A model of cardiovascular disease in people with reduced renal function using routine healthcare data

Miss Claire Simons[1], Dr Iryna Schlackow[1], Dr Jason Oke[2], Dr Benjamin Feakins[2], Dr Richard Stevens[2], Professor Rafael Perera[2], Professor Borislava Mihaylova[1,3]

[1]Health Economics Research Centre (HERC), Nuffield Department of Population Health, University Of Oxford, Oxford, United Kingdom, [2]Nuffield Department of Primary Care Health Sciences, University of Oxford, Oxford, United Kingdom, [3]Centre for Primary Care and Public Health, Queen Mary University of London, London, United Kingdom

Introduction

Reduced renal function is associated with increased cardiovascular disease (CVD) risk. We used a large individual patient-level routine primary care dataset (Clinical Practice Research Datalink (CPRD), UK) linked with secondary care (Hospital Episodes Statistics (HES), UK) and mortality registry data to model long-term cardiovascular outcomes and survival in people with reduced renal function.

Methods

A cohort of 1.13 million patients with at least two eGFR measurements <90 mL/min/1.73m² ≥90 days apart between 2005 and 2015 was formed. Information on patients' risk factors, including sociodemographic (eg age, gender, smoking status) and clinical characteristics (eg blood pressure, history of diabetes, cholesterol levels, urinary albumin-to-creatinine ratio), as well as renal function measures and CVD events, were used to model the risks of major CVD events (myocardial infarction (MI), stroke, hospital admission for heart failure and vascular death) using parametric survival regression models separately for men and women with and without prior cardiovascular disease. The covariates in risk models were selected using statistical information criteria and a-priori epidemiological evidence. Missing covariate data were multiply imputed using chained equations. A Markov state disease model, developed using the separate risk equations, was validated in categories of participants by gender, category of eGFR (90-60; 60-45; 45-30; 30-15; <15 mL/min/1.73m²) and CVD history at baseline. External data informed annual cost and quality of life in the model depending on patient characteristics at entry and current health state.

Results

The patient cohort included 509,179 men (77% without and 23% with prior CVD at entry) and 630,369 women (83% without and 17% with prior CVD at entry) followed for a median of 4.9(IQR 2.3-7.8) years. At baseline 74.4% had an eGFR of 60-90; 18.1% 45-60; 6.0% 30-45; 1.3% 15-30; and 0.2% <15mL/min/1.73m². 6% of patients without and 11% with CVD experienced a non-fatal stroke or MI; and 2% and 8%, respectively, died from vascular causes. In all risk equations, age, contemporaneous CKD stage, and, where relevant, prior CVD, were major determinants of subsequent CVD (see Figure 1 for hazard ratios (HR) for the risk of MI, stroke or vascular death by gender and prior CVD patient category). The model-projected CVD risks corresponded well to CVD risks observed in categories of patients during follow-up.

Discussion

We present a model that projects long-term cardiovascular risks, quality-adjusted survival, healthcare costs and the effects of CVD preventive interventions on these outcomes in people with reduced renal function.