Examining the use of AI models in the automated OCT analysis and prediction of treatment outcomes in DMO

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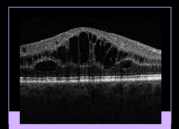
Background

Purpose

Diabetic Macular Oedema

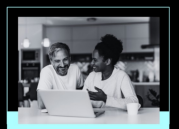
5.8M

Living with diabetes in the UK



7.8%

Affected by Diabetic Macular Oedema (DMO)



1st

Leading cause of vision loss amongst working age adults

Problem

01 Experimental process

Problem 01

Limited models to predict outcomes and act quickly

02 Limited staff

Problem 02

75% of ophthalmology departments do not have enough consultants

Ophthalmology makes up to 10% of entire NHS waiting list

03 Worsening outcomes

Problem 03

Patients clinics being delayed late treatment, late detection

Solution → AI

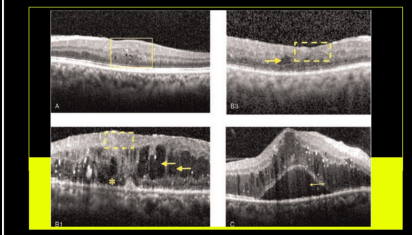
Examining the use of deep learning models to automate OCT analysis and predict treatment outcomes in Diabetic Macular Oedema

Goals

- → Developing and evaluating a fully automated DL model
- → Speed up detection
- → Predict visual and anatomical outcomes to improve treatment decision-making

Objectives

Aims



- Summarize the role of AI in managing DMO via OCT analysis.
- Highlight current AI applications: detection, grading, and outcome prediction.
- Identify research gaps and future directions.

Key Questions:

- How effective are AI models in detecting DMO?
- Can AI accurately grade severity and identify biomarkers?
- What is AI's predictive power for treatment outcomes?

Methods

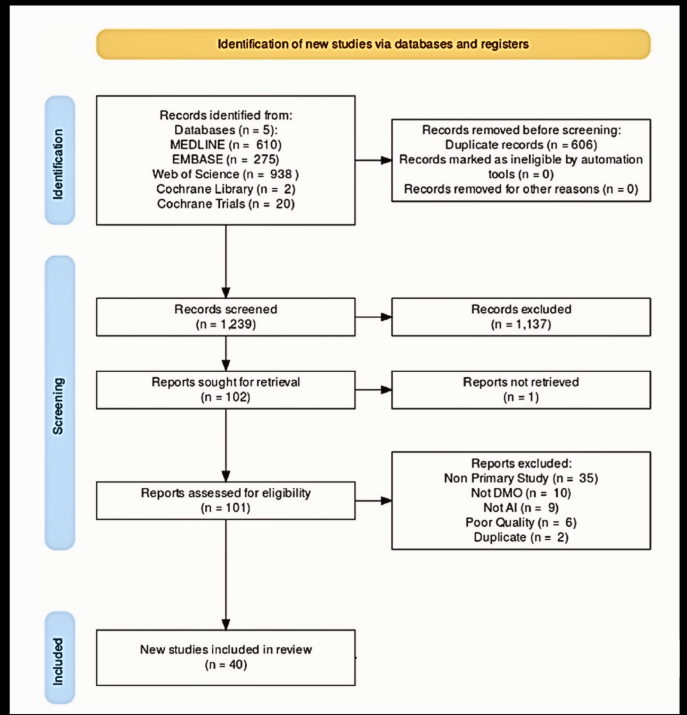
Methods

Search Strategy:
- Databases: MEDLINE, EMBASE, Cochrane, Web of Science.
- Keywords: AI, machine learning, OCT, DMO.
- Timeframe: Studies published 2000–2024.

Study Selection Process:
- Total records: 1845.
- Duplicates removed: 606.
- Screened: 1239; Included: 40 studies.

Inclusion Criteria:
- Peer-reviewed human studies employing AI and OCT for DMO.
- Focused on detection, grading, or prediction.

Exclusion Criteria:
- Non-human or non-diabetic studies.
- Case reports, conference abstracts, or opinion pieces.



Results

Results

Diagnostic Accuracy- 18 Studies

18 studies focused on diagnosing DMO.
- High performance metrics:
  - Sun et al., 2019: Accuracy = **99.7%**, Sensitivity = **99.5%**, Specificity = **99.8%**.
  - Gan et al., 2023: Accuracy = **93.8%**, AUC = **99.0%**.

Biomarker Detection- 16 Studies

16 studies examined biomarkers (IRF, SRF, HRF)
- **IRF Segmentation:**
  - Terry et al., 2021: Dice Similarity Coefficient (DSC) = **0.81**.
  - Hsu et al., 2022: DSC = **0.80**.
- **SRF Segmentation:**
  - Hsu et al., 2022: DSC = **0.89**.
  - Terry et al., 2021: DSC = **0.78**.
- **HRF Detection:**
  - Midena et al., 2023: Accuracy = **94–95%**, Kappa = **>0.80**.

Severity Grading- 1 Study

1 study (Cai et al., 2023) classified DMO severity:
Vision Transformer model achieved AUC = **0.87–0.98** for grading stages:
- Early, advanced, severe, and atrophic stages.

Limited work addressing classification of severity across other studies.

Outcome Prediction- 8 Studies

8 studies predicted treatment outcomes:
- **Visual Acuity Predictions:**
  - Gerendas et al., 2017: R^2 = **0.23** for BCVA at one year.
- **Anatomical Predictions:**
  - Baek et al., 2024: Accuracy = **85.4%** using GAN models.

Conclusions

Key Take Aways

1. AI performs well in diagnosis and biomarker detection, showing high accuracy
2. Severity grading and outcome prediction remain underdeveloped
3. Limited external validation for real-world applications.
4. AI has the potential to revolutionise DMO management and treatment