IMAGENDO® Endometriosis Diagnosis using Artificial Intelligence: Improving Detection with Magnetic Resonance Imaging, Leveraging Unpaired Endometriosis Ultrasounds.

Avery J[1]; Zhang Y[1,2], Leonardi M[1.3], Deslandes A[1], Wang H[1,2], Knox S[1,4], To MS[5], Condous G[1,6], Carneiro G[1,7], Hull, ML[1].

1.Robinson Research Institute, University of Adelaide, South Australia
2. Australian Institute of Machine Learning, University of Adelaide, South Australia
3. Mc Master University, Hamilton, Canada
4. Benson Radiology, South Australia
5. South Australia Department of Health
6. Omni Gynaecological Care, New South Wales
7. Centre for Vision, Speech and Signal Processing, University of Surrey, UK

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INTRODUCTION:

Endometriosis causes pain in 1 in 9 women and those assigned female at birth. It is a chronic, incurable condition, which causes fertility issues and is responsible for absences from work and study.

Using the traditional method of diagnostic laparoscopy, the average wait for a diagnosis of endometriosis is 6.4 years.

Our 2016 systematic review found, that using Imaging, detection of pelvic endometriosis, through identifying markers, has a 95% specificity from endometriosis ultrasound (eTVUS) and 72% from endometriosis magnetic resonance imaging (eMRI). This accuracy was reflected in updated ESHRE guidelines, which now state that imaging can be used for endometriosis diagnosis.

IMAGENDO aims to address this diagnostic delay, by combining eTVUS and eMRI using Artificial Intelligence (AI). Our novel multimodal AI approach improves diagnostic accuracy when detecting of POD obliteration in endometriosis, using imaging data from eTVUS and eMRIs.

AIM:

To improve the accuracy of POD obliteration detection using eMRI, by leveraging results of detection from unpaired eTVUS data.

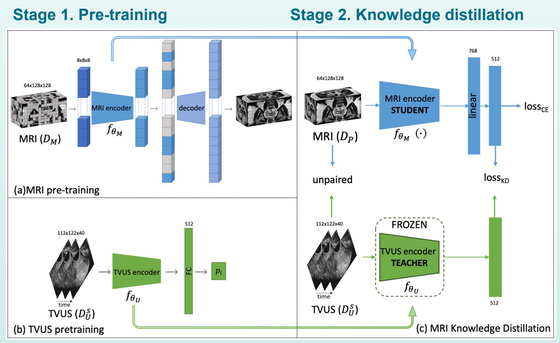

Figure 1. Two-stage Knowledge Distillation

METHODOLOGY:

We recruited retrospective images from women who had been investigated for pelvic symptoms from private radiography and sonography clinics in Adelaide, South Australia.

Our datasets from specialist private and public imaging of the female pelvis, enabled us to pre-trained a machine learning model using a public dataset of 8,984 MRIs (Fig 1)

To detect Pouch of Douglas (POD) obliteration, we then fine-tuned the algorithm using 89 private eMRIs. Introducing another 749 unpaired eTVUSs, further improved our diagnostic model.

RESULTS:

Our results illustrate effective multimodal analysis methods which improve POD obliteration detection accuracy from eMRI datasets.

This model demonstrated improvement in the Area Under the Curve (AUC) from 65.0% to 90.6%. (Table 1)

TROUBLESHOOTING:

Confounding problems with our eMRI datasets were compensated for using model checking, student auditing and expert radiology review. These were present as a result of artefacts, mislabelling, and misreporting.

Table 1: Results

Method	Training Modality	Testing Modality	AUC mean± stddev
3D ViT	MRI	MRI	**0.650±0.102**
3D ViT + MAE Pretraining	MRI	MRI	0.872±0.094
3D ViT + Knowledge Distillation	MRI, TVUS	MRI	0.667±0.107
3D ViT + MAE Pretraining + Knowledge Distillation	MRI, TVUS	MRI	0.772±0.087
3D ViT + MAE Pretraining + FT + Knowledge Distillation	MRI, TVUS	MRI	**0.906±0.099**

ENDOMETROSIS TAKES TOO LONG TO DIAGNOSE

CONCLUSION:

We can use a novel detection method for POD obliteration, which can improve the accuracy of diagnosing endometriosis from eMRIs.

Distilling knowledge from unpaired eTVUSs, our model enhances the automated detection of POD obliteration when only data from eMRIs are available.

We have found that the first step in improving the diagnosis of endometriosis is combining digital data from different imaging modalities, which can allow extrapolation of results when either imaging modality is missing.

IMAGENDO will enable people with endometriosis to obtain a faster, more accessible diagnosis for endometriosis, without surgery provided specialist scanning is available.

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Australian Institute for Machine Learning adelaide.edu.au/aiml

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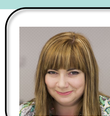

Dr Jodie Avery
IMAGENDO
@Jodie_Avery

Abstract #T-037