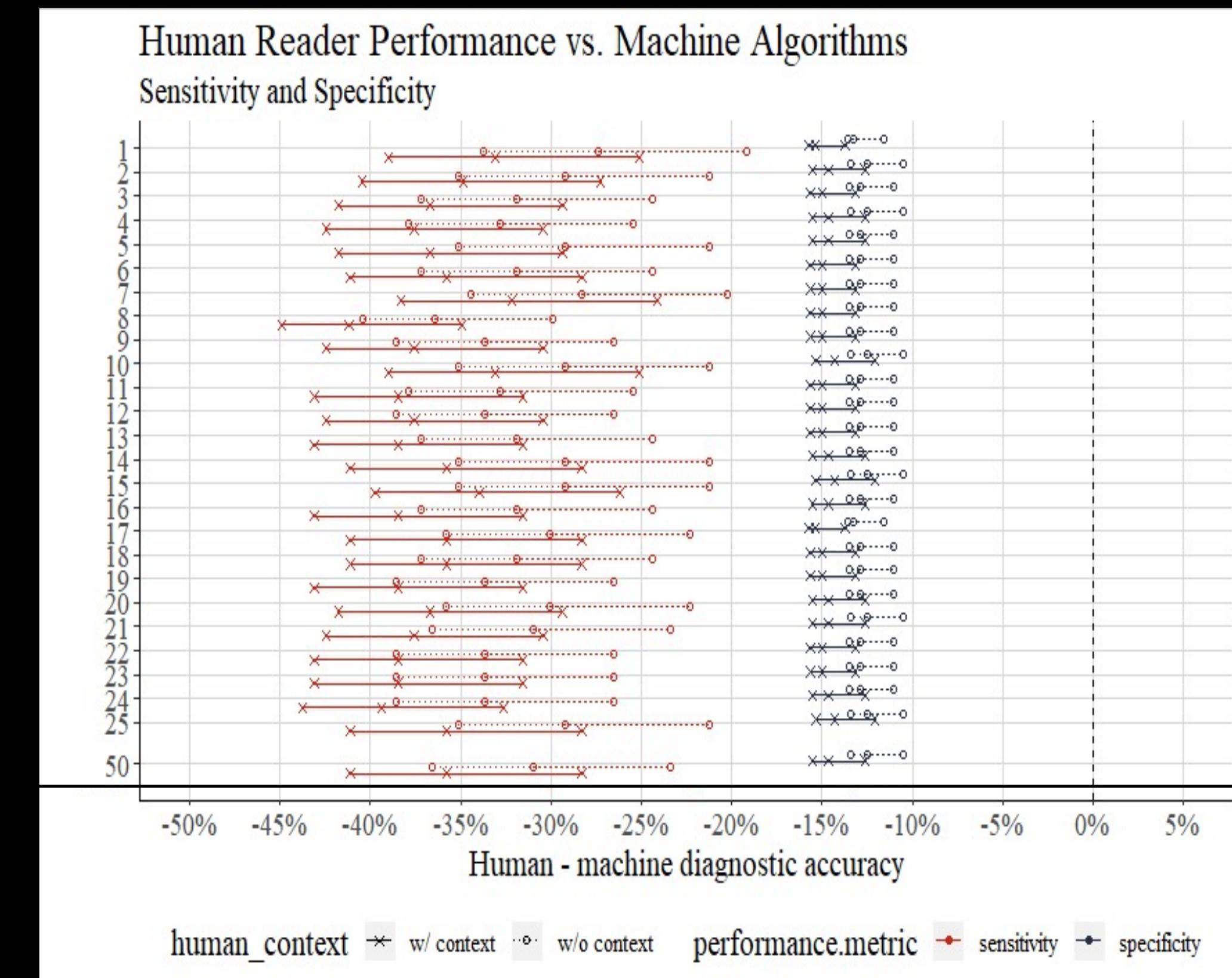
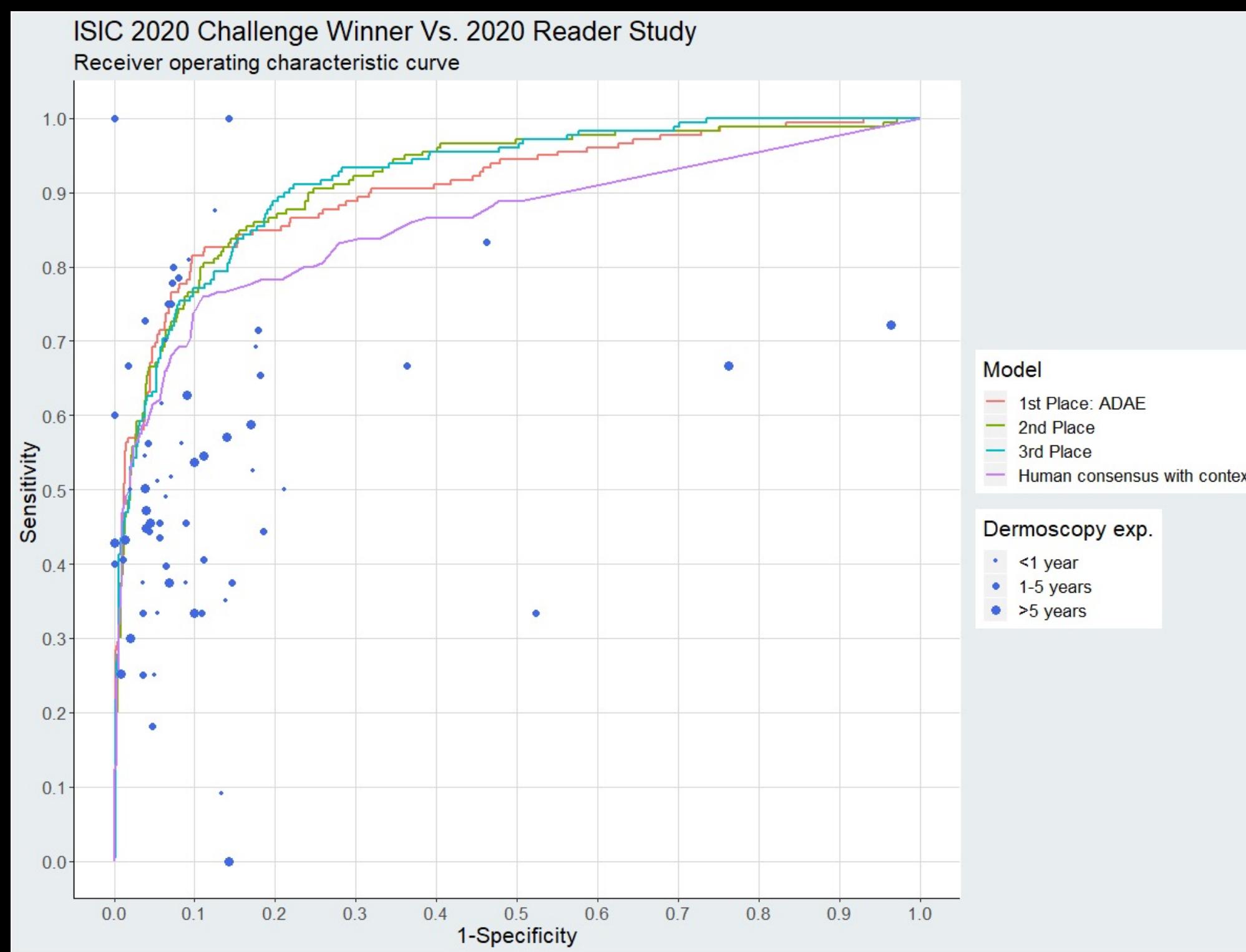
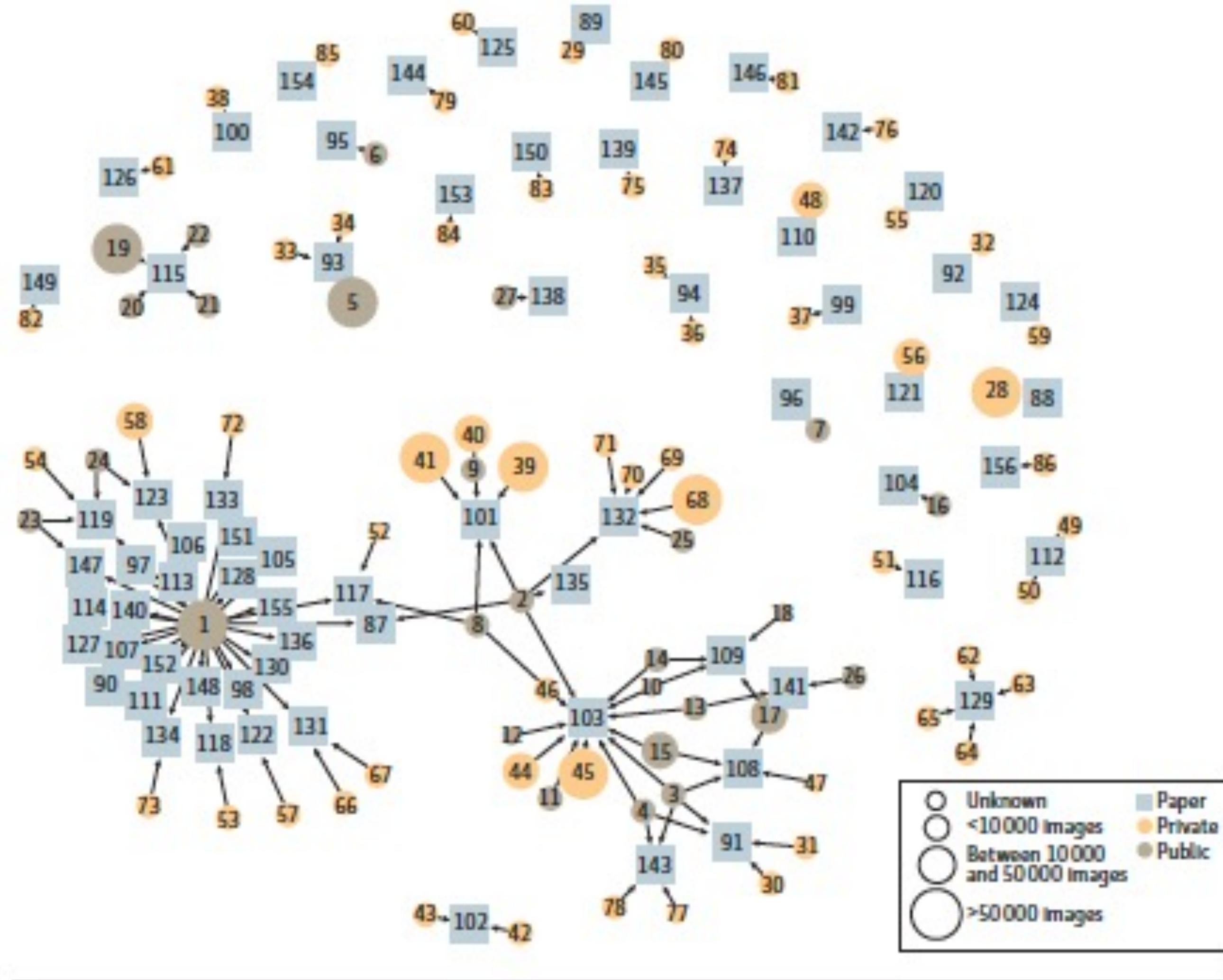


Table 2. Public Data Sets Used in 3 or More Publications

Data set source	No. of Images	No. of patients	Type of Image	Diseases	Label	Gold standard for malignant neoplasm diagnosis (pathological finding)	Fitzpatrick skin type description and breakdown	Ethnicity description and breakdown
ISIC 2016 Challenge	1279	Not specified	Dermoscopic	Nonmelanoma and melanoma	Benign (nonmelanoma): expert consensus; malignant (melanoma): pathological findings	Yes	No	No
ISIC 2017 Challenge	2750	Not specified	Dermoscopic	Benign nevi, seborrhoeic keratosis, and melanoma	Benign nevi: expert consensus; seborrhoeic keratosis: expert consensus; melanoma: pathological findings	Yes	No	No
ISIC 2018 Challenge (HAM10000)	10 015	Not specified	Dermoscopic	Actinic keratosis, Intraepithelial carcinoma (Bowen disease), BCC, benign keratosis, dermatofibroma, melanocytic nevi, vascular skin lesions, and melanoma	Actinic keratosis: consensus; Intraepithelial carcinoma: pathological findings; BCC: pathological findings; benign keratosis: consensus; dermatofibroma: consensus; melanocytic nevi: consensus; vascular skin lesions: consensus; melanoma: consensus	Yes	No	Yes; nationality breakdown (as a percentage of the 10 015 Images in the data set): 2.0% Portuguese (PH2); 22.6% Australian (Rosendahl); Australian (VIDIR) not specified (Atlas and ISIC 2017)
Hellenic Dermatological Atlas	2663 (as of April 2021)	Not specified	Clinical	Various: 43 broad categories of disease	Not specified	Unable to assess	No	No
Dønderm Atlas of Clinical Dermatology	>3000 (as of April 2021)	Not specified	Clinical	Various: Common skin diseases under 9 broad categories	Not specified	Unable to assess	No	No
MED-NODE database	170	Not specified	Clinical	Melanoma and nevi	Nevi: pathological findings; melanoma: pathological findings	Yes	No	No
Edinburgh Dermofit Library	1300	Not specified	Clinical	Actinic keratosis, BCC, melanocytic nevus (mole), seborrhoeic keratosis, SCC, intraepithelial carcinoma, pyogenic granuloma, hemangioma, dermatofibroma, and malignant melanoma	Expert opinion (Including dermatologists and dermatopathologists) based on clinical information and pathological findings	Yes	No	No
DermNet NZ	>20 000	Not specified	Clinical	Various: 1000s of categories listed	Not specified	Unable to assess	No	No

Abbreviations: BCC, basal cell carcinoma; ISIC, International Skin Imaging Collaboration; SCC, squamous cell carcinoma; VIDIR, Vienna Dermatologic Imaging Research.

**Figure. Overview of Data Sets and Studies**



Squares represent studies; circles, data sets; and arrows, use of a data set. The number of images in a given data set is represented by the size of the circle. Private data sets are often only connected to 1 study, whereas public data sets help generate multiple studies. A mapping of the corresponding data sets and studies is provided in the eFigure in the Supplement.

# ISIC Projects

- Annotations
- Multimodal Data Curation
- Human-AI collaboration

# Expert Annotation Study (PI: Liopyris)

ISIC Archive      Gallery ▾ Staff ▾ Upload Images Collections Studies Stats API ▾

## EASY Dermoscopy Expert Agreement Study

Name: EASY Dermoscopy Expert Agreement Study  
Contributors:  
Memorial Sloan Kettering Cancer Center  
Various  
Number of images: 248  
Public: yes  
Locked: no

Actions ▾

A collection of 248 melanocytic lesions that were submitted by experts as exemplars for 1 out of 31 dermoscopic features (8 images per feature), and used for evaluating agreement among (unrelated) experts on (1) malignancy, (2) feature presence, and (3) feature localization within a lesion. The repository of image masks and superpixel annotations is here: <https://github.com/ISIC-Research/expert-annotation-agreement-data>

Page 1 of 9 [next](#) [last »](#)  
[fewer columns](#) | [more columns](#)

<a href="#">ISIC_0016080</a>	<a href="#">ISIC_0016081</a>	<a href="#">ISIC_0016082</a>	<a href="#">ISIC_0016084</a>	<a href="#">ISIC_0016085</a>	<a href="#">ISIC_0016092</a>	<a href="#">ISIC_0016094</a>	<a href="#">ISIC_0016101</a>
<a href="#">ISIC_0016103</a>	<a href="#">ISIC_0016105</a>	<a href="#">ISIC_0016112</a>	<a href="#">ISIC_0016114</a>	<a href="#">ISIC_0016123</a>	<a href="#">ISIC_0016125</a>	<a href="#">ISIC_0016127</a>	<a href="#">ISIC_0016128</a>
<a href="#">ISIC_0016131</a>	<a href="#">ISIC_0016133</a>	<a href="#">ISIC_0016137</a>	<a href="#">ISIC_0016139</a>	<a href="#">ISIC_0016143</a>	<a href="#">ISIC_0016145</a>	<a href="#">ISIC_0016150</a>	<a href="#">ISIC_0016153</a>
<a href="#">ISIC_0016159</a>	<a href="#">ISIC_0016161</a>	<a href="#">ISIC_0016162</a>	<a href="#">ISIC_0016165</a>	<a href="#">ISIC_0016168</a>	<a href="#">ISIC_0016175</a>		

Page 1 of 9 [next](#) [last »](#)

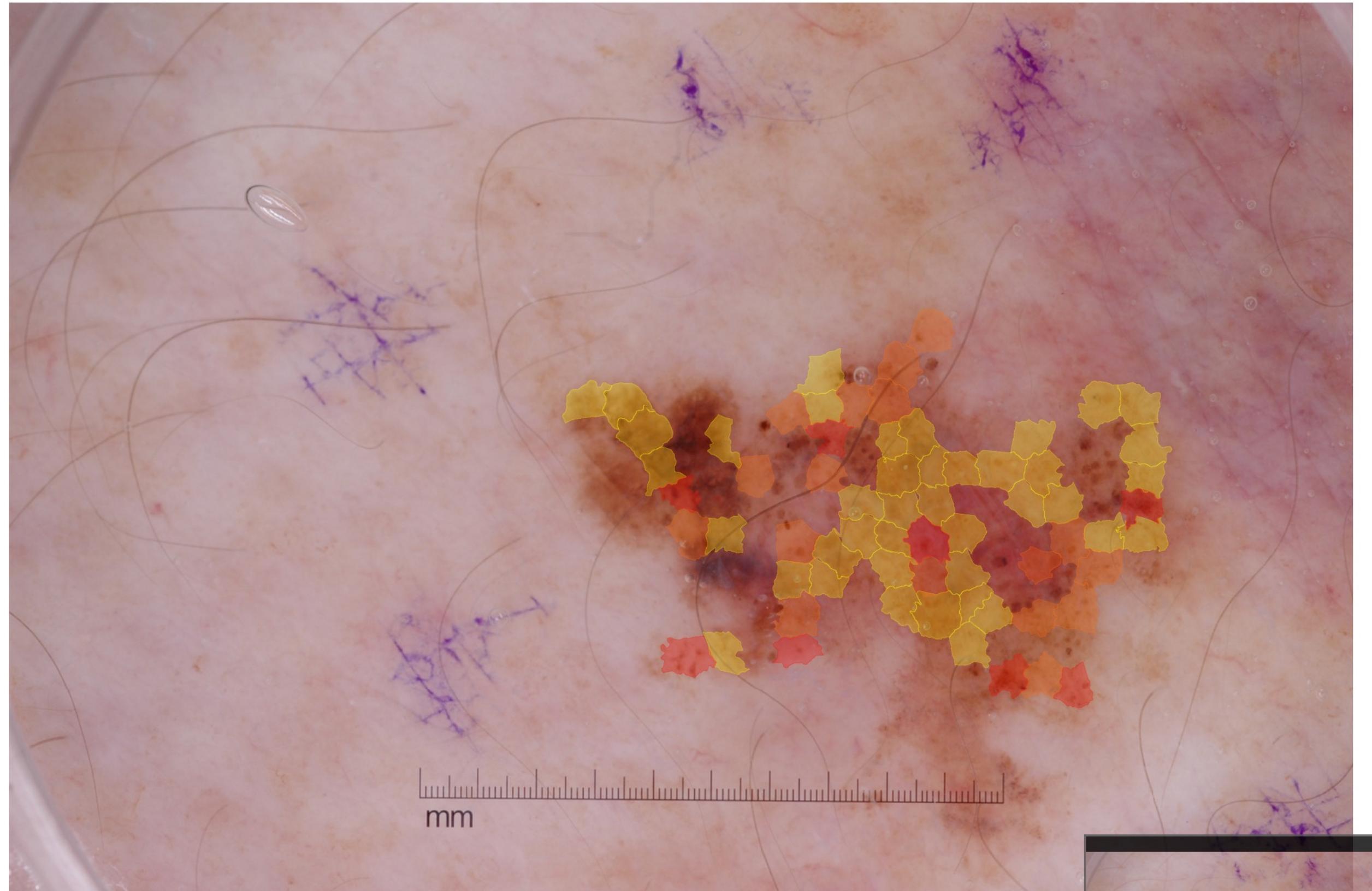
## MultiRaterThumbPanel

Total: 248

ISIC_0016080	ISIC_0016081
ISIC_0016082	ISIC_0016084
ISIC_0016085	ISIC_0016092
ISIC_0016094	ISIC_0016101
ISIC_0016103	ISIC_0016105



MultiRater Opacity



## Features Present In Image

Globules Clusters : Irregular	5	Lines : Branch streaks	1	Network : Atypical pigment network...	4	Structureless Blue-whitish veil	2
Structureless Milky red areas	2	Dots : Irregular	2	Regression structures : Pepperini...	2	Globules Clusters : Milky red	1
Lines : Pseudopods	1	Regression structures : Scarlike...	1	Structureless Blotch irregular	1		

Rater	Color	spxMarkedFor	# Spxs Marked	Disp
moreThan1	<span style="background-color: yellow; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	415,440,441,4	41	<input checked="" type="checkbox"/>
moreThan2	<span style="background-color: orange; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	364,394,436,4	17	<input checked="" type="checkbox"/>
moreThan3	<span style="background-color: red; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	482,546,573,5	8	<input checked="" type="checkbox"/>
6IGA	<span style="background-color: blue; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	364,394,397,4	77	<input type="checkbox"/>
OFE6	<span style="background-color: orange; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	397,401,476,4	29	<input type="checkbox"/>
CXLH	<span style="background-color: green; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	462,476,480,4	22	<input type="checkbox"/>
3CKV	<span style="background-color: red; border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>	397,401,476,4	26	<input type="checkbox"/>
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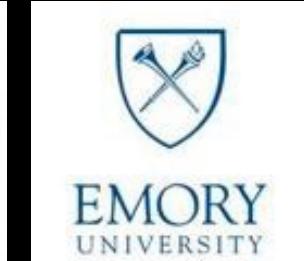
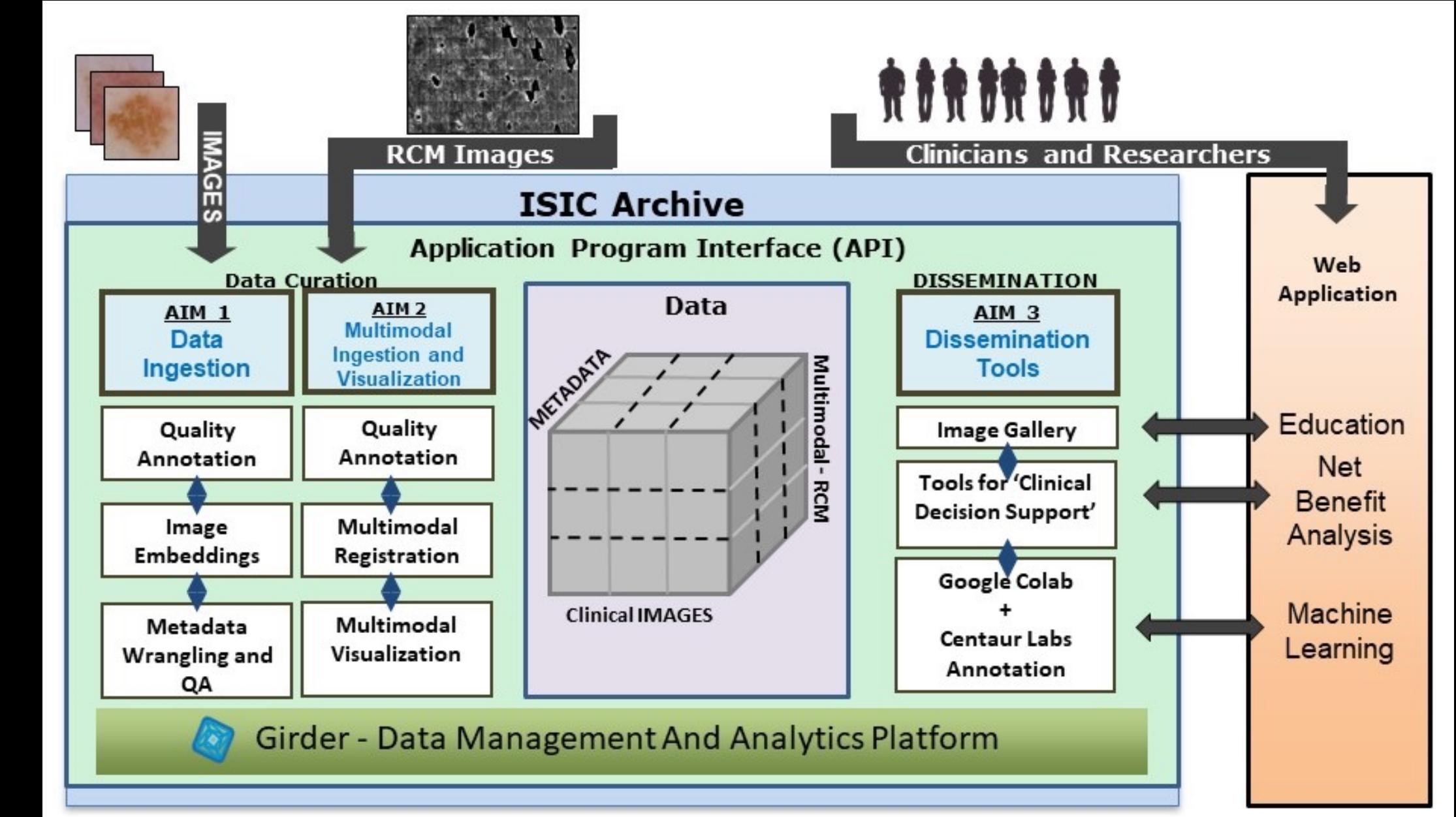
<https://github.com/ISIC-Research/expert-annotation-agreement-data>
<https://easy.dermannotator.org/#!/top/multirater>

# M-ISIC

NIH U24 Award

PIs: Rotemberg, Kose

- Ease data ingestion
- Efficient data organization
- Enable multimodal data storage visualization and annotation
- Multi-modal dataset generation
- Enable AI experimentation via API development

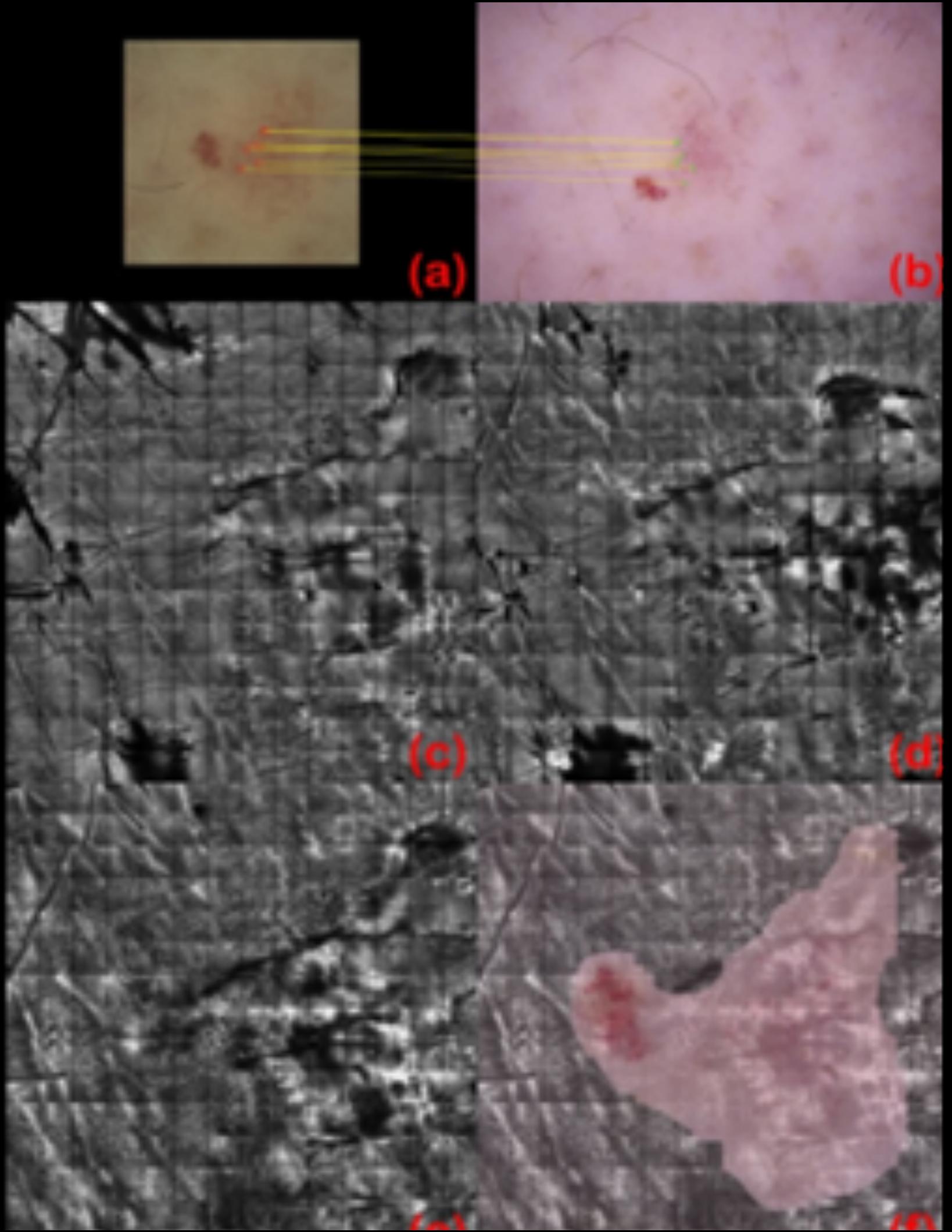


# Multimodal Data Curation

Initial Experiments:

Emphasis on RCM-Dermoscopy but with applications to pathology and Total Body Photography as well

Registration of widefield (left) image with dermoscopy image (right) and underlying mosaic (below)



# Next steps

Expand

Expand existing resources for AI development into multimodal approaches (Dr. Kivanc Kose)



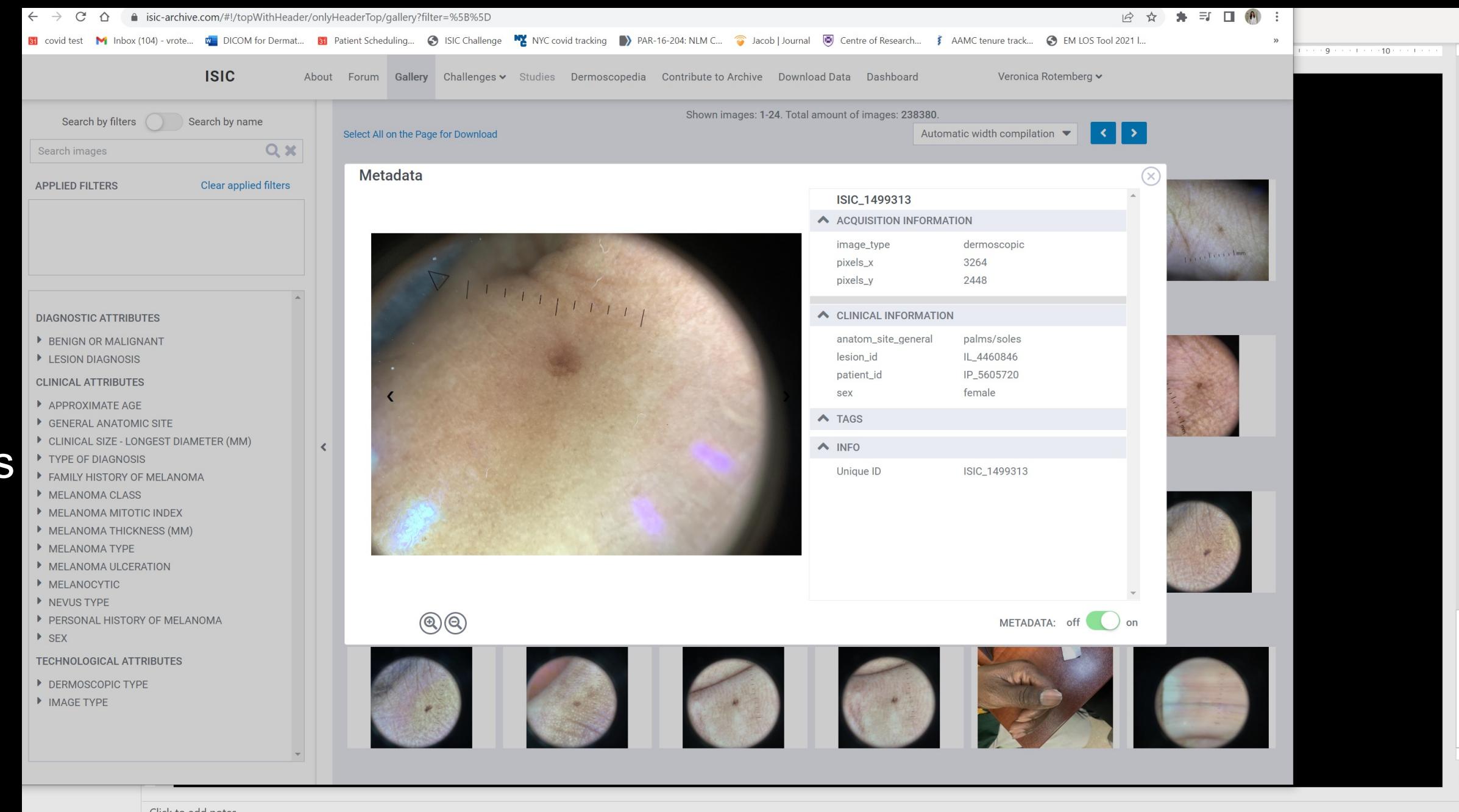
Use

Use the tools developed for prospective clinical studies (Dr. Jonathan Kentley)

# M-ISIC

## Enabling Nimble Experimentation

- Enable both clinicians and the engineers to be able to access data in an easy way
- Enable dataset generation with any criteria
  - Image content
  - Metadata
- Easy integration with online coding platforms
  - Google Colab etc...
- Multimodal Dataset Generation



# Human – AI collaboration

Next steps:

- Enable easy annotation ingestion and better understanding of Human-AI collaboration
- Better understand features (annotated by experts) that predict/correlate with AI performance

# Thank you!



- MSK:
  - Jochen Weber
  - Nick Kurtansky
  - Allan Halpern
  - Steve Dusza
  - Michael Marchetti
  - Steven Wang
  - Kivanc Kose
  - Milind Rajadhyaksha
- Hospital Clinic Barcelona:
  - Josep Malvehy
  - Marc Combalia
- Medical University of Vienna
  - Harald Kittler
  - Philipp Tschandl
- Emory
  - David Gutman
- The University of Queensland
  - Liam Caffery
  - Peter Soyer
  - Brigid Betz-Stablein
- Melanoma Institute Australia and Sydney Melanoma Diagnostic Center **International Skin Imaging Collaboration**
  - Pascale Guitera
- University of Athens
  - Kontantinos Lioprys
  - Alexander Stratigos
- Kaggle team
  - Julia Elliot
  - Phil Culliton
- SIIM
  - George Shih
  - Steve Langer
  - Anna Zawacki
  - Cheryl Carey
  - SIIM Leadership