Artificial Intelligence in Clinical Imaging

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Disclosures

- CRADA: NVIDIA
- CRADA: Philips
- Royalties from NIH
- Patents in the field of AI
- Research samples of an MRI artificial intelligence (AI) algorithm developed in NCI in collaboration with NVIDIA will be shown in this talk

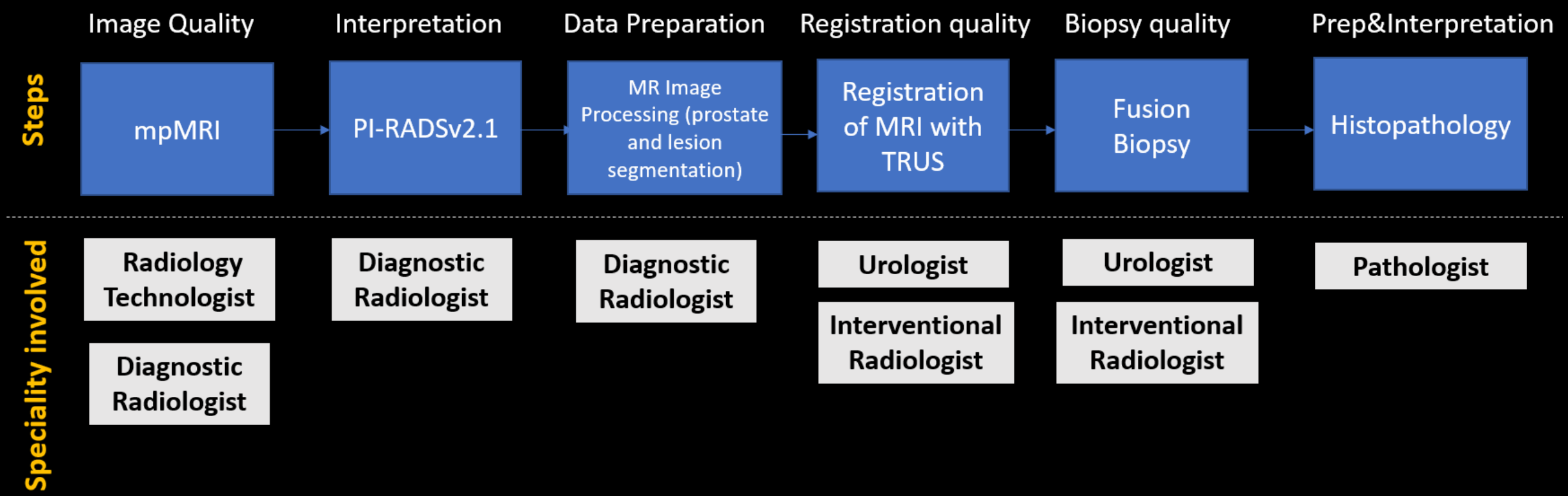
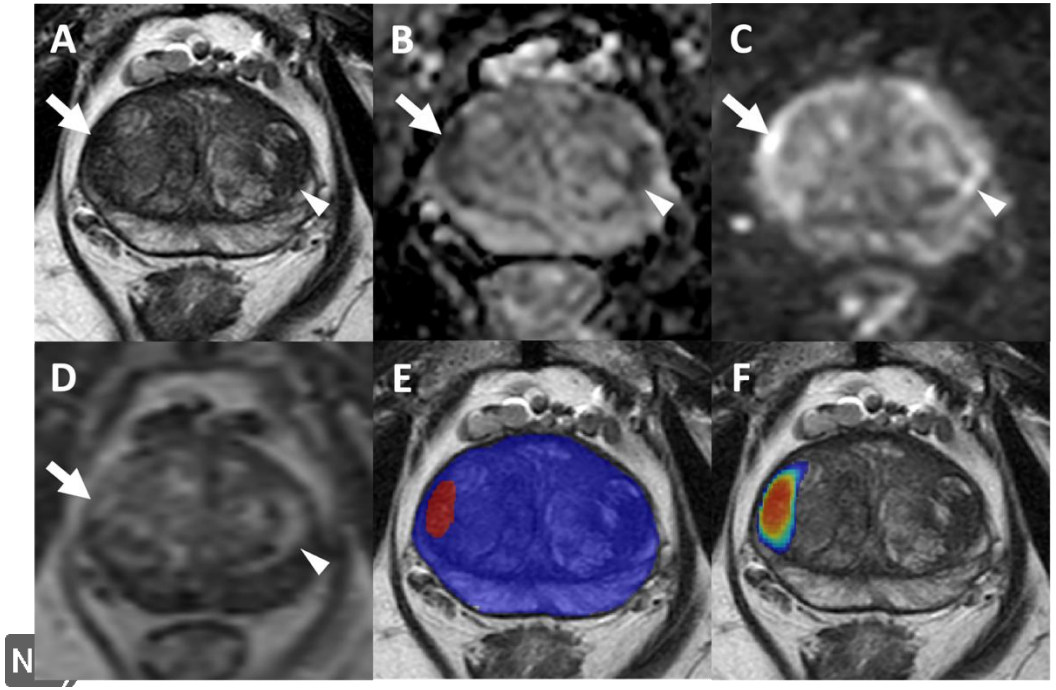


Image Quality
Interpretation
Data Preparation
Registration quality
Biopsy quality
Prep&Interpretation
Steps
mpMRI
PI-RADSv2.1
MR Image Processing (prostate and lesion segmentation)
Registration of MRI with TRUS
Fusion Biopsy
Histopathology
Speciality involved
Radiology Technologist
Diagnostic Radiologist
Diagnostic Radiologist
Diagnostic Radiologist
Urologist
Interventional Radiologist
Urologist
Interventional Radiologist
Pathologist

Original Investigation

A Cascaded Deep Learning–Based Artificial Intelligence Algorithm for Automated Lesion Detection and Classification on Biparametric Prostate Magnetic Resonance Imaging

Sherif Mehralivand, MD, Dong Yang, PhD, Stephanie A. Harmon, PhD, Daguang Xu, PD, Ziyue Xu, PhD, Holger Roth, PhD, Samira Masoudi, PhD, Thomas H. Sanford, MD, Deepak Kesani, DO, Nathan S. Lay, PhD, Maria J. Merino, MD, Bradford J. Wood, MD, Peter A. Pinto, MD, Peter L. Choyke, MD, Baris Turkbey, MD



- 1390 patients (n=350 outside NIH)
  - train/test (89%/11%)
- Lesions were contoured + assigned PI-RADS category
- 3D U-Net: lesion detection and segmentation
- Two 3D residual neural network: PI-RADS categorization

- PPV (CDR) = 63%
- False positives/patient = 0.44 lesion/patient
  - TP= 82% were cancer
  - FP=51% were benign
- Lesion segmentation (DSC) = 0.36
- PI-RADS classification accuracy=58%

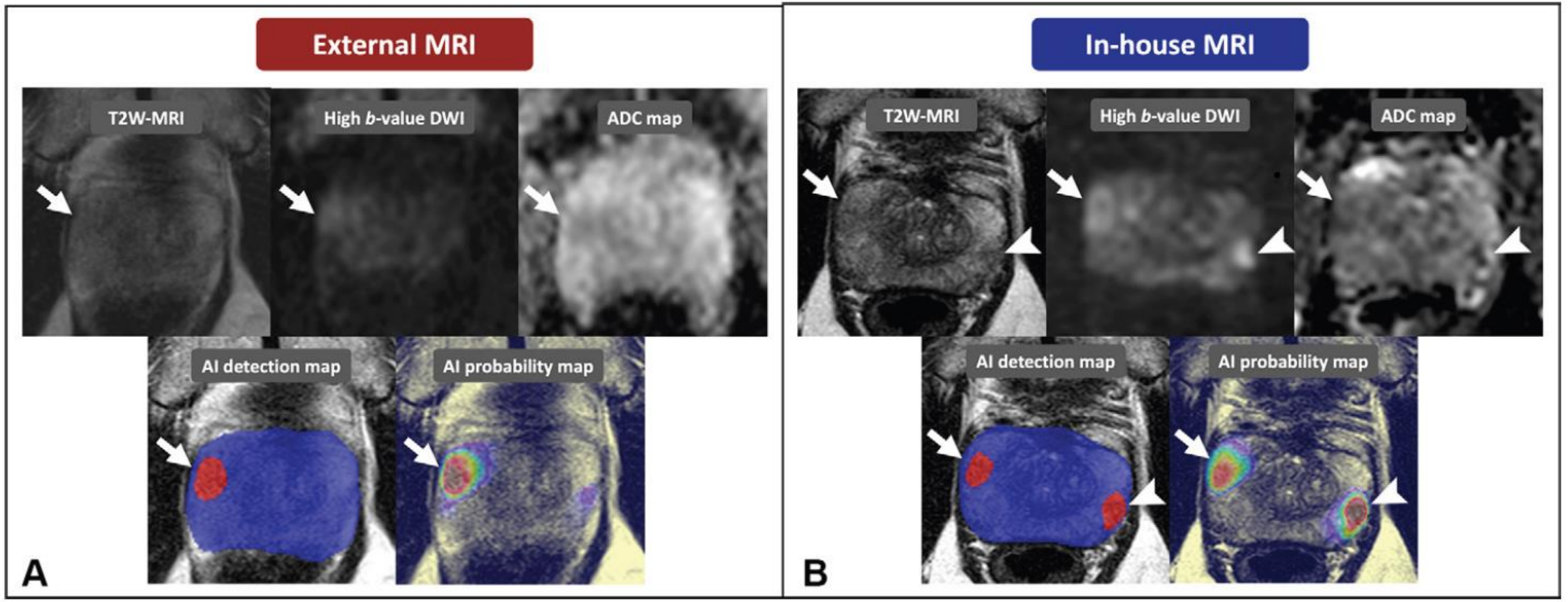
Radiology: Imaging Cancer

ORIGINAL RESEARCH

External Validation of a Previously Developed Deep Learning–based Prosta and In-House

Enis C. Yilmaz, MD • Ste
Yue Lin, MD • David G.

Scan Source	T2W-MRI Diagnostic (Class 2) proportion (%)	DW-MRI Diagnostic (Class 2) proportion (%)	Overall Lesion-based: Sensitivity	PCa+ Lesion-based: Sensitivity	csPCa+ Lesion-based: Sensitivity	≥GG3 Lesion-based: Sensitivity
External MRI	41% (82/201)	36% (72/201)	40% (149/375)	53% (72/137)	61% (54/89)	70% (23/33)

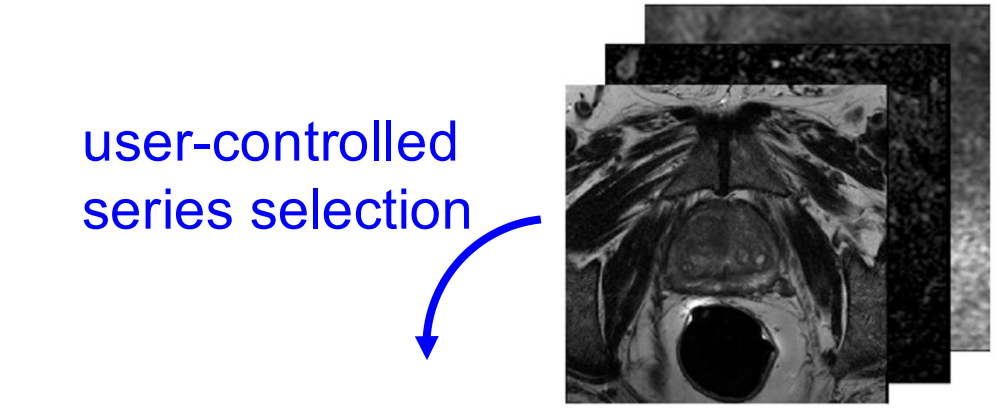


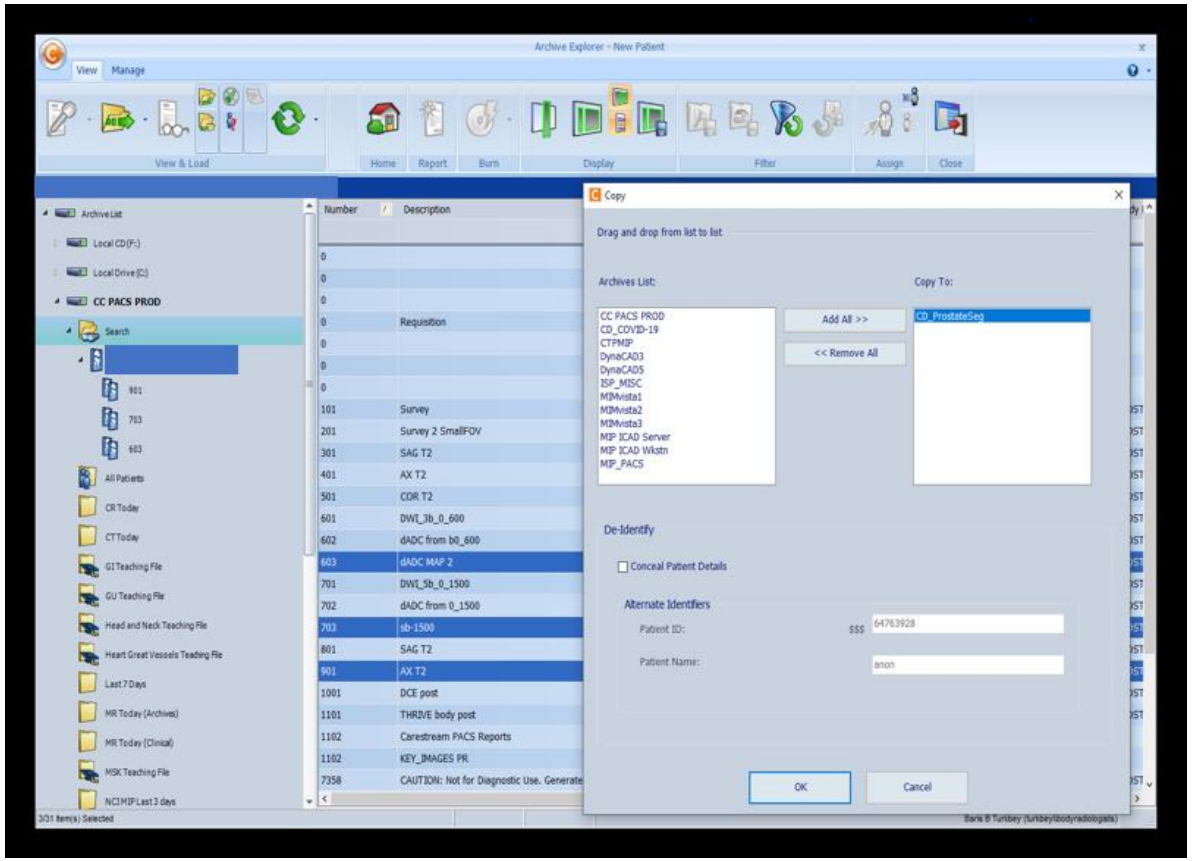
Sensitivity
(csPCa+ Lesion Detection)

Workflow

- DICOM images pushed from PACS under Application Entity Titles specifically associated to each inference pipeline

- Patient selection and pipeline execution are controlled by the PACS user (radiologist)

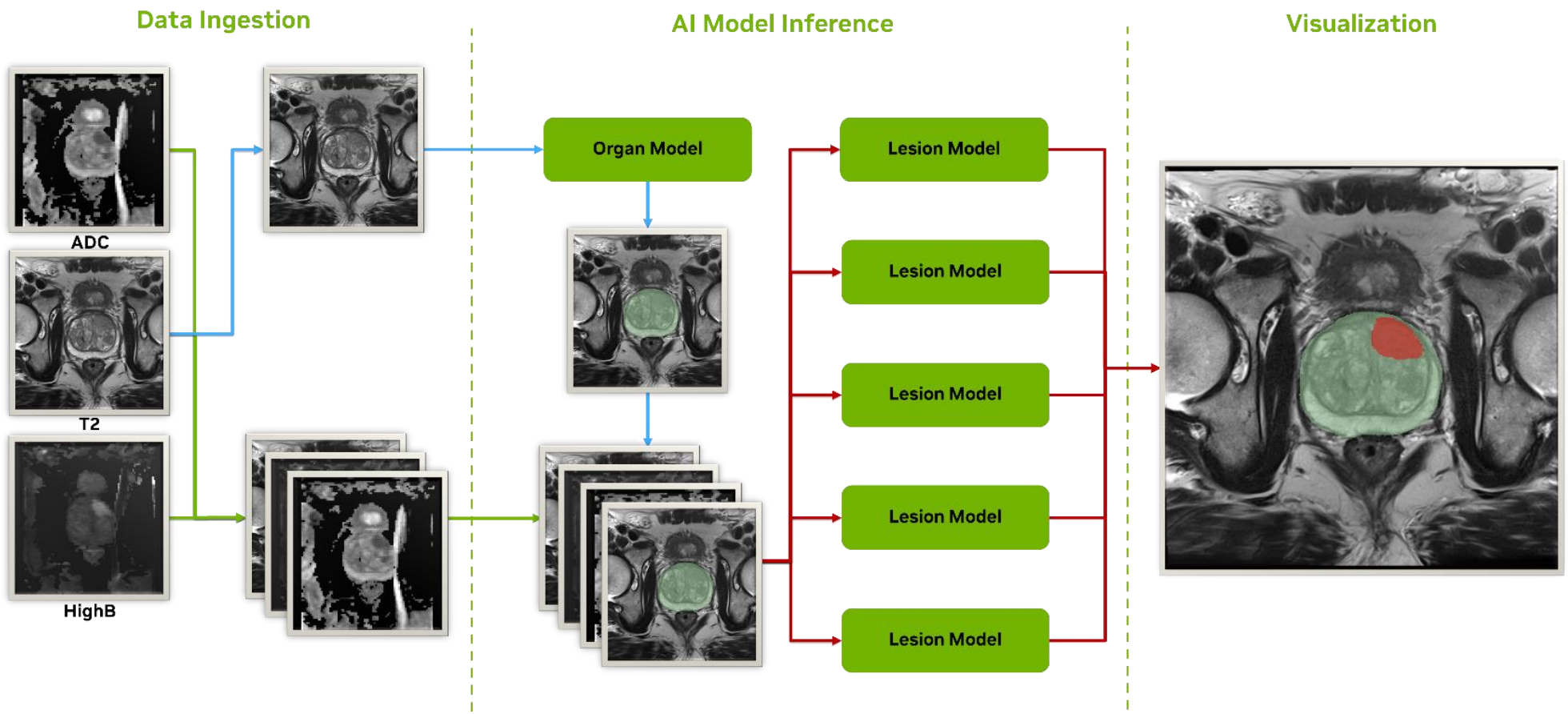




Harmon, Turkbey et al. 2025

AI Pipeline

MONAI Deploy Express



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PACS Display

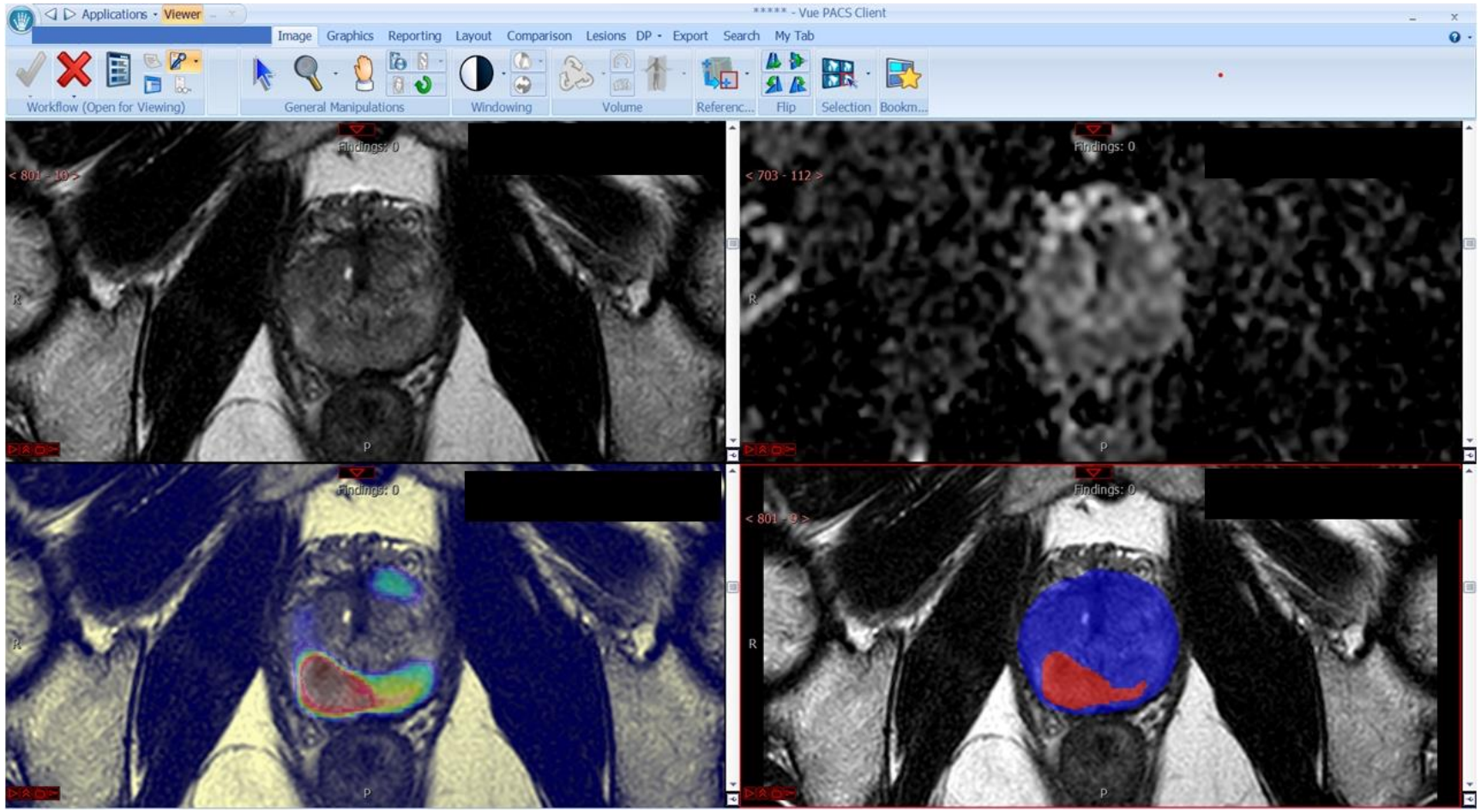


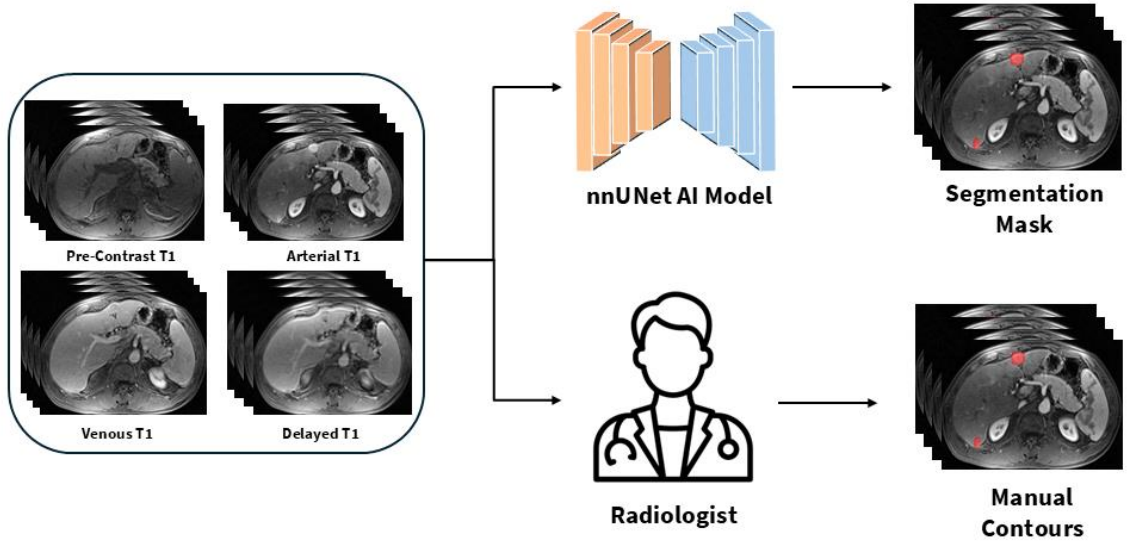
Table 3 Phase 2—CDRs by lesion categorization

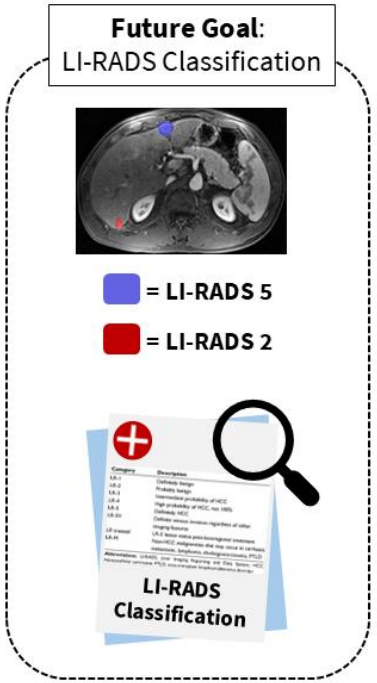
Summary	AI+/Rad+ ($n=28$)	AI+/ Rad- ($n=23$)	AI-/Rad+ ($n=21$)
# Lesions	28	23	21
Biopsy result			
Benign	5	12	14
3+3	11	7	3
3+4	9	2	4
4+3	1	1	0
4+4	1	0	0
4+5	1	1	0
PCa CDR	82.1% (23/28)	47.8% (11/23)	33.3% (7/21)
csPCa CDR	42.9% (12/28)	17.4% (4/23)	19.0% (4/21)

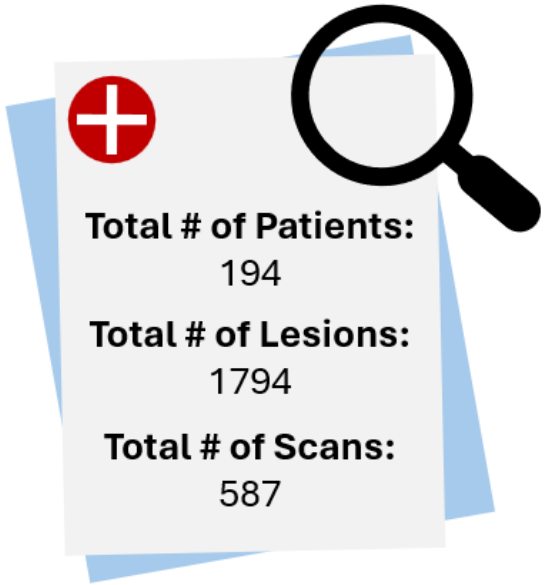
NCI Prostate MRI AI model

Harmon, Turkbey et al. 2025

Liver Lesion Segmentation Model in Cirrhosis Patients







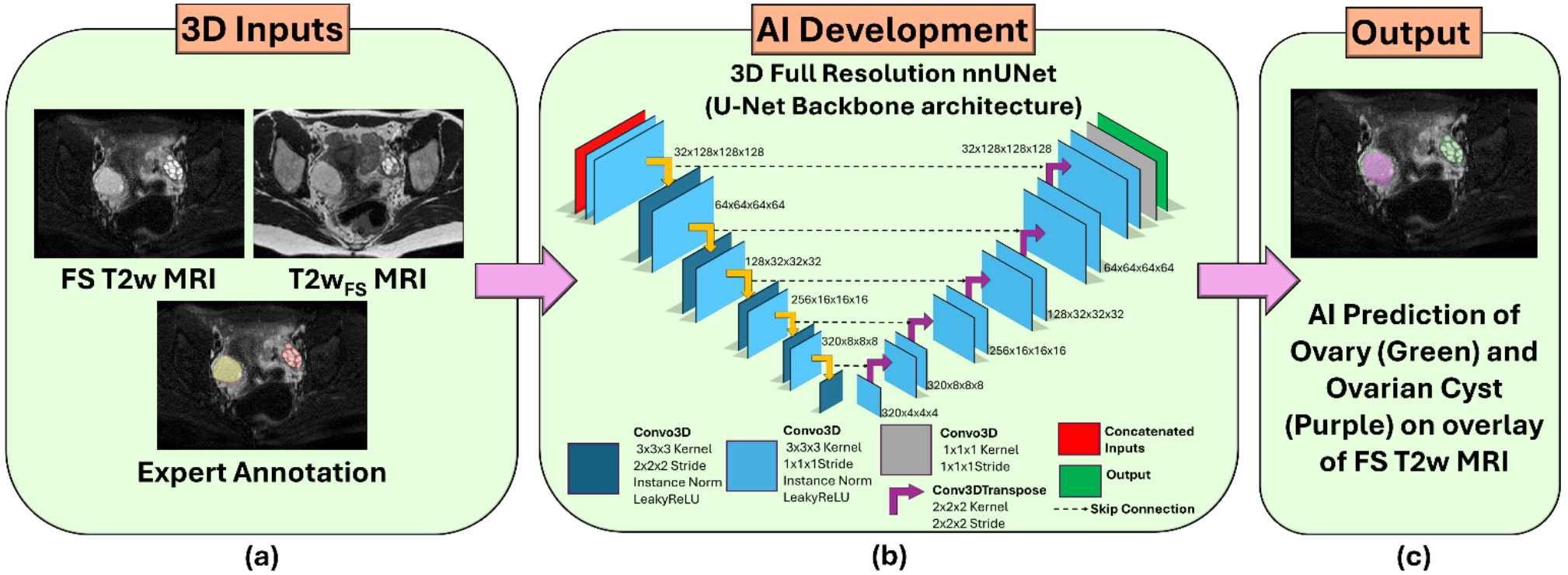
Emma Stevenson, BS

	All LIRADS Scores	LIRADS Scores 3 and above	LIRADS 4,5, and TR
Number of Scans	117	81	56
Sensitivity	63.4	71.9	78.1
Specificity	91.7	91.7	91.7
PPV	96.7	95.3	92.6
NPV	39.3	57.9	75.9
Accuracy	69.23	77.78	83.9

AI for Automated Gonad Volume Quantification in Healthy Adolescents across Puberty

Aim: To develop open-source AI models to segment gonads at MRI

Dr. Fahmida Haque



AI for Automated Gonad Volume Quantification in Healthy Adolescents across Puberty

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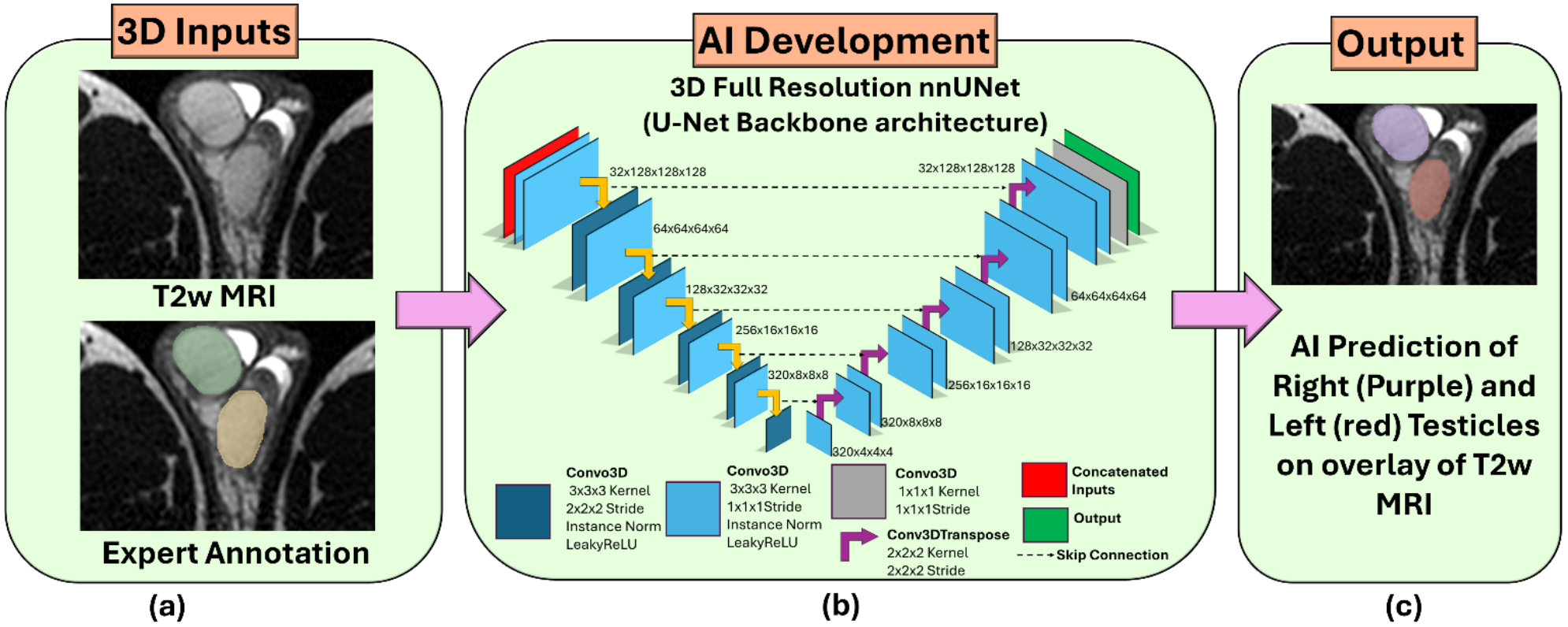


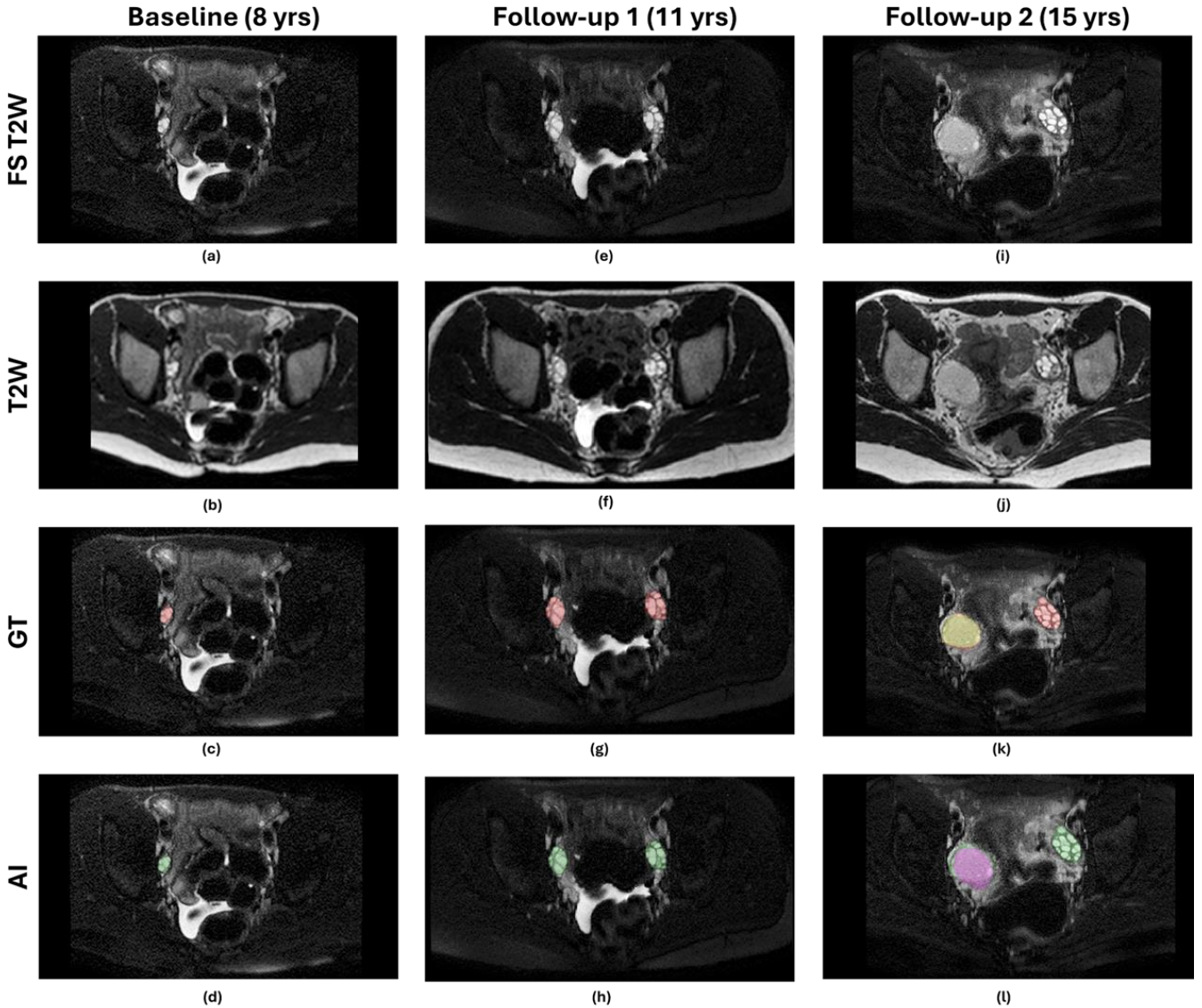
Dataset Description

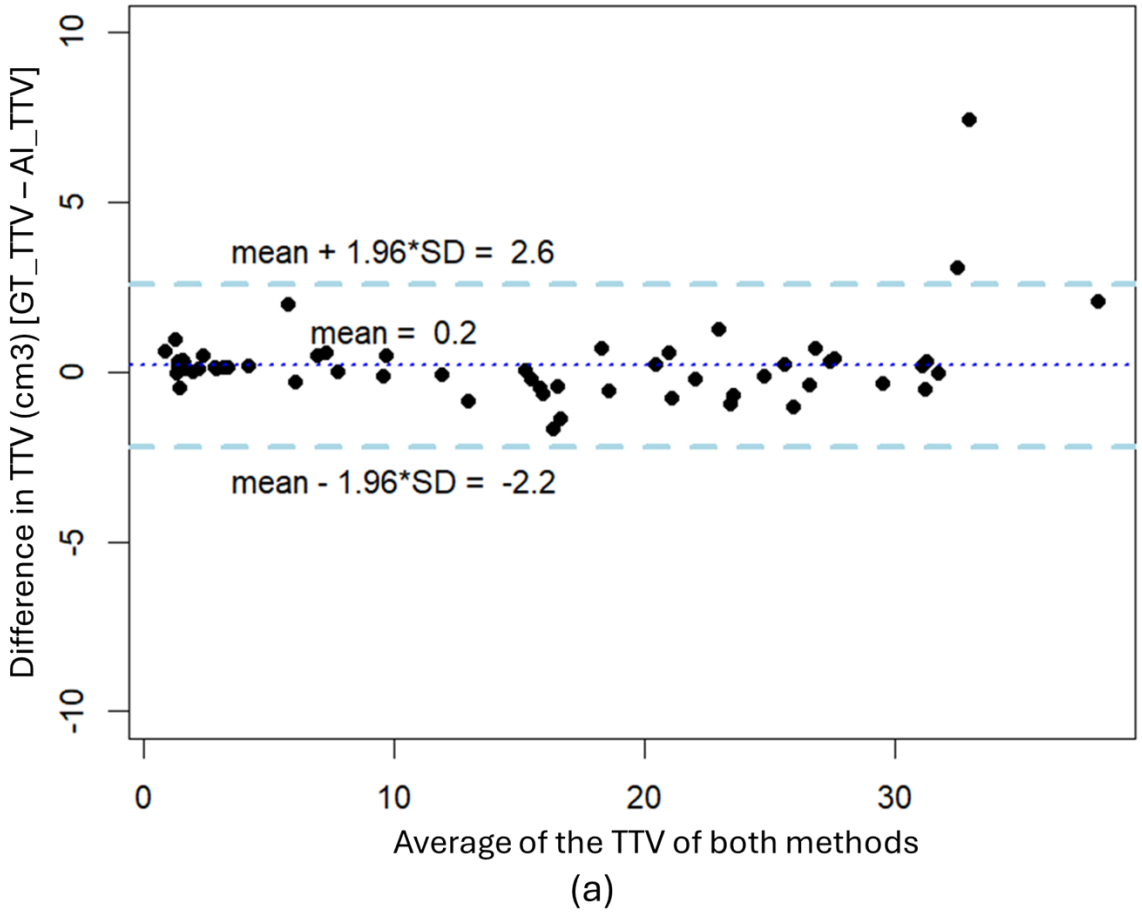
Data splits	Patients	Scans with ovary annotation	Scans with Cysts (>3cm)
Train	14	123	4
Validation	3	15	4
Test	5	32	6

3d U-Net model from the nnUNet framework

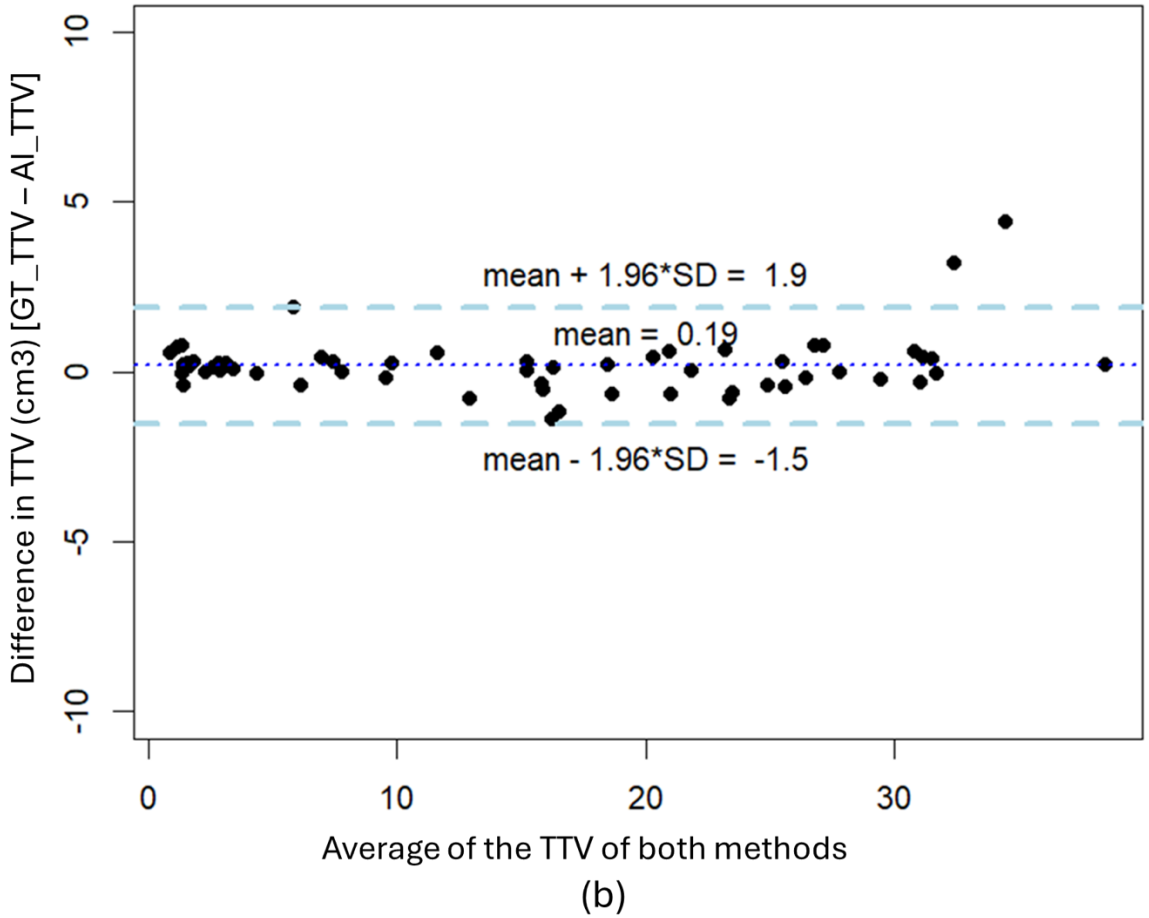
AI Performance Evaluation

Organ/Cyst Level	Modality: T2 only		Modality: FS only		Modality: T2+FS	
	Ovary	Cyst	Ovary	Cyst	Ovary	Cyst
TP	72	7	72	7	72	7
FN	0	0	0	0	0	0
FP	0	0	0	1	0	2
Sensitivity	100	100	100	100	100	100
PPV	100	100	100	87.5	100	77.78
Dice	0.75	0.85	0.85	0.78	0.86	0.69

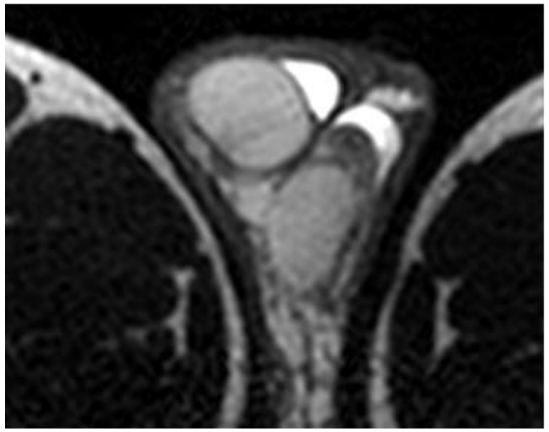



Difference in TTV (cm3) [GT_TTV – AI_TTV]
10
5
0
-5
-10
mean + 1.96*SD = 2.6
mean = 0.2
mean - 1.96*SD = -2.2
0
10
20
30
Average of the TTV of both methods

(a)

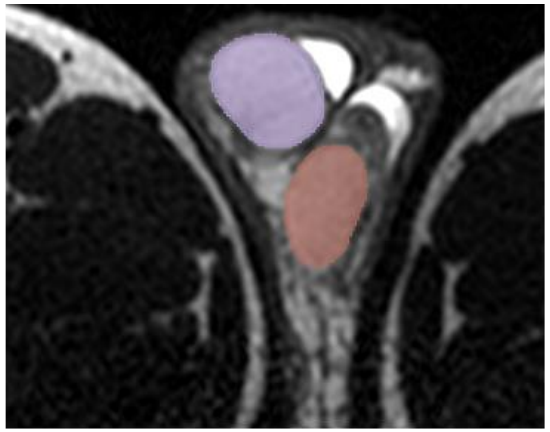

Difference in TTV (cm3) [GT_TTV – AI_TTV]
10
5
0
-5
-10
mean + 1.96*SD = 1.9
mean = 0.19
mean - 1.96*SD = -1.5
0
10
20
30
Average of the TTV of both methods

(b)

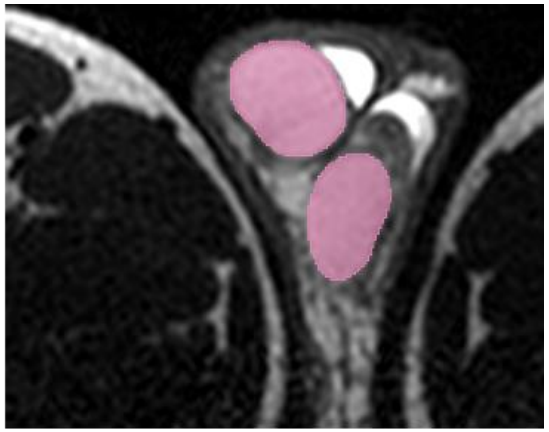


T2w MRI
(a)

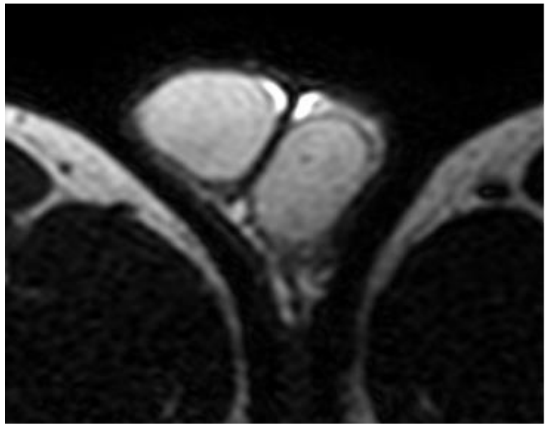
Ground Truth
(b)



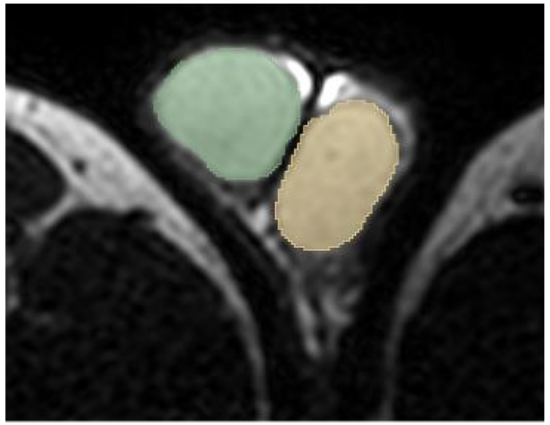
$\text{Testicular}_{\text{side-sep}}$ Prediction
(c)



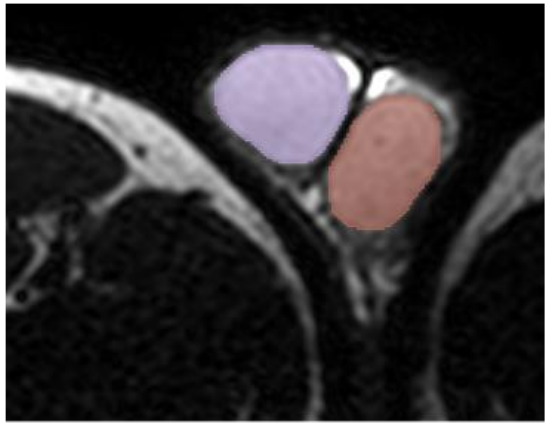
$\text{Testicular}_{\text{Whole}}$ Prediction
(d)



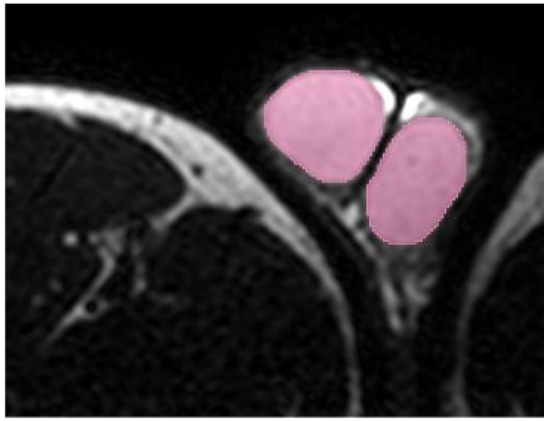
T2w MRI
(e)



Ground Truth
(f)



$\text{Testicular}_{\text{side-sep}}$ Prediction
(g)



$\text{Testicular}_{\text{Whole}}$ Prediction
(h)

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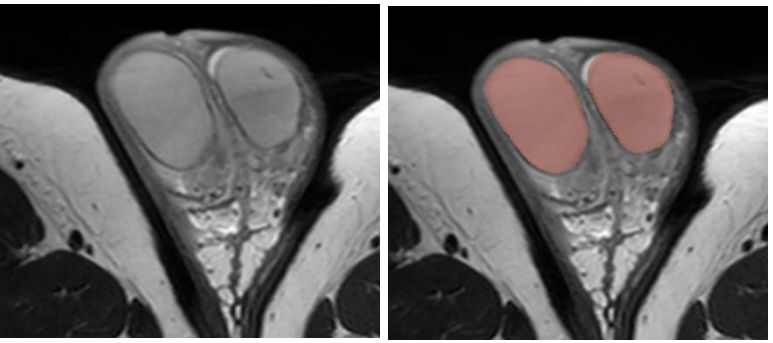

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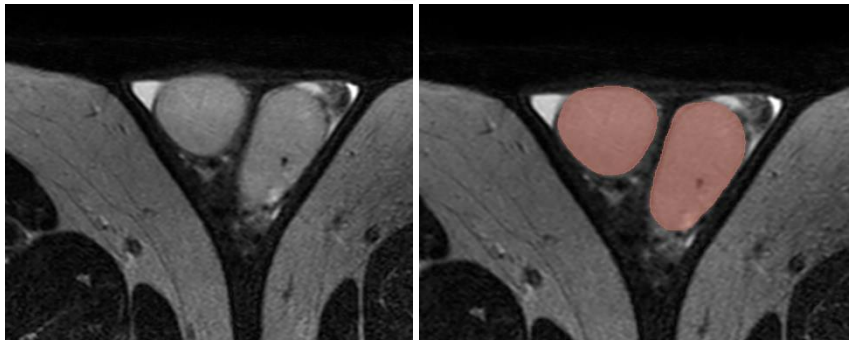

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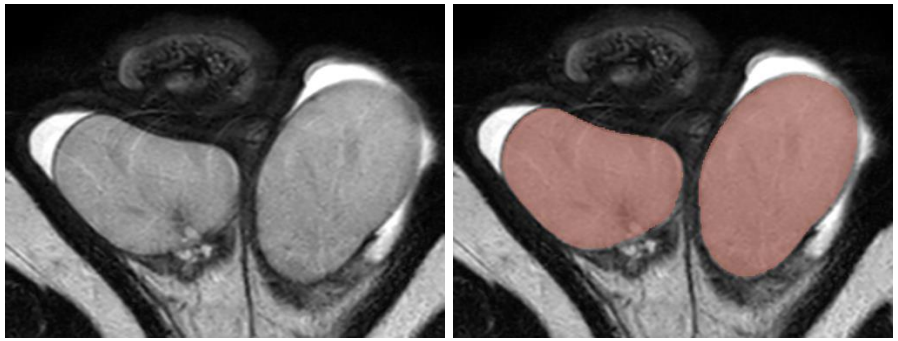

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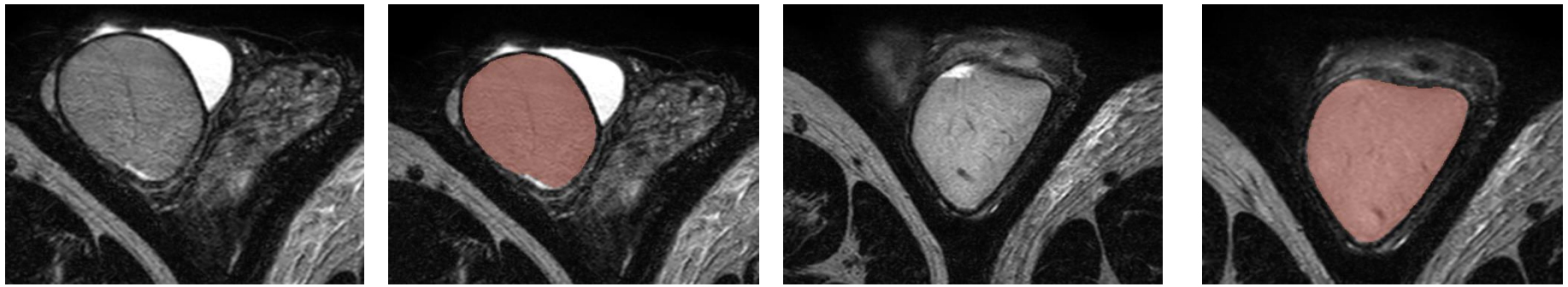


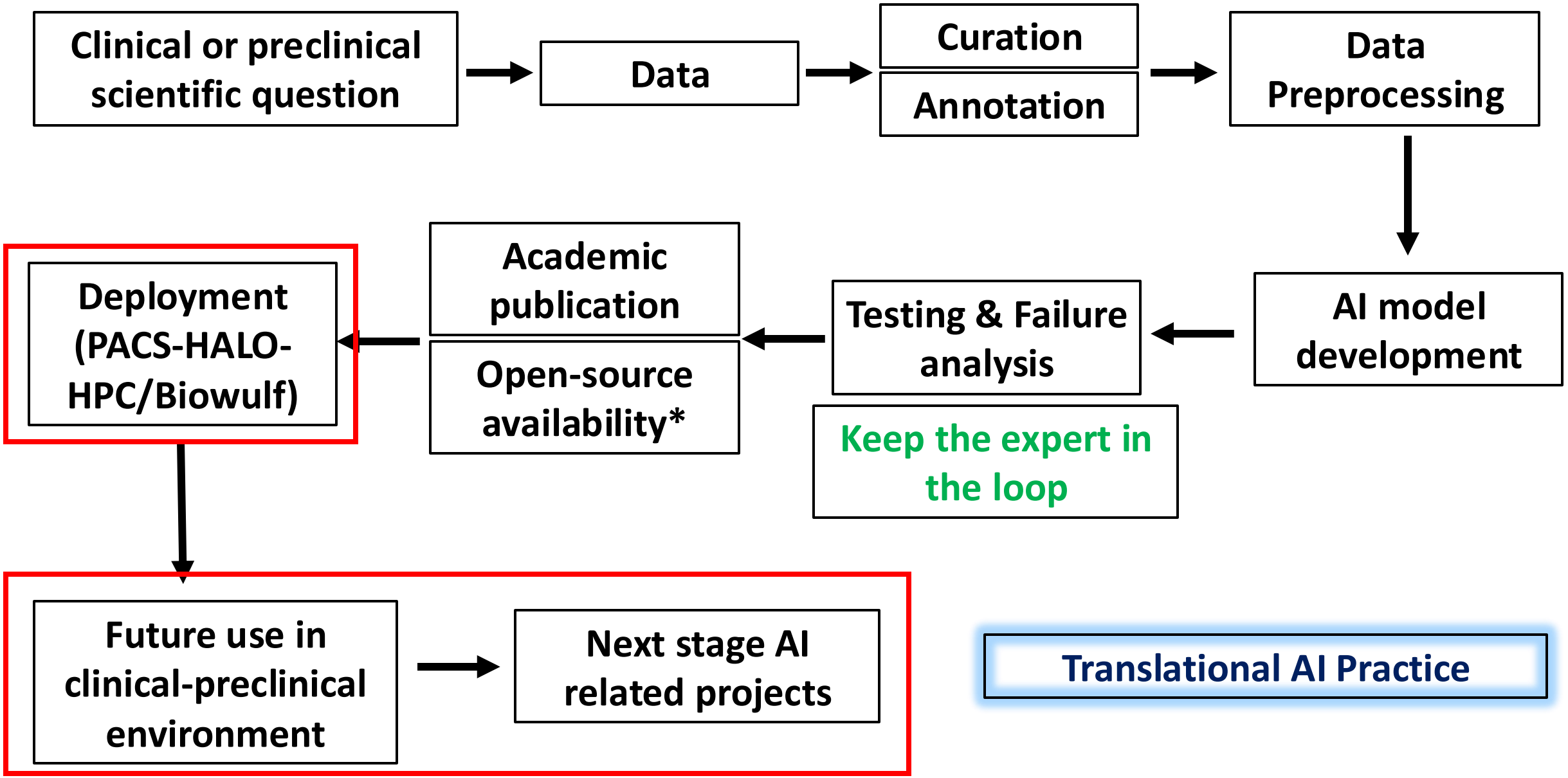
Steps for AI development

Artificial Intelligence Resource (AIR)

Data/Projects:

- Clinical and preclinical
- Radiology (MRI, CT, x-ray, PET/CT, ultrasonography), digital pathology, endoscopy, EHR

- **Deployment (PACS-HALO-HPC/Biowulf)**
- **Future use in clinical-preclinical environment**
- **Training to fellows and researchers in NCI, NIH**


Clinical or preclinical scientific question
Data
Curation
Annotation
Data Preprocessing
AI model development
Testing & Failure analysis
Keep the expert in the loop
Academic publication
Open-source availability*
Deployment (PACS-HALO-HPC/Biowulf)
Future use in clinical-preclinical environment
Next stage AI related projects
Translational AI Practice

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Stadtman Investigator

Sushant Patkar PhD
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Fahmida Haque PhD
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Omer Esengur, MD, MIB post-doc Fellow
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Peter Schmidt, NIMH

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