Artificial Intelligence (AI) In Early Triaging Of Referred Patients With Retinal Disease AI Solutions In Ophthalmic Health Care.

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Abstract

Introduction
Ophthalmology has the highest number of outpatient appointments, and one of the longest treatment backlogs in the NHS. 7.5 million in 2021/22 alone (England). 158,258 new patients with sight threatening blinding disease are still waiting for an outpatient appointment in 2024 (Wales)

Purpose
To integrate and test a cloud-based AI Framework to the referrals process, early in a patient pathway, available at a national Scale which interfaces into the NHS Wales National Architecture. Referral images are analysed by AI and recommendations added to referral.

Methods
The relevant R&D approvals for this proof-of-concept study were obtained. A pre-existing open electronic referral system (OpenERS) was used. Figure 1 represents the clinical pathway, used in our assessment.
48 anonymised data and images (DICOM Format) of known pathology were collected, put through OpenERS to an AI vendor's diabetic retinopathy engine. The AI vendor processed the images and returned its results and recommendations directly to OpenERS (Figure 2a&b). The returned results and images were analysed by a Consultant Ophthalmologist for clinical accuracy.

Results
OpenERS worked well and performed well with the AI framework & AI engine. Clinicians were able to receive the AI results, AI recommendations and Images within OpenERS (Figures 3&4). Accuracy of the AI engine used was 80%. This is only reflective of the AI engine used not the AI Framework that allowed us to use the Vendors Diabetic AI engine.

Conclusion
We have demonstrated that adding an AI framework enhancement to (OpenERS)→(OpenERSAI) – as a standalone referral portal that is linked to the NHS Wales national architecture, is able to support any specialty which utilises images within their specialty as an external referral process. This includes Ophthalmology, dermatology, and it can be adapted and utilised by other specialties such as radiology, pathology and more for their image analysis across the whole of England & Wales.

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Disclosures

This study utilized software provided by Toukan Labs. The authors have no financial affiliations with Toukan Labs.

INTRODUCTION

Of all medical specialties across the National Health Service (NHS), ophthalmology has the highest number of outpatient appointments, and one of the longest treatment backlogs. In 2021/22 alone, there were over 7.5 million ophthalmology outpatient appointments in England.

Latest data on waiting lists highlights an extremely concerning picture. As of September 2022, 656,814 people in England were waiting for treatment or diagnosis by an ophthalmologist. This is almost 10% of the entire NHS backlog but even these stark figures underplay the scale of the backlogs in ophthalmology, because patients awaiting a follow-up appointment are not included in these figures and amount to an estimated 11 million patients.

In Wales, while there are no overall figures for patients waiting for a new appointment, as July 2024, there are 158,258 new patients with sight threatening blinding disease still waiting for an outpatient appointment.

Current provisions hence cannot support the demand capacity in Ophthalmology and patients are going blind as a direct result of the delay.

PURPOSE

To integrate and test a cloud-based AI Framework to the referrals process, early in a patient pathway, with minimal disruption to patient flow, available at a national Scale (optometrists) which interfaces into the NHS Wales National Architecture. Referral images are analyzed by AI and recommendations added to referral.

METHODS AND MATERIALS

The relevant R&D approvals for this proof-of-concept study was obtained. Access to a pre-existing open electronic referral system (OpenERS) was obtained. Figure 1 represents the clinical pathway, used in our assessment which provides a real time integration of the AI algorithms into the patients' ophthalmic pathway.

48 anonymised data and images (DICOM Format) of known pathology were collected, put through OpenERS to an AI vendor's diabetic retinopathy engine. The AI vendor processed the images and returned its results and recommendations directly to OpenERS. The returned results and images were analyzed by a Consultant Ophthalmologist for clinical accuracy.

FIGURES

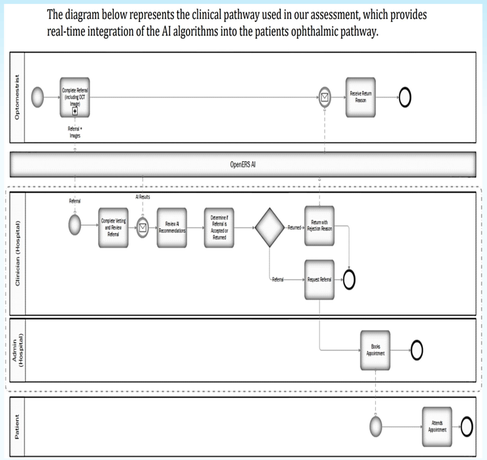


Figure 1. Patients Clinical Ophthalmic Pathway & AI Algorithms.

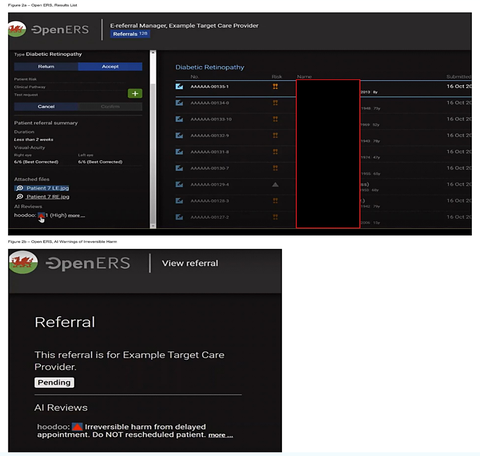


Figure 2a & b. Open ERS Referrals & AI Warnings of Harm

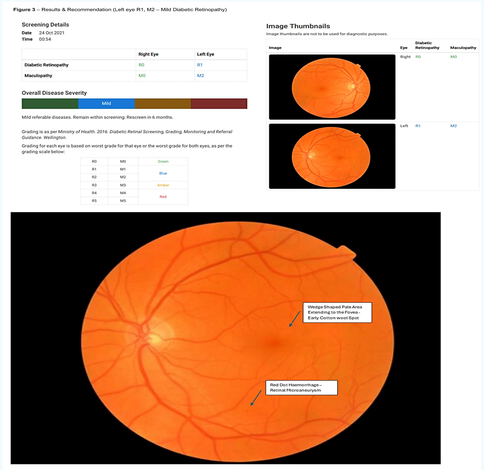


Figure 3. AI Results & Recommendations – Mild Diabetic Retinopathy.

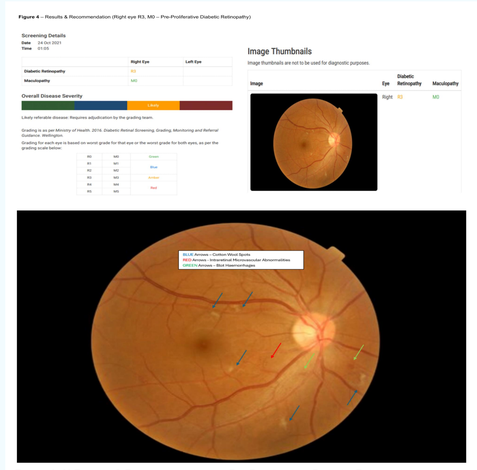


Figure 4. AI Results & Recommendations – Pre-Proliferative Diabetic Retinopathy.

RESULTS

OpenERS performed well and worked well with the AI framework & AI engine. Clinicians were able to receive the AI results, AI recommendations and Images sent from the AI framework within OpenERS (Figures 2&3).

Accuracy of the AI engine used was 80%. This is only reflective of the AI engine used not the AI Framework that allowed us to use the Vendors Diabetic AI engine.

DISCUSSION

OpenESRAI is a means of utilising any suitable AI engine to analyse referred images and produce a recommendation on high-risk vs low risk or malignant vs benign or any other category a specific Specialty requires from the AI engine.

Regarding accuracy, 80% is a good outcome, however it can be improved. This will involve the AI engine leveraging several techniques within a deep learning framework. It will be up to the clinical specialty to use tried and tested AI engines with the highest accuracies available.

CONCLUSIONS

We have demonstrated that adding an AI framework enhancement to (OpenERS)→(OpenERSAI) – as a standalone referral portal that is linked to the NHS Wales national architecture is able to support any specialty which utilises images within their specialty as an external referral process – This includes Ophthalmology, dermatology, etc, and could be adapted and utilised by other specialties such as radiology, pathology and more for their internal analysis of images. It is widely applicable to many specialties across the whole of England & Wales.

REFERENCES

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2. https://statswales.gov.wales/Catalogue/Health-and-Social-Care/NHS-Hospital-Waiting-Times/Eye-care/eyecaremeasuresfornhsoutpatients

Please Note: Arrows & Text boxes on the fundus images in Figs 3&4 are annotated by the main author to illustrate the diabetic changes.