

Leveraging Artificial Intelligence to Improve Risk Stratification and Timely Care in Chronic Kidney Disease

Introduction and Rationale

Chronic Kidney Disease (CKD) is a significant global health challenge. In the UK, it is estimated to affect over 10% of the adult population ¹. The clinical course of CKD is often unpredictable, and progression rates vary widely among individuals due to genetic, environmental, and lifestyle factors. Early identification of CKD patients at high risk of rapid kidney function decline or late presentation is critical to optimising clinical outcomes.

Currently, the Kidney Failure Risk Equation (KFRE) is used in many centres to forecast the risk of progression to kidney failure ². While KFRE has proven valuable, it may not account for the full spectrum of patient characteristics, comorbidities, and contextual factors contributing to CKD progression.

In addition to general progression risk, there is a specific subpopulation of CKD patients who present late to dialysis, often missing timely counselling about dialysis modality, vascular access creation, and transplant evaluation. This late referral and lack of preparation are linked to poorer survival and quality of life³. Identifying patients likely to present late could prompt targeted interventions, optimising their care pathways and potentially improving outcomes.

Artificial Intelligence (AI) and machine learning techniques have the potential to incorporate diverse, nuanced patient data—such as demographics, comorbid diseases, socioeconomic status, and medication patterns—into more individualised risk prediction models.

The purpose of this research project is to utilise patient-level data to develop, validate, and implement AI models that 1) predict the rate of CKD decline more accurately than current tools, and 2) identify patients at risk of late dialysis presentation.

Intended benefits:

1. **Enhanced CKD Monitoring:** AI-driven predictions will improve the stratification of clinic appointments, ensuring high-risk patients receive the close follow-up they need.
2. **Targeted Interventions for Late Presenters:** By flagging individuals at risk for late dialysis presentation, the healthcare team can implement educational, infrastructural, and psychosocial support measures earlier.
3. **Patient-Centred Care:** More accurate models reduce unnecessary clinical visits for stable patients and foster individualised care plans.
4. **Novel Use of Data:** This project exemplifies data-driven innovation in clinical practice, paving the way for future AI applications in kidney disease.

References:

1. Kidney Research UK. https://www.kidneyresearchuk.org/wp-content/uploads/2023/06/Economics-of-Kidney-Disease-full-report_accessible.pdf. *Kidney Disease: A UK Public Health Emergency The Health Economics of Kidney Disease to 2033*. (2023).
2. <https://www.nice.org.uk/guidance/ng203/resources>. Chronic kidney disease: assessment and management. (2021).
3. <https://www.kidneyresearchuk.org/2024/03/14/late-diagnosis-causes-irreversible-and-major-harm-to-kidney-patients/>. Late diagnosis causes irreversible and major harm to kidney patients. (2024).