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The high prevalence of unrecognised anaemia among patients with diabetes and chronic kidney disease: a population-based e-Epidemiology study

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Background: This study demonstrates the Informatics challenge of healthcare data integration and transformation, for epidemiological purposes, requiring metadata that exist only in tacit form among a community of experts: Anaemia occurs earlier, and is more severe, in chronic kidney disease (CKD) related to diabetes than in non-diabetic CKD. Anaemia has a negative impact on patients' quality of life, contributing to morbidity and aggravating hypoxia-induced diseases (e.g. angina and cardiac failure). Whilst anaemia management is integral to the provision of CKD care, it has been largely ignored in diabetes management. Unfortunately there are few studies that report the prevalence of anaemia among people with diabetes. The aim of this study was to estimate the prevalence of anaemia, by stage of CKD, in patients with diabetes mellitus in the adult population.

Population: The study population was defined as all patients having glycated haemoglobin samples processed by the biochemistry laboratory at Hope Hospital in Salford within a six week period in 2007.

Methods: The hospital number, age, sex, glycated haemoglobin level and creatinine level were obtained from the hospital electronic patient record and managed using a prototype 'e-Lab' research query system built with Microsoft SQL server. Six Hb and creatinine measurements were identified for each patient corresponding to the most recent measurement within six, six month periods back to August 2004. The estimated glomerular filtration rate (eGFR) was calculated using the 4-variable Modification of Diet in Renal Disease (MDRD) formula:

$$eGFR = 175 \left(\frac{\text{creatinine} - 3.08}{1.004 \times 88.4} \right) - 1.154 \times \text{age} - 0.203 \left(\times 0.742 \text{ if female, } \times 1.21 \text{ if black} \right)$$

The hospital number was used to identify patients known to have diabetes. In those not known to have diabetes, all glucose measurements from the preceding three years were reviewed. Where there was no biochemical evidence of diabetes, patients were considered not to have diabetes and were excluded from the analysis. Patients receiving renal replacement therapy were identified using the renal information system. This was also used to identify people using erythropoiesis-stimulating agents (ESA). Anaemia at the level where treatment was indicated was defined as use of ESA or Hb < 110 g/L. Anaemia below normal range was defined as Hb < 115 g/L in women or Hb < 130 g/L in men. Renal function was stratified according to eGFR, using the ranges of the Kidney Disease Outcomes Quality Initiative (K/DOQI) classification, with those having eGFR > 60 ml/min being considered together.

Results: 840 glycated haemoglobin samples were analysed for Hb. Figure 1 shows the relation between Hb and eGFR. This relation was approximately linear below eGFR of 83 ml/min/1.73m², where a linear regression of Hb on eGFR, age and gender showed that for every 1 ml/min/1.73m² fall in eGFR there was a 0.4 (0.3–0.5) g/L fall in Hb. The non-linear relation we observed between Hb and eGFR, across its full range, was consistent with anaemia not being a feature of diabetes until eGFR becomes significantly impaired and with non-renal determinants of anaemia predominating at higher levels of eGFR.

Figure 2 shows the prevalence of anaemia increased progressively with worsening CKD. People with CKD 3 accounted for the largest number of people with anaemia; 17% (12%–23%) had Hb < 110 g/L. Those with eGFR < 60 ml/min/1.73m², and not on ESA or dialysis, were 4 (2–7) times more likely than patients with better renal function to have Hb < 110 g/L.

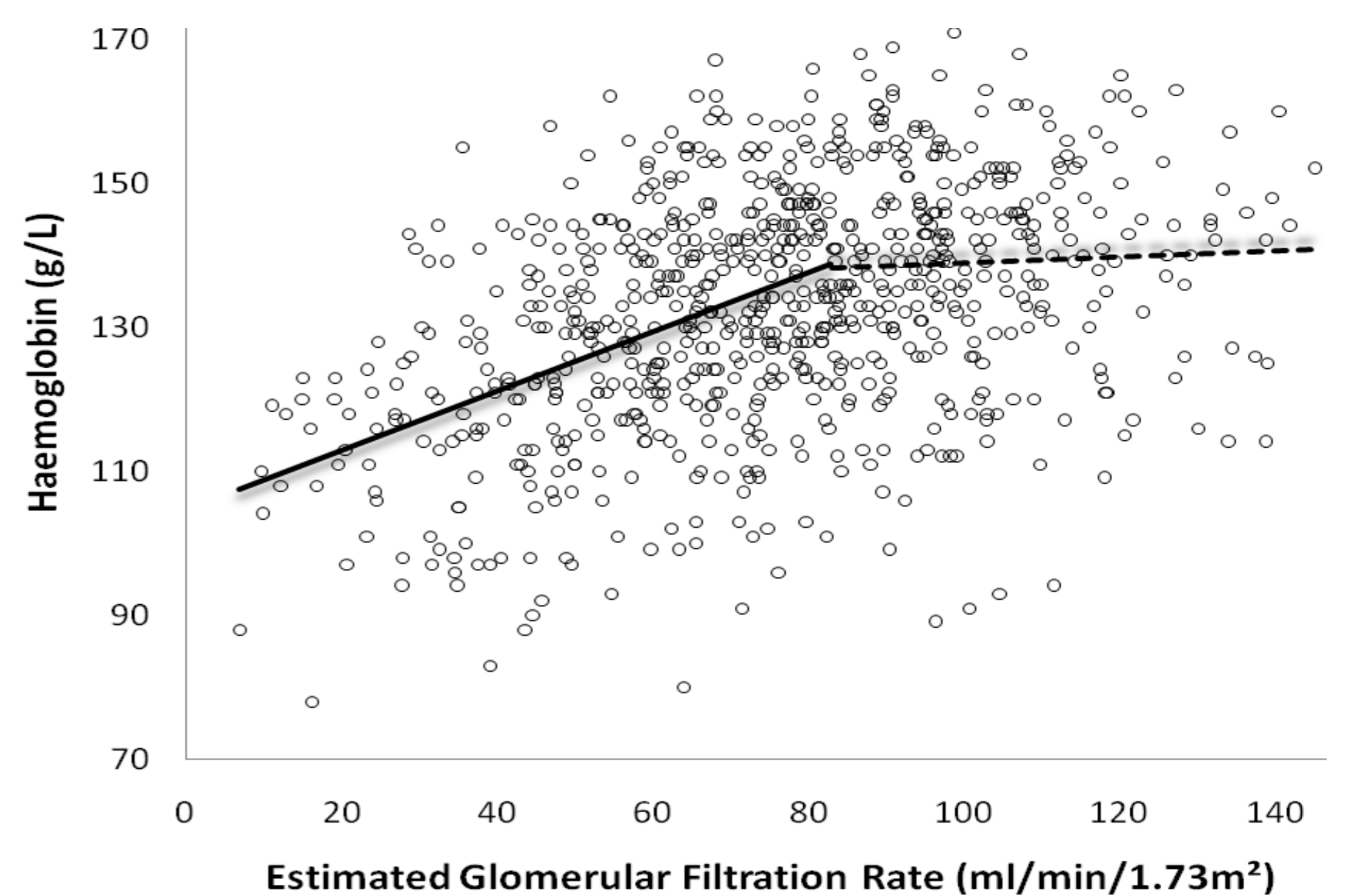


Figure 1: The relation of haemoglobin (Hb) to estimated glomerular filtration rate (eGFR) in people with diabetes.

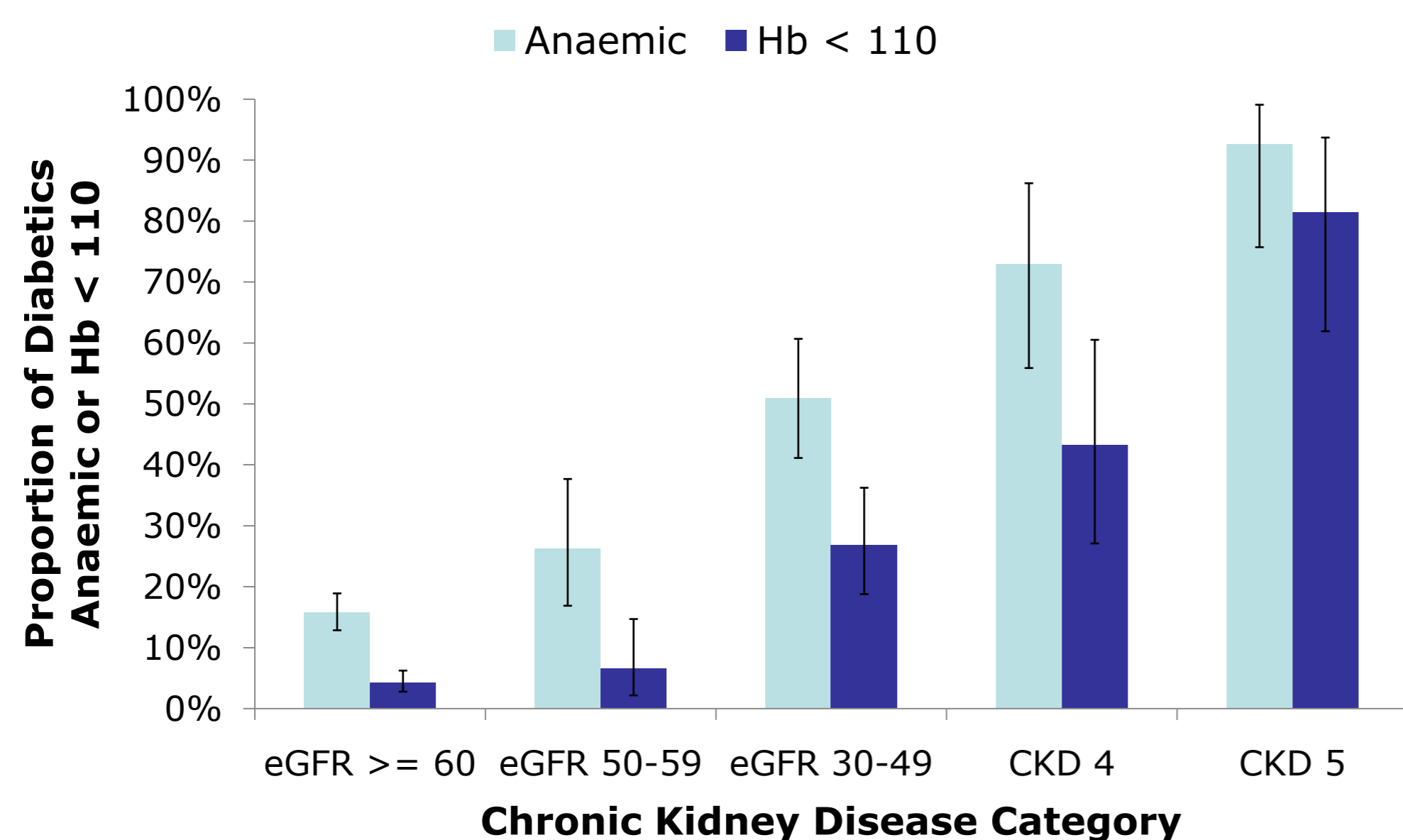


Figure 2: Proportion (with 95% confidence intervals) of people with diabetes, by chronic kidney disease (CKD) category, who were anaemic or have haemoglobin (Hb) < 110 g/L.

Clinical/epidemiological Conclusion: This study demonstrates that anaemia, at levels where treatment is indicated, occurs commonly in people with diabetes and CKD stage 3 or worse. Screening for anaemia is not currently part of diabetes management. This study suggests that screening for anaemia, with appropriate treatment, would improve the quality of care for people with diabetes, improving their quality of life.

Informatics conclusion: This study highlighted a key requirement for building an 'e-Lab' of integrated and enhanced data for epidemiological purposes. Namely, the need for metadata about the (re)construction of derived variables from their constituent parts.