



Trustworthy Artificial Intelligence for Medical Imaging and Analysis

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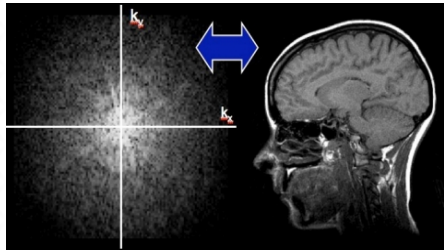
AI Shapes Medical Imaging



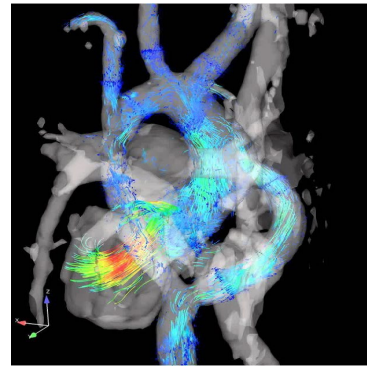
From image acquisition to patient prognosis



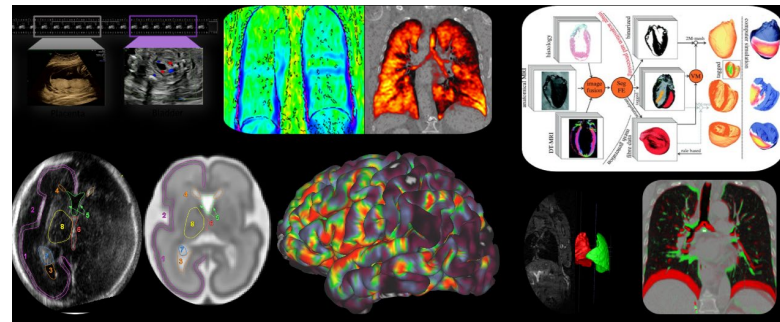
Acquisition



Reconstruction



Visualization (XR)



Analysis & Diagnosis



Treatment & Prognosis

Safer, Faster, Better

See the unseeable, Accurate, Quantitative

Decision Support, Minimize Risk

Background and Impact



- DL in Medical Image Analysis

ORIGINAL RESEARCH • NEURORADIOLOGY

A Deep Learning Model to Predict the Progression of Alzheimer Disease by Using the Brain

JAMA | Original Investigation

Diagnostic Assessment of Breast Cancer for Detection of Lymph Node Metastases in Women With Breast Cancer

ARTICLES

<https://doi.org/10.1038/s41591-018-0107-6>

nature
medicine

ARTICLES

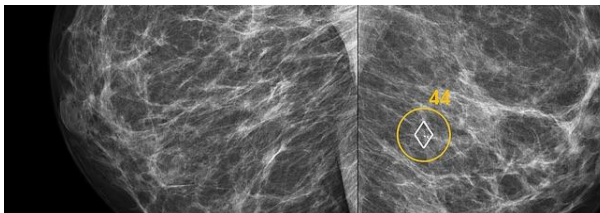
<https://doi.org/10.1038/s41591-019-0508-1>

Clinically applicable deep learning for detection and referral in retinal disease

Clinical-grade computational pathology using weakly supervised deep learning on whole slide images

- FDA/NMPA Approved AI-based Medical Products

ScreenPoint
Medical



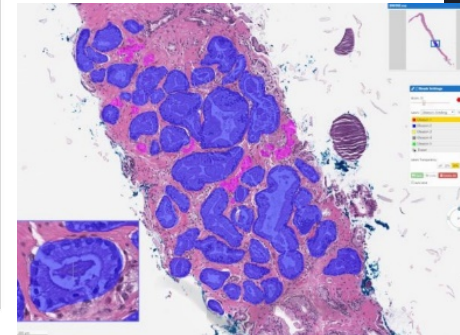
Mammogram



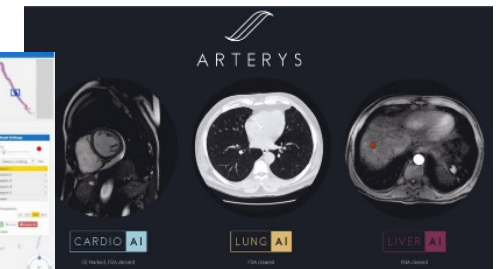
Ultrasound



Fundus



Pathology

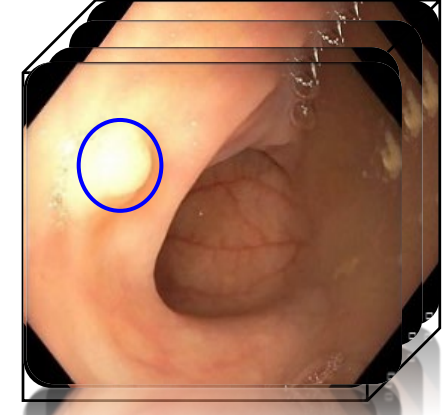
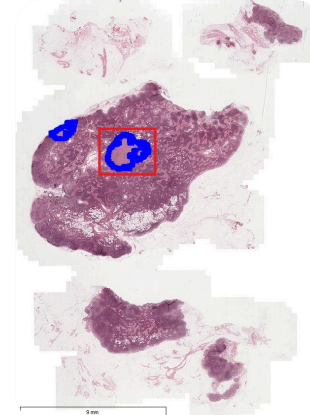
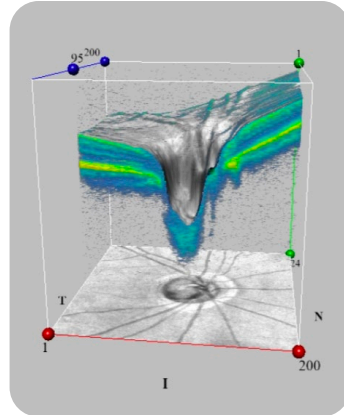
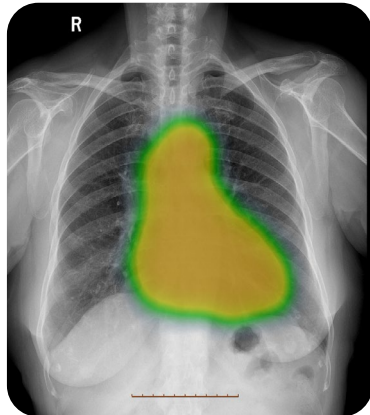


CT & MRI

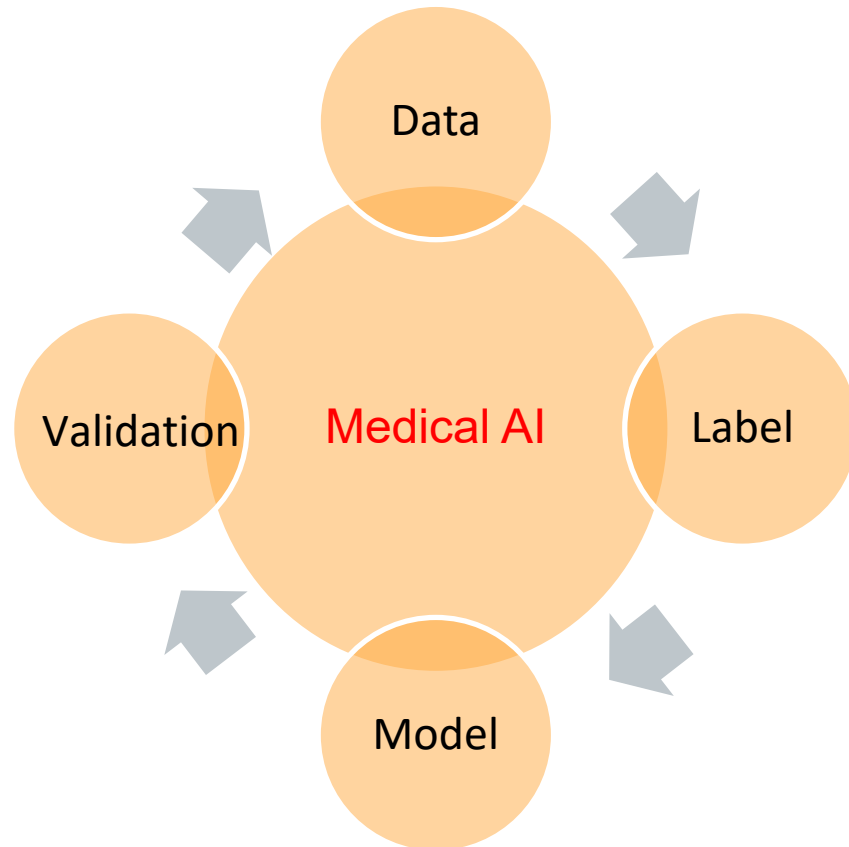
Trustworthy AI Algorithms

- New machine learning methods for improving the label-efficiency, robustness, adaptation, and generalization capability of AI models.
- Model explainability and privacy-preserving, multi-modal learning and fusion (e.g., multi-omics), human-machine collaboration, etc.

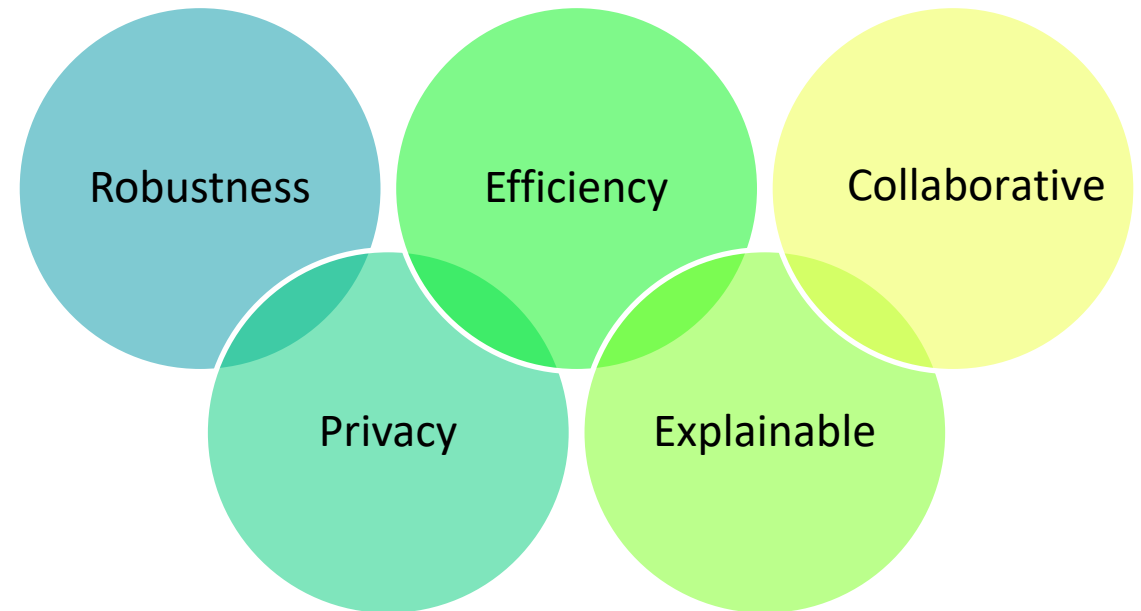
Healthcare Applications



Trustworthy AI for Healthcare



Cycle of Developing AI Models



Key Evaluation Metrics

Artificial Intelligence for Multimodal Data Analysis



- Our team have achieved **state-of-the-art results** on **15+** international grand medical challenges.
- **100+** top-tier publications (e.g., IEEE TMI, MedIA, CVPR, MICCAI, ICCV, JAMA, Lancet Digital Health; Google Scholar Citations **17800+**) in AI for multimodal analysis, with **Three Best Paper Awards**.

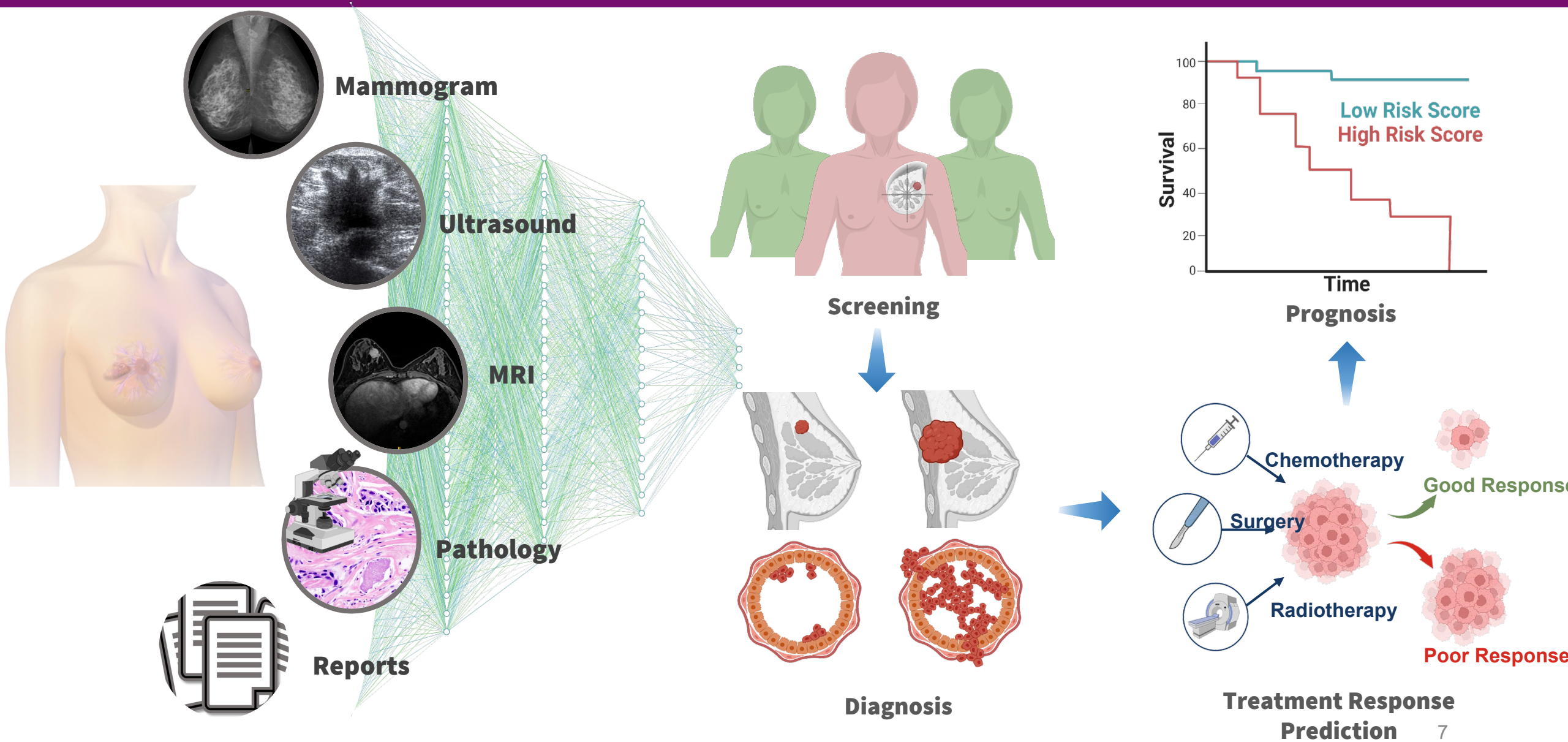


Best Paper Awards and Championships



Domain	Challenge	Title	Rank
Pathology	MICCAI-2018	Multi-organ Nuclei Segmentation	1
	MICCAI-2018	Retinal Fundus Glaucoma Analysis	1
	MICCAI-2015	Gland Segmentation	1
	MICCAI-2015	Nuclei Segmentation	1
	MICCAI-2014	Mitosis Detection	1
Radiology	Kaggle	Pneumonia Detection	1
	MICCAI-2017	Liver Tumor Segmentation	1
	ISBI-2016	Lung Nodule Detection from CT	1
	MICCAI-2015	IVD Localization	1
	MICCAI-2016	IVD Localization and Segmentation	1
	MICCAI-2016	Whole-Heart and Vessel Segmentation	1
	MICCAI-2013	Brain Segmentation from MRI	1
Endoscopy	MICCAI-2015	Polyp Detection from Videos	1
Others	MICCAI-2016	Surgical Workflow Recognition	1
	ISBI-2016	Skin Lesion Classification	1

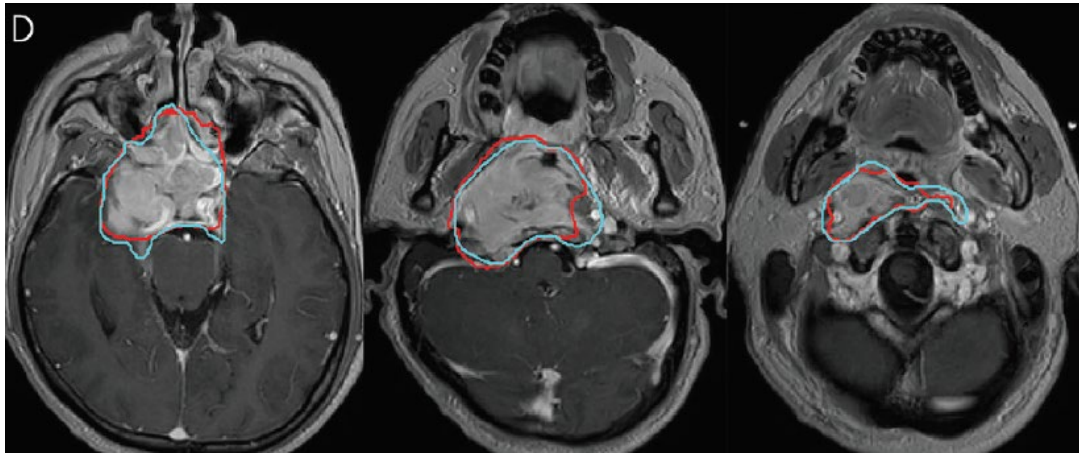
Application: AI for Breast Cancer



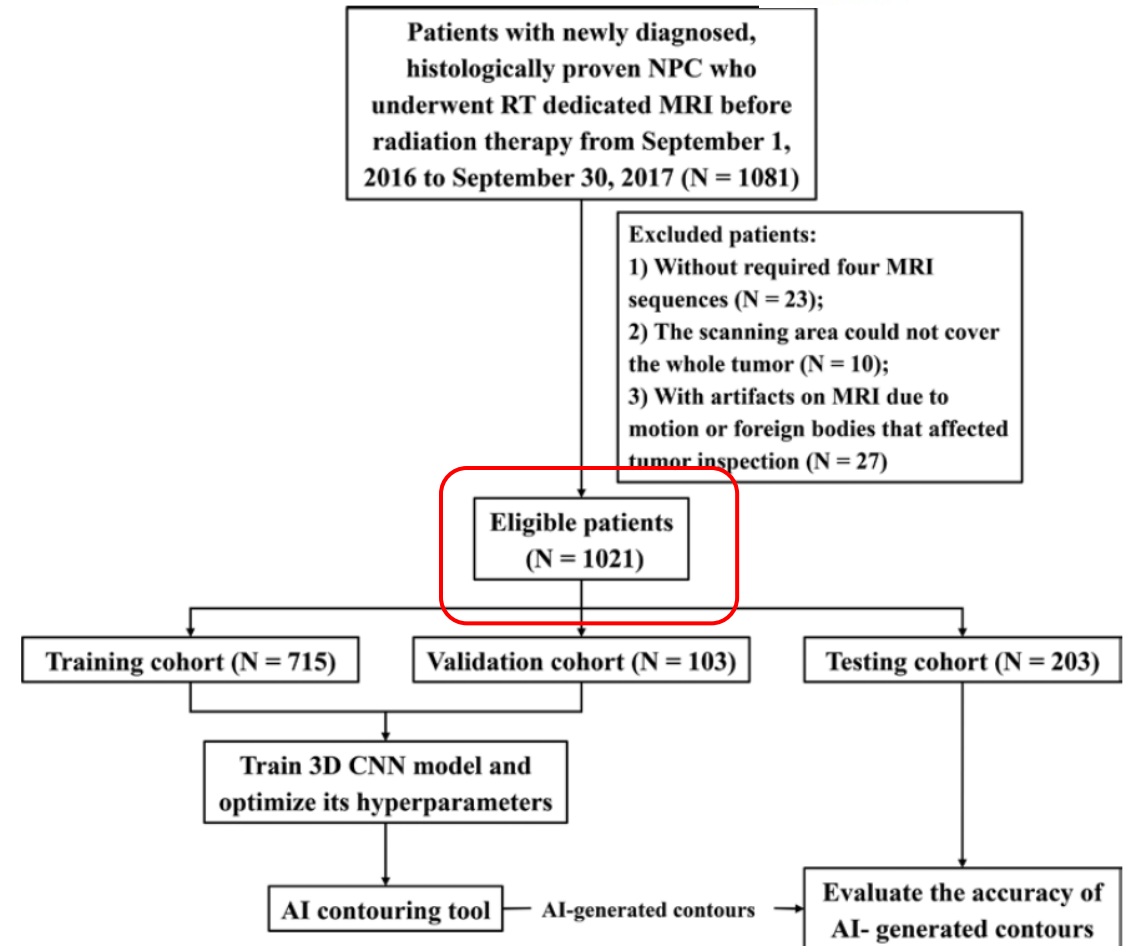
Application: AI-assisted Radiotherapy



- Automated Contouring of Primary Tumor Volume (PTV) in NPC



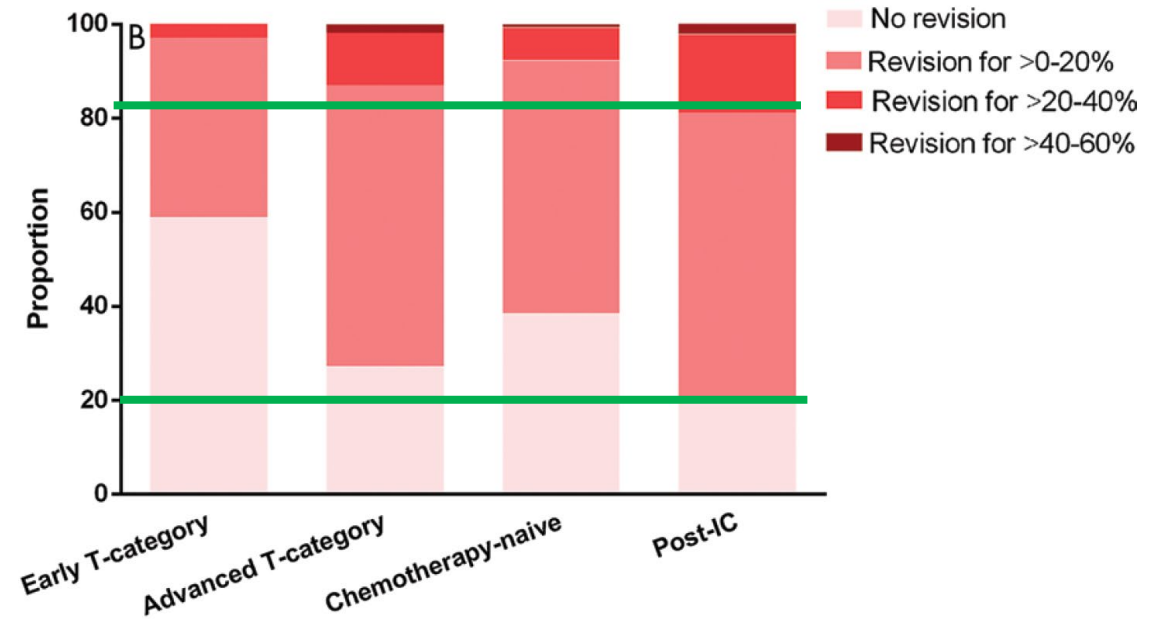
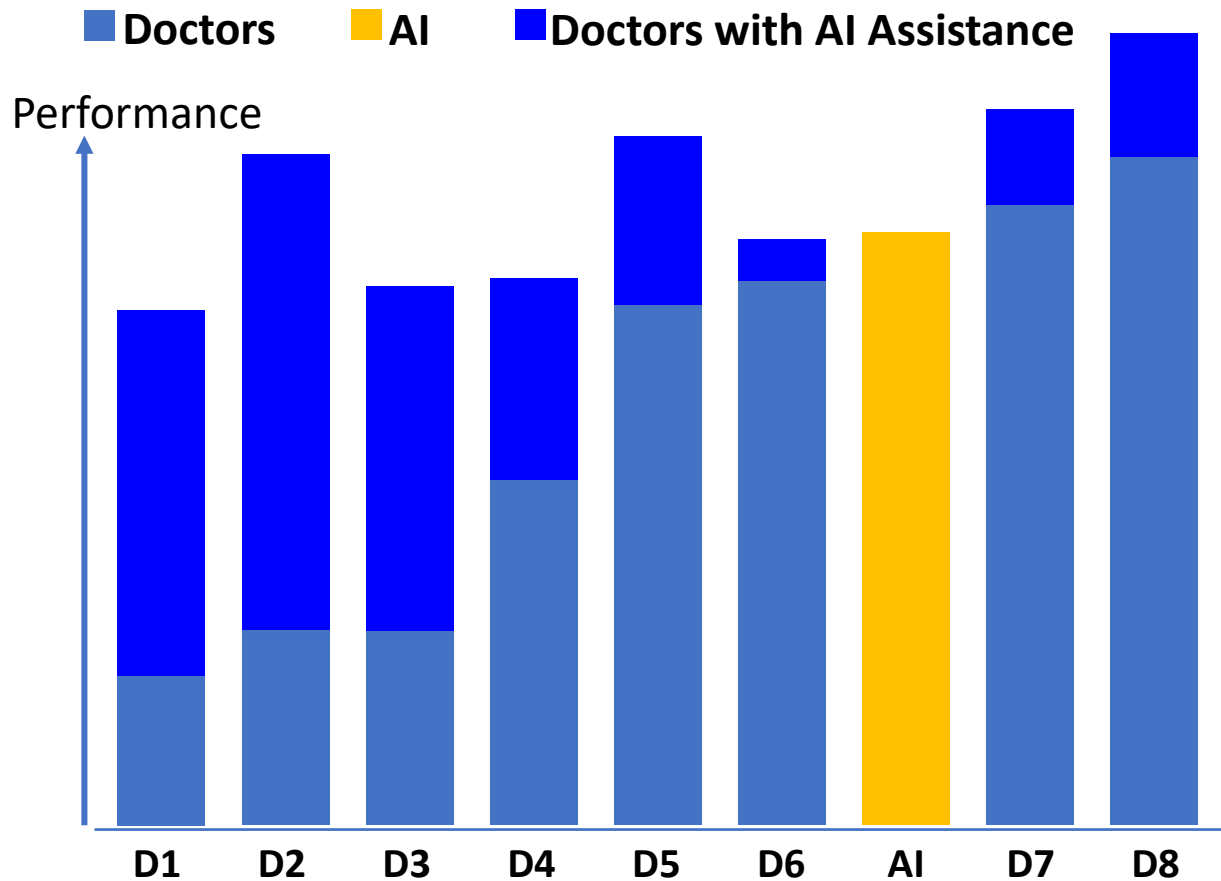
Blue and red lines are delineated human experts and AI, respectively.



Application: AI-assisted Radiotherapy



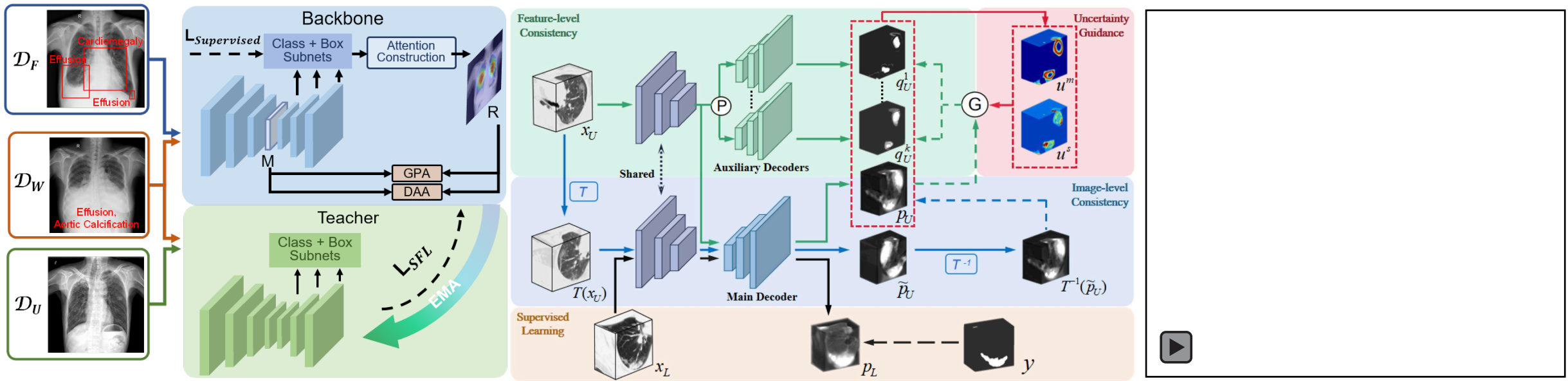
- Automated Contouring of PTV in NPC



Application: AI-assisted Radiology Diagnosis



- Thoracic disease **detection** from chest **X-rays** with omni-supervised under various annotation granularities. It's applied to the disease triaging for prioritizing the urgent cases.
- COVID-19 lesion **segmentation** from **CTs** with semi-supervised learning from the unlabeled data.
- Integrated AI platform for COVID-19 **trialoging, screening, quantitative diagnosis, longitudinal monitoring and severity assessment.**

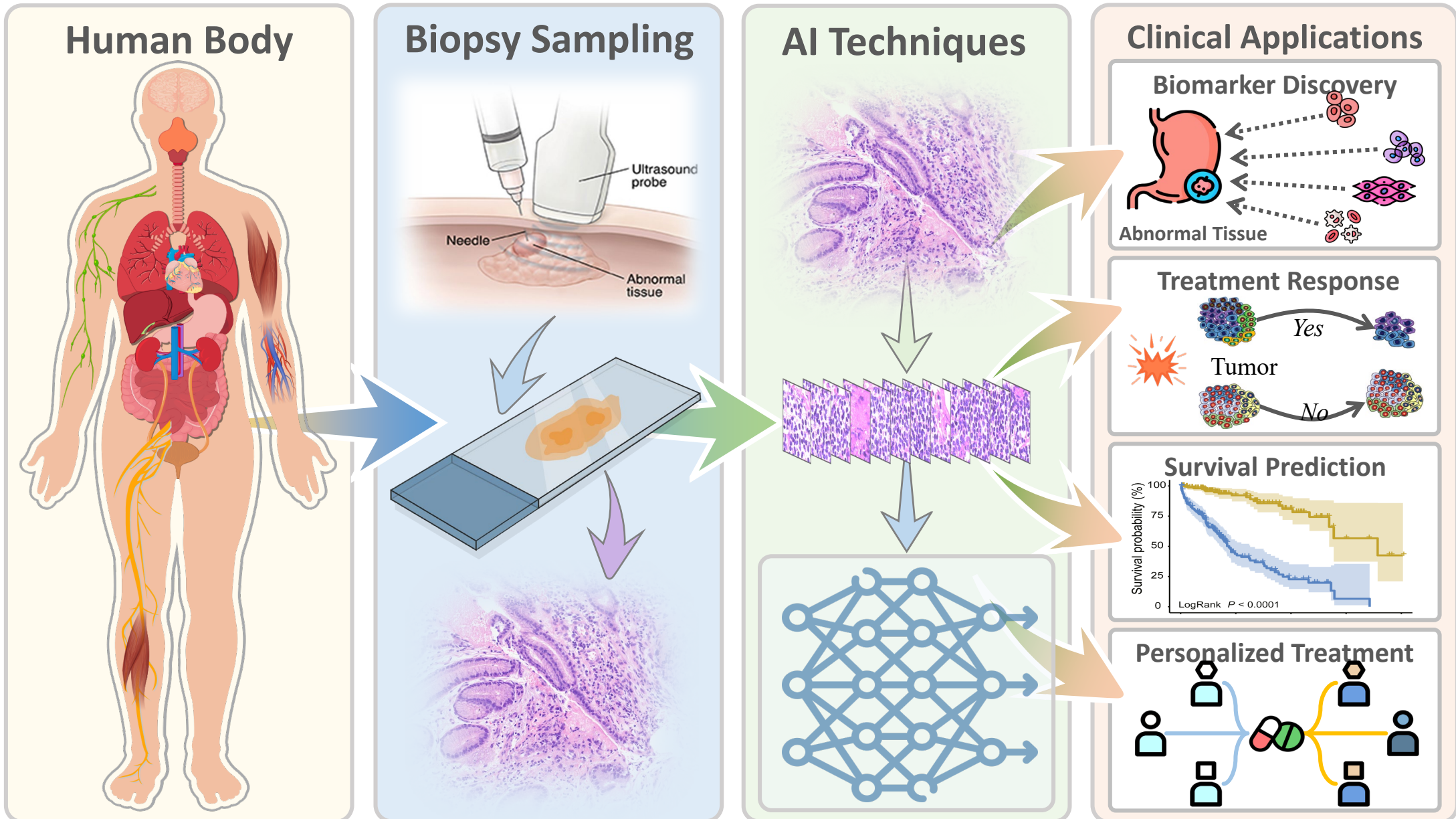


Thoracic Disease Detection from Chest X-rays

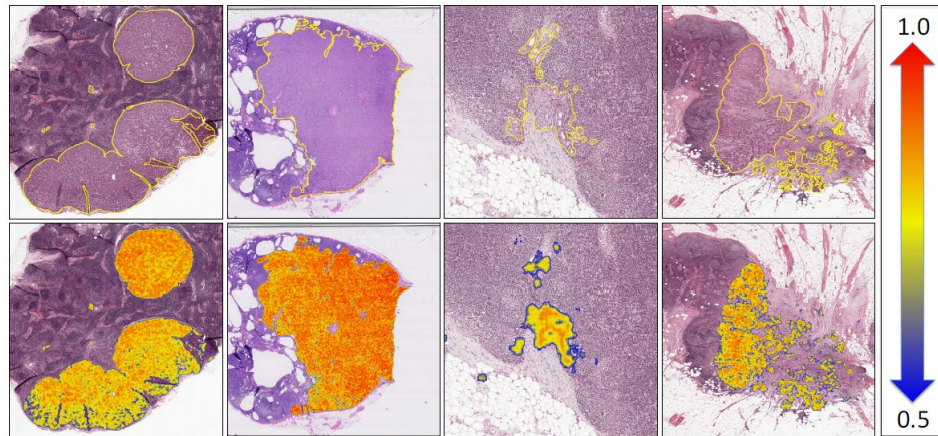
COVID-19 Lesion Segmentation from CTs

Longitudinal Visualization

Application: Computational Pathology

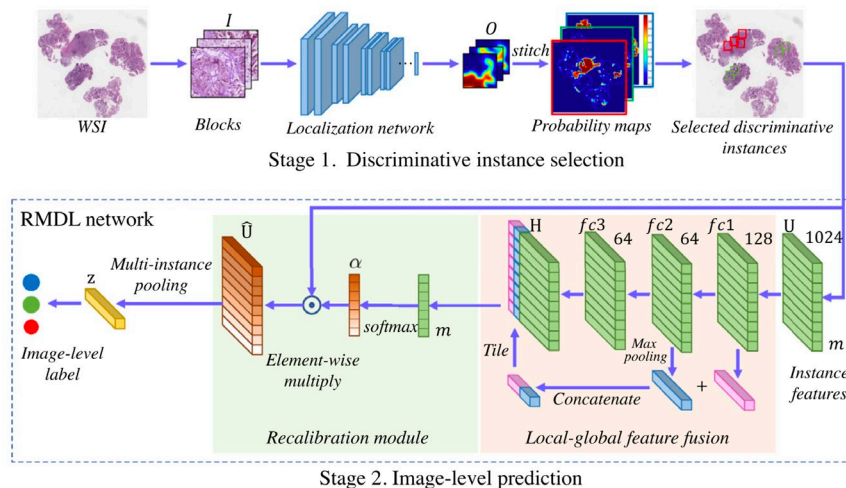


Application: Computational Pathology



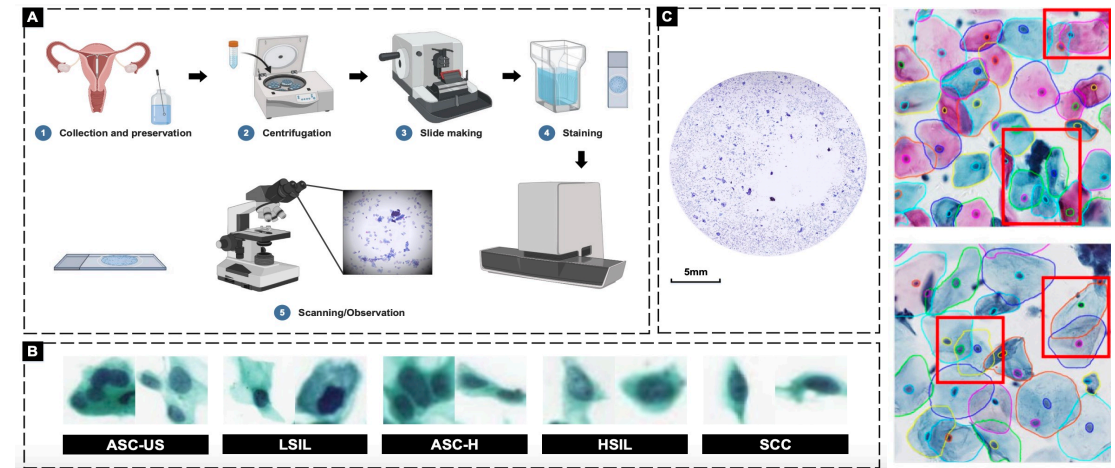
AI excels pathologists in metastasis localization

[JAMA 2017, WACV 2018, TMI 2019]



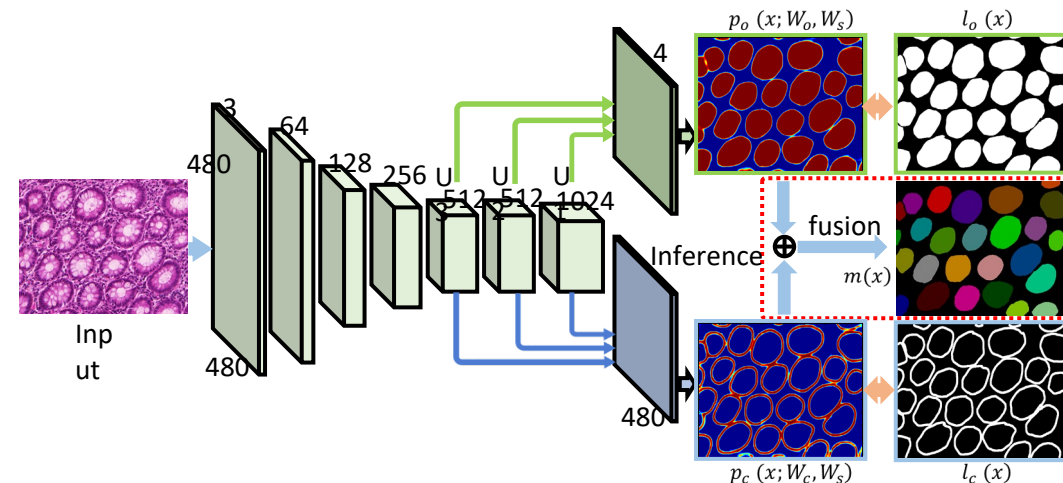
Multi-instance DL for gastric cancer diagnosis

[MIA 2019]



AI stratifies cervix cancer screening

[MIA 2021, ISBI 2022, TMI 2019]



Instance-aware morphology profiling

[CVPR 2016, MIA 2017, **Winners of two MICCAI Challenges**]¹²

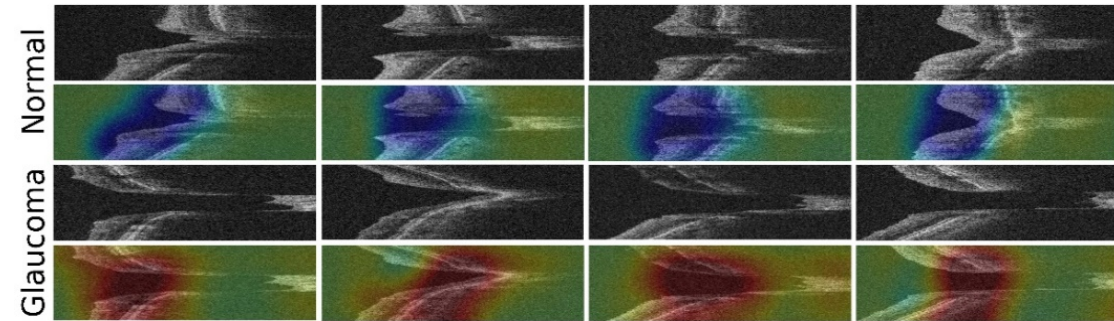
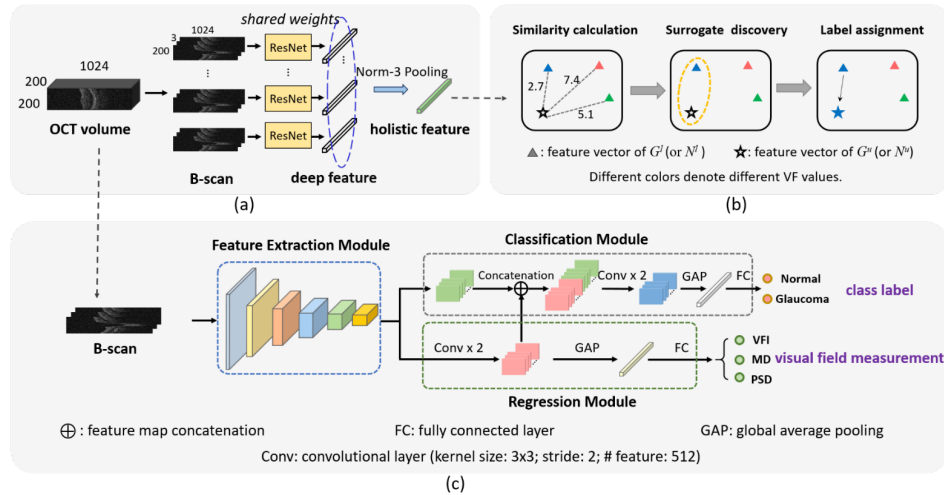
Application: AI in Ophthalmology



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Ophthalmology
and Visual Sciences

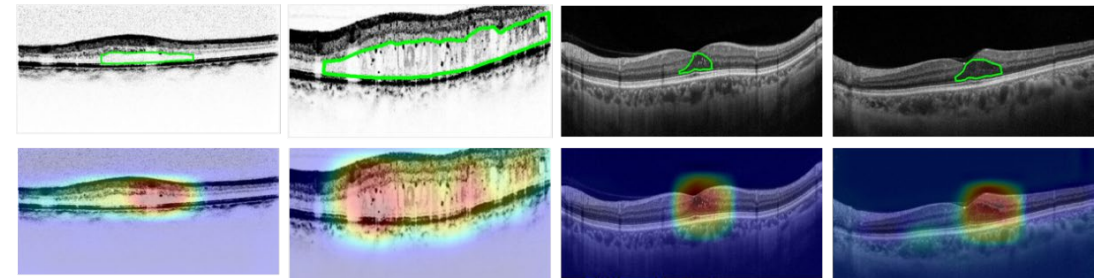
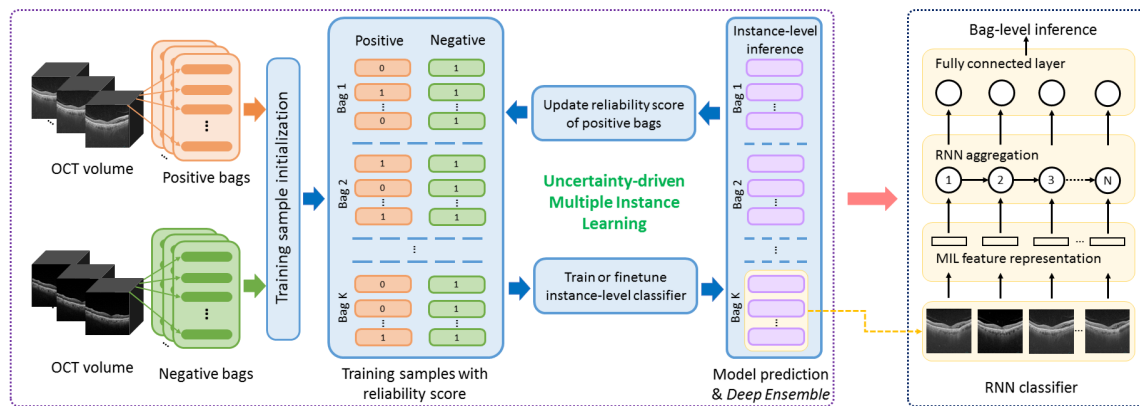


Hong Kong Eye Hospital



Glaucoma OCT image screening with multi-task learning

[Wang et al. MedIA 2020, Ran, et al. Lancet Digital Health 2019 **Cover Page**]



Uncertainty-driven MIL for DME classification from OCT [Wang et al. IEEE JBHI 2020]

Challenges in Practice



Data Quality

- Scanning
- Thickness
- Dosage
- Artifact
- Dyeing
- Annotation noise

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Clinical Integration

- Seamless
- Enhanced iteration
- Privacy-preserving
- Continuous optimization

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Generalization

- Different hospitals
- Various vendors
- Different protocols

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Maintainability

- Easy retrieval
- Massive clinical data validation
- Diversity of data distributions

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User Friendly

- Integrated into clinical pathways
- In line with doctors' habits
- Interpretation
- Transparent decision

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Thank you!

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