

How Can Artificial Intelligence Improve Fetal Screening?

T.G. Day, J. Matthew, E. Skelton, S. Budd, J. Tan, A. Farruggia, L. Venturini, B. Kainz, J. Hajnal, J.M. Simpson, and R. Razavi

The Problem:

Not all babies with health problems are diagnosed before birth

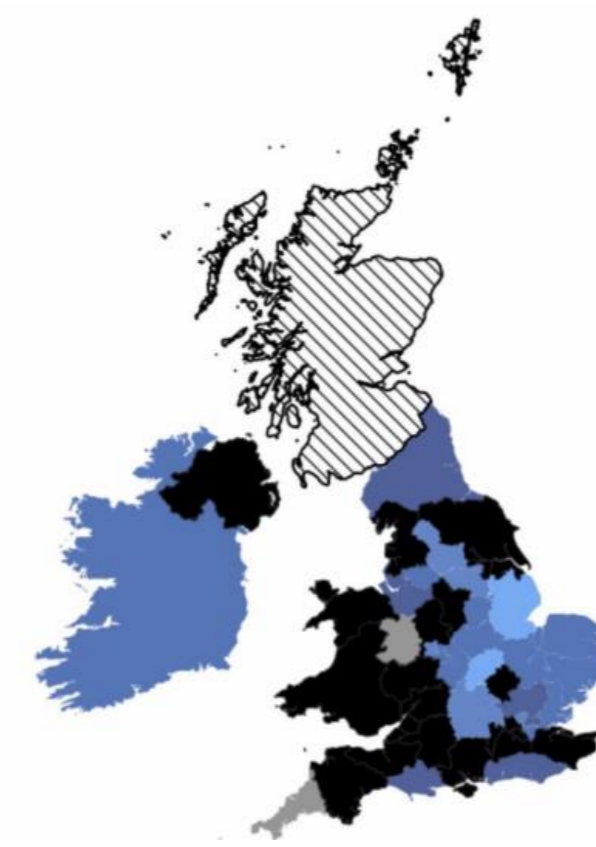


All pregnant people in the UK are offered an ultrasound scan at 20 weeks' gestation

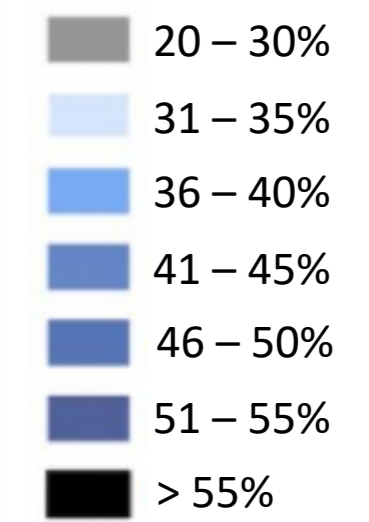
Aim is to diagnose fetal health problems before birth

Better survival after birth for affected babies

Better long term development for affected babies



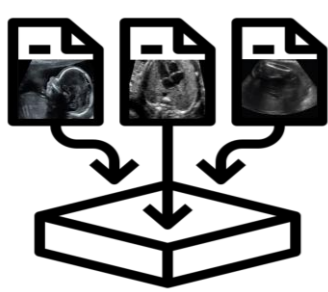
Babies with serious heart disease diagnosed before birth:



- Unfortunately not all babies are correctly diagnosed
- This map illustrates the huge regional variation in prenatal detection of serious congenital heart disease around the UK ¹
- In some areas of the UK this is below 30%: a **diagnostic postcode lottery**

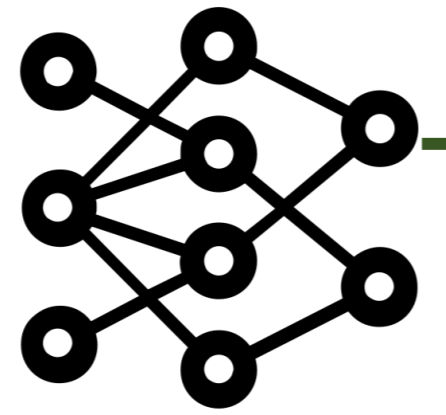
Solution:

Train artificial intelligence (AI) to help sonographers



Imaging data collected from over 10,000 routine and 6,000 specialist fetal ultrasound scans

Machine learning models trained

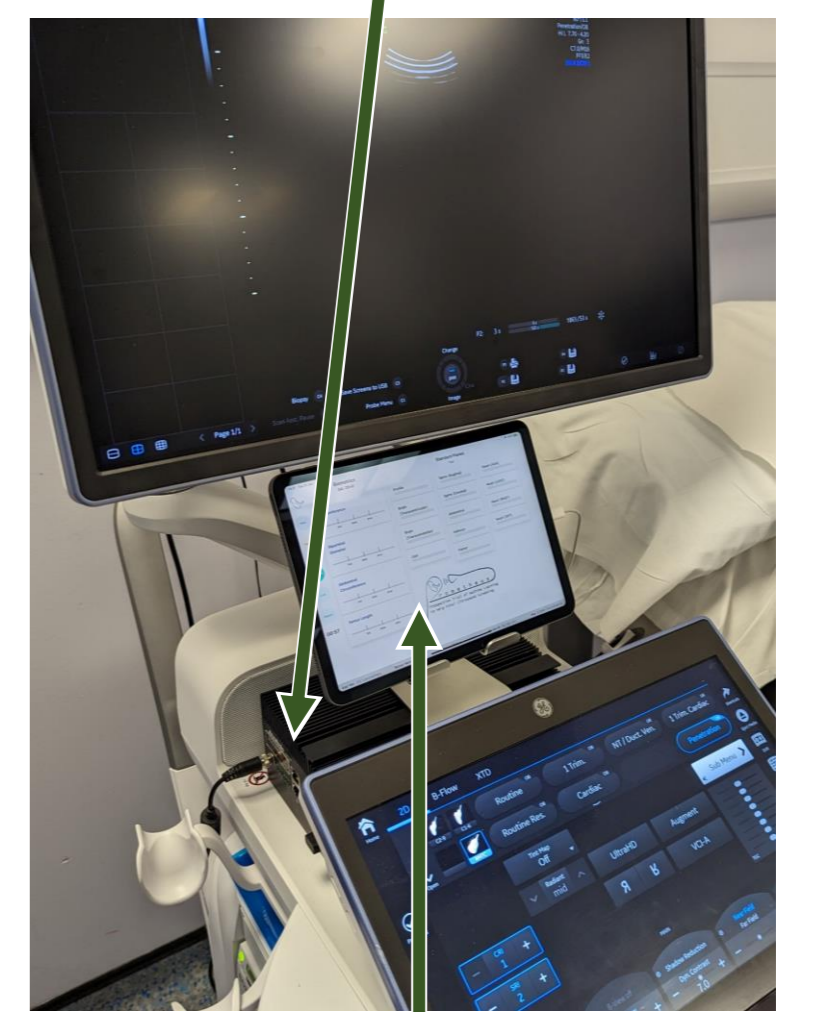


Automatic measurement of fetal size ²

Automatic classification of fetal view ³

Combined into a single clinically-usable package

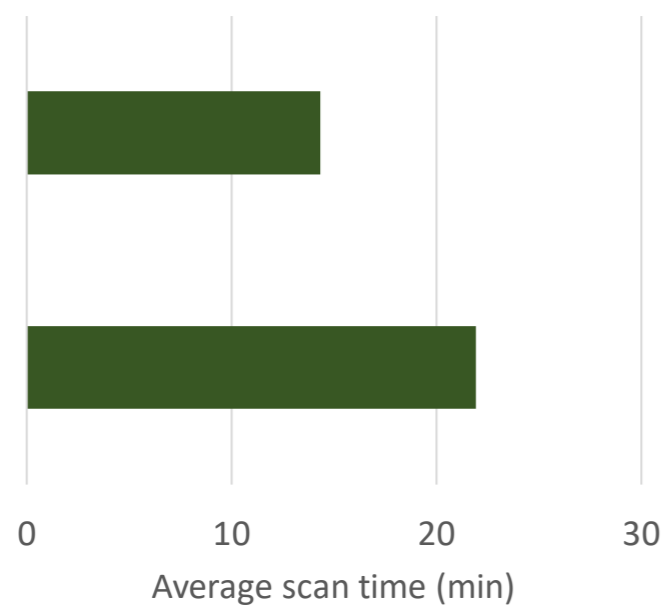
Continuous stream of ultrasound frames analysed by AI models on computer



Outputs of AI models fed back to sonographer in real time

Study of AI tools in 23 pregnant women with healthy fetuses ⁴:

AI-assisted scan

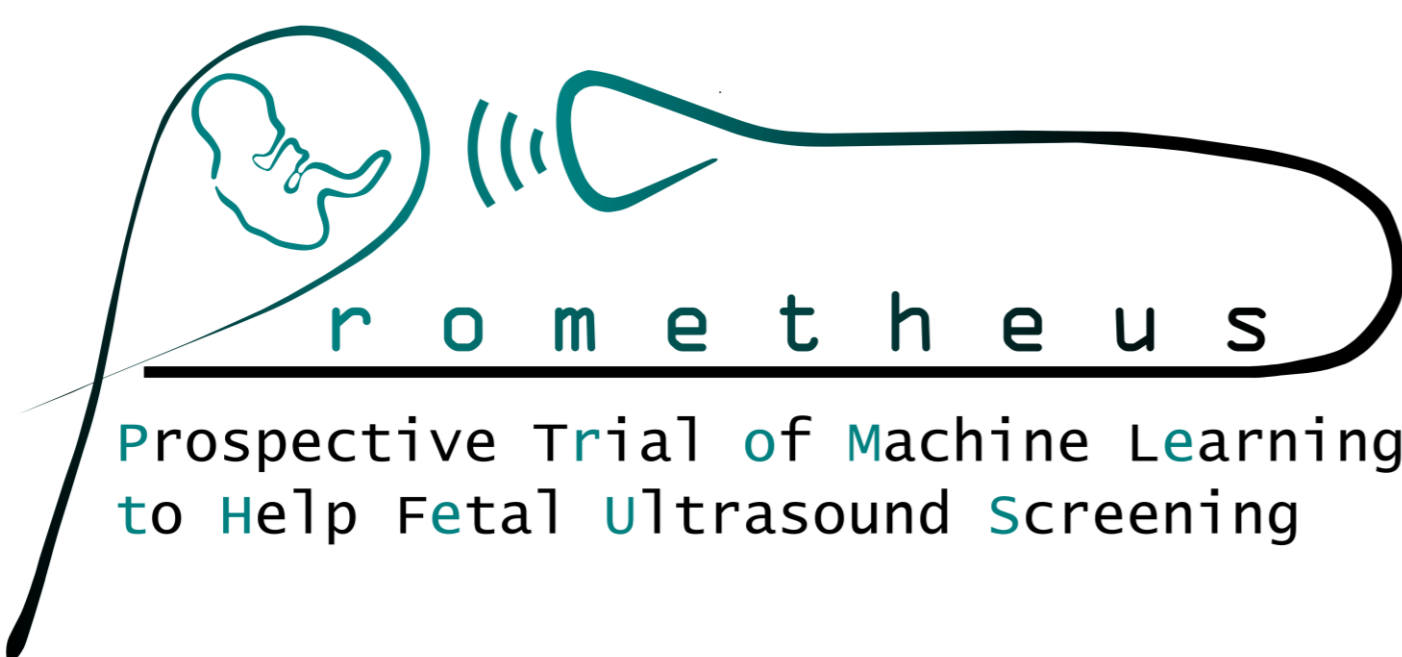


AI-assisted scans were significantly faster, saving over 7 minutes on average



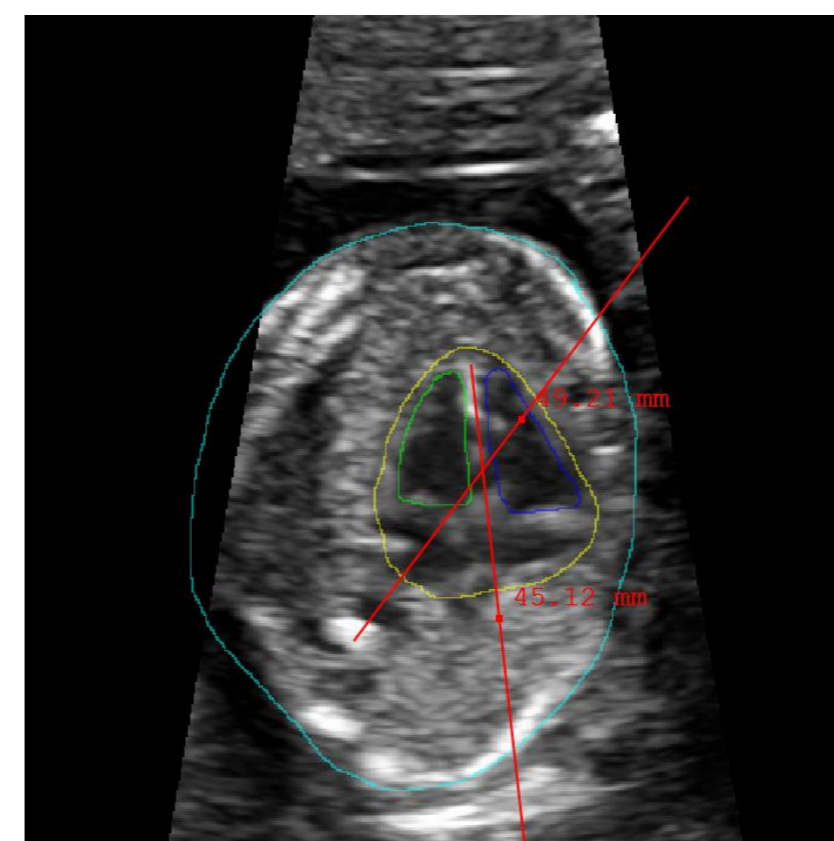
Automated measurements were accurate and reproducible

Ongoing work:

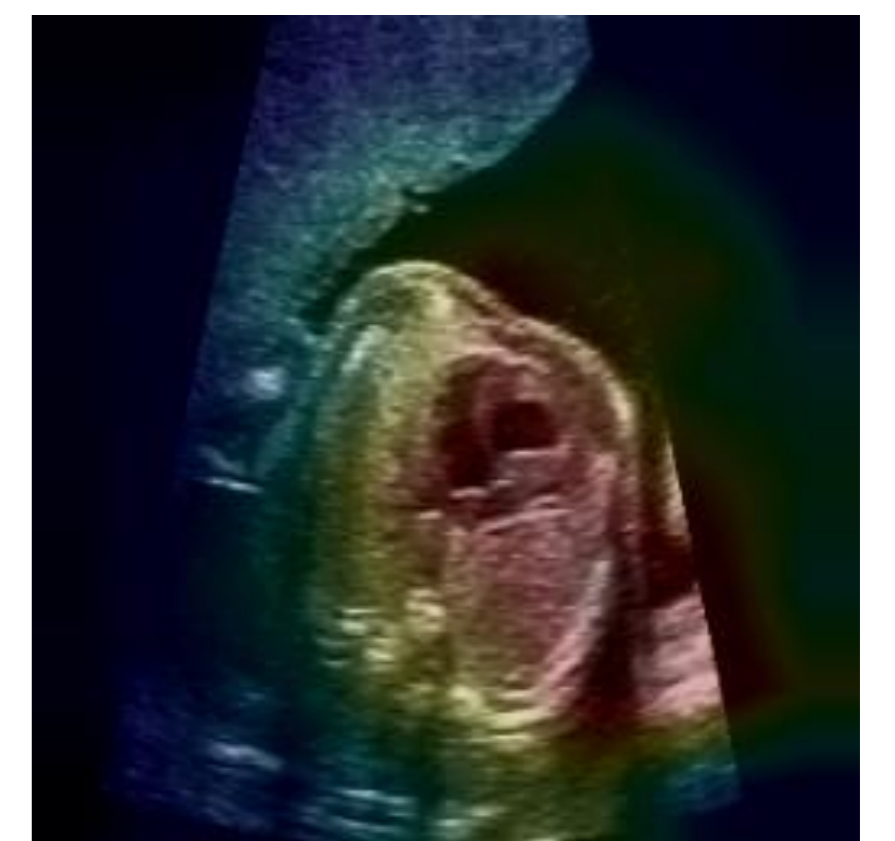


- Taking the previous study further:
 - 87 pregnant women, including some with fetal health problems
 - 58 volunteer sonographers from across London
 - All women scanned twice, to compare manual vs AI-assisted scanning
- The **first randomised clinical trial in the world** using AI in this way
- Aim is to assess impact of AI on diagnostic rates and time savings
- Will be completed in Summer 2023

AI tools to revolutionise the diagnosis of heart abnormalities before birth



- AI model trained to measure orientation of the fetal heart, and sizes of chambers
- Can be used to diagnose disease indirectly ⁵



- AI model trained to identify a specific fetal heart disease: hypoplastic left heart syndrome (HLHS) ⁶

1. National Congenital Heart Disease Audit, Summary Report. The National Institute for Cardiovascular Outcomes Research, 2021.
 2. Sinclair M, Baumgartner CF, Matthew J, et al. Human-level Performance on Automatic Head Biometrics in Fetal Ultrasound Using Fully Convolutional Neural Networks. In: Proceedings of the Annual International Conference of the IEEE Engineering in Medicine and Biology Society, EMBS. 2018. DOI:10.1109/EMBC.2018.8512278.
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 4. Matthew J*, Skelton E*, Day TG* (*joint 1st authors) et al. Exploring a New Paradigm for the Fetal Anomaly Ultrasound Scan: Artificial Intelligence in Real Time. Prenat Diagn 2021. DOI:10.1002/pd.6059.
 5. Budd S, Sinclair M, Day TG, et al. Detecting Hypo-plastic Left Heart Syndrome in Fetal Ultrasound via Disease-Specific Atlas Maps. Medical Image Computing and Computer Assisted Intervention – MICCAI 2021. In: de Bruijne M, Cattin PC, Cotin S, et al., eds. Cham: Springer International Publishing, 2021: 207–17.
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