Health Economics and Outcomes Research

Health Economic Modelling of Current Population Health Management Interventions for Chronic Kidney Disease in the UK Using a Population–Level Markov Model

Agathangelou G[1], Gofman L[2], Kulkarni R[3], Jaffe JN[1], Farrimond B[1], Sharma S[4]

[1]ZS Associates, London, UK, [2]ZS Associates, Princeton, NJ, USA, [3]ZS Associates, Bethesda, MD, USA, [4]ZS Associates, New Delhi, India.

Background

There is a growing body of evidence indicating that the burden of chronic kidney disease (CKD) can be reduced through early detection, pharmacological intervention and outreach.[1] A modelling exercise was undertaken to understand whether a basket of potential population-level interventions for managing CKD, including end-stage kidney disease, could be cost-saving or cost-effective.[2]

Methods

A population-level Markov model was used to estimate the current and future incidence/prevalence and economic burden of CKD across all stages and show the directional impact of the four interventions based on costs and outcomes. The model was developed to capture both NHS (direct cost) and UK economy (wider economic cost) perspectives. It also estimated the progression between undiagnosed and diagnosed people with CKD. The schematic was modified to include additional health states for transplantation (acute event), post-transplant, cardiovascular disease (acute event) and post-CVD. Based on the availability and quality of data, CKD stages 1 and 2 within the model were disaggregated, and stages 3a and 3b were combined. Each cycle length was defined as quarterly (every 3 months) and the time horizon for the model was set to 10 years.

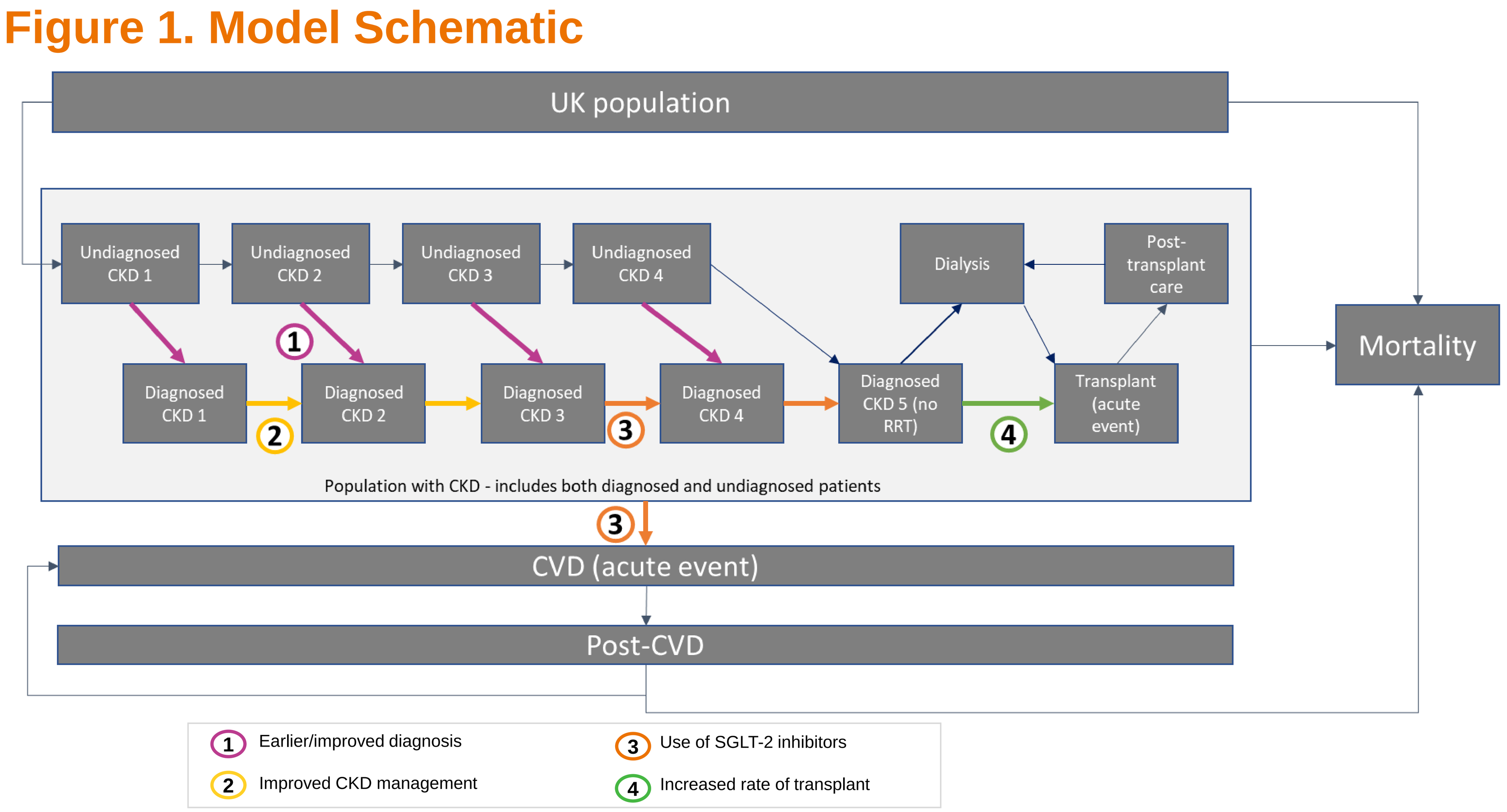
Two modeling scenarios were evaluated: constrained and unconstrained. The constrained view estimates the growth for dialysis and transplantation based on NHS historical rates. The unconstrained view estimates the growth for dialysis and transplantation based on transition probabilities for disease progression. This represents future potential unmet need. The unconstrained view is reported here.

Modelled Interventions

Through stakeholder engagement, several interventions were cited as having the potential to improve clinical outcomes associated with chronic kidney disease. The following interventions were applied to the model **(Figure 1)**:

- **Intervention 1. Early/improved diagnosis:** This intervention targets underserved populations through outreach programmes to improve screening opportunities and increase early diagnosis and is illustrative of the benefits which can be achieved through well-targeted early/improved diagnosis in general.
- **Intervention 2. Improved CKD management:** This intervention targets eligible patients with CKD who are either untreated or not receiving standard care according to clinical guidelines (e.g., adequate blood pressure management).
- **Intervention 3. Use of SGLT-2 inhibitors:** This intervention aims to increase uptake of new medications such as sodium-glucose transport protein 2 (SGLT-2) inhibitors to reduce cardiovascular events and slow progression to end-stage kidney disease.
- **Intervention 4. Increased rates of transplant:** This intervention models the impact of increased outreach and awareness to increase pre-emptive live donor transplants. It is illustrative of the benefits of improving transplantation rates more generally.

Figure 1. Model Schematic

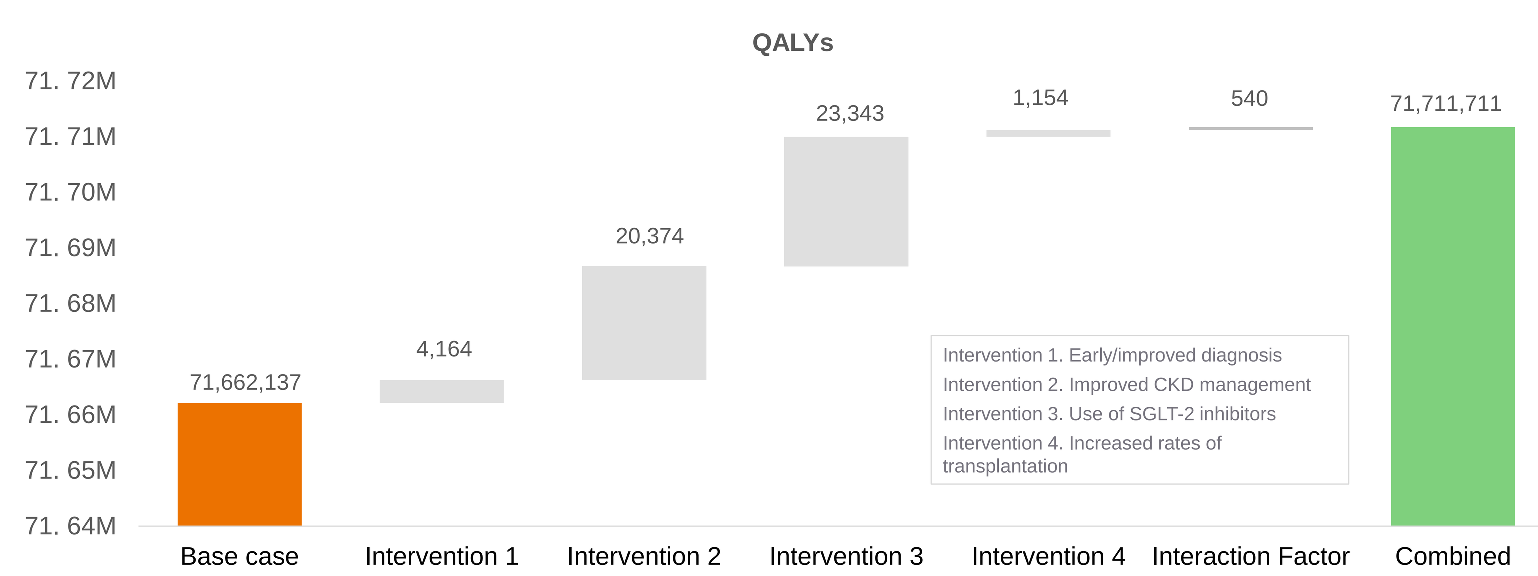


Results

All interventions, individually or combined, showed a cost-effective or cost-saving Incremental Cost-Effectiveness Ratio (ICER). When combined, interventions prevented more than 10,000 deaths over the 10-year time horizon, with 49,574 quality-adjusted life years saved. This is predicted to cost £7,688 per quality-adjusted life years **(Figure 2)**. The reduction in indirect costs (travel and lost economic productivity) of £445.7 million would more than offset the total increase in NHS costs of £381.1 million **(Table 1)**.

Figure 2.

A) QALYs gained by intervention



B) Summary of ICERs in the unconstrained view

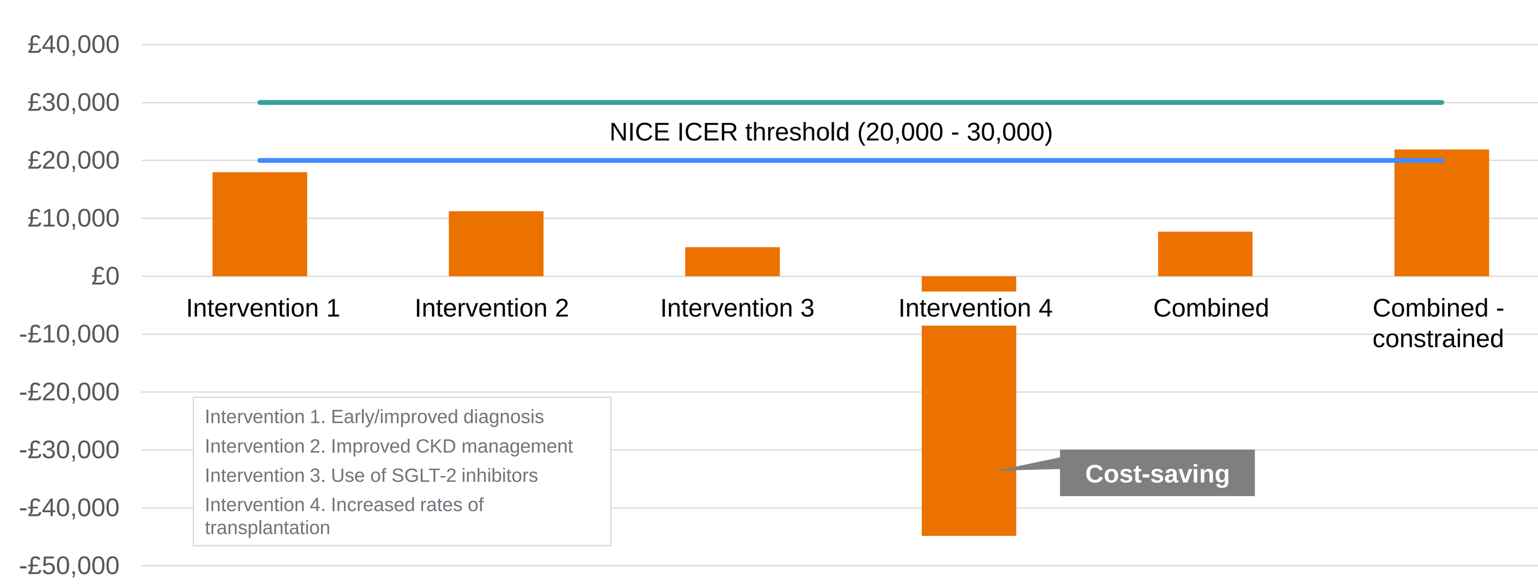


Table 1. Economic Impact of Combined Interventions (Unconstrained)

Scenario (Years 1-10)	Direct costs	Indirect costs	Total costs	QALYs
Base Case	70,683,534,208	20,334,744,603	91,018,278,811	71,662,137
Combined interventions	71,064,652,248	19,889,062,335	90,953,714,583	71,711,711
Difference	381,118,041	(445,682,268)	(64,564,228)	49,574
% change	0.5%	-2.2%	-0.1%	0.1%

Conclusions

- Economic modelling suggests that improved implementation of four illustrative healthcare interventions could save more than 10,000 lives by 2033.
- The combination of interventions is predicted to cost £7,688 per QALY – significantly below the National Institute for Health and Care Excellence's (NICE's) willingness-to-pay threshold of £20,000 - £30,000 per QALY.
- These interventions individually and collectively are shown to be cost-effective or cost-saving where costs to the NHS are offset by QALYs gained.

References

1. National Institute for Health and Care Excellence (NICE). Shared decision making. https://www.nice.org.uk/guidance/ng197.
2. Kidney Research UK (KRUK) 2023. Kidney disease: A UK public health emergency: The health economics of kidney disease to 2033.

This study was conducted in collaboration with Kidney Research UK (KRUK)