



## PROJECT

**Supervisor:** Giuseppe Querques

**Title:** Predicting the risk of diabetic neurodegenerative disorders by  
artificial intelligence tools based on retinal imaging

**Curriculum:** Clinical and Experimental Medicine

Link to the  
personal page of  
the University or  
relevant hospital  
site website:

<https://www.hsr.it/dottori/giuseppe-querques>

<https://www.unisr.it/docenti/q/querques-giuseppe>

## Description of the Project (max 3,000 characters including spaces)

### **Background/gap of knowledge**

Diabetic Retinopathy (DR) is the most prevalent complication of diabetes and is strongly associated with micro- and macrovascular events. Recent evidence suggests a close link between retinal vascular abnormalities and neurodegenerative complications in type 2 diabetes (T2D). Although retinal imaging has proven effective in assessing DR, no validated tools currently exist in clinical practice for predicting cognitive decline in T2D patients using these non-invasive techniques. Furthermore, while AI models have shown promise in detecting systemic conditions from retinal images, their potential in forecasting neurodegenerative outcomes remains underexplored.

### **Rationale and hypothesis**

Given the retina's unique anatomical and physiological resemblance to brain microvasculature, retinal imaging may serve as a non-invasive biomarker for neurodegenerative risk. The hypothesis is that deep learning (DL)-based artificial intelligence (AI) tools can predict the risk of developing or worsening neurodegenerative/cognitive disorders in T2D patients based on retinal imaging biomarkers.



### **Objectives and specific aims**

The primary objective is to develop and validate an AI-based model capable of identifying T2D patients at risk of cognitive impairment, defined as a >2-point decline in the Montreal Cognitive Assessment (MoCA) scale over 24 months. Secondary aims include:

- Assessing the robustness, reproducibility, and reliability of the AI model across different retinal imaging modalities (OCT, OCT-A, retinography).
- Identifying clinical phenotypes of T2D patients with a higher predisposition to cognitive decline based on retinal biomarkers.

### **Expected outcomes**

This study will deliver a validated AI tool to assist clinicians in early identification of T2D patients at risk for neurodegenerative complications. By integrating ophthalmologic and cognitive assessments, the project aims to support cost-effective, large-scale screening programs and personalized management strategies. This study could serve as base for interventional studies and digital health frameworks to mitigate the societal and economic burden of diabetes-related cognitive decline.

### **Skills that the student should acquire** (max. 600 characters including spaces):

- Design and conduct prospective clinical studies in Clinical and Experimental Medicine with focus on retinal pathologies;
- Utilize advanced retinal imaging techniques
- To develop the necessary competencies to understand the functioning of artificial intelligence algorithms and tailor their application to clinical practice."
- Develop standardized clinical protocols for patient monitoring and determination of optimal treatment intervals;
- Critically analyze scientific literature and interpret results in the clinical context;
- Communicate scientific findings through conference presentations and publications in sector journals.

### **References** (max. 15)

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- 7) Crincoli E et al. Reshaping the use of artificial intelligence in Ophthalmology: sometimes you need to go backwards. *Retina*. 2023 Jun 19. doi:10.1097/IAE.0000000000003878
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**APPLICATION TO ACT AS SUPERVISOR AND  
RESEARCH PROJECT PROPOSAL**

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