OMOP Based CKD Detection Algorithm

Tim Howcroft[1], Quin Ashcroft[1], Vishnu V Chandrabalan[1], Beng So[2]

1. Department of Data Science, Lancashire Teaching Hospitals NHS Foundation Trust
2. Department of Nephrology, Lancashire Teaching Hospitals NHS Foundation Trust

https://www.lancsteachinghospitals.nhs.uk/

DataScience@lthtr.nhs.uk @LTHTR_DS

Background

Lancashire Teaching Hospitals (LTH) in Northwest England provides secondary, tertiary, and laboratory services to central Lancashire. Routine blood test results from the hospital's laboratory are included in the hospital's electronic patient record (EPR) and transformed into an OMOP CDM instance, providing a comprehensive testing history from both primary and secondary care.

Chronic kidney disease (CKD) affects over 1.8 million people in the UK, with around one million more likely undiagnosed. CKD leads to a gradual decline in kidney function, with symptoms like appetite loss, fatigue, sleep problems, swelling, and shortness of breath. CKD's under-recognition leads to 18% of patients starting dialysis late, resulting in rushed dialysis preparation and a fivefold increase in treatment costs.

Numerous CKD detection algorithms exist, ranging from observing two eGFR results below 60 mL/min/1.73m² ninety days apart to more complex machine learning approaches. Previous CKD detection algorithms built on OMOP offer comprehensive patient classifications. A simple yet robust algorithm was developed for early CKD detection, aiming for clinical acceptance through easy explanation to primary care physicians. Early CKD identification can slow progression, prevent complications, and make management in primary care easier.

Methods

The OMOP CDM instance at LTH uses a medallion architecture (figure 1). The silver layer retains re-identification capabilities, allowing it to inform patient care. Three pilot GP practices provided a patient list, including those manually identified as having CKD.

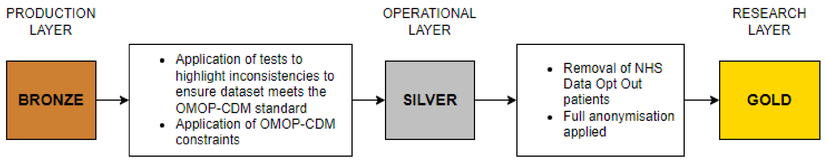

Figure 1. Overview of the medallion architecture of the LTH OMOP CDM.

A novel algorithm, developed in Python with a nephrologist, was applied to eGFR results. It identifies patients with eGFR <60 mL/min/1.73m² for >50% of the time over four timeframes (12 months, 18 months, 3 years, and 5 years). This method is more robust than the standard approach of identifying two results <60 mL/min/1.73m² 90 days apart, accounting for patients who hover near the threshold or whose eGFR improves over time. OMOP integration allowed for combining urine albumin-creatinine ratio (uACR) data with eGFR results for a fuller picture of renal function.

The algorithm's results were compared to the GP's curated CKD list to identify areas of agreement and discrepancy. The resulting patient list was shared with the GP practice for validation and patient care decisions.

Outcomes

The pilot GP practices data (summarised in table 1) shows that there was a large overlap between the algorithm and the manually identified CKD patients for all practices. In two of three practices (practices 1 and 3) the algorithm suggests that there may be too many patients identified as CKD, while for the third practice there were many more new patients identified.

The GPs' manually identified patients, missed by the algorithm, provided valuable feedback for further nephrologist investigation. Additionally, many of the CKD patients identified by the algorithm had never undergone a uACR test, highlighting priority patients for further testing. All healthcare decisions are made by GPs and the algorithm only currently serves as a guide.

GP Practice	Approximate Number of Patients	GP Recorded CKD Patients	Algorithm Identified Patients	Identified by both GP and Algorithm	New Patients Detected by the Algorithm	Patients Identified by GPs that may not be CKD
1	22000	803	769	680	90	172
2	17000	1093	1294	935	360	189
3	6000	447	430	359	72	108

Table 1. Summarised results for the three GP practices.

Conclusions

CKD detection algorithms are a growing area of research globally. This straightforward, explainable algorithm successfully identified additional CKD patients. It operates in the background, easing the burden on busy GPs and identifying patients with gradual or recent CKD progression. This algorithm, and the channel of communication it creates with GPs, can be further expanded and there is some interest in using similar approaches for other health conditions, such as diabetes.

OMOP facilitates the regional deployment of this algorithm, saving time and effort once data mapping is complete. After testing and validation, the algorithm will be available to all healthcare providers with the necessary data mapped. The medallion architecture at LTH, with re-identifiable bronze and silver layers, empowers a unified OMOP dataset for direct patient care, provided that governance, ethics, and security requirements are met.

References

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