
**COST-EFFECTIVENESS OF
EARLY DETECTION AND INTERVENTION
TO PREVENT PROGRESSION OF
CHRONIC KIDNEY DISEASE IN AUSTRALIA**

EXECUTIVE SUMMARY



This report was commissioned by
Kidney Health Australia with the objective being to
undertake comprehensive research into the
economic burden of kidney disease in Australia.

ACKNOWLEDGEMENTS AND DISCLAIMERS

This report was commissioned by Kidney Health Australia with the objective being to undertake comprehensive research into the economic burden of kidney disease in Australia. The research was undertaken and the Report written by [The George Institute for International Health](#) in collaboration with the University of Sydney, Royal Prince Alfred Hospital, The Queen Elizabeth Hospital and the Australia and New Zealand Dialysis and Transplant Registry (ANZDATA).

Some of the data presented in this report is drawn from ANZDATA. The analysis and conclusions presented are the responsibility of the authors, not the ANZDATA Registry.

Some of the data presented in this report is drawn from the AUSDIAB study. The analysis and conclusions presented are the responsibility of the authors, not the AUSDIAB study research team.

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Key Points – Burden of Disease

1. Approximately 1 in 7 (almost 2 million) Australian adults have chronic kidney disease (CKD) (1).
2. CKD significantly increases a person's risk of suffering a heart attack. People with moderate to severe CKD have at least a 40% increased risk of hospitalisation for a cardiovascular event (2).
3. CKD causes or contributes to approximately 9% of all deaths. It is commonly reported with cardiovascular disease and diabetes (3).
4. The most severe form of CKD is end-stage kidney disease (ESKD) — when death will occur unless kidney functions, essential to life, are replaced by dialysis or by kidney transplantation. People with less severe CKD are many times more likely to die prematurely, largely due to cardiovascular disease, than to receive dialysis or a transplant (4).
5. People with CKD have a poor quality of life (5).

Key Points – Prevention Strategies for Chronic Kidney Disease within a Coordinated National Strategy for Chronic Disease Management

6. The best-available evidence supports a strategy for the control of CKD through screening and intensive management of three risk factors for CKD and for its progression — diabetes, high blood pressure and protein in the urine.
7. General practice-based opportunistic screening of 50 to 69-year-olds and intensive management of screen-detected patients with diabetes, high blood pressure or protein in the urine is likely to be a cost-effective strategy for preventing ESKD and cardiovascular morbidity and mortality.
8. More intensive management of patients already known to have diabetes, high blood pressure and protein in the urine would also be cost-effective.
9. There is a significant gap between evidence-based management of diabetes and hypertension and current management by Australian doctors.
10. The estimates of the cost-effectiveness of a CKD screening program appear favourable when compared with estimates of the cost-effectiveness for the three cancer screening programs currently supported in Australia — cancer of the breast, cervix and large bowel.

Background

This report explores the cost-effectiveness of early detection and intervention strategies to prevent the progression of CKD in Australia. It is the companion document to Report I, titled “The Economic Impact of End-stage Kidney Disease in Australia”, which focussed on the burden and costs of ESKD and explored the cost-effectiveness of strategies to improve the delivery of dialysis and kidney transplant services. Report II provides the first comprehensive assessment of the impact of interventions designed to decrease the burden of CKD in Australia. The Report estimates the cost-effectiveness of opportunistic screening and best-practice management of diabetes, hypertension and proteinuria among Australian adults. These are research questions of crucial relevance to the development of national strategies for the prevention and management of chronic disease in general.

Based on a systematic review of research evidence regarding costs and effectiveness of best-practice management and prevention of progression of CKD, the costing data presented in this report are novel. All interventions modelled are based on the results of published, randomised controlled trials. Through the Markov model, we apply this evidence to the Australian situation, taking cognisance of CKD prevalence and current management practices. While this approach provides a realistic and conservative picture, certain key constraints must be acknowledged:

- (1) The strategies chosen were restricted to those for which randomised controlled trials have provided evidence of an impact on outcomes. This enabled modelling of interventions targeting diabetes, hypertension and proteinuria. Although other strategies have been proposed to prevent CKD progression, no supporting data on the effectiveness of those proposed strategies are available.
- (2) Modelling was restricted to single interventions. We recognise that a multi-level intervention might be appropriate for many patients with CKD, for instance diabetic nephropathy, where anti-hypertensive, anti-proteinuric and hypoglycaemic interventions should be employed concurrently. However, existing clinical trials focus on single interventions. No reliable data are available on the interactions between therapies.
- (3) The costs incurred in the management of complications of CKD are not easily isolated from other chronic diseases. Cardiovascular disease in particular is both a cause and a consequence of CKD. This report includes only those health sector costs directly attributable to CKD. Indirect costs, such as lost productivity, have also been excluded from this analysis. Thus, the estimates of total cost attributable to CKD are conservative.

Objectives

The objectives of this study were to provide preliminary estimates of the incremental costs and effects of combining two approaches to reducing the impact of CKD:

- 1) Opportunistic screening and early detection of hypertension, diabetes (with or without urinary protein) and urinary protein in the Australian population aged 25 years and older; and
- 2) Better management of known and screening-detected patients with risk factors for CKD.

These interventions were compared with current Australian treatment of people with diabetes and/or hypertension and urinary protein.

The scope of the analysis

Following a systematic review of evidence regarding CKD prevalence, risk of disease progression and effectiveness of screening and intervention, it became clear that the currently available data do not support a full cost-effectiveness analysis. Until the AusDiab follow-up study, conducted in 2004, is reported, the available longitudinal population-representative data regarding the incidence and progression of CKD are limited. In addition, we have developed our model on the basis of best-available, randomised trial evidence, demonstrating the effectiveness of the proposed CKD management strategies. However, randomised trials have not been undertaken which assess the effectiveness of population screening for proteinuria in particular; and there is some residual uncertainty concerning the effectiveness of the proposed CKD screening strategies. The cost-effectiveness analysis undertaken for this Report should be seen as delivering 'preliminary' findings suggesting that the proposed screening and intensive management strategies would be cost-effective.

Research Questions

The economic model was used to estimate the incremental cost-effectiveness ratios for each of the following comparisons:

- 1) Intensive treatment of people known to have diabetes (intensive glucose control +/- intensive blood pressure control +/- ACE inhibitor therapy) against current treatment of people with diabetes;
- 2) Opportunistic screening for diabetes and intensive treatment of asymptomatic people found to have diabetes PLUS better treatment of people known to have diabetes (intensive glucose control +/- intensive blood pressure control +/- ACE inhibitor therapy) against current treatment of people with diabetes;
- 3) Intensive treatment of people known to have hypertension (intensive blood pressure control) against current treatment of such people;
- 4) Opportunistic screening for hypertension and intensive treatment of asymptomatic people found to be hypertensive PLUS intensive treatment of people known to be hypertensive (intensive blood pressure control) against current treatment of people with hypertension; and
- 5) Opportunistic screening for urinary protein and intensive treatment of asymptomatic people found to have urinary protein PLUS intensive treatment of people known to have urinary protein (ACE inhibitor therapy) against current treatment of people with urinary protein.

Methods

A Markov Monte Carlo simulation model (MARCK-E) was constructed as the basis for estimating the costs and benefits of screening and management strategies, compared to patient cohorts undergoing routine treatment.

A Monte Carlo simulation is used to sample a starting age from a) the existing age distribution of known patients with risk factors (from AUSDIAB) (for the treatment interventions), or b) the existing age distribution of the Australian population > 25 years (for screening interventions), with a sufficient number of iterations to ensure model stability.

After screening or clinical diagnosis a patient progresses to the appropriate state and follows a series of annual transition probabilities to determine whether they die, have a non-fatal cardiac event, stay in the current state or progress. For the diabetes states, patients progress through diabetes with no albuminuria, to diabetes with microalbuminuria, to diabetes with macroalbuminuria, and eventually to a state of ESKD requiring RRT. For Hypertension and proteinuria states, patients have an annual probability of progressing to a state of ESKD requiring RRT.

A discount rate of 5% per annum was applied to all costs and benefits in cost-effectiveness analyses.

Results

Key Results 1: Estimate of the cost effectiveness of improved management of known patients with uncontrolled diabetes and hypertension; and annual opportunistic screening of asymptomatic 50 to 69-year olds attending general practices for diabetes, hypertension and urinary protein, in combination with improved management for all uncontrolled patients.

Incremental cost-effectiveness ratios (ICER) for screening and improved management strategies to reduce the burden of CKD		
	\$ per LYS*	\$ per QALY*
<u>Improved Management</u>		
<i>Intensive glycaemic control in known diabetics</i>	\$24,236	\$18,514†
<i>Intensive blood pressure control in known hypertensives</i>	\$11,812	\$15,589
<i>Addition of an ACE inhibitor in known diabetics</i>	\$2,761	\$3,652
<u>Screening</u>		
<i>Screening (50-69 yrs) for diabetes and intensive glycaemic control in known and screen-detected diabetics</i>	\$24,627	\$29,060
<i>Screening (50-69 yrs) for hypertension and intensive blood pressure control in known and screen-detected hypertensives</i>	\$2,347	\$3,292
<i>Screening (50-69 yrs) for proteinuria and addition of an ACE inhibitor in all known diabetics and screen-detected patients with proteinuria</i>	\$3,398	\$4,269

* This model presents the incremental cost-effectiveness for screening and improved management strategies to reduce the burden of CKD expressed as \$ per Life Year Saved (LYS) and \$ per Quality Adjusted Life Year (QALY). The \$ per LYS estimates can be interpreted as the amount of money that would have to be expended to produce one additional year of life. A QALY is a measure of outcome that combines survival with a subjective valuation of quality of life. The \$ per QALY estimates can be interpreted as the amount of money that would have to be expended to produce one additional year of life *in full health*.

† In this model, we used AusDiab data for quality of life weights for Australians with controlled and uncontrolled diabetes. In AusDiab, people with controlled diabetes were found to have higher quality of life. As a consequence, the improved glycaemic control strategies that we model in this Report result in direct improvement in quality of life, unlike the other “Improvement Management” strategies. This is discussed further in Section 4.1 of the Report.

Key Results 2: Estimate of the total cost and total health outcomes for a cohort of one million individuals who undergo annual opportunistic screening for diabetes, hypertension and urinary protein, from age 50 to 69, followed until death or a maximal age of 95

Costs and outcomes for screening and improved management strategies to reduce the burden of CKD*							
Outcome	Age at last screen	Total Cost Intervention (\$M)	Total Cost Comparator (\$M)	Additional cost (\$M)	Total Health outcomes (intervention)	Total Health outcomes (comparator)	Additional health outcomes gained
<i>Diabetes Screening and intensive glycaemic control in known and screen detected patients (50-69 yrs)</i>							
LYS	69	\$9,909 M	\$8,455 M	\$1,454 M	14,191,000 LY 11,136,000	14,133,000 LY 11,085,000	58,000 LY
QALYs	69	\$9,909 M	\$8,455 M	\$1,454 M	QALYs	QALYs	51,000 QALYs
<i>Hypertension screening and intensive blood pressure control in known and screen detected patients (50-69 yrs)</i>							
LYS	69	\$10,712 M	\$9,820 M	\$892 M	14,508,000 LY 11,272,000	14,128,000 LY 11,001,000	380,000 LY
QALYs	69	\$10,712 M	\$9,820 M	\$892 M	QALYs	QALYs	271,000 QALYs
<i>Proteinuria screening and ACEi treatment for all known diabetics and patients with known and screen detected proteinuria (50-69 yrs)</i>							
LYS	69	\$9,116 M	\$8,783 M	\$333 M	14,184,000 LY 11,098,000	14,086,000 LY 11,020,000	98,000 LY
QALYs	69	\$9,116 M	\$8,783 M	\$333 M	QALYs	QALYs	78,000 QALYs

* Based on the age distribution of the Australian population over the age of 25 years, the average starting age of the cohort is 49 years.

Key Results 3: Estimate of the health outcomes prevented for a cohort of one million individuals who undergo annual opportunistic screening for diabetes, hypertension and urinary protein, from age 50 to 69, followed until death or a maximal age of 95

Based on the age distribution of the Australian population over the age of 25 years, the average starting age of the cohort is 49 years, meaning, on average, the model runs for 46 years (cycles).

Diabetes screening and intensive glycaemic control in known and screen-detected patients (50-69 yrs)

- Diabetes screening prevents, on average, 2,151 cases of ESKD requiring RRT over 46 years
- Diabetes screening prevents, on average, 20,015 deaths over 46 years, comprising:
 - 23,168 fewer deaths from CVD causes
 - 3,951 more deaths from non-CVD causes (due to competing mortality)
 - 767 fewer deaths from kidney failure, and
 - 32 fewer deaths following failed transplant

Hypertension screening and intensive blood pressure control in known and screen-detected patients (50-69 yrs)

- Hypertension screening prevents, on average, 10,563 cases of ESKD requiring RRT over 46 years
- Hypertension screening prevents, on average, 63,195 deaths over 46 years, comprising:
 - 65,171 fewer deaths from CVD causes
 - 5,782 more deaths from non-CVD causes (due to competing mortality)
 - 3758 fewer deaths from kidney failure, and
 - 48 fewer deaths following failed transplant

Proteinuria screening and ACEi treatment for all known diabetics and patients with known and screen-detected proteinuria (50-69 yrs)

- Proteinuria screening prevents, on average, 2,149 cases of ESKD requiring RRT over 46 years
- Proteinuria screening prevents, on average, 13,391 deaths over 46 years, comprising:
 - 13,842 fewer deaths from CVD causes
 - 1,244 more deaths from non-CVD causes (due to competing mortality)
 - 778 fewer deaths from kidney failure, and
 - 21 fewer deaths following failed transplant

Research Implications

This Report presents findings of cost-effectiveness modelling using the best-available evidence regarding the prevalence of CKD in Australia and regarding the effectiveness of screening and intensive management of the key CKD risk factors — diabetes, hypertension and proteinuria. The cost-effectiveness of these interventions was modelled in terms of their effect on overall mortality, on cardiovascular mortality and morbidity and on progression to ESKD. Our findings suggest that:

- A CKD-control strategy based on opportunistic screening of 50 to 69-year-olds in general practice plus intensive management of diabetes, hypertension and proteinuria would be cost-effective, in some cases highly cost-effective.
- If a decision-maker is willing to spend up to \$50,000 per Quality-Adjusted Life Year gained, these proposed strategies should be strongly considered in the development of a national chronic disease prevention and management strategy.

Assessing ‘value for money’ on CKD screening and better management strategies can be done only by comparing the ICER with other *competing* calls on public money for preventive services. Three cancer screening programs are currently supported in Australia: for breast cancer, cervical cancer, and most recently, colorectal cancer. Cost-effectiveness analyses of these cancer-screening programs indicate wide variability in the magnitude of cost per life year saved, or cost per QALY measures. (See Chapter 5). However, the estimates for screening strategies most closely aligned to the current Australian cancer screening programs range from \$30,000 to more than \$100,000 per life year saved/per QALY.

These data suggest that the efficiency of screening for risk factors for CKD, as modeled in the current evaluation, is within the range of, or in some cases better than, the estimated efficiency of screening programs already available in Australia.

The screening and prevention strategies proposed in this Report are entirely consistent with a coordinated national approach to chronic disease prevention and management.

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