Evaluating environmental sustainability in deployment of AI-enabled clinical pathways in radiology

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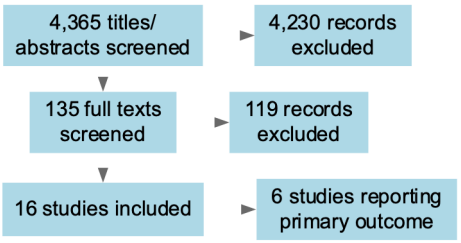
The clinical problem

Data- and energy-heavy artificial intelligence (AI) technologies are increasingly applied in healthcare, often without consideration of their potential environmental consequences.

In this project I aimed to assess current practice in evaluating environmental sustainability (ES) impacts of AI-enabled clinical pathways in radiology, and to conduct an environmental assessment of an AI-enabled pathway in NHS Greater Glasgow & Clyde.

PRISMA diagram



Methods

Systematic review of current practice

- The databases MEDLINE and Embase were systematically searched on 5th November 2024 for **clinical radiology studies using AI** to aid in radiological diagnosis or intervention **which discussed ES impacts**
- Peer-reviewed, English-language studies from 2015 onwards were included
- The **primary outcome** was any quantitative reporting of ES impacts (including carbon emissions, energy/water/mineral usage, waste generation/disposal, and impacts on material environments)
- The **secondary outcome** was any within-text discussion of ES impacts

Environmental assessment of RADICAL trial

- The Radiograph Accelerated Detection and Identification of Cancer in the Lung (RADICAL) trial is **a mixed methods digital health technology assessment** evaluating the introduction of AI into the 'urgent suspicion of cancer (USC) chest x-ray (CXR)' clinical pathway in NHS GGC
- The AI intervention was **qXR by Qure.ai**, using five features (mass, mediastinal widening, cavity, nodule, hilar enlargement) to flag outpatient CXRs for USC prioritisation to the reporting radiologist(s) within 30s
- Using guidance from the Sustainable Healthcare Coalition[1], a bespoke **carbon calculator** was created in Excel for RADICAL outcome data
- Qure.ai directly measured the **equivalised CO_2 generated for each CXR** processed by the algorithm

Results

- In the systematic review, of 16 included studies only 6 reported quantitative ES measures:
  - 3 reported on **carbon emissions** and 5 reported on **energy use**
- All 6 quantitative studies evaluated algorithms designed to be resource/time efficient
- For all datapoints, **study algorithms outperformed state-of-the-art comparators on both environmental and technical performance**, producing
  - From **2.2 to 17.2 times less carbon emissions** (median 7.8)
  - From **1.6 to 751.6 times less energy consumption** (median 3.2)
- No existing studies compared ES outcomes for AI vs standard-of-care
- 70% of studies for the secondary outcome included just a single sentence on sustainability
- The RADICAL carbon calculator counts **CO_2 emitted, water used, and waste generated for ten care pathway modules**: the AI algorithm itself, GP consultations, outpatient consultations, emergency department, inpatient bed days, diagnostics, treatment, surgical procedures, self-management, and patient travel
- Outcome data from the RADICAL trial is awaited to complete the work

Discussion

- Despite increasing concern about the climate impacts of AI, **environmental outcomes are rarely measured** or discussed within evaluations of AI-enabled clinical pathways in radiology
- However, the review suggests **designing AI products with sustainability in mind can substantially reduce their carbon footprint**, and highlights that more sustainable AI products already exist
- There is a **large evidence gap** around comparing climate impacts of AI versus no AI in clinical pathways, which we aim to address with the RADICAL environmental assessment once data are available
- **Environmental sustainability should be better integrated into AI evaluation and procurement** to ensure costs and benefits for both climate and health are fully considered

1. https://shcoalition.org/sustainable-care-pathways-guidance/