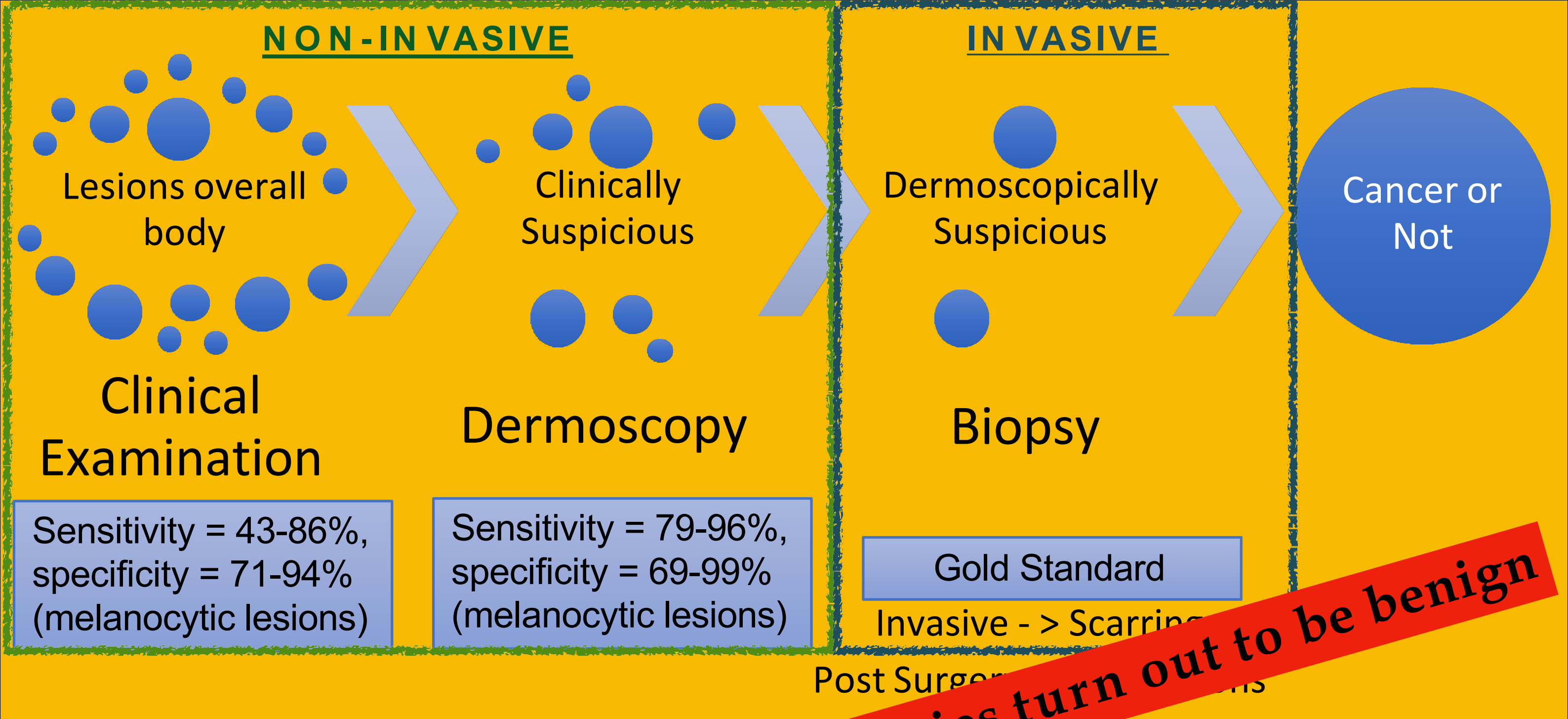


Tools for clinician-AI collaboration and dermatology AI research

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

Imaging in Derm@MSKCC

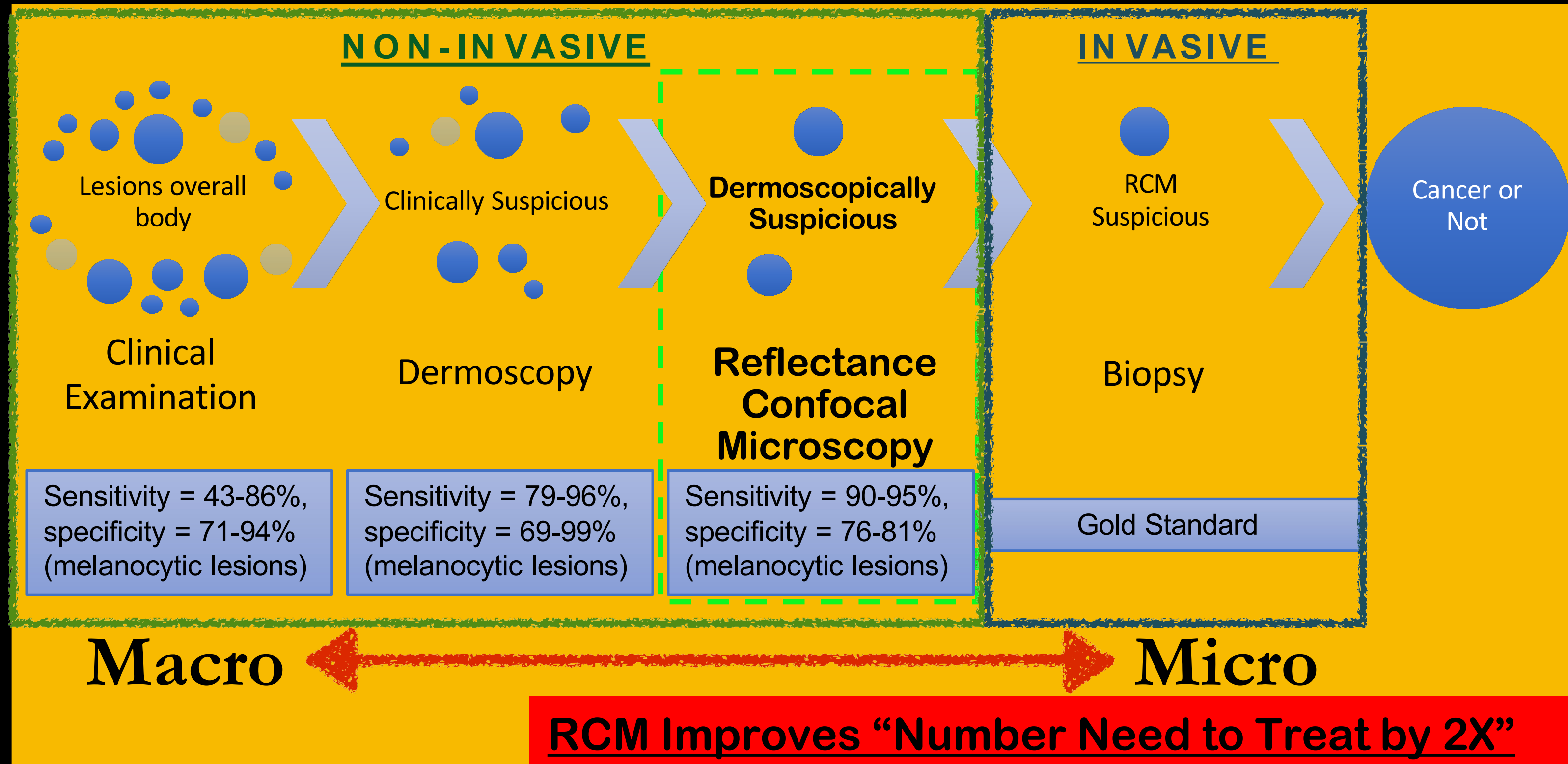


Macro

Micro

~20-40% biopsies turn out to be benign

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

Developing Computer Vision and AI for These Techniques

Dermal Epidermal Junction Detection
Morphology Segmentation
Videomosaicking



Image Informatic Group

International Skin Imaging Collaboration (ISIC)

Ingestion of Data from Collaborators
AI Challenges

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

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

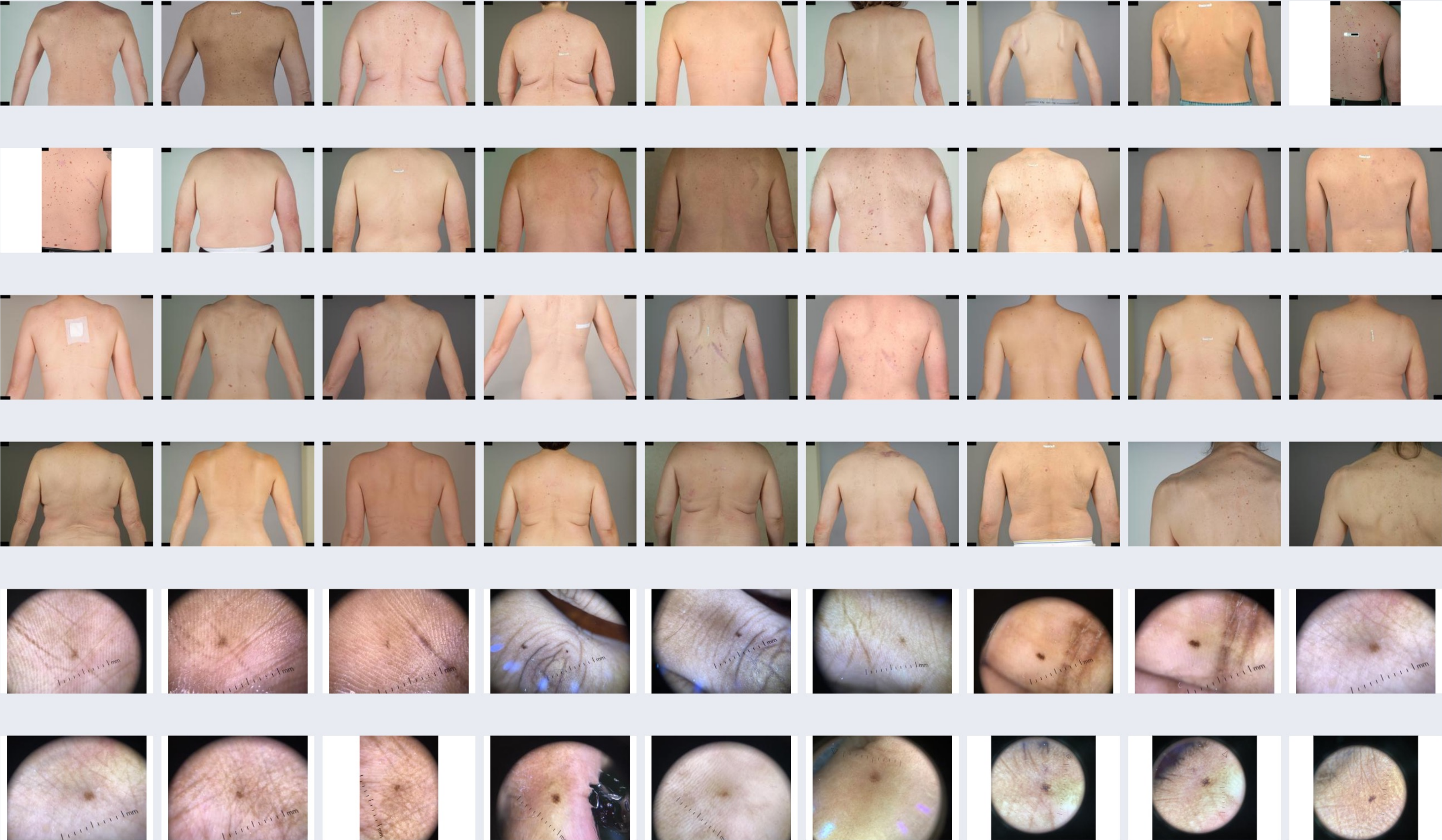
TECHNOLOGICAL ATTRIBUTES

- ▶ DERMOSCOPIC TYPE
- ▶ IMAGE TYPE

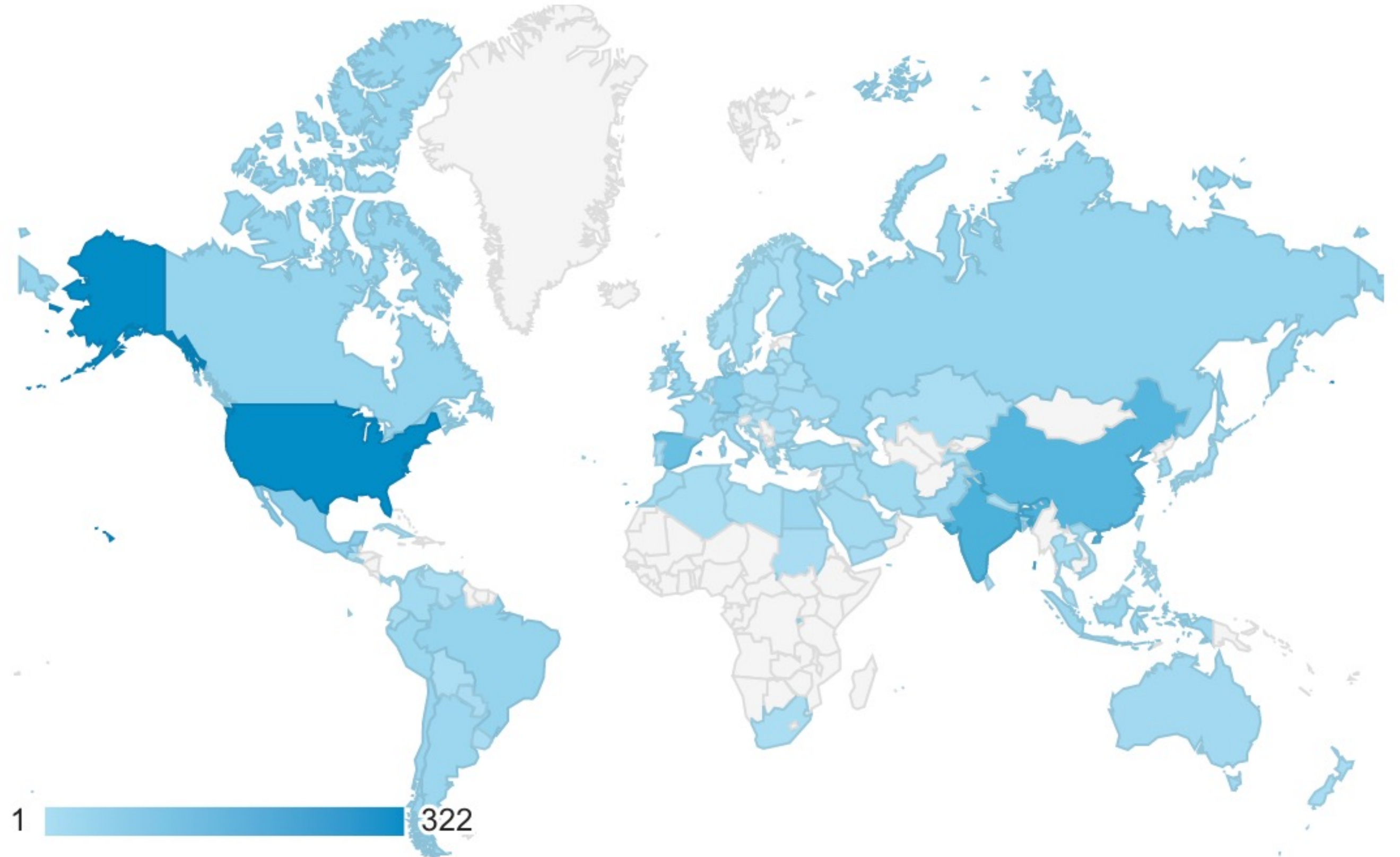
Shown images: 1-54. Total amount of images: 238416.

[Select All on the Page for Download](#)

Automatic width compilation



Users ▼



ISIC Grand Challenges for Melanoma Detection						
Year	Conference	Number of Diagnoses	Training (N images)	Test (N images)	Participants	
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

The image shows a screenshot of the Kaggle website. On the left is a navigation sidebar with links to Home, Compete, Data, Notebooks, Discuss, Courses, and Jobs. The main content area displays the 'SIIM-ISIC Melanoma Classification' competition, which has a prize money of \$30,000. Below the competition header, there are tabs for Overview, Data, Notebooks, Discussion (which is selected), Leaderboard, Rules, Team, and Host. A 'New Topic' button is also visible. The 'Discussion' tab shows a list of 870 topics, sorted by 'Hotness'. The topics listed include 'Call for Manuscripts!', 'Call for Submissions: With/Without Context Special Prizes!', 'Join SIIM AI Conference Virtually on 9/13-14', 'True duplicates in this dataset', 'Welcome!', 'Join me in congratulating the TPU Stars!', 'AUROC vs AUC of Precision-Recall Curve as Evaluation Metric', 'Thank you Kagglers - 1st Place Datasets, 1st Notebooks, 1st Discussions', 'How to combine meta features with Images?', and 'H5 File ?????'.

Search

Featured Prediction Competition

SIIM-ISIC Melanoma Classification
Identify melanoma in lesion images

\$30,000
Prize Money

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

Overview Data Notebooks **Discussion** Leaderboard Rules Team Host

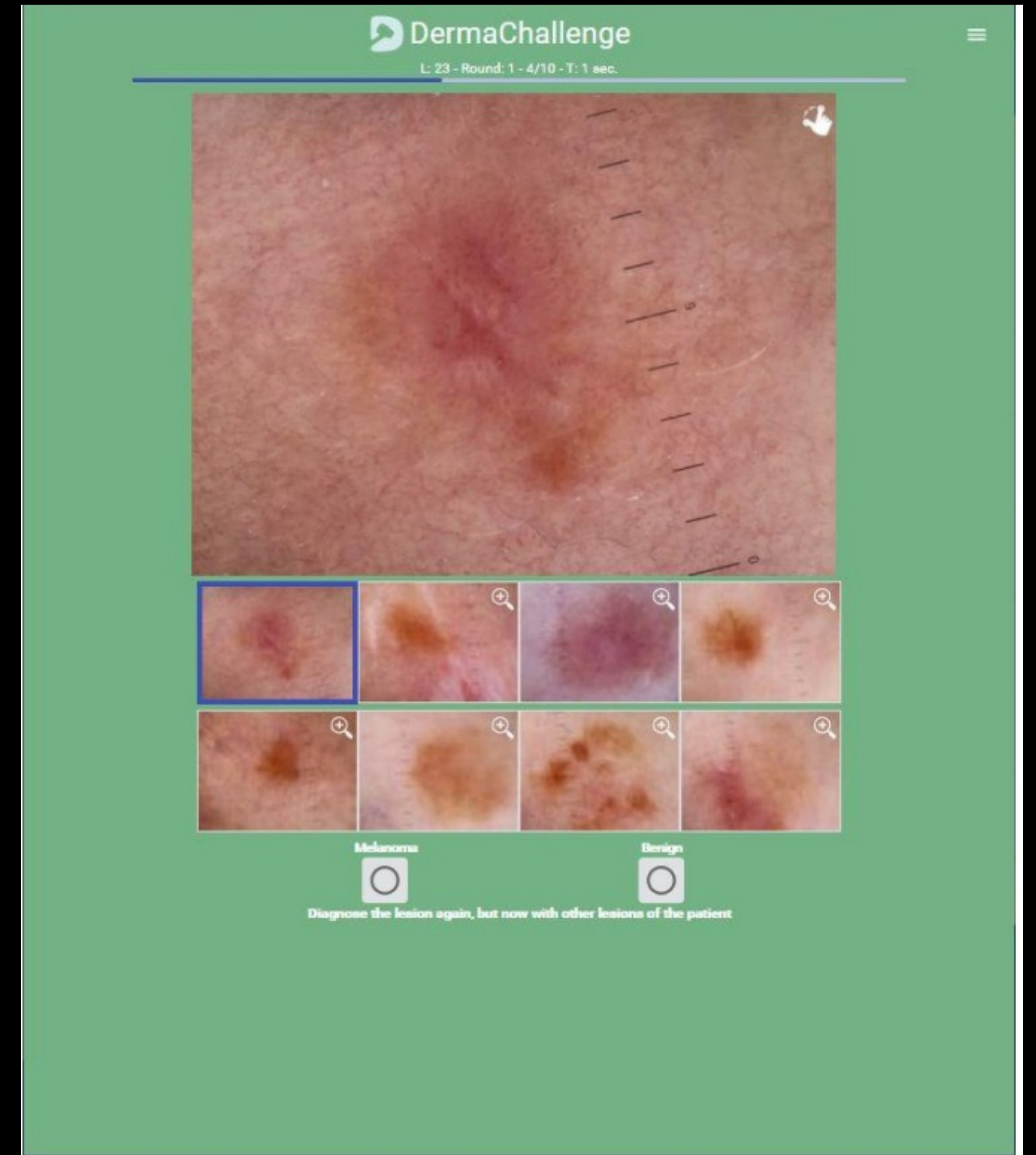
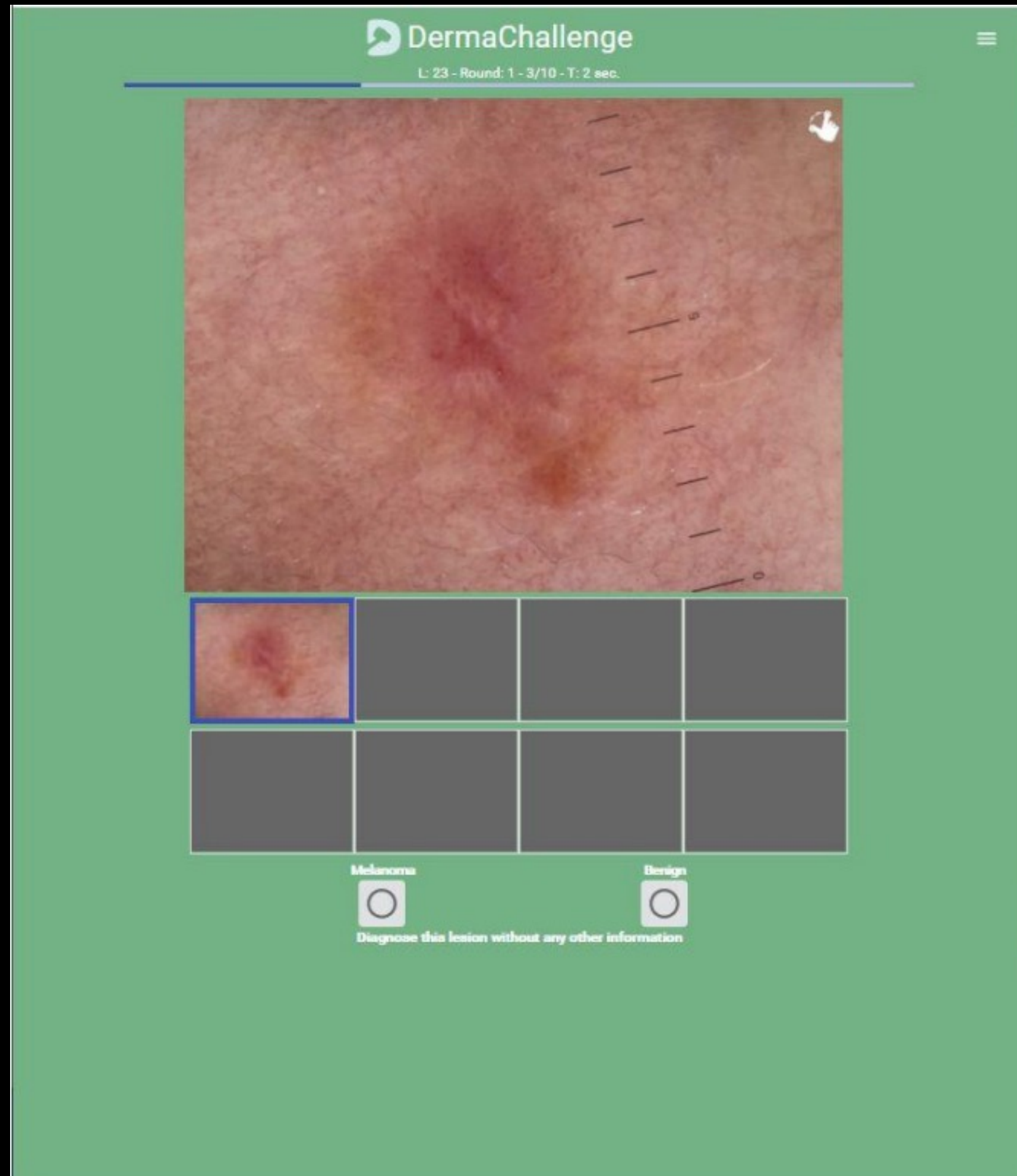
My Submissions **New Topic**

870 topics **Following** Sort by Hotness

All Owned Upvoted Search Topics

2		Call for Manuscripts! Julia Elliott 2mo ago	Last comment 3d ago by Girdhari	6
5		Call for Submissions: With/Without Context Special Prizes! Julia Elliott 2mo ago	Last comment 2mo ago by Julia Elliott	11
22		Join SIIM AI Conference Virtually on 9/13-14 Anna Zawacki 2mo ago	Last comment 2mo ago by Guilherme Maia	6
62		True duplicates in this dataset Jochen Weber 4mo ago	Last comment 2mo ago by Markin	19
15		Welcome! Phil Culliton 5mo ago	Last comment 2mo ago by Julia Elliott	34
29		Join me in congratulating the TPU Stars! Julia Elliott 1mo ago	Last comment 1mo ago by Ronaldo S.A. Batista	6
10		AUROC vs AUC of Precision-Recall Curve as Evaluation Metric TeYang Lau 3mo ago	Last comment 6d ago by Anthony Leo	3
652		Thank you Kagglers - 1st Place Datasets, 1st Notebooks, 1st Discussions Chris Deotte 2mo ago	Last comment 20d ago by ROHAN SAHANA	313
1		How to combine meta features with Images? Amritvir Singh 1mo ago	Last comment 21d ago by Ali Abdin	2
-3		H5 File ????? H5 File 1mo ago	Last comment 1mo ago	2

Comparison of Algorithm to Human Raters



Context does not improve human performance as compared to AI

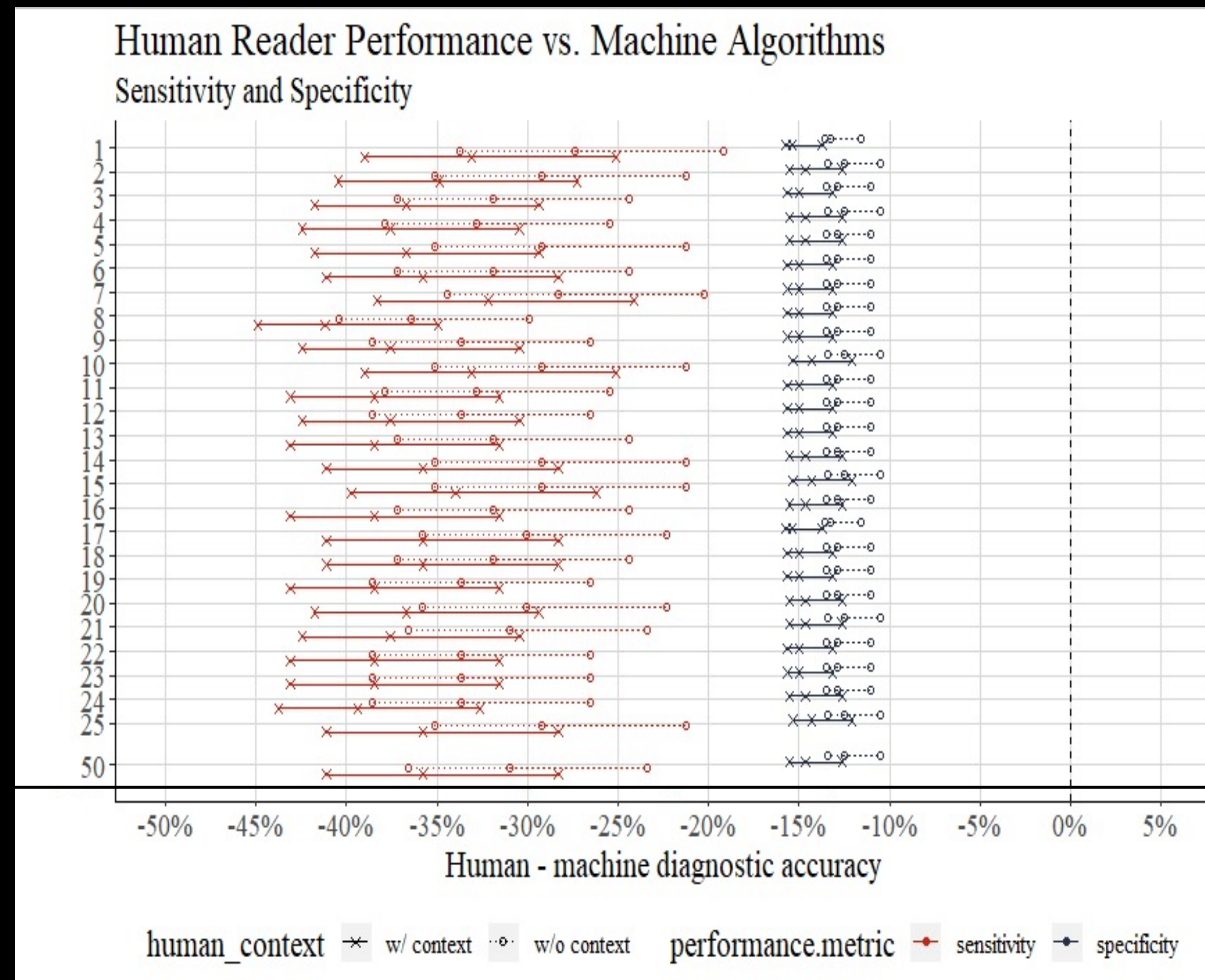
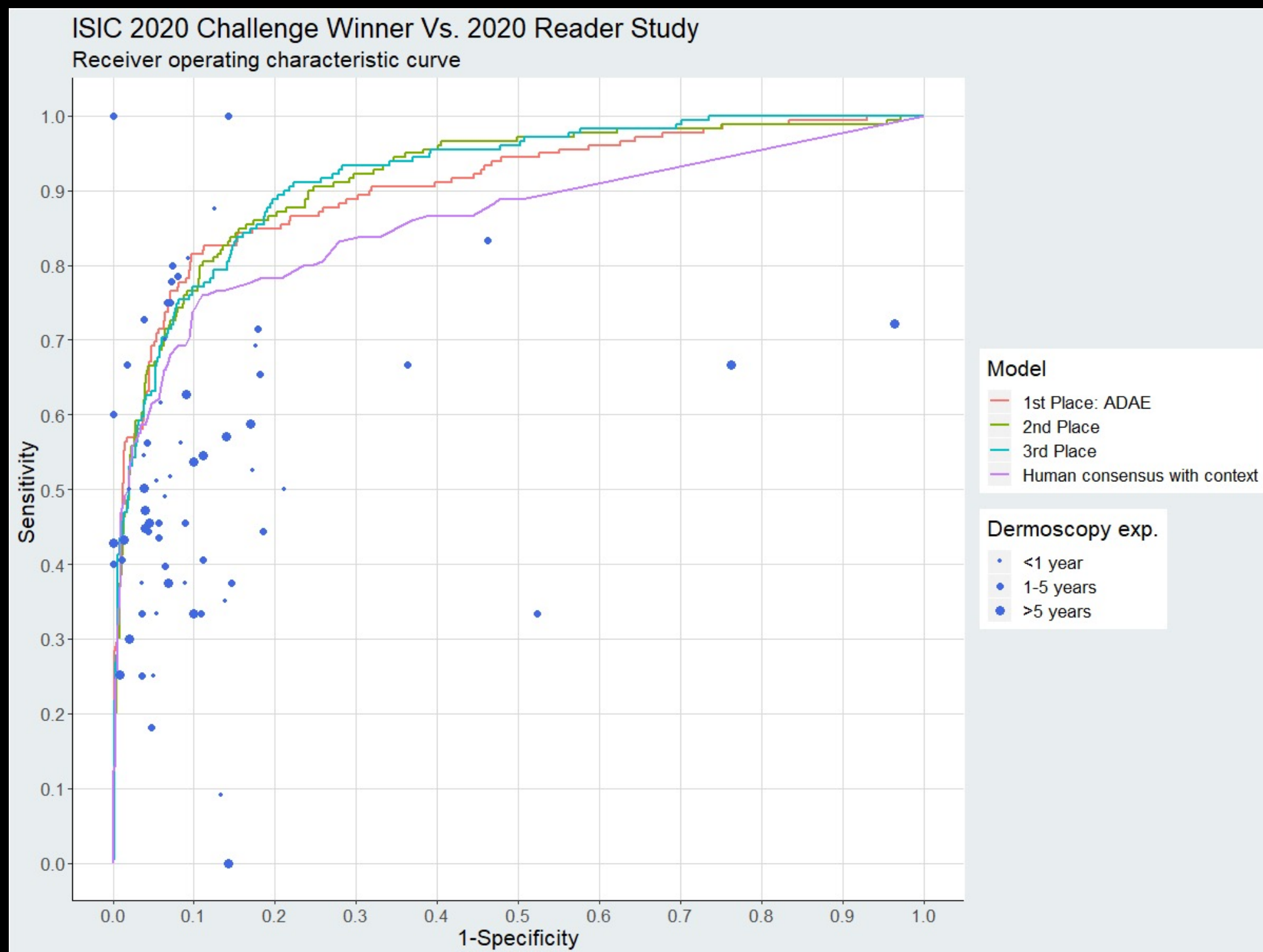
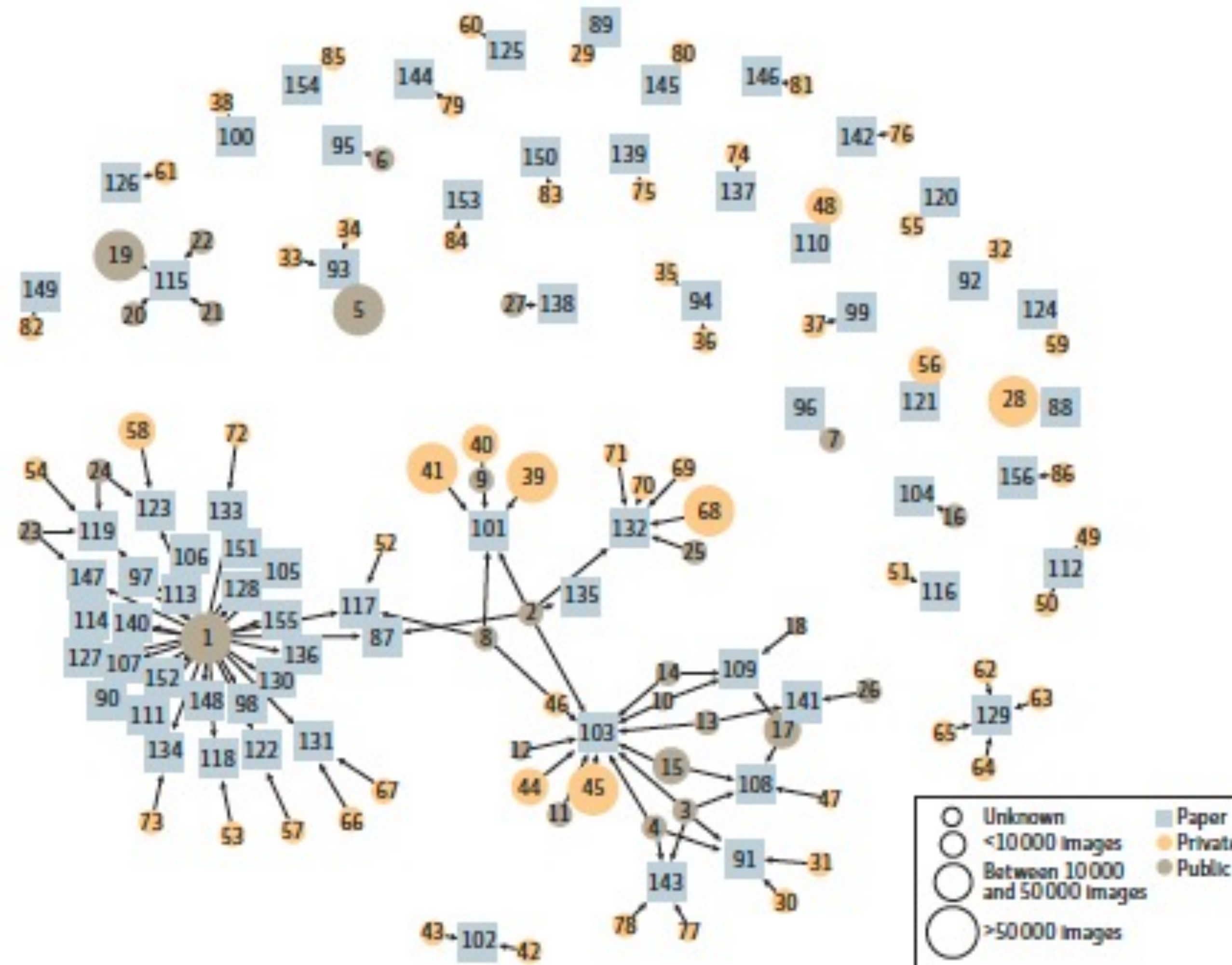


Table 2. Public Data Sets Used in 3 or More Publications

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, seborrheic keratosis, and melanoma	Benign nevi: expert consensus; seborrheic 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); Austrian (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
Dænderm 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), seborrheic 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

Actions

Name: EASY Dermoscopy Expert Agreement Study

Contributors:
Memorial Sloan Kettering Cancer Center
Various

Number of images: 248

Public: yes

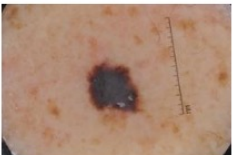
Locked: no

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>

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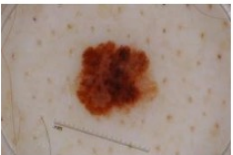
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fewer columns | more columns




ISIC_0016080

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ISIC_0016081

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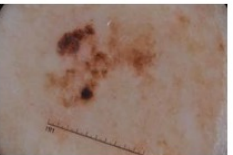
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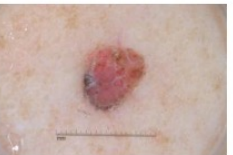
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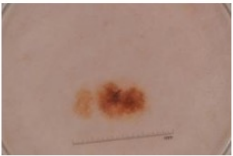
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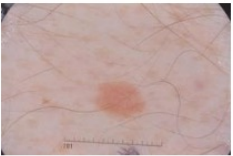
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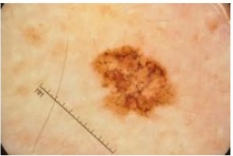
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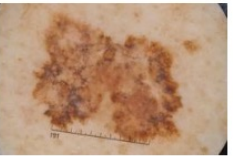
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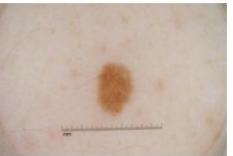
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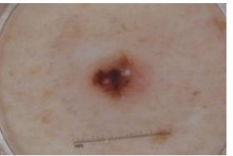
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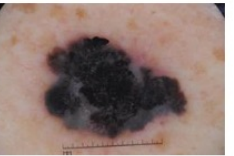
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ISIC_0016127

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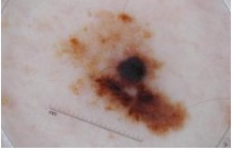
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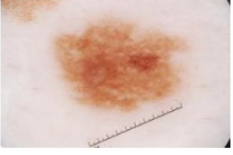
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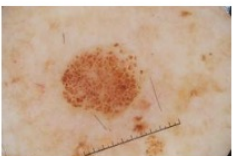
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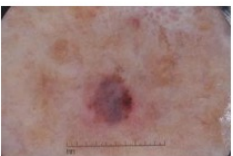
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ISIC_0016159

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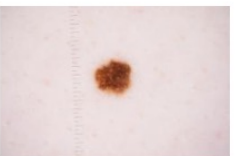
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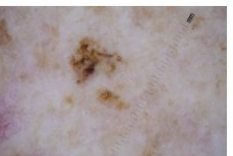
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ISIC_0016168

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ISIC_0016175

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MultiRaterThumbPanel

Total: 248

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ISIC_0016081

ISIC_0016082

ISIC_0016084

ISIC_0016085

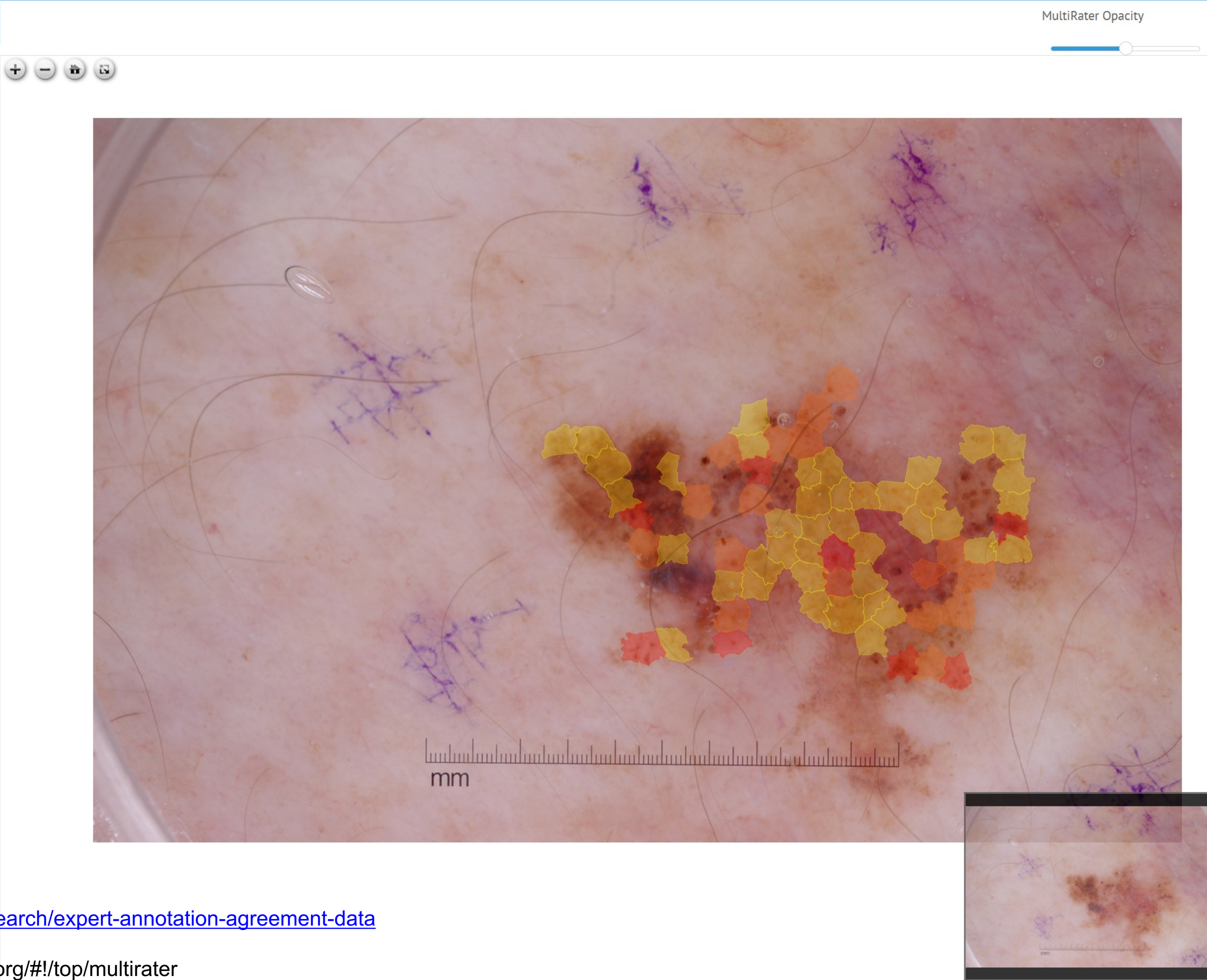
ISIC_0016092

ISIC_0016094

ISIC_0016101

ISIC_0016103

ISIC_0016105



MultiRater Opacity

Features Present In Image

Globules Cloud 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 : Peppering... 2

Globules Cloud Milky red 1

Lines : Pseudopods 1

Regression structures : Scartike... 1

Structureless Blotch irregular 1

Rater	Color	spxMarkedFor	# Spxs Marked	Disj
moreThan1	Yellow	415,440,441,4	41	<input checked="" type="checkbox"/>
moreThan2	Orange	364,394,436,4	17	<input checked="" type="checkbox"/>
moreThan3	Red	482,546,573,5	8	<input checked="" type="checkbox"/>
6IGA	Blue	364,394,397,4	77	<input type="checkbox"/>
OFE6	Orange	397,401,476,4	29	<input type="checkbox"/>
CXLH	Green	462,476,480,4	22	<input type="checkbox"/>
3CKV	Red	397,401,476,4	26	<input type="checkbox"/>
PKTZ	Purple	364,394,397,4	41	<input type="checkbox"/>

<https://github.com/ISIC-Research/expert-annotation-agreement-data>

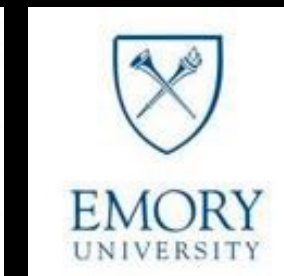
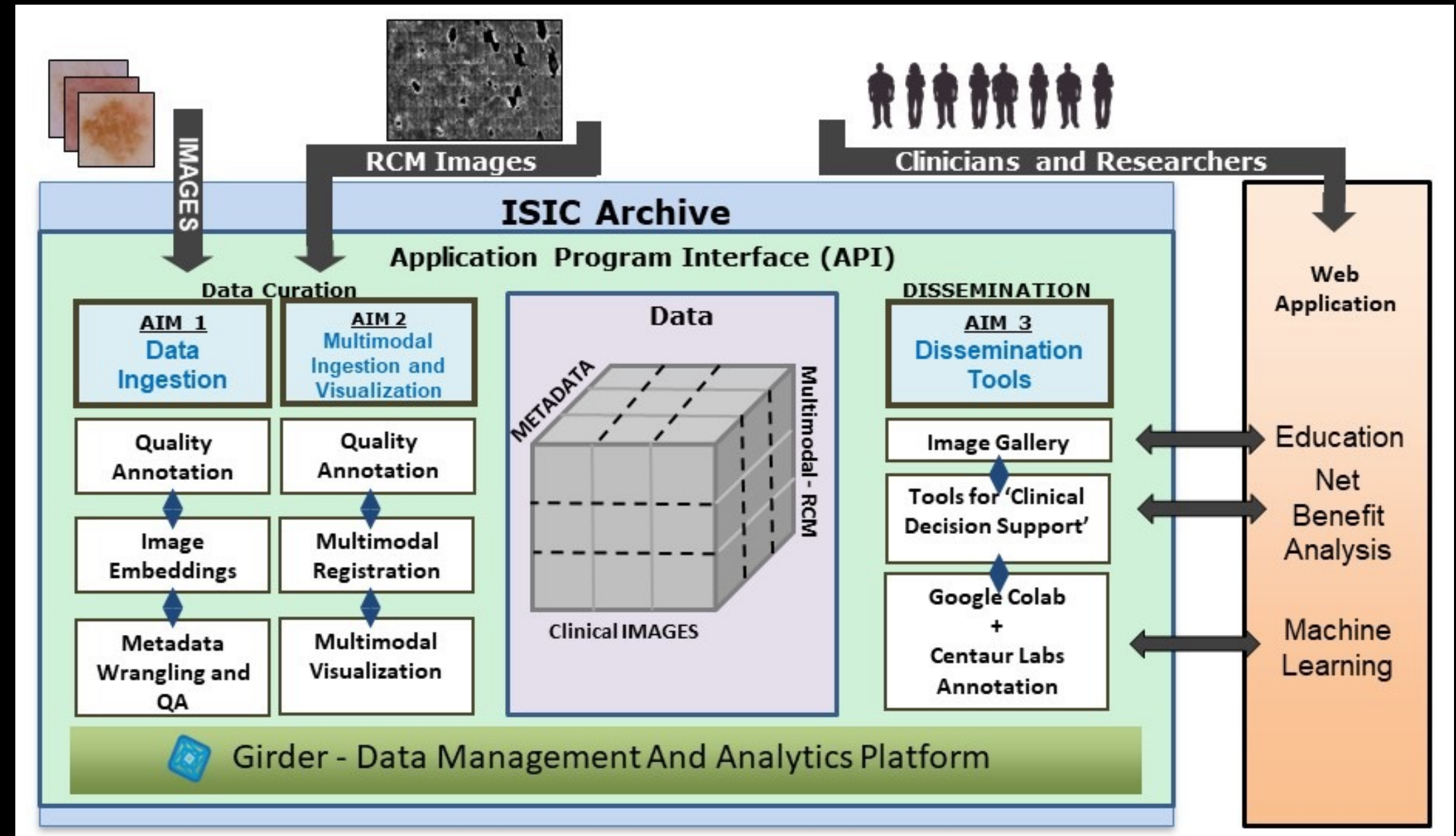
<https://easy.dermannotator.org/#!/top/multirater>

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

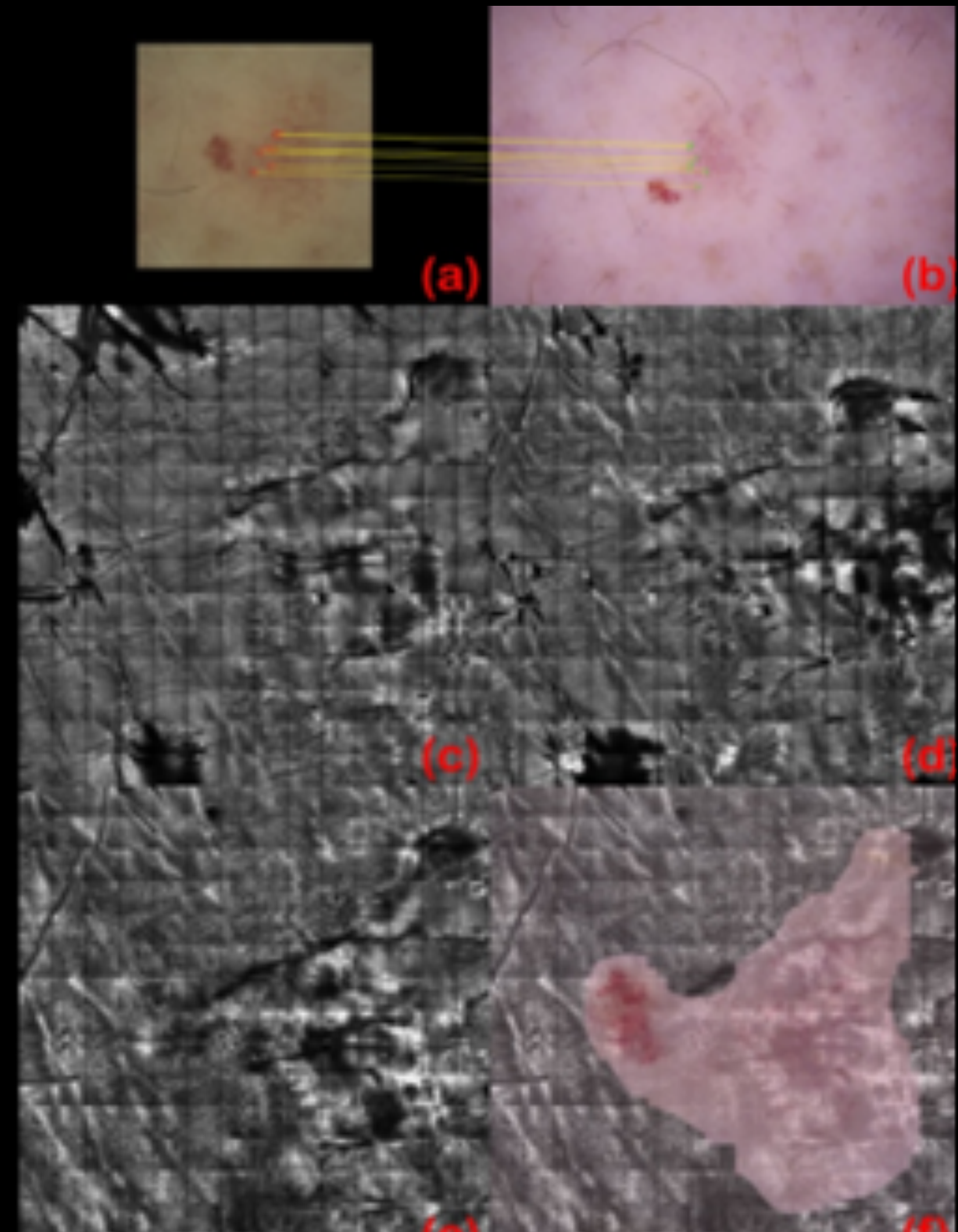


Multimodal Data Curation

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)



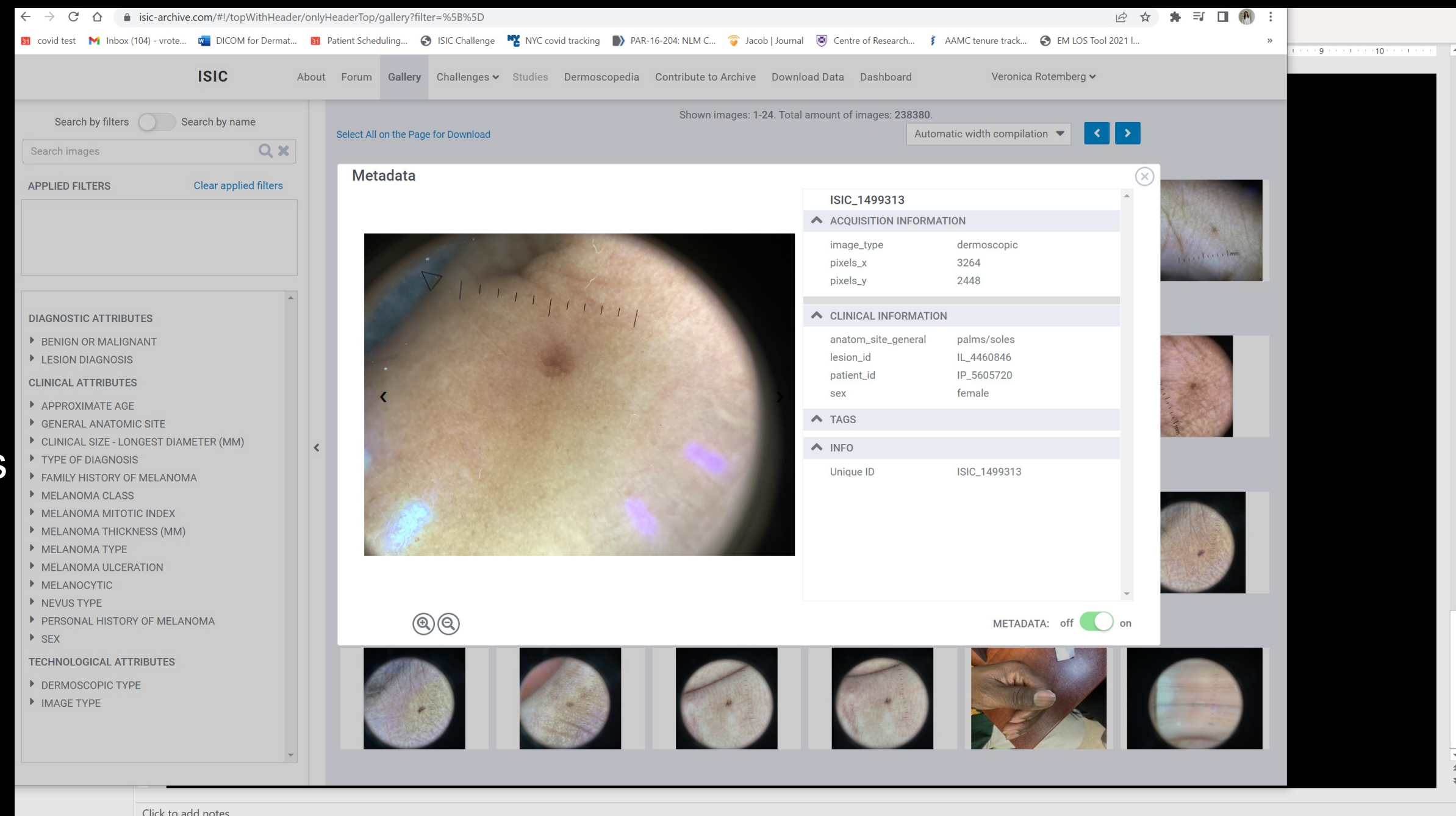
Use

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
 - 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

International Skin Imaging Collaboration

