Deloitte Access Economics

Benefits of Credentialled Diabetes Educators to people with diabetes and Australia

Australian Diabetes Educators Association Limited

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Deloitte.

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Dear Daniel

Benefits of Credentialled Diabetes Educators (CDEs) to people with diabetes and Australia

We are pleased to assist the Australian Diabetes Educators Association with a detailed literature review and data analysis of the benefits of Credentialled Educators in Australia. It has been a pleasure working with you.

Yours sincerely,

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Contents

Tables

Figures

Glossary

ADEA	Australian Diabetes Educators Association
ADDQoL	Audit of Diabetes Dependent Quality of Life
AIHW	Australian Institute of Health and Welfare
AR-DRG	Australian Refined Diagnosis Related Group
AUD	Australian dollars
BCR	benefit cost ratio
BoD	burden of disease
CDE	Credentialled Diabetes Educators
CEA	cost effectiveness analysis
DALY	disability adjusted life year
EUR	Euro
GDP	gross domestic product
GP	general practitioner
HbA1c	glycosylated haemoglobin
HR-QOL	Health Related Quality of Life
ICER	incremental cost effectiveness ratio
IHPA	Independent Hospital Pricing Authority
NDSS	National Diabetes Service Scheme
NHCDC	National Hospital Cost Data Collection
QALY	quality adjusted life year
UK	United Kingdom
US(D)	United States (dollar)
VSLY	value of a statistical life year
WHO	World Health Organization

Executive Summary

Deloitte Access Economics was commissioned by the Australian Diabetes Educators Association (ADEA) to assess the benefits of Credentialled Diabetes Educators (CDEs) to people with diabetes, the Australian health system and society. CDEs are specialists in providing diabetes self-management education and provide expertise in clinical practice, research, diabetes education and counselling. CDEs have an undergraduate degree in a relevant discipline[1], have completed an ADEA accredited Graduate Certificate in diabetes education, have undertaken a minimum of 1,800 hours of practice in diabetes education, and have engaged in a six month mentoring relationship with an experienced CDE.

The team conducted a literature review to inform the cost effectiveness analysis (CEA) which was used to assess the costs and benefits of CDEs. A 'PICO' approach was undertaken for the analysis:

- P – Target Population;
- I – Intervention;
- C – Comparator; and
- O – Outcomes.

All costs and benefits have been estimated for 2014. The cost of the credentialling process has not been included as it is absorbed by individual educators.

The relevant **target population** was Australians with diabetes. Deloitte Access Economics estimates that in 2014 there are almost 1.4 million people with type 1, type 2 or gestational diabetes (Australian Institute of Health and Welfare 2013a, Australian Bureau Statistics 2013c). The patient population was classified into simple and complex cases using earlier ADEA research. This breakdown assisted in estimating the number of educator consultation hours required for best practice care.

Costs

The **intervention** was diabetes educator consultation or group programs which were based on diabetes education. The cost per patient was based on an estimated hourly rate for 2014 and the consultation hours based on best practice care for the complexity of the case. The cost was an average of $173 per person with diabetes per annum, or $237 million if all those with diabetes in Australia received CDE services in 2014.

Unfortunately, there were very few studies which assessed the effectiveness of (credentialled) diabetes educators. However, there were several that assessed the effectiveness of diabetes education. It can safely be assumed that the benefits of diabetes education equate to the *minimum* benefits from diabetes educators. That is, a CDE will provide assistance to the patient which is, at the very least, as good as that provided by health professionals in general. Moreover, absent a CDE, a patient may not receive any

[1] Registered Nurses (Division One), Accredited Practicing Dietitians, Registered Medical Practitioners, Registered Pharmacists, Podiatrists and Accredited Exercise Physiologists deemed acceptable by the ADEA

diabetes education, whereas with a CDE, they are guaranteed to receive benefits equal or greater to those modelled herein.

The **comparator** was modelled as the absence of the intervention i.e. standard care services as currently provided. In some cases such services may be partial, absent altogether, or even make outcomes worse (Day et al, 2003).

Benefits

Four key **outcome** measures were considered following the detailed literature review:

1. quality adjusted life years (QALYs);
2. glycosylated haemoglobin (HbA1c);
3. reduced incidence of co-morbidities; and
4. health system expenditure.

Diabetes education is very cost effective. The World Health Organisation (WHO) considers an intervention to be "highly cost effective" if it saves one quality adjusted life year (QALY) for less than gross domestic product (GDP) per capita. In Australia, GDP per capita is around $67,000. Diabetes education saves one QALY for just $650, or 1% of GDP per capita (Section 3.4.2). The current CDE workforce is capable of caring for 57% of patients with diabetes (Pekarsky 2010) which equates to a total lifetime averted burden of disease of $38 billion. If diabetes education was available for the entire population of people with diabetes (1,372,577 people), the total averted burden could be around $6.1 billion per annum.

In addition to this huge burden of disease saving is the reduced health system cost of diabetes which results from diabetes education. This includes savings from reduced frequency of hospital admissions, emergency presentations, GP visits and comorbidities. An average of $2,827 in annual health system costs is saved per recipient of CDE care, equalling $3.9 billion if all Australians with diabetes received care.

> Over $16 is saved in health system costs for every dollar spent on diabetes education.

Additional outcome measures (e.g. health workforce productivity) have been described but were unable to be included in the calculation owing to a lack of reliable data.

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1 The CDE model

Diabetes mellitus (diabetes) is a highly prevalent chronic metabolic disorder that interferes with the body's ability to produce or effectively use insulin. It affects an estimated 1.4 million Australians and has been designated as a National Health Priority Area since 1997 (Australian Institute of Health and Welfare (AIHW) 2012b). There are three main types of diabetes; type 1, type 2 and gestational diabetes. Type 2 accounts for 85-90% of all diabetes diagnosed, and is expected to become the leading cause of disease burden in Australia by 2023 (AIHW 2010b).

Diabetes is associated with a reduced quality of life, disability and morbidity (AIHW, 2008). The most commonly reported comorbidities are cardiovascular disease (60%), disability (56%), depression (19%) and vision impairment (7%) (AIHW 2010a). Diabetes is also linked to increased hospitalisation rates and higher mortality (Pekarsky 2010*)*. In 2009, the direct cost of diabetes was $1.5 billion[2] with an additional $153 million spent on governmental programs, subsidies and research (AIHW 2010a).

In Australia, General Practitioners (GPs) are often the first point of contact for people with diabetes. The referral pathway for newly diagnosed individuals depends on the type of diabetes, the level of care required by the patient and access to services. Patients with type 1 diabetes and those with longstanding type 2 diabetes can be referred to tertiary (hospital) care, although patients are increasingly being managed within a primary care setting. Tertiary care practitioners include endocrinologists and ophthalmologists, whereas optometrists and podiatrists practise most often within a primary care setting. Credentialled Diabetes Educators (CDEs) and dietitians operate in both tertiary and primary care settings.

1.1 Diabetes education

It has been recognised that diabetes education can play a major role in effective diabetes self-management. Barlow et al (2002) defined self-management as “the individual’s ability to manage the symptoms, treatment, physical and psychosocial consequences and lifestyle changes inherent in living with a chronic condition.” Improved diabetes self-management can positively impact glycaemic control, mental wellbeing and quality of life (ADEA 2012) and is a necessary part of disease control (Deakin et al 2005).

Structured education and treatment programs have been found to bring about a sustained improvement in patient outcomes, reduced utilisation of hospital services and mortality for people with Type 2 diabetes (Lowe et al 2009). A recent Australian study (Fenwick et al 2013) found that National Diabetes Service Scheme (NDSS) membership, educator input and ophthalmologist consultations were associated with better diabetes knowledge, which in turn improved clinical outcomes.

[2] Direct costs include inpatient, outpatient and medication costs in 2008-09 for diabetes mellitus

Internationally, diabetes education has been included as part of Diabetes Management Programs in general practices, and has been the focal point of research projects such as the Dose Adjustment for Normal Eating research programme in the United Kingdom (UK) and the Diabetes Strategy Evidence Project in Canada.

Nationally, the Australian Diabetes Educators Association (ADEA) has undertaken initiatives to promote diabetes education for patients. Despite these efforts, more than half of diabetes patients have not participated in a structured diabetes education program (Browne et al 2013). In 2010, Pekarsky (2010) estimated that the CDE workforce was capable of serving just over half (57%) of patients in Australia.

1.2 Credentialled diabetes education

1.2.1 Governing body

ADEA is a professional member organisation that sets national standards for diabetes education and CDEs in Australia. The Association is responsible for administering the credentialling and re-credentialling programs for CDEs, and authorising the use of the CDE certification trademark for eligible health professionals.

CDEs are recognised by Medicare Australia and their patients are eligible for a Medicare rebate. They are also recognised by the Department of Veterans Affairs and some private health insurers for rebate purposes.

1.2.2 Registration

A health professional practising in an eligible discipline can apply for ADEA CDE registration once they have satisfied the required criteria. The six eligible practitioners are GPs, nurses, dietitians, pharmacists, podiatrists and exercise physiologists.

The first step in qualifying for the CDE certification is the completion of an ADEA accredited Graduate Certificate course of study in diabetes education and care. Upon completion of the course, the health professional must complete 1,800 hours of clinical practice (spread over four years) and engage in a minimum six month mentoring relationship with an experienced CDE. To maintain their credential, CDEs must complete a minimum of 40 Continuing Professional Development hours across all domains of practice and reapply to ADEA every three years for status renewal.

There are 1,021 registered CDEs in Australia, and 144 mentors engaged in 412 ongoing mentoring partnerships.

1.2.3 Role of a CDE

The role of a CDE is to educate people with diabetes and their families about the condition and how to manage it. CDEs are able to authorise registrations for the NDSS, access insulin pump consumables, and certain practitioners (GPs, nurse practitioners) can provide an initial supply of insulin. In addition to providing detailed diabetes education, CDEs also provide a range of other (complementary) services, including elderly care (55%), insulin pump therapy (35%), pre-conception care (20%), and assistance to Indigenous Australians (17%) (ADEA 2012).

There is a high demand for CDE input with the workforce able to service just 57% of patients in Australia (Pekarsky 2010), indicating a skills shortage. While diabetes education can also be provided by other health professionals, such as nurses, GPs and dietitians, superior care and advice is provided by CDEs. Without a CDE consultation, a patient may not receive any diabetes education at all.

An ADEA survey of GPs cited access to CDE services as a common problem. GPs also expressed concerns regarding the increasing out of pocket expenditure for patients who consult CDEs due to the limit imposed on the number of visits which are reimbursed through Medicare and lack of reimbursement through private health insurance. In addition, GPs observed that Diabetes Management Plans (set up between GPs and the allied health workforce) increase workload on GPs and act as a disincentive for referral.

1.2.4 Diabetes educators

Both diabetes educators and CDEs play a major role in self-empowering people with diabetes by focusing on an individual's needs, providing knowledge, motivation and support to aid the prevention of diabetes related health complications.

In contrast to diabetes educators, CDEs must have adequate tertiary qualifications, adhere to professional standards of practice, and must demonstrate ongoing commitment to maintaining their credentialling. The CDE recognition allows patients to claim rebates for CDE consultations upon referral from their GP.

1.2.5 Australian context

Currently, chronic disease management approaches supported by the Australian government involve a range of incentives (Practice Incentive Payments and Service Incentive Payments), quality improvement programs (National Primary Care Collaboratives) and the implementation of Medicare Benefits Schedule item numbers (Chronic Disease Management) to support systemised care in general practice. People with diabetes are eligible for a Medicare rebate for the use of allied health practitioner services (including CDEs) for up to five visits under existing chronic disease management item numbers[3]. It is likely those with diabetes need to see a number of health care professionals and visits to a CDE may not be covered by the five visits. Additionally, the Medicare rebate only relates to a 20 minute consultation, which is an insufficient amount of time for a robust CDE review and education.

The Government is also funding the Diabetes Care Project to reform the provision of coordinated multidisciplinary education and care and support a more consumer-centred approach to care through expanding the choices available to adults (18 years and over) with either type 1 or type 2 diabetes.

[3] Aboriginal and Torres Strait Islanders are eligible for an additional five follow up visits under Medicare

2 Literature evidence for better outcomes

The overall objective of the literature review was to find evidence of diabetes management outcomes that occur following input from a diabetes educator (including CDEs) compared to no educator input (standard care). In particular, information was sought in relation to the following outcomes:

- quality adjusted life years (QALYs);
- disabilities;
- clinical metrics (such as glycosylated haemoglobin (HbA1c) and secondary complications);
- health expenditure; and
- patient and carer productivity.

2.1.1 Sources

A targeted search of the following references was conducted:

- Pubmed and the Cochrane Library (for published papers using search terms listed in Table 2.1);
- papers provided, or suggested by the ADEA; and
- past work done by Deloitte Access Economics related to diabetes education.

2.1.2 Search terms used for published paper search

Search terms used are outlined in Table 2.1.

Table 2.1: Search terms for published paper review

	Search 1	Search 2	Search 3	Search 4
Pubmed and Cochrane Library*	educat* AND diabet*	review AND diabet*	instruct* AND diabet*	advice AND diabet*

* Pubmed filtered for abstracts available and English only, Cochrane Library filtered for Cochrane Reviews

The relevant articles found through all searches were as follows.

Table 2.2: Relevant articles identified by area of interest

Literature review topic	Relevant articles identified
QALYs	Rasekaba et al (2012) Rogers et al (2009) Urbanski et al (2007) Brownson et al (2009) Dijkstra et al (2006)
disabilities	Colagiuri and Walker (2008)
clinical metrics	Dorland and Liddy (2014) Halbron et al (2014) Khunti et al (2012) Health Quality Ontario (2009) Gagliardino et al (2013)
health expenditure	Colagiuri et al (2013) Duncan et al (2009) Balamurugan et al (2006) Baker IDI Heart & Diabetes Institute study (2012)
patient and carer productivity	Colagiuri et al (2003) Urbanski et al (2007)

2.2 Literature review findings

In accordance with the aims of the literature review, the findings are discussed under each outcome of interest. The evidence reported focuses on findings that were able to be used in the cost effectiveness analysis in Section 3.

Overseas cost estimates were translated into Australian dollars (AUD) using purchasing power parity rates from the Organisation for Economic Co-operation and Development in the relevant year of the study. These rates were then inflated using the consumer price index to restate them in 2014 values.

2.2.1 QALYs

Traditionally, measurement of health outcomes that combine duration and quality of life has been undertaken using the QALY. QALYs assess the improvement in quality adjusted life expectancy obtained through a specific health intervention relative to a situation in which no intervention or a standard alternative intervention is provided.

QALYs and disability adjusted life years (DALYs) are common outcome measures used in economic evaluations such as cost effectiveness analyses. QALYs and DALYs are measures that combine mortality and morbidity into a single numerical unit. These measures are similar in that they express health in time (life years) and give a weight to the degree of disability incurred by a disease. The key difference between these measures is that QALYs measure health gain and DALYs, health loss. This 'burden of disease' approach to valuing healthy life was developed by the World Health Organization (WHO) and is estimated in Australia by the AIHW.

The WHO estimates that an intervention (such as diabetes education) is cost effective if it costs three times the gross domestic product (GDP) per capita to save a year of life. Locally, the Department of Prime Minister and Cabinet requires all government agencies to use the value of a statistical life year (VSLY) in cost benefit analysis to estimate the value of a healthy life year as approximately $184,000 in 2014, which is based on observed marketplace risk valuations, and is also around three times GDP per capita. Interventions which cost less to produce a QALY gain or DALY loss are deemed highly cost effective. Cost-effectiveness is typically expressed as an incremental cost-effectiveness ratio (ICER), the ratio of change in costs to the change in QALY effects.

Brownson et al (2009) used a benchmark of USD50,000 (AUD42,898) per QALY to estimate the cost-effectiveness of diabetes self-management programs in United States (US) community primary care settings. In total, four study sites were considered and the interventions included group diabetes education classes, family home visits and individual consultations with an educator or dietitian. Progression parameters were based on the UK Prospective Diabetes Study and incorporated lifetime reductions in disease progression (microvascular and macrovascular diseases), costs of adverse events, and increases in quality of life. The study estimated that the intervention reduced long-term complications, leading to an increase in remaining life years and **0.30 QALYs** with an ICER of USD39,563 (AUD34,802) per QALY, which was below the benchmark.

Dijkstra et al (2006) assessed the cost effectiveness of two diabetes intervention strategies for people with type 2 diabetes in the Netherlands. Participants were randomly assigned to a control group, a professional directed care program or a patient centred care program. Patient centred care largely involved self-management, with input from specialists and diabetes education. After 12 months a reduction in HbAc1 levels in both intervention groups (0.2% reduction in professional directed care and 0.3% reduction in patient centred care) was observed, together with an increase of 0.2% in the control group. Life expectancy improved by 0.34 and 0.64 years which equated to a **QALY gain of 0.29 and 0.59** respectively. The study concluded that both intervention strategies in secondary care were cost effective compared to usual care, estimating an ICER of EUR32,218 (AUD21,989) for professional directed care and EUR16,353 (AUD11,161) for patient centred care compared with the control group.

Other studies have demonstrated improved quality of life resulting from diabetes education and self-management programs. Health Related Quality of Life (HR-QOL) (from patient surveys) is a measure designed to capture the impairments in life consequent upon intrinsic health conditions across illness, independent living, social relationships, physical senses, and psychological well-being, and suitable for use in the calculation of QALYs.

An Australian study conducted by Rasekaba et al (2012) showed that a multidisciplinary disease management program for patients with poorly controlled type 2 diabetes can improve both glycaemic control and HR-QOL for the majority of patients at 12 months. Care was provided by an endocrinologist and diabetes nurse educator, with input from other specialities as needed. The educator reviewed the patient's knowledge and understanding of diabetes management, and set treatment goals and strategies to implement lifestyle modifications. At 12 months, 64% patients had an increase in their quality of life score, 6.9% had no change and 29.1% had deteriorated. The authors concluded that optimised medical management and increasing patients' self-management skills was capable of improving diabetes control over a 12 month period.

Rogers et al (2009) also found that a structured five day education program for people with Type 1 diabetes can deliver improved diabetes control. The program was based on the Dose Adjustment for Normal Eating in the UK which has demonstrated sustained improvement in HbA1c and quality of life. Specialist medical and nursing staff were trained to deliver the program, instruction was based on an educator training program. Diabetes control and quality of life were assessed at 1 year post-course using the Audit of Diabetes-Dependent Quality of Life (ADDQoL) and a Diabetes Treatment Satisfaction Questionnaire. The ADDQoL provides a diabetes impact rating weighted by importance for 18 potentially applicable domains including dietary freedom, whereas the Diabetes Treatment Satisfaction Questionnaire measures how satisfied a person would be to continue their present form of treatment and their perceived frequency of hyperglycaemia and hypoglycaemia. The study reported an average HbA1c drop of 0.4% to 7.9% at 12 months and improved quality-of-life measures. The negative impact of diabetes on diabetes-related quality of life reduced from 2.17 to 1.50 (as measured by the ADDQoL), representing a quality of life improvement from 0.93 to 1.52.

2.2.2 Disabilities

The AIHW (2010a) reported that approximately one quarter of Australians with diabetes and a disability considered their diabetes to be the main condition causing their disability. The DALY was developed by the WHO to measure the disability imposed on an individual. Thus a DALY is a negative concept, estimating the years of healthy life lost due to disability from disease, and the years of life lost due to premature death.

While there is limited data linking diabetes education with DALY outcomes, Colagiuri and Walker (2008) estimated that the cost per DALY of a lifestyle intervention aimed at improving nutrition and exercise in Australia was $50,000. The authors hypothesised that if 175,000 newly diagnosed people with diabetes aged 45-74 years underwent a lifestyle program, **36,009 DALYs would be averted**.

2.2.3 Clinical metrics

HbA1c

The impact of improved diabetes self-management upon patient HbA1c has been widely studied. A recent paper by Dorland and Liddy (2014) evaluated the impact of two types of diabetes education classes, a one hour class and three weekly classes of two hours in length. After six months, lower HbA1c was observed amongst class participants, an average **reduction of 0.2%, and 0.6%** after the two and six hours of education respectively. Patients with HbA1c ≥ 8% showed a drop of 1.1% in HbA1c just months after either class (p = 0.004). The study also indicated that shorter sessions using didactic teaching methods may be equally effective in producing improvements in diabetes self-management as more intensive course formats.

Halbron et al (2014) evaluated if a five day patient centred inpatient education program in type 1 diabetes can achieve individualised therapeutic targets. At 12 months, those who were initially poorly controlled (HbA1c > 7.5%) had improved from a baseline average **HbA1c of 9% to 8.4%**. Just over half of these patients had a drop of at least 0.5%.

Khunti et al (2012) measured whether the benefits of a UK based single education and self-management structured program for newly diagnosed people with type 2 diabetes were sustained at three years. This group education program had a duration of six hours and was delivered in the community by two educators compared with usual care. The results indicated that HbA1c levels at three years had **decreased for both the intervention and standard care groups**.

The Medical Advisory Secretariat in Ontario, Canada (Health Quality Ontario 2009) conducted an evidence based review of literature to determine the efficacy of specialised multidisciplinary community care for the management of type 2 diabetes compared to usual care. Specialised multidisciplinary community care was defined as outpatient care provided by at least two health care disciplines (of which at least one must be a specialist in diabetes) with integrated communication between the care providers. Usual care was defined as health care provision by non-specialist(s) in diabetes, such as primary care providers with potential referral to other health care professionals/services as deemed necessary. The primary outcomes for this review were HbA1c and systolic blood pressure. The study concluded that specialised multidisciplinary community care had demonstrated a statistically and clinically significant **reduction in HbA1c of 1.0%** compared with usual care after six months or longer.

Slingerland et al (2013) studied patient-centred type 2 diabetes care in the Netherlands. The care given was similar to that provided by CDEs. An **average 0.83% reduction in HbA1c** at one year was observed in patients who had a baseline HbA1c >8.5%. This improvement corresponded to an average lifetime gain of 0.54 QALYs. Trial participants with a baseline HbA1c of 7.0–8.5% had a **drop of 0.49%** and a 0.24 QALY gain. The study found that patient centred care was not cost-effective for patients with a baseline HbA1c<7.0%; this group reported a **fall of only 0.08%**.

Impact of HbA1c reductions on co-morbidities

A Canadian study (Medical Advisory Secretariat 2009) estimated the impact of reduction in HbA1c levels on mortality and the risk of microvascular and macrovascular disease. It found that intensive blood glucose and blood pressure control lower the risk of microvascular and macrovascular complications in people with type 2 diabetes. In particular, it found that a **1% reduction in HbA1c has been associated with a 10% reduction in diabetes-related mortality and a 25% reduction in microvascular end-points**. Further, results indicated that intensive blood pressure control was associated with a 32% reduction in risk of mortality from diabetes-associated conditions, two-thirds of which are cardiovascular diseases. Tight blood pressure control was also associated with a 34% reduction in the risk of macrovascular disease (including myocardial infarction, sudden death, stroke, and peripheral vascular disease), 44% reduction in the risk of stroke and 37% reduction in the risk of microvascular disease.

Further, a local Baker IDI Heart & Diabetes Institute study (2012) modelled the impact of tighter glycaemic control (as defined by a HbA1c reduction from 8% to 7%) over a five year period. A significant reduction in co-morbidities was seen including a **reduction in end stage kidney disease by 40%, of amputations by 20%, of advanced eye disease by 42% and of myocardial infarction by 15%**. Although during a five year period as considered in the study, only a small number of people would develop each of these complications, the study found that improvement in glycaemic control had significant impacts on quality of life, health costs and productivity.

2.2.4 Health expenditure

Colagiuri et al (2013) estimated that annual direct per person costs were $1,898 in 2005 ($3,099 in 2014) for those with normal glucose tolerance, rising to $4,390 ($7,167) for those with known diabetes. Costs were substantially higher in people with diabetes and both micro- and macrovascular complications.

A US study by Duncan et al (2009) found people with diabetes with private health insurance who access diabetes education cost, on average, 5.7% less than members who do not participate in diabetes education. The cost is even less (14%) for those without private health insurance who receive education.

Balamurugan et al (2006) found that over one year, (US) diabetes self-management education patients had a 0.45% decline in mean HbA1c, fewer hospital admissions, emergency room visits, and outpatient visits. Over three years, they estimated that savings in diabetes related costs were USD415 (AUD365) per program completer. Over 10 years, completers were estimated to experience a decrease in coronary heart disease events and microvascular disease events by 12% and 15%, respectively. Study results (Table 2.3) show that self-management education brought about 0.23 fewer hospital admissions per patient and 1.17 fewer emergency department visits. The number of physician visits related to diabetes did not reduce significantly for course completers; however, the overall number of physician visits was 0.97 greater amongst those who did not receive the education. The reduced health service utilisation led to significant cost savings.

Table 2.3: Impact of diabetes education on health service utilisation in the US, 2003

	Diabetes self-management education participants	Non-participants
Hospital admissions	0.44	0.67
Emergency department visits	1.89	3.06
Physician visits: for diabetes	2.55	2.58
Physician visits: all	5.60	6.57

Source: Balamurugan et al (2006)

2.2.5 Patient and carer productivity

Productivity losses are the cost of production lost when people with illnesses and disorders are unable to work because of their condition. They may work less than they otherwise would (either being employed less, being absent more often or being less productive while at work) or they may die prematurely.

Absenteeism costs are shared by the worker and the employer based on access to sick leave. Presenteeism costs are borne by employers. Other productivity costs of illness are incurred by the worker (lost income if they reduce their working hours) and the government (taxation revenue forgone).

The American Diabetes Association (2013) estimated the economic cost of diabetes in the US in 2012 to be $176 billion in direct medical costs and $69 billion in reduced productivity across 22.3 million people in the US diagnosed with diabetes, representing about 7% of the population. The average annual productivity loss per person aged 18 years or older with diabetes was $US 3,100.

Table 2.4: Indirect costs of diabetes in the US, 2012

Cost component	Productivity loss	Loss per patient[a]
Workdays absent	25 million days	1.1 days
Reduced performance at work	113 million days	5.1 days
Reduced productivity days for those not in labour force	20 million days	0.9 days
Reduced labour force participation due to disability	130 million days	5.8 days

Source: American Diabetes Association (2013) (a) estimated by dividing the total loss by total number diagnosed with diabetes

Colagiuri et al (2003) estimated that the average income lost by patients and carers unable to attend work due to type 2 diabetes was $35 ($47 in 2014) per person per year. The study sample had a mean age of 65 years and therefore few participants were employed. The average income lost per person, particularly for carers, increased if complications were present. The impact of diabetes in terms of lost income is likely to be higher if people with Type 1 diabetes are included, because this type of diabetes generally develops at a much younger age and therefore affects parents of children with the disease as well as employed people who themselves have Type 1 diabetes. Australian data available on the indirect costs associated with Type 1 diabetes were not retrieved.

2.3 Conclusion

The outcome measures found in the literature search which can be used in the model are outlined in Table 2.5.

Table 2.5: Summary of outcomes for CEA modelling

Outcome	Reference, country	Intervention	Provider	Value and timeframe
QALYs	Brownson et al (2009), US	Primary care programs	Community health centres	0.3 QALY gain over three years
	Dijkstra et al (2006), Netherlands	Outpatient patient centred care program	Physicians working in general hospitals	0.59 QALY gain over one year
	Colagiuri and Walker (2008), Australia	Lifestyle intervention aimed at nutrition and exercise	Medical practitioners	0.21 DALY reduction over 10 years
	Slingerland et al (2013)	Patient-centred care	Diabetes specialist nurses	0.037 QALY gain over one year
HbA1c	Dorland and Liddy (2014), US	A two hour education class	Dietitian, nurse and pharmacist	0.2% reduction in HbA1c after six months
	Dorland and Liddy (2014), US	Three two hourly weekly classes	Dietitian, nurse and pharmacist	0.6% reduction in HbA1c after six months
	Halbron et al (2014), UK	Five day inpatient education program	Dietitians, clinical psychologists, nurses and diabetologists	53% of patients (with baseline HbA1c>7.5%) reduced HbA1c by at least 0.5% after one year
	Khunti et al (2012), UK	Single education and self-management structured program	Trained healthcare professional educators	No different to comparator
	Health Quality Ontario (2009), Canada	Specialised multidisciplinary community care	Registered nurse, registered dietitian and physician (primary care and/or specialist) *versus* pharmacist and a primary care physician	1% reduction in HbA1c after six or more months

	Balamuru-gan et al, (2006), US	Self-management education	Registered nurse and a registered dietitian who followed the American Association of Diabetes Educators' core curriculum for diabetes education	0.45% reduction in HbA1c over one year
Secondary complica-tions	Health Quality Ontario (2009), Canada	Community-based care for the management of Type 2 Diabetes	Registered nurse, registered dietitian and physician (primary care and/or specialist) *versus* pharmacist and a primary care physician	1% reduction in HbA1c has been associated with a 10% reduction in diabetes-related mortality and a 25% reduction in microvascular end-points.
	Baker IDI Heart & Diabetes Institute study (2012)	Tighter glycaemic control (as defined by a HbA1c reduction from 8% to 7%)	N/A	Reduction in the cumulative incidence of end stage kidney disease by 40%, of amputations by 20%, of advanced eye disease by 42% and of myocardial infarction by 15%, over five years.
	Balamuruga n et al, (2006), US	Diabetes self-management education	Registered nurse and a registered dietitian who followed the American Association of Diabetes Educators' core curriculum for diabetes education	Decrease in coronary heart disease event and microvascular disease events by 12% and 15%, respectively, over 10 years.
Health expenditure	Duncan et al (2009), US	Diabetes education	Diabetes educators (as defined by the American Association of Diabetes Educators	Health costs 5.7% less for PHI patients, and 14% less for Medicare patients, over three years
	Balamuruga n et al, (2006), US	Diabetes self-management education	Registered nurse and a registered dietitian who followed the American Association of Diabetes Educators' core curriculum for diabetes education	Health costs reduced by AUD365.07 over three years. 0.23 fewer hospital admissions 1.17 fewer emergency department visits 0.97 fewer physician visits over one year

3 Cost effectiveness of CDEs in Australia

A PICO approach was adopted for the cost effectiveness analysis (CEA):

- P – Target Population;
- I – Intervention;
- C – Comparator; and
- O – Outcomes.

3.1 Target population

There are approximately 1.4 million Australians with diabetes in 2014, comprising roughly 163,000 cases of type 1 diabetes, 1.2 million of type 2 diabetes and almost 44,000 Australians with gestational diabetes. Cases were further broken down by complexity of disease (ADEA 2012).

Table 3.1: Number of people with diabetes by type, stage and complexity of condition

Diabetes type	Less complex	More complex	Total number[a]
Newly diagnosed type 1	301	2,315	2,616
Ongoing type 1	26,787	133,934	160,720
Newly diagnosed type 2	19,195	6,398	25,594
Ongoing type 2	851,360	288,364	1,139,724
Gestational			43,922
Total			**1,372,577**

Source: AIHW (2013a), ABS (2013c) (a) totals have been rounded and therefore may not sum exactly

According to Pekarsky (2010), the current CDE workforce is able to serve 57% of patients in Australia.

3.2 Intervention

3.2.1 Intervention costs

The hourly wage for a salaried CDE in 2012 was $55 ($58/hour in 2014), and a private practice CDE, $75 ($78/hour) (ADEA 2012). The intervention modelled was best practice care, as defined by the ADEA (2012). This care is composed of individual consultations and group sessions, with CDE hours based on the complexity of the patient. The cost of CDE input was calculated by multiplying the required hours for best practice care by the hourly wage. The private practice wage ($78/hour) was used as it is more likely to include all employment costs, such as private practice overheads, superannuation and workers compensation.

Table 3.2: Hours and total cost for CDE best practice care, 2014

Diabetes type	Hours per less complex patient	Hours per more complex patient	Total cost[b]
Newly diagnosed type 1	2.4	4.8	**$923,243**
Ongoing type 1	2	4.4	**$50,144,710**
Newly diagnosed type 2	1.4	3.6	**$3,892,809**
Ongoing type 2	1	4.8	**$174,369,540**
Gestational[a]	3.1		**$7,605,187**
Total			**$236,935,489**

Source: ADEA (2012) (a) number of hours estimated by averaging the newly diagnosed patient hours for type 1 and 2 diabetes (b) Total cost if all Australians with diabetes receive CDE input

> The average cost of educator care was $173 per person with diabetes, and would be $237 million if all Australians with diabetes received care in 2014.

In the model all Australians with diabetes receive the services of a CDE in 2014, and these costs are compared against benefits received in 2014.

- Some degree of follow up may be needed to lock in the benefits of CDE interventions. The majority of the case studies used in this report which cited $ per QALY were multi-year interventions. Tang et al (2006) found that without follow-up, health gains from diabetes education are not sustained over the long term. They note that this has led to initiatives such as the Lifelong Management program where patients were encouraged to attend sessions as frequently as needed: weekly, monthly, or whenever needed due to events in patients' lives.

3.3 Comparator

The comparator considered was standard care, where no input is provided by a specialist diabetes educator. Hence for the comparator, the educator costs of $173 per person with diabetes in 2014 are saved.

3.4 Outcomes

Sufficient data was found to enable the following outcomes to be included in the cost effectiveness modelling:

- QALYs/DALYs;

- HbA1c;
- reduced incidence of co-morbidities; and
- health system expenditure.

In the first instance, results of the literature review (as detailed in Table 2.5) were averaged for **QALYs/DALYs, HbA1c and co-morbidities** to estimate the average impact of diabetes education on each outcome, given there was some similarity between the values. The length of the education intervention and follow up period differed between studies. Given it cannot be predicted whether the outcome will persist, or even improve over time, the reported outcomes were simply averaged (rather than proportioned for duration). Furthermore, most interventions appraised as part of the literature review involved those with type 2 diabetes. Outcome values were applied to the entire Australian population with diabetes, given people with type 2 diabetes make up the vast majority of the CDE caseload.

The impact of diabetes education on **health system expenditure** was estimated using Balamurugan et al (2006) as Duncan et al (2009) stratified people with diabetes by health insurance status and this is not known for Australians with diabetes.

Productivity losses for employed people with diabetes were estimated using American Diabetes Association (2013).

Table 3.3: Average of outcome values

Outcome	Number of papers considered	Simple average of outcome values
QALYs/DALYs	3	0.27[c]
HbA1c	6	0.46[a]
Microvascular co-morbidities[b]	3	0.28
Macrovascular co-morbidities[b] (heart disease)	2	0.14

Source: Deloitte Access Economics calculation based on Table 2.5 (a) Halbron et al (2014) HbA1c reduction applied to all participants. (b) Assumes education brings about a 1% drop in HbA1c, as reported by Medical Advisory Secretariat (2009). (c) Where QALY gains occur over a number of years, future gains are discounted at 7%.

The scenario considered was all Australians with diabetes receiving educator input. Current capacity would not enable this situation and the workforce would need to be expanded to achieve these results.

3.4.2 QALYs

An average gain of 0.27 QALYs/DALYs per patient[4] was multiplied by the total Australian population with diabetes in 2014 and then multiplied by the VSLY to estimate the lifetime burden of disease savings. The average age of an Australian with diabetes (63 years[5]) was

[4] Average of outcomes in Brownson et al (2009), Dijkstra et al (2006) and Colagiuri and Walker (2008), as detailed in Table 2.5

[5] Weighted average age of individuals with diabetes mellitus who responded to the Australian Health Survey (ABS 2012)

subtracted from their life expectancy (74 years[6]) to estimate the number of years over which savings would be considered (11 years). The total lifetime burden of disease savings resulting from Australians with diabetes receiving CDE care in 2014 was estimated at $67 billion, or $6.1 billion per annum on average.

- By way of comparison, Slingerland et al (2013) using Dutch data, estimate that the average participant in their trial would also be expected to live with diabetes for another 11 years. Dijkstra et al (2006) also using Dutch data, report an expected future duration of 14 years. Colagiuri and Walker (2008), using Australian data, model benefits over 10 years.
- While all four studies cited in Table 3.4 calculate lifetime QALYs saved, they do not provide an estimate of what adverse events would be prevented at what stage within this timeframe. Further complicating matters, it is not known how long it is between when a patient is diagnosed and when they see an educator. Nor how long they may have had diabetes before being diagnosed. For example, Slingerland et al (2013) record that the average patient in their trial had been diagnosed 12.5 years before hand – plus or minus 11.5 years.
- Accordingly, it is assumed that QALYs saved are evenly distributed across remaining life years. The AIHW (Begg et al, 2007) report that the vast majority (78%) of DALYs due to diabetes are due to its disability weight, which can be managed by CDE intervention. (That is, rather than premature death.)

The cost-effectiveness ratio is calculated as $650/QALY. By way of benchmarking, Slingerland et al (2013) report an incremental cost effectiveness ratio (ICER) of $US 261/QALY, and Dijkstra et al (2006) report an ICER of € 881 per QALY.

The WHO estimates that it is cost effective to spend three times GDP per capita to save a year of healthy life (QALY). An intervention that saves a QALY for less than GDP per capita is considered highly cost effective. Similarly, the Department of Prime Minister and Cabinet requires all government agencies to use the VSLY, in cost benefit analysis to estimate the value of a healthy life year as approximately $184,000 in 2014, which is based on observed marketplace risk valuations, and is also around three times GDP per capita. Intuitively, most people chose to spend around one third of their lives at work. If they placed a lower value on their free time, they would work more.

Australian GDP was $66,985 per person in 2013 (ABS 2014). Thus, an intervention which saves a QALY for less than $67,000 can be considered highly cost effective.

Table 3.4: QALY outcomes from diabetes education

Study	Intervention	Provider	Years	QALYS
Brownson et al (2009), US	Primary care programs	Community health centres	3	0.30
Dijkstra et al (2006), Netherlands	Outpatient patient centred care program	Physicians working in general hospitals	1	0.59

[6] Average of male and female life expectancy (ABS 2013b) in 2012 (most recent) minus expected life expectancy reduction due to diabetes (Eight years at 40 (Roper et al 2001))

Colagiuri and Walker (2008), Australia	Lifestyle intervention aimed at nutrition and exercise	Medical practitioners	10	0.21
Slingerland et al (2013)*	Patient-centred care	Diabetes specialist nurses	1	0.04
Average (net present value)				**0.27**

Note: Slingerland reported QALY improvements of between 0.24 and 0.54 for those patients where Hb1Ac > 7.0%.

3.4.3 Burden of disease

The average gain in QALYs from diabetes education was 0.27 (Table 3.4). Valuing one QALY at $183,781 (the VSLY) indicates that burden of disease averted is $48,839 (=$183,781 * 0.27[7]).

Thus, if diabetes education was available for the entire population of people with diabetes in 2014 (1,372,577 persons), the total averted burden of disease would be $67.0 billion over their lifetime. With the current educator supply (57% coverage of patients), the averted lifetime burden of disease would be $38.2 billion.

3.4.4 HbA1c

Slingerland et al (2013) investigated the impact of patient-centred diabetes care (the type of care provided by CDEs) on HbA1c (at 12 months) and estimated the corresponding QALY gain. Results (Table 3.5 and Table 3.6) indicated that the HbA1c drop and QALY gain was dependent on the level of glycaemic control at baseline. The average HbA1c drop (0.47%) was almost identical to that calculated in Table 3.3 (0.46%). It was assumed that the average starting HbA1c for each group was the midpoint between a 1.5% HbA1c range (or 9.3%, 7.8% and 6.3% respectively). The absolute change in HbA1c was calculated together with the relative change in HbA1c. A weighted average drop in HbA1c of 0.33% (absolute) was then estimated using the distribution of Australian people with diabetes by HbA1c (Michaelides et al, 2008). For an average CDE expenditure of $173 per patient, this translates into $465 for a 1% drop in HbA1c.

Table 3.5: Relative HbA1c reduction

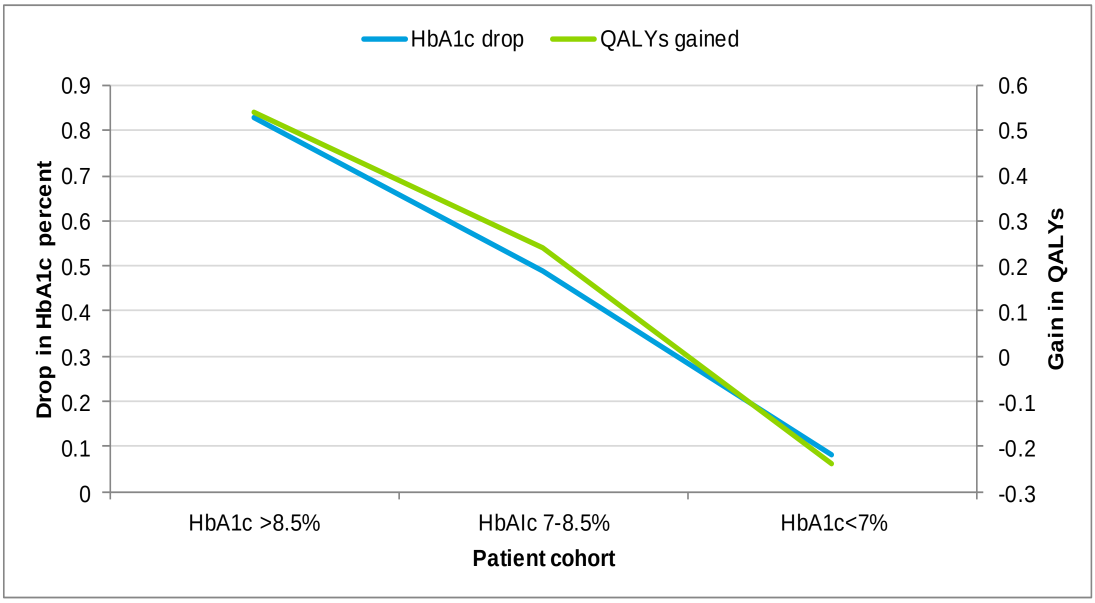
Starting HbA1c	Midpoint	Absolute HbA1c reduction after 1 year	Proportion of Australian people with diabetes	Relative HbA1c reduction after 1 year
HbA1c>8.5%	9.25%	0.83%	17%	9.0%
7.0-8.5%	7.75%	0.49%	30%	6.3%
<7.0%	6.25%	0.08%	53%	1.3%
Weighted average HbA1c reduction		**0.33%**		**4.1%**

Source: Slingerland A et al (2013), Michaelides et al (2008)

[7] For greater accuracy, the un-rounded average QALY gain was used in burden of disease calculations

Slingerland et al (2013) show a linear relationship between HbA1c reductions and QALYs gained. Hence, increased glycaemic control can be translated into reduced burden of disease, using the VSLY to monetise QALYs gained.

Figure 3.1: QALYs gained by HbA1c group



Source: Slingerland et al (2013).

The QALYs gained by a fall in a given HbA1c level was modelled for HbA1c < 7%, HbA1c between 7 and 8.5% and HbA1c > 8%, based on the diabetes prevalence in the population.

Table 3.6: QALY gain by HbA1c group

Starting HbA1c	Midpoint	Absolute HbA1c reduction after 1 year	QALY gain per person with diabetes	QALYs gained overall
HbA1c>8.5%	9.25%	0.83%	0.54	126,744
7.0-8.5%	7.75%	0.49%	0.24	98,496
<7.0%	6.25%	0.08%	-0.24	-174,592
Total QALY gain				**50,648**

Source: Slingerland A et al (2013), Michaelides et al (2008).

3.4.5 Health system expenditure

> Translating the disease impact parameters (frequency of hospital admission, emergency presentation, GP visits, comorbidities) from the literature search into their current Australian costs, diabetes education may prevent up to $2,827 per patient, per annum. For the annual costs of CDEs per patient of $173, this represents a benefit cost ratio (BCR) of 16.3 to 1.

Direct cost savings from visits averted for diabetes

Balamurugan et al (2006) observed a reduction in health service utilisation in the year following diabetes education.[8] Namely, 0.23 fewer hospital admissions, 1.17 fewer emergency department visits and 0.97 fewer physician visits. To estimate the per person health system savings, the average cost of each visit was first calculated and then multiplied by the number of visits averted.

The AIHW (2013) reported that the per separation expenditure for hospital admitted patient services was $7,567 in 2008-09 ($8,585.16 in 2014). However, the AIHW did not report the cost of emergency department visits. Instead, this was calculated based on data from the Independent Hospital Pricing Authority (IHPA) National Hospital Cost Data Collection (NHCDC). The NHCDC is an annual collection of public hospital data. The latest available report was for the financial year 2011-12. The NHCDC groups data is based on the Australian Refined Diagnosis Related Group (AR-DRG) classification system. This provides a meaningful way to relate the number and types of patients treated in a hospital to the resources required by the hospital (IHPA 2014). IHPA AR-DRG codes provide cost details for several hundred types of cases treated, including how involved emergency departments are in each case. The NHCDC data provided emergency department costs related to four AR-DRG codes associated with diabetes (K60A, K60B, K01A and K01B). A weighted average of the emergency department costs was $665.10 in 2011-12 ($698.22 in 2014).

[8] Balamurugan et al (2006) do not specify whether costs are for diabetes only, or include comorbidities. While Balamurgan (2005) does report on these costs separately, in the interests of conservatism it is assumed that costs here include complications from diabetes.

Table 3.7: Costs averted for diabetes treatment from CDEs, 2014

Health service	Average cost	Visits averted	Total costs averted per person per annum
Hospital admissions	$8,585.16	0.23	$1,974.59
Emergency department visits	$698.22	1.17	$816.92
Physician visits	$36.30[c]	0.97	$35.21
Total			**$2,826.72**

Source: IHPA. (c) Medicare Benefits Schedule item number 23

Cost savings from reduced co-morbidities

According to Fowler (2008), common microvascular complications of diabetes are retinopathy, nephropathy and neuropathy. Macrovascular complications are coronary heart disease, myocardial infarction and stroke.

To estimate the impact of education on micro and macrovascular complications, the expected prevalence of each condition amongst people with diabetes was multiplied by the expected reduction (28% and 14% respectively) which occurs following education. Cases averted were then multiplied by the cost of treating each case (using earlier work undertaken by Deloitte Access Economics) to estimate health cost savings in 2014.

The health system costs per person for chronic kidney disease, amputations and myocardial infarction were calculated using the IHPA NHCDC. Chronic kidney disease was calculated as the weighted average of health system costs for AR-DRG codes L09A, L09B and L09C. Amputations were assigned the health system cost related to the AR-DRG code F13B. Myocardial Infarction was assigned a weighted average of health system costs related to the AR-DRG codes F62A and F62B.

The cost savings thus estimated from secondary complications were $749 per person.[9]

Table 3.8: Costs of secondary complications averted from CDEs, 2014

Co-morbidity	Prevalence amongst people with diabetes	Health system costs per person per annum	Expected cost per person	Reduction from glycaemic control	Expected savings
Retinopathy	10.7%	$5,090*	$544.63	28%	$154.67
Chronic kidney disease	6.0%	$5,912	$354.74	14%	$47.89
Amputations	4.1%	$10,361	$424.81	14%	$57.35

[9] As per the discussion around Table 3.7, these comorbidity costs are assumed to be a component of, rather than additional to, diabetes health system costs.

Coronary heart disease	10.0%	$26,898*	$2,689.76	14%	$363.12
Myocardial Infarction	10.0%	$8,228	$822.78	14%	$111.07
Stroke	5.0%	$2,202*	$110.08	14%	$14.86
Total					**$748.97**

* indicates total health system costs from previous Deloitte Access Economics, 2013a. Source: Deloitte Access Economics calculations, Balamurugan et al (2006), Baker IDI Heart and Diabetes Institute (2012), Medical Advisory Secretariat (2009), AIHW (2008), AIHW (2008a)

If all 1.37 million people with diabetes were to receive self-management education, health expenditure would be reduced by $3.6 billion (net of the intervention) compared to a situation where no one with diabetes received self-management education.

- By way of perspective, this would represent a 2.6% saving against national health expenditure ($140.2 billion in 2011-12)[10], and diabetes currently accounts for 6.2% of the total burden of disease in Australia (AHIW 2010b).
- The actual outcome would be somewhere between these two end points. The National Diabetes Service Scheme (Pekarsky 2010) estimates that the CDE workforce can potentially reach 57% of people with diabetes, but it is not known how many people actually receive effective education.

3.4.6 Productivity impacts

While Deloitte Access Economics literature search uncovered substantial evidence of the deleterious impact of diabetes on productivity (section 2.2.5), it was unable to find any studies that were able to connect the activities of diabetes educators with improved productivity outcomes.

3.5 Cost effectiveness model calculation

A situation whereby the entire Australian population with diabetes received CDE care during 2014 has been considered. As noted, just over half of this population is able to be served with the current CDE workforce (Pekarsky 2010).

Diabetes education is very cost effective. The World Health Organisation (WHO) considers an intervention to be “highly cost effective” if it saves one QALY for less than gross domestic product (GDP) per capita. In Australia, GDP per capita is around $67,000. Diabetes education only costs $650 per QALY (Section 3.2.1)

Diabetes education is estimated to save $2,827 per person with diabetes per annum in direct health system costs spent on diabetes itself as well as on avoided comorbid conditions.

The BCR with reference to direct health care expenditure and the average cost of educator care per person with diabetes is 16.3 to 1. When the burden of disease is accounted for, the indicated BCR becomes at 42 to 1.

[10] AIHW 2012a

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