Multinational AI Research: How to Engage Globally

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Friday 6 May

SCMR
Society for Cardiovascular Magnetic Resonance

EACVI
European Association of Cardiovascular Imaging
European Society of Cardiology

Declaration of Interest

- We have no conflicts to declare

Challenges that need global engagement

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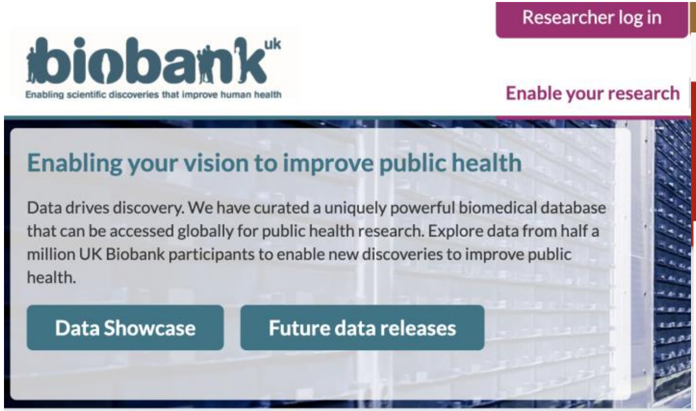
- Data availability and data sharing
- Generalizability
- Mitigation of unintended bias
- Data protection and privacy preserving
- Validation of performance for regulatory approval
- Clinical education for global adoption of AI-enabled solutions
- Democratization: opportunities for low- and middle-income countries

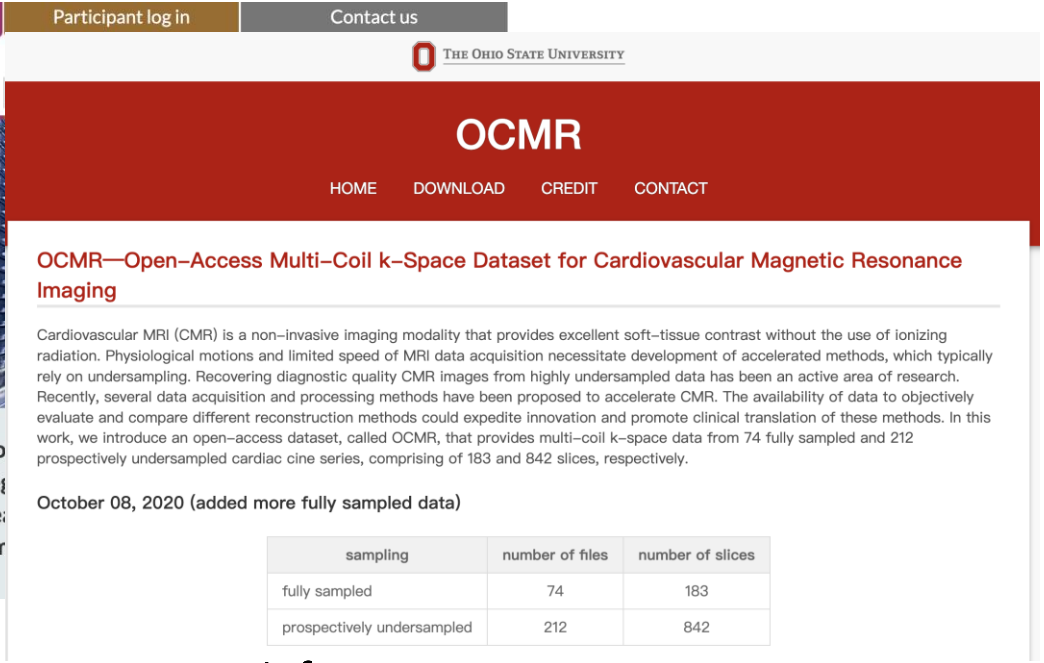
Data availability and data sharing

- Biobanks and Registries
- Benchmark challenges
- Global effort for annotations/labels

Data availability and data sharing

- **Biobanks**





OCMR—Open–Access Multi–Coil k–Space Dataset for Cardiovascular Magnetic Resonance Imaging

Cardiovascular MRI (CMR) is a non–invasive imaging modality that provides excellent soft–tissue contrast without the use of ionizing radiation. Physiological motions and limited speed of MRI data acquisition necessitate development of accelerated methods, which typically rely on undersampling. Recovering diagnostic quality CMR images from highly undersampled data has been an active area of research. Recently, several data acquisition and processing methods have been proposed to accelerate CMR. The availability of data to objectively evaluate and compare different reconstruction methods could expedite innovation and promote clinical translation of these methods. In this work, we introduce an open–access dataset, called OCMR, that provides multi–coil k–space data from 74 fully sampled and 212 prospectively undersampled cardiac cine series, comprising of 183 and 842 slices, respectively.

October 08, 2020 (added more fully sampled data)

sampling	number of files	number of slices
fully sampled	74	183
prospectively undersampled	212	842

UK Biobank is a large-scale biomedical database and research reso
information from half a million UK participants. The database is reg
globally accessible to approved researchers undertaking vital rese
diseases. It is a major contributor to the advancement of modern m
scientific discoveries that improve human health.

Ukbiobank.ac.uk

ocmr.info

Data availability and data sharing

- **SCMR Registry**

Challenges

- **MICCAI**

STACOM 2022
September 2022, Singapore

Program Submission Challenges Organisers

The **Statistical Atlases and Computational Modeling of the Heart (STACOM)** workshop has been running annually at MICCAI since 2010. The 13th edition of STACOM workshop is going to be held in conjunction with the MICCAI 2022 in Singapore. The STACOM workshop is aiming to create a collaborative forum for young/senior researchers (engineers, biophysicists, mathematicians) and clinicians, working on: statistical analysis of cardiac morphology and dynamics, computational modelling of the heart and fluid dynamics, data/models sharing, personalisation of cardiac electro-mechanical models, quantitative image analysis and translational methods into clinical practice.

https://stacom.github.io/stacom2022/

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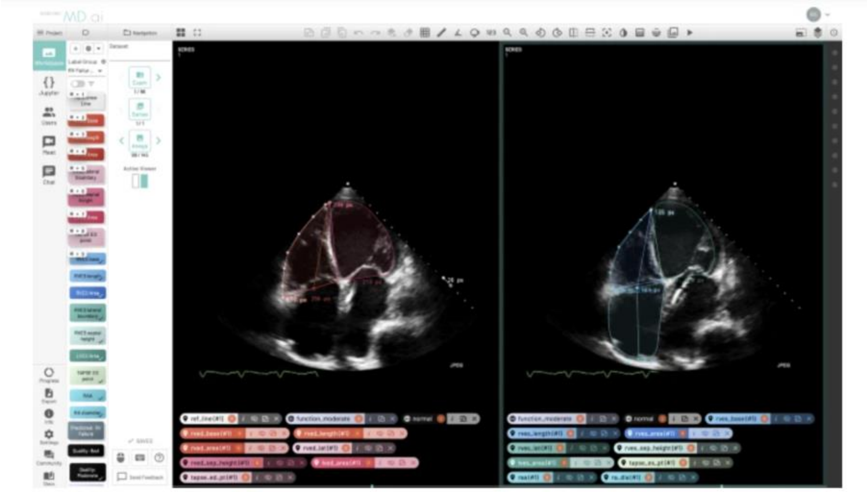
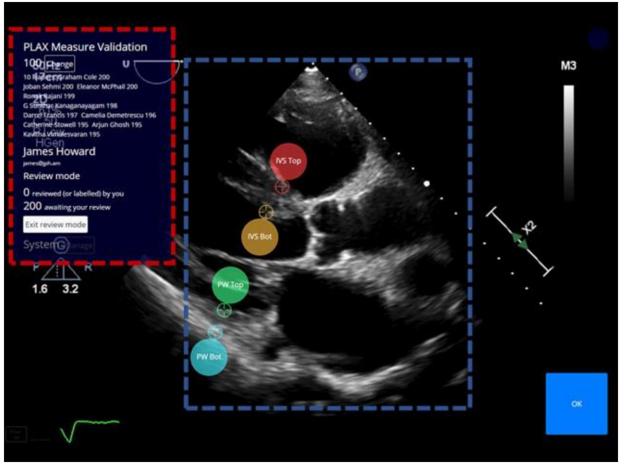
Data availability and data sharing

- **Efforts for annotations/labels**



Cloud-based tools such as MD.ai can be used to generate expert-annotated datasets and evaluate them against clinical experts via a secure connection. An implementation of MD.ai in which clinical experts make a variety of 2D measurements to quantify cardiac function is shown. Credit: MD.ai Inc, NY.

Nature Machine Intelligence 3:929–935 (2021)



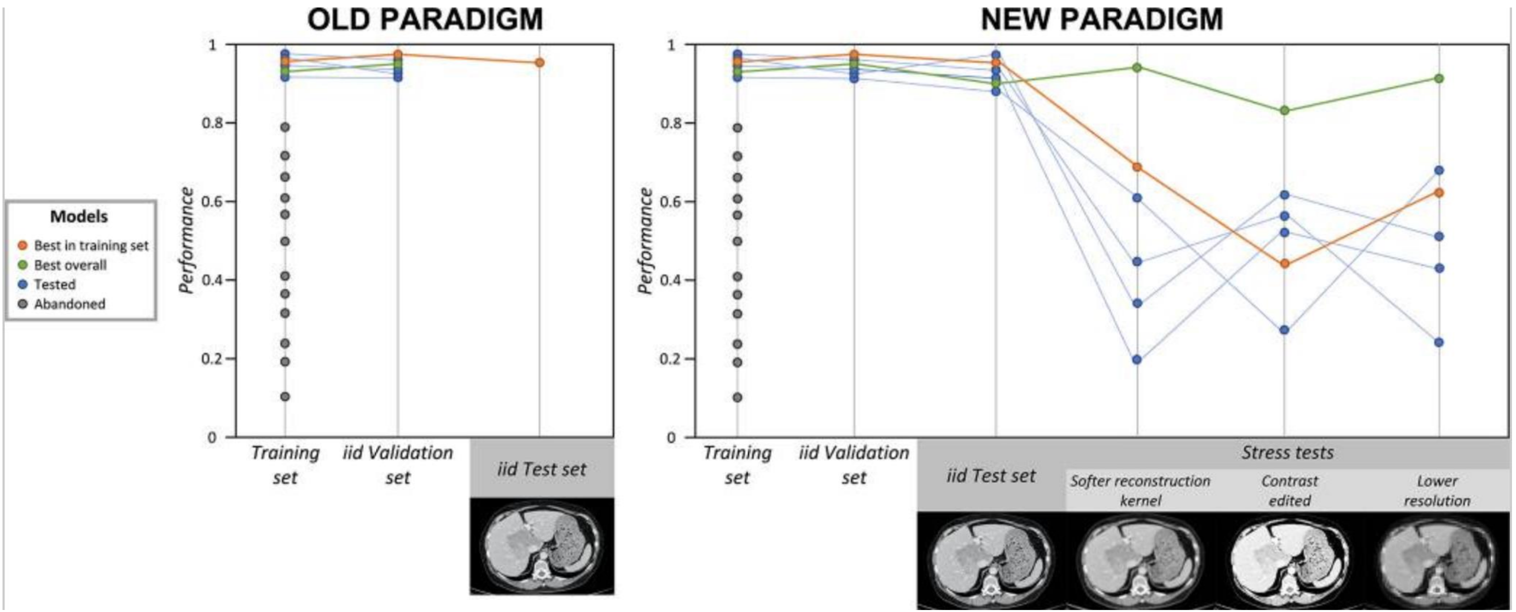
The unity interface (www.unityimaging.net)

Circ Cardiovasc Imaging. 2021;14:e011951.

Generalizability

- Across sites and vendors
- Across imaging sequences and applications
- Across patient cohorts
- Across race and gender

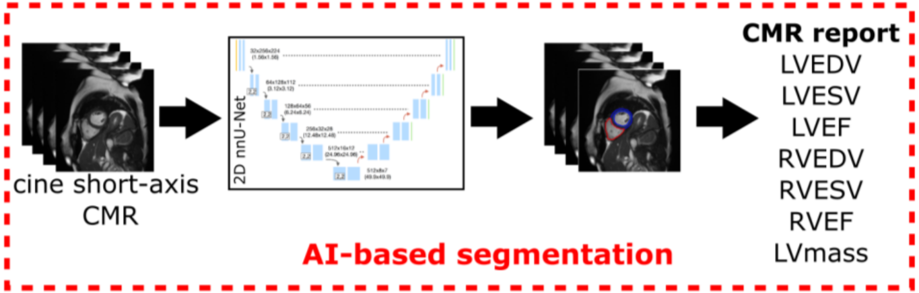
Generalizability

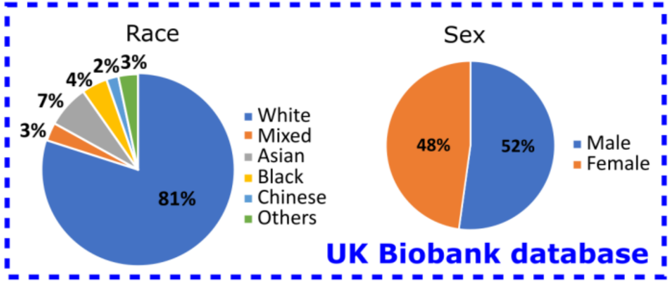


Radiol Artif Intell. 2021 Nov; 3(6): e210097.

Generalizability

- **Across race and gender**





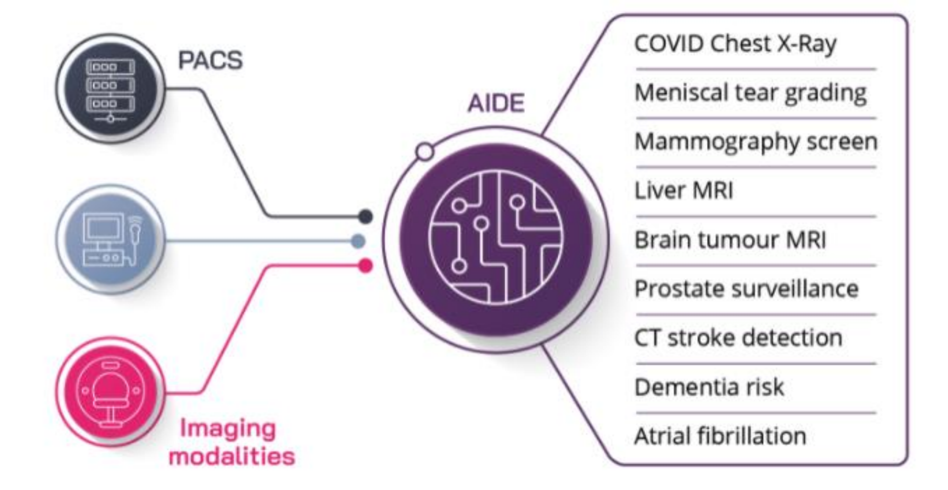
N = 1,250	Dice similarity	Absolute difference LVEDV	LVESV	LVmass	RVEDV
Total	93.0 (3.8)	4.6 (3.0)	3.7 (3.1)	7.4 (5.6)	6.2 (4.7)
Male	93.0 (3.6)	4.7 (3.0)	3.7 (2.9)	7.9 (6.2)*	6.1 (4.6)
Female	93.1 (4.0)	4.6 (3.0)	3.6 (3.2)	6.8 (5.0)*	6.3 (4.7)
White	93.9 (3.1)	4.2 (2.7)*	3.3 (2.8)*	7.1 (5.9)*	5.9 (4.7)*
Mixed	86.7 (2.1)	7.1 (3.5)*	6.2 (2.9)*	7.7 (4.3)	8.5 (3.1)*
Asian	89.8 (4.4)	6.1 (3.5)*	4.9 (4.1)*	8.7 (4.3)*	8.2 (4.3)*
Black	89.9 (2.6)	6.2 (3.3)*	4.3 (3.8)	7.3 (3.7)	7.9 (2.7)*
Chinese	86.3 (5.5)	8.0 (3.9)*	6.4 (4.1)*	10.6 (4.8)*	8.2 (4.0)
Others	88.8 (2.8)	6.3 (3.2)*	5.7 (4.0)	7.6 (3.6)	7.3 (5.7)

Frontiers Cardiovasc. Med., 07 April 2022 | https://doi.org/10.3389/fcvm.2022.859310

AI4VBH

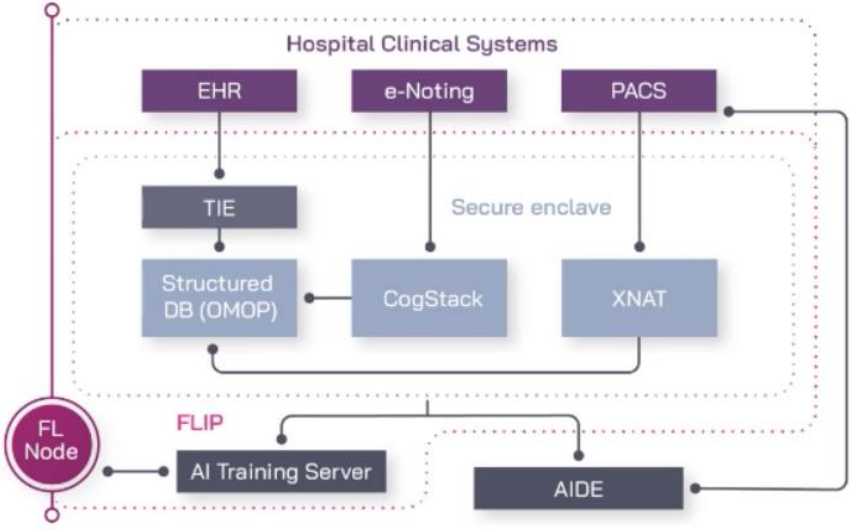
Data Pathway:

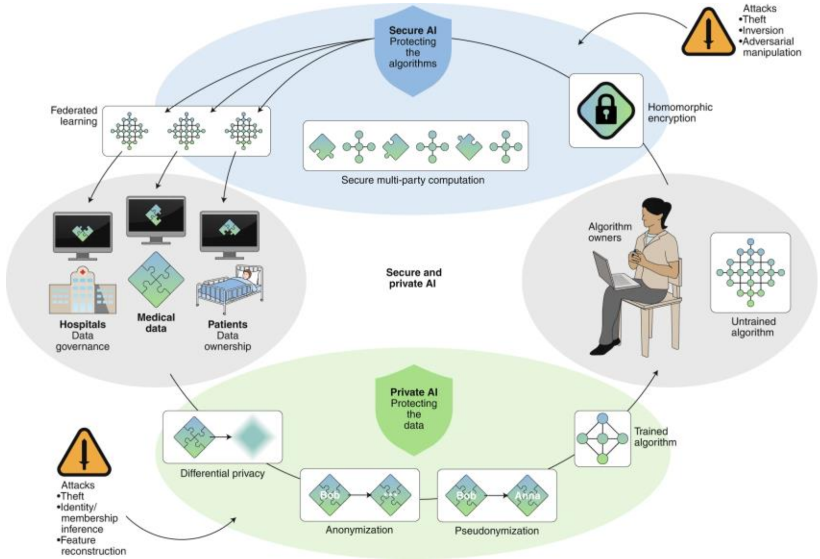
- Retrospective cases identified by GSTT team
- Images (MRI exams, over time) obtained from PACS
- Associated clinical information (height, weight, diagnosis, type of interventions) obtained from reports
- Data is anonymised (identifying information removed, including exact dates)
- Ported to database at KCL
- Processing by approved personnel
- Relationships, markers, predictions identified, published
- Tools tested prospectively at GSTT and elsewhere



Data protection and Privacy preserving

- **Federated learning**





npj Digital Medicine (2020) 3:119; Nature Machine Intelligence 2: 305–311 (2020)

Validation for regulatory approval

- **Multicenter studies and evaluation**
- **Multicenter Clinical trials**

https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-software-medical-device
https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1270.pdf
https://www.nhsx.nhs.uk/ai-lab/ai-lab-programmes/the-national-strategy-for-ai-in-health-and-social-care/

Clinical education for global adoption of AI-enabled solutions

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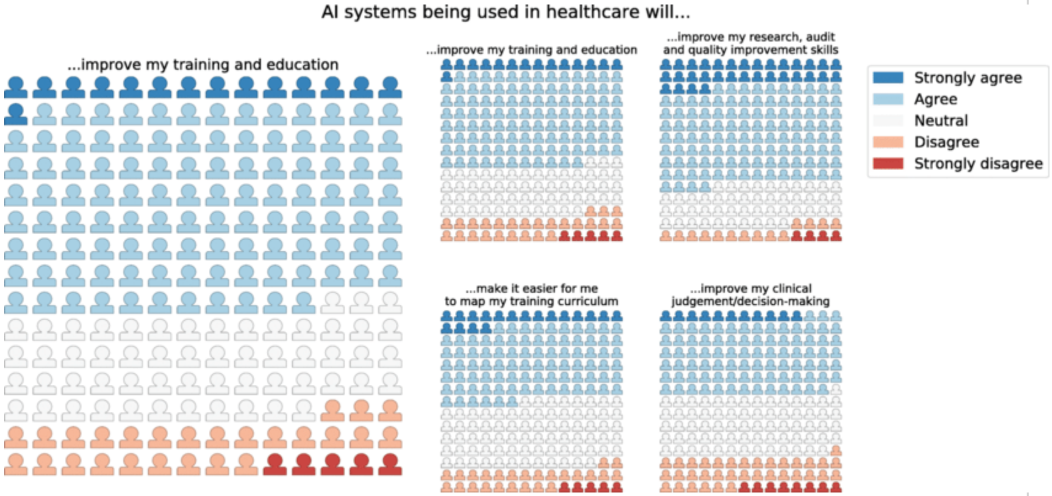
AI training domains

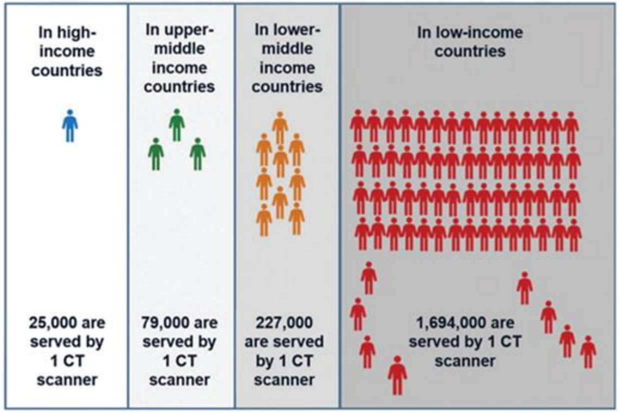
- Data entry and curation
- ML theory and statistics
- Algorithm interpretation
- Explainable AI communication
- AI ethics
- Information overload resilience



BMC Medical Education 21(1) DOI:10.1186/s12909-021-02870-x

Democratization: opportunities for low and middle-income countries

Artificial Intelligence in Low- and Middle-Income Countries: Innovating Global Health Radiology



Comparison of CT accessibility in low-, middle-, and high-income countries.

- Artificial intelligence (AI) introduction in low- and middle-income countries (LMICs) should proceed differently than in high-income countries.
- Large differences in personnel, clinical experience, disease patterns, demographics, digital infrastructure, and radiology equipment dictate the need for a global health radiology AI strategy.
- A comprehensive model for AI adoption in LMICs integrates clinical education, infrastructure deployment, and phased AI introduction.

Mollura DJ et al. Published Online: : October 6, 2020
https://doi.org/10.1148/radiol.2020201434
Radiology

Summary

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