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Health economic aspects of using serum cystatin C for early detection of chronic kidney disease in type 2 diabetics in Germany

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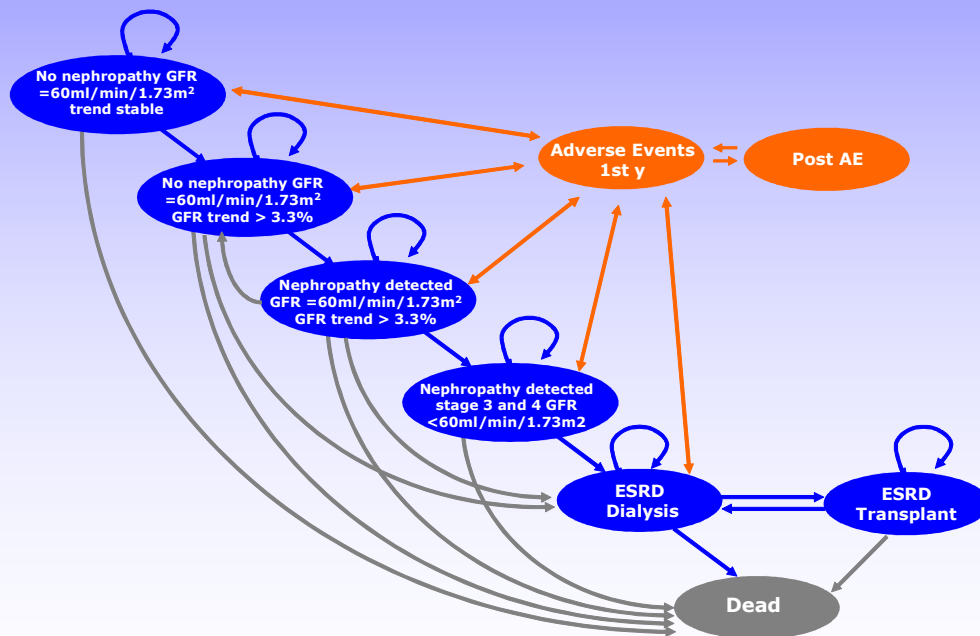
Objectives

Diabetic nephropathy is a serious and common complication in diabetic patients. However the onset and the course of the diabetic nephropathy can be favourably influenced by appropriate therapy when detected early. In 2004 the independent international Kidney Disease Improving Global Outcome Organisation (KDIGO) recommended 2 laboratory tests for an early detection of chronic kidney disease (CKD): determination of serum creatinine to estimate glomerular filtration rate (eGFR) using the simplified equation derived from the Modification of Diet in Renal Disease Study (MDRD) and determination of proteinuria preferably microalbuminuria corrected for urine creatinine. Creatinine as a marker for eGFR has metabolic and technical limitations, especially in patients with only mild impairment of kidney function. As an alternative marker serum Cystatin C (CysC) has been proposed for early detection of CKD.

Methods

We developed a cost-utility-model to simulate the long-term consequences of diabetic nephropathy using CysC instead of creatinine to monitor renal function. Markov-modelling-techniques were used to describe complications and disease progression; one arm assessed the costs and effects of CysC reporting, disease progression and complications, and the other assessed the cost and effect of routine eGFR reporting. Probabilities of complications were derived from clinical and epidemiological studies. The model includes eleven a priori defined health states to describe the disease progression and occurrence of adverse events. Disease progression leads to a passover to the next health state; the others remain. The Markov-cycle length is one year.

Fig. 1: Model Design



Source: developed by IPF

Cohort definition was taken from the UKPDS study. Costs are represented using data from 2009 from the health-care-systems perspective. Outcomes are QALYs (Quality Adjusted Life Year). QALYs and costs were projected over a life-time horizon and discounted at 5% pa. Data on the resource use of diabetic nephropathy was collected in two steps: first the medical resources were derived by literature. In a second step missing data were collected by a questionnaire. Answers of seven German nephrology and diabetology experts were included.

Results

An early detection of CKD with CysC leads to lifetime costs of 52,950€ and 14.19 QALYs (3,732 costs per QALY). Detection with creatinine amounts to 64,912€ and 12.82 QALYs (5,063€ per QALY) over lifetime. Monitoring of kidney function with CysC leads to cost saving of 11,962€ per patient for the German health care system and a QALY gain of 1.37 per patient. The cumulative incidence of diabetes-related complications was estimated to be lower for CysC versus creatinin (-15%). Early detection with CysC leads to a decreased number of patient years (14%-points) spent in end stage renal disease, due to a later onset.

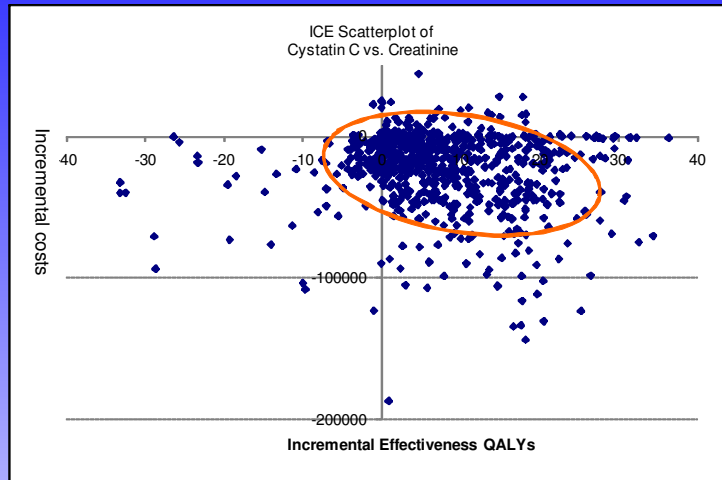
Tab. 1: Results

Strategy	Cost (C)	Difference Cost (ΔC)	Utility value QALYs (E)	Difference QALYs (ΔE)	Cost-effectiveness (C/E)	Incremental C/E (ICER)
Serum cystatine C	52,950.13€		14.19		3,531.51€	dominant
Serum creatinine	64,912.02€	11,961.89€	12.82	-1.37	5,063.34€	

Source: IPF own calculations

Sensitivity Analysis

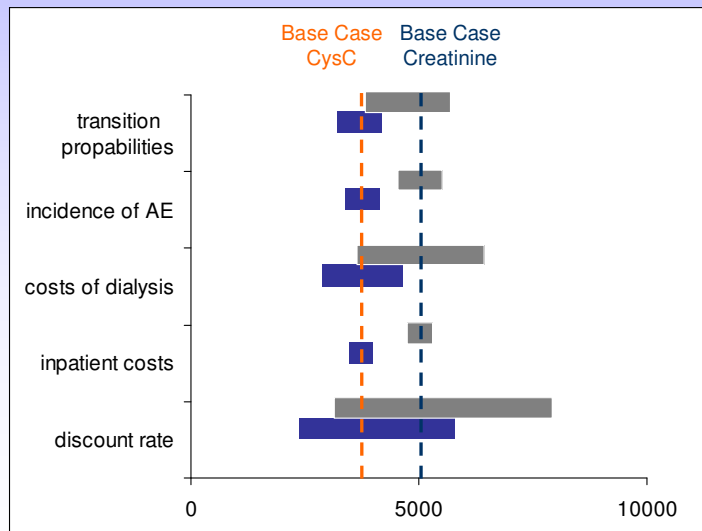
Fig. 2: Probabilistic Sensitivity Analysis



Source: IPF own calculations

Monte Carlo probabilistic sensitivity analysis, results of 1,000 trials plotting incremental cost versus incremental effects, demonstrated that an early detection of CKD with CysC was cost effective compared to creatinine. In more than 99% of the simulations CysC was associated with lower costs and higher effectiveness (plots in the lower right quadrant of Fig. 2).

Fig. 3: Deterministic Sensitivity Analysis (costs per QALY)



Source: IPF own calculations

Fig. 3 display deterministic sensitivity analysis. Results show that an early detection of CKD with CysC remained cost-effective or become cost-saving in nearly all sensitivity analyses (except the variation of the discount rate).

The probabilistic as well as the deterministic sensitivity analyses show the robustness of the model.

Conclusion

Our data suggest a substantial economic benefit by using serum cystatin C instead of creatinine for early detection of chronic kidney disease in type 2 diabetes patients in Germany. This is due to a marked reduction in complication and disease progression.

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Additional Literature with the authors

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