ACCESS ECONOMICS Pty Limited

1 May 2008

The burden of venous thromboembolism in Australia

Report by Access Economics Pty Limited for

The Australia and New Zealand Working Party on the Management and Prevention of Venous Thromboembolism

CONTENTS

Acknowledgements ..... **iv**

Glossary of acronyms ..... **v**

Executive summary ..... **vi**

1. Background **9**

1.1 Structure of this report 9

1.2 Cross-cutting methodological issues 9

1.2.1 Incidence and prevalence approaches to cost measurement 9

1.2.2 Net present value and the discount rate 10

2. Incidence and epidemiology **12**

2.1 Definitions 12

2.2 Risk factors for VTE 13

2.3 Mortality, morbidity, prevention and treatment 14

2.3.1 Mortality and morbidity 14

2.3.2 Prevention 15

2.3.3 Diagnosis and management 17

2.4 Estimating incidence rates 17

2.4.1 Literature evidence 17

2.4.2 Incidence estimates from Western Australian (WA) data 19

2.4.3 Incidence estimates from AIHW hospital data 20

2.5 New cases in Australia in 2008 22

3. Health system expenditures **24**

3.1 Health system impacts of VTE overseas 24

3.2 Australian hospital inpatient costs 24

3.3 Other health system expenditures 26

4. Productivity and other financial costs **28**

4.1 Productivity losses from premature death 28

4.1.1 Number of deaths 28

4.1.2 Calculating the productivity losses for those who die 29

4.1.3 Search and hiring costs 30

4.2 Other productivity losses 32

4.2.1 Reduced workforce participation and absenteeism 32

4.2.2 Carers' lost productivity 32

4.3 Taxation revenue forgone 33

4.4 Deadweight losses (DWLs) 33

4.5 Other financial costs 35

4.6 Summary of productivity and other financial costs 36

5. Burden of disease 37
5.1 Disability weights and the burden of disease 37
5.1.1 Years of life lost due to disability (YLDs) 37
5.1.2 Years of life lost due to premature death (YLLs) 38
5.1.3 Total DALYs due to VTE 38
5.2 The value of the burden of disease 39
5.2.1 The value of a statistical life year (VSLY) 39
5.2.2 Gross value of the burden of disease 40
5.2.3 Net value of the burden of disease 40
6. Summary and comparisons 42
6.1 Summary of costs 42
6.2 Comparisons 44
6.2.1 Prevalence and mortality comparisons 44
6.2.2 Cost comparisons 45
References 47

FIGURES

Figure 1-1: Prevalence and incidence approaches to cost measurement 10
Figure 1-2: 10-year government bond yields (daily) 10
Figure 2-1: Formation of DVT and PE 12
Figure 2-2: Individual patient-related risk factors for VTE 14
Figure 2-3: Cases of DVT, PE and VTE, by age and gender, 2008 23
Figure 3-1: Health system expenditure on VTE, 2008 (% total) 27
Figure 4-1: DWL of raising taxation revenue 34
Figure 5-1: Loss of wellbeing due to VTE (DALYs), by age and gender, 2008 38
Figure 6-1: Financial costs of VTE, by type of cost (% total) 43
Figure 6-2: Financial costs of VTE, by bearer (% total) 44
Figure 6-3: Comparison of deaths by selected causes, 2003 45

TABLES

Table 2-1: Survival and mortality after VTE (%) 15
Table 2-2: Incidence of first-time VTE (PE and DVT) per 100,000 people, by age 18
Table 2-3: VTE recurrence and cumulative recurrence 19
Table 2-4: VTE & PE incidence, WA 1999-2001, by age & gender (per 100,000 & % total) 20
Table 2-5: ICD codes for VTE events 20

Table 2-6: AIHW VTE separations by age and gender, rate per 100,000 and % PE 21
Table 2-7: Cases of DVT, PE and VTE, by age and gender, 2008 23
Table 3-1: Hospital inpatient expenditure on VTE, 2004-05 ($) 25
Table 3-2: Health expenditure per case on VTE, by age and gender, 2008 ($) 27
Table 4-1: Remaining lifetime earnings, 2008 31
Table 4–2: Taxation requirement and DWL due to VTE, 2008 35
Table 4–3: Summary of other financial costs of VTE, 2008 36
Table 5–1: Estimated YLDs lost due to VTE, 2008 (DALYs) 37
Table 5-2: Estimated YLLs lost due to VTE, 2008 (DALYs) 38
Table 5–3: Net cost of lost wellbeing, $ million, 2008 41
Table 6–1: VTE, total costs by type of cost and bearer, Australia, 2008 ($ million) 42
Table 6–2: VTE, costs by type of cost and bearer, Australia, 2008 ($ per capita) 43
Table 6–3: VTE, prevalence comparisons with other conditions 44
Table 6–4: VTE, total cost comparisons with other conditions ($ billion, $/capita) 46

ACKNOWLEDGEMENTS

Access Economics would like to acknowledge with gratitude the inputs, prior research and comments from the Australia and New Zealand Working Party on the Management and Prevention of Venous Thromboembolism (VTE). Over the past 14 years, Working Party members have produced four editions of the VTE Best Practice Prevention Guidelines in a pocket book size and, this year, the Working Party has accompanied the booklets with both surgical and medical posters summarising the recommendations. These booklets have been well accepted by clinicians and have been used by the National Institute of Clinical Studies (NICS) as well as New South Wales Health and other jurisdictions. Working Party members now assist NICS and the National Health and Medical Research Council in their ongoing work in improving VTE prevention into the future. Taskforce members are listed below.

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GLOSSARY OF ACRONYMS

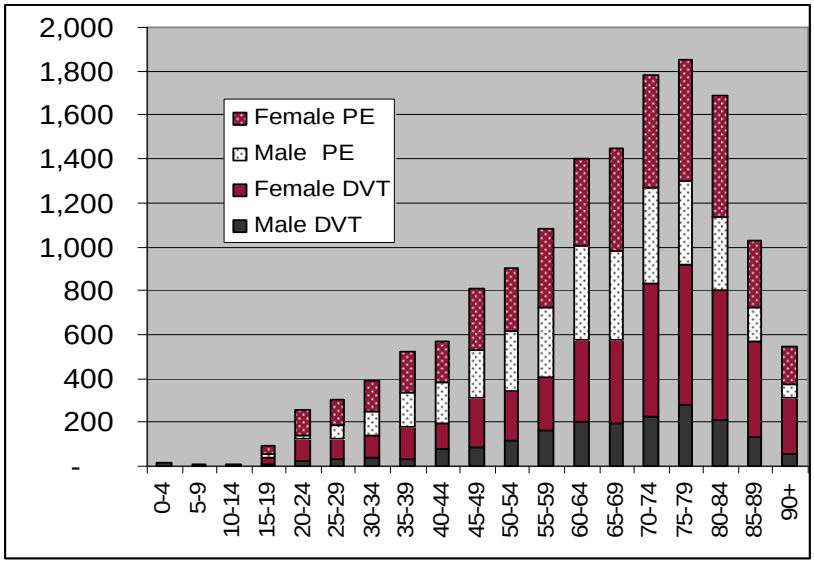
ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
AWE	Average Weekly Earnings
DALY	Disability Adjusted Life Year
DCIS	Disease Costs and Impacts Study (AIHW)
GDP	Gross Domestic Product
ICD(-10)	International Classification of Disease (tenth revision)
IPC	intermittent pneumatic compression
LMWH	low molecular weight heparin
NHPA	National Health Priority Area
NICS	National Institute of Clinical Studies
NPV	net present value
OR	odds ratio
PE	pulmonary embolism
PVD	peripheral vascular disease
QALY	Quality Adjusted Life Year
RR	relative risk
UK	United Kingdom
US	United States (of America)
VSL(Y)	Value of a Statistical Life (Year)
VTE	venous thromboembolism
WA	Western Australia
WTP	willingness to pay
YLD	Year of healthy life Lost due to Disability
YLL	Year of Life Lost due to premature mortality

EXECUTIVE SUMMARY

Incident cases of venous thromboembolism (VTE)

- In **2008 there were an estimated 14,716 cases of VTE** – 5,466 males and 9,250 females – in Australia, based on Australian Institute of Health and Welfare (AIHW) hospital separations data, triangulated against Western Australian (WA) and overseas data.
- This represents a rate of **70 separations for VTE per 100,000 Australians** for all ages – 52 per 100,000 for males and 87 per 100,000 for females.
  - The rate has increased by 2 per 100,000 since 2004-05 due to demographic ageing.
- Of these cases, **8,253 (56%) were estimated for pulmonary embolism (PE) and 6,462 for deep vein thrombosis (DVT)** and:
  - 6,335 (43.0%) were people of working age (15-64 years);
  - 30 (0.2%) were children aged up to 15 years;
  - 3,232 (22.0%) were aged 65-74; 3,544 (24.1%) were aged 75-84 and 1,575 (10.7%) were aged 85+.

CASES OF DVT, PE AND VTE, BY AGE AND GENDER, 2008



Source: Access Economics estimates based on AIHW hospital separations and ABS demographic data.

- The AIHW data thus suggest somewhat unusually that **females have a higher rate of VTE at each age** (except 0-4 years) than males, and Australia's **share of PE is relatively high** compared to other countries and compared to WA, suggesting there may be more prophylactic avoidance of PE that can be realised in the eastern states, South Australia and the Northern Territory.

Costs

In 2008, the **financial cost of VTE was $1.72 billion** (0.15% of GDP) (Table 6–1). Of this:

- 1.38 billion (80.0%) was productivity lost primarily due to premature death of Australians with VTE;

- 162 million (9.4%) was the efficiency loss (DWL) from taxation forgone and government health expenditures;
- 148 million (8.6%) was direct health system expenditure
- 22 million (1.3%) was bring-forward of funeral costs; and
- 12 million (0.7%) was the value of the informal care for people with VTE.

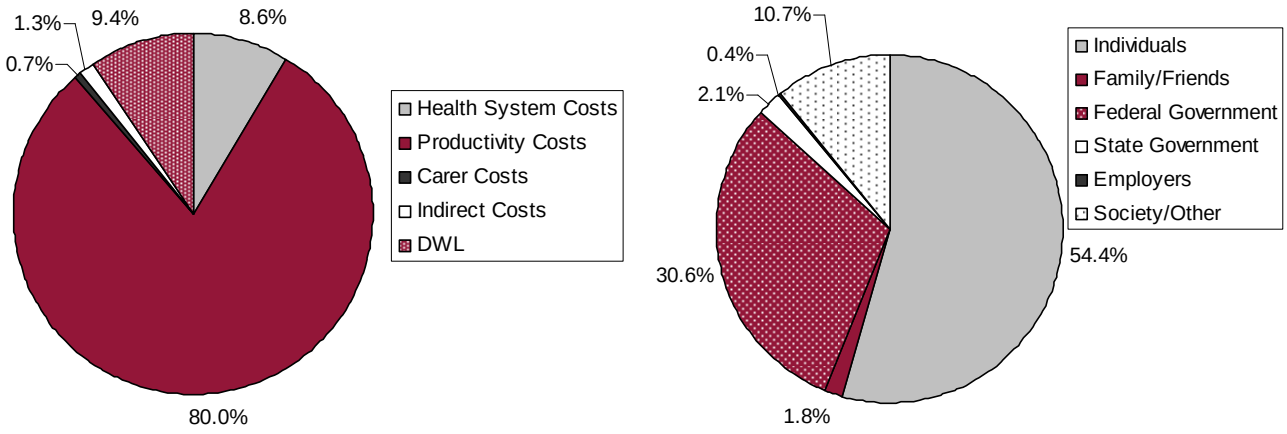
Additionally, **the value of the lost wellbeing (disability and premature death) was a further $19.99 billion ($11.97-27.31 billion)**. Sensitivity analysis surrounds this estimate due to the uncertainty involved in estimating the value of a statistical life year (VSLY) on which it is based.

VTE, TOTAL COSTS BY TYPE OF COST AND BEARER, AUSTRALIA, 2008 ($ MILLION)

Cost item	Indi-viduals	Family/ Friends	Federal Government	State Government	Employers	Society/ Other	Total
Burden of disease	**19,986**	**0**	**0**	**0**	**0**	**0**	**19,986**
Health system	25	0	63	37	0	22	148
Productivity	911	0	460	0	6	0	1,377
Informal carers	0	8	4	0	0	0	12
Other indirect	0	22	0	0	0	0	22
DWLs	0	0	0	0	0	162	162
Total financial costs	**936**	**31**	**527**	**37**	**6**	**184**	**1,721**
Total	**20,923**	**31**	**527**	**37**	**6**	**184**	**21,708**

In per capita terms, this amounts to a **financial cost of $116,970 per person with VTE** in 2008. Including the value of lost wellbeing, the cost approaches $1.5 million per person.

FINANCIAL COSTS OF VTE (% TOTAL), BY TYPE OF COST (LEFT) AND BEARER (RIGHT)



Individuals with VTE bear 54% of the financial costs, and their families and friends bear a further 2%. Federal government bears around one third (31%) of the financial costs (mainly through taxation revenues forgone). State governments bear 2% of the costs, while employers bear less than 1% and the rest of society bears the remaining 11%. If the burden of disease (lost wellbeing) is included, individuals bear 96% of the costs and Federal government bears 2%, with other entities in society together sharing the remaining 2%.

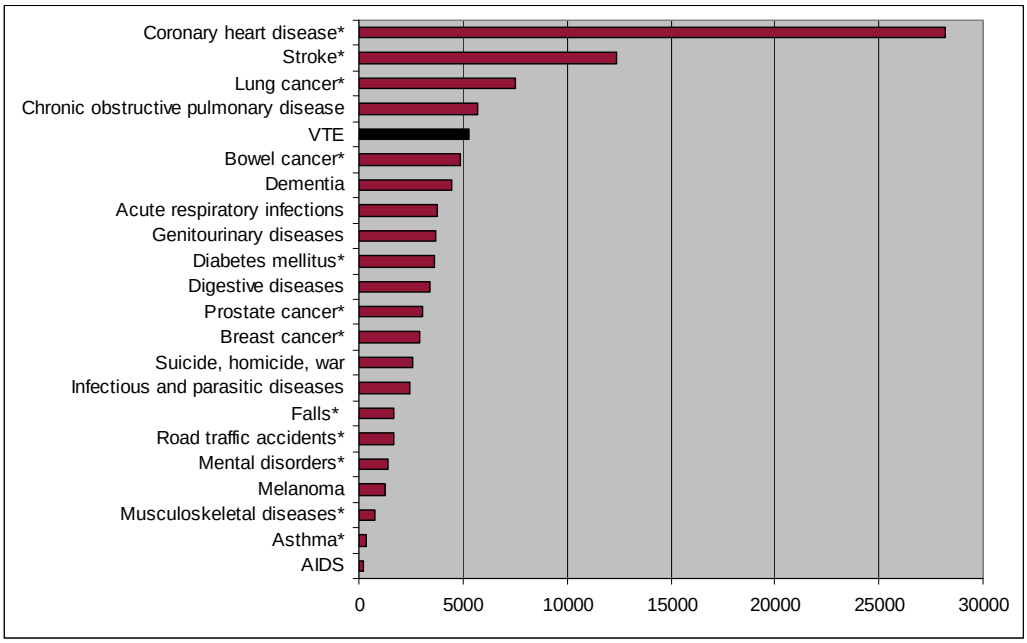
Conclusions

The very high cost of VTE arises due to its substantial mortality burden. Based on epidemiological evidence, VTE was estimated to be responsible for **5,285 deaths** in Australia in 2008. While this is higher than previously estimated, it is conservative compared to recent per capita estimates 50% higher in the UK and 4 times higher in the US.

VTE is part of cardiovascular disease, a national health priority, albeit a relatively under-recognised component, unlike coronary heart disease, stroke or heart failure.

- VTE is more common than the most common types of cancer and nearly as common as multiple sclerosis, stroke and road traffic accidents.
- In terms of mortality, VTE causes more deaths than all transport accidents and falls combined. It is a bigger killer than bowel or breast cancer and over 40 times more deadly than AIDS. VTE deaths represent some 7% of all deaths in Australian hospitals (compared to 0.2% of total hospital separations).

COMPARISON OF DEATHS BY SELECTED CAUSES, 2003



Source: Begg et al (2007) except for VTE (this report) for 2008. *=NHPAs.

Compared to other conditions costed by Access Economics, VTE is second only to muscular dystrophy on a financial cost per case basis. If the heavy dollar value of the burden of disease cost from premature mortality is included, VTE ranks most costly overall.

Access Economics
1 May 2008

1. BACKGROUND

Access Economics was commissioned by the VTE Taskforce in February 2008 to estimate the incidence, financial impact and burden of disease from VTE in Australia for the year 2008, to raise awareness of the impact of VTE.

1.1 STRUCTURE OF THIS REPORT

The rest of this chapter addresses cross-cutting methodological issues.

- Chapter 2 provides background information on the epidemiology (definitions, risk factors, mortality, morbidity), management and incidence of VTE in Australia by age and gender, categorised as Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE).
- Chapter 3 estimates the direct health system costs of VTE in Australia, categorised as hospital inpatient costs and other costs.
- Chapter 4 estimates lost productivity due to VTE in Australia and associated reductions in taxation revenue that, in turn, lead to efficiency losses.
- Chapter 5 estimates the burden of disease, measured in terms of disability adjusted life years (DALYs), of VTE in Australia, disaggregated by the mortality component (years of life lost due to premature death – YLL) and the morbidity component (years of life lost due to disability – YLD), converted into a reasonable monetary equivalent.
- Chapter 6 provides a comparison of VTE costs relative to other diseases considered priorities for the Government.

1.2 CROSS-CUTTING METHODOLOGICAL ISSUES

1.2.1 INCIDENCE AND PREVALENCE APPROACHES TO COST MEASUREMENT

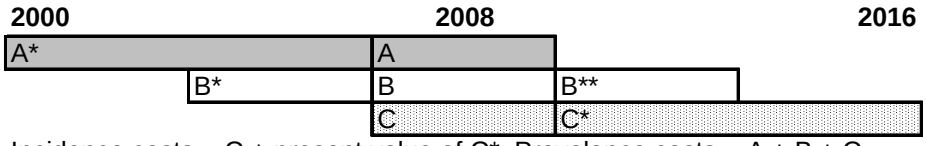
The costing methodology is based on an incidence approach to cost measurement, since VTEs are acute events and the data sources lend themselves to utilisation of such an approach. Incidence approaches measure the number of new cases of a given condition (in this case VTE) in a base period (in this case calendar year 2008) and the costs associated with treating them, as well as other financial and non-financial costs (eg, productivity losses, loss of quality of life) over the person's lifetime, due to the condition. The total costs represent the net present value (NPV) of current and future costs incurred due to new cases in the year in question.

In contrast, prevalence approaches measure the number of people with a given condition in a base period and the costs associated with treating them as well as other financial and non-financial costs (productivity losses, loss of quality of life) in that year, due to the condition. Prevalence approaches can be more suitable for chronic conditions and for a snapshot of total economy-wide costs that will be borne in a given year.

Figure 1-1 depicts the difference between an incidence approach, estimating the present value of the lifetime costs of new cases of VTE in 2008 (area C plus the present value of C*) and a prevalence approach (areas A+B+C). Consider person A, who experienced VTE in 2000 and continued to experience its impacts until death in 2008. This person would be included in a prevalence approach (but not in an incidence approach), although only the costs incurred in 2008 would be included (ie, A but not A*, where A includes the present value of premature mortality costs if the death was premature). Person B developed VTE in

2004 and experiences its impacts through to 2011 (with costs of B+B*+B**); she also would be counted (but only costs of B) using a prevalence approach, but not using an incidence approach. Person C (shaded in grey dots) is newly diagnosed with VTE in 2008 and his costs in 2008 (C) would be included in a prevalence approach but not future costs (C*). In an incidence approach, only person C is included, with total costs being C plus the present value of C*.

FIGURE 1-1: PREVALENCE AND INCIDENCE APPROACHES TO COST MEASUREMENT



Incidence costs = C + present value of C*. Prevalence costs = A + B + C

1.2.2 NET PRESENT VALUE AND THE DISCOUNT RATE

Where future costs are ascribed to the year 2008 throughout the report the formula for calculating the NPV of those cost streams is provided below.

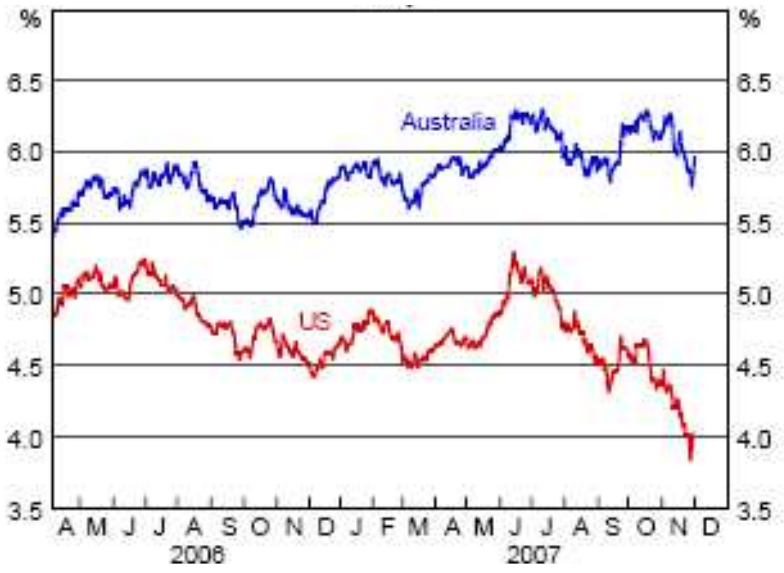
$$NPV = \Sigma C_i/(1+r)^{\wedge i} \text{ where } i=0,1,2\ldots n \qquad \text{where}$$

$$C_i = \text{cost in year } i,\ n = \text{years that costs are incurred and } r = \text{discount rate.}$$

Choosing an appropriate discount rate is a subject of some debate, as it varies depending on what type of future income or cost stream is being considered. The discount rate needs to appropriately take into account risks, inflation and positive time preference.

- **Risk and positive time preference**: The minimum option that one can adopt in discounting future expected healthy life streams and other costs is to set future values on the basis of a risk free assessment about the future ie, assume the future flows are similar to the certain flows attaching to a long-term Government bond. From recent history, the long-term nominal bond rate has averaged 5.8% per annum (Figure 1-2). If there were no positive time preference, people would be indifferent between having something now or a long way off in the future, which applies to all goods and services.

FIGURE 1-2: 10-YEAR GOVERNMENT BOND YIELDS (DAILY)



Source: Bloomberg e-statistics, Reserve Bank of Australia.

- **Inflation**: The Reserve Bank has a clear mandate to pursue a monetary policy that delivers 2% to 3% inflation over the course of the economic cycle. This is a realistic longer run goal and an inflation rate in this range (2.8%) is used in arriving at the discount rate for healthy life below. It is important to allow for inflation in order to derive a real rather than nominal rate.

In discounting healthy life and other costs in this report, a real discount rate for Australia is thus used of (5.8 – 2.8 =) 3%.

2. INCIDENCE AND EPIDEMIOLOGY

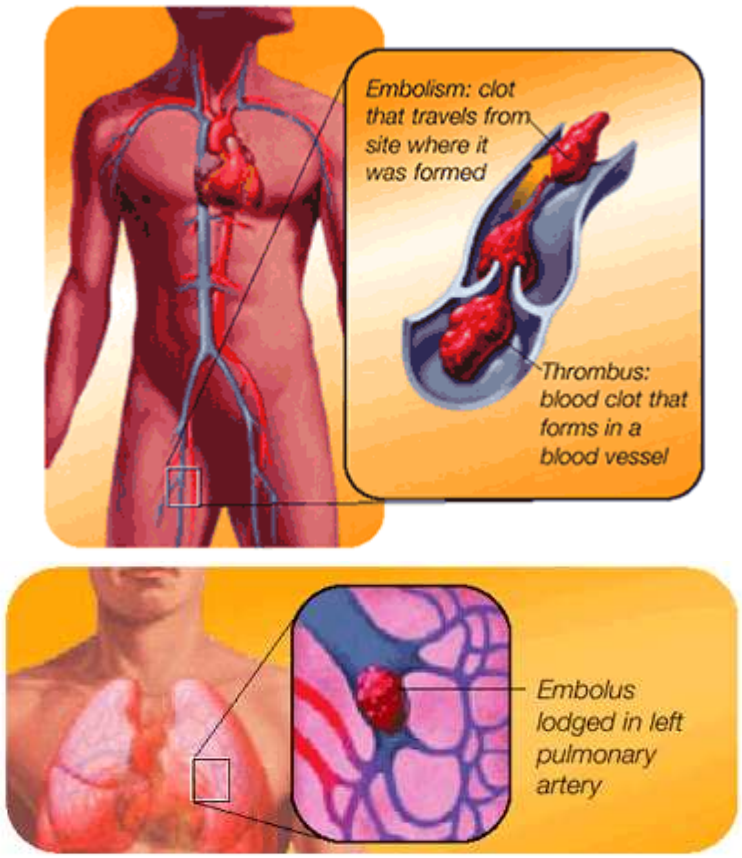
This chapter defines VTE events (Section 2.1) and, drawing on the literature and data evidence, Section 2.2 briefly presents risk factors for VTE – including age, gender, ethnicity, time of year, fracture, major general surgery, chemotherapy, malignancy, previous VTE, obesity, underlying cardiovascular disease and others. Section 2.3 summarises mortality outcomes and associated morbidity (disability), comorbidity and the impacts of VTE, as well as summarising diagnosis, prevention and treatment strategies, and overall survival (up to eight years). Section 2.4 identifies age and gender specific first time incidence and recurrence rates to be used in the analysis, from literature and data investigation including hospital data from the AIHW. Overall incidence rates are then applied to ABS population data for 2008 to estimate cases of VTE in 2008 (Section 2.5).

2.1 DEFINITIONS

This report focuses on venous thromboembolism (VTE) comprising deep vein thrombosis (DVT) and pulmonary embolism (PE), defined as follows.

- **DVT**: A blood clot (thrombus) that forms in the 'deep veins' in the legs, thighs or pelvis.
- **PE**: A blood clot that breaks off from the deep veins and travels round the circulation to block the pulmonary arteries (arteries in the lung). Most deaths arising from DVT are caused by PE.

FIGURE 2-1: FORMATION OF DVT AND PE



Source: http://www.patienthealthinternational.com/ncmprintchapter.aspx?type=article&param=509955

2.2 RISK FACTORS FOR VTE

A number of factors have been identified as contributing to VTE risk. Hospitalisation is a key risk. White (2003) summarises risk factors as :

- age – risk increases exponentially with age;
- sex – risk may be higher for men;
- ethnicity – higher among Caucasians and African Americans than among Hispanic persons and Asian-Pacific Islanders;
- time of year – higher incidence in winter than summer[1]; and
- importantly, comorbid conditions (especially malignant conditions) and associated surgical and medical treatments.

Anderson (2003) summarised strong, moderate and weak risk factors based on odds ratios (ORs) as follows:

- **strong risk factors** (OR>10): fracture (hip or leg), hip or knee replacement, major general surgery, major trauma and spinal cord injury;
- **moderate risk factors** (OR 2-9): arthroscopic knee surgery, central venous lines, chemotherapy, congestive heart or respiratory failure, hormone replacement therapy, malignancy, oral contraceptive therapy, paralytic stroke, pregnancy/post-partum, previous VTE and thrombophilia; and
- **weak risk factors** (OR 1-2): bed rest of more than three days, immobility due to sitting (eg, prolonged care or air travel), increasing age, laparoscopic surgery, obesity, pregnancy/ante-partum and varicose veins.

Other studies reviewed generally aligned with Anderson's findings, with some examples below.

- Oger et al (1997) found five factors associated with DVT (ORs in brackets) – age over 65 years (1.75); prior history of VTE (1.68); surgery or leg trauma within the past three months (1.69); malignancy (5.59); and varicose veins (2.56).
- In a meta-analysis of 12 studies (Ageno et al, 2006), the relative risk (RR) of VTE was 2.1 among postmenopausal hormone replacement therapy users and was highest (3.5) during the first year of use.
- Heit et al (2000) reported independent risk factors for VTE as surgery (OR, 21.7; 95% CI, 9.4-49.9), trauma (OR, 12.7; 95% CI, 4.1-39.7), hospital or nursing home confinement (OR, 8.0; 95% CI, 4.5-14.2), malignant neoplasm with (OR, 6.5; 95% CI, 2.1-20.2) or without (OR, 4.1; 95% CI, 1.9-8.5) chemotherapy, central venous catheter or pacemaker (OR, 5.6; 95% CI, 1.6-19.6), superficial vein thrombosis (OR, 4.3; 95% CI, 1.8-10.6), and neurological disease with extremity paresis (OR, 3.0; 95% CI, 1.3-7.4). Although this Minnesota study was not large (n=1,250) it was population-based, nested and case-controlled, comprising patients with a first lifetime VTE diagnosed over a 15-year period from 1976 to 1990. Each of the two groups (625 with VTE and 625 without) were matched on age, sex, calendar year, and medical record number.

When risk factors were combined, risk increased commensurately. For example, Anderson (2003) found the frequency of VTE increased two to three-fold in patients undergoing surgery for malignant disease compared with those undergoing surgery for non-malignant conditions.

[1] In northern hemisphere studies.

Chemotherapy further increased risk. Women with breast cancer having chemotherapy in association with surgery had three times the risk of VTE compared with women who undergo surgery alone.

The National Collaborating Centre for Acute Care summarised risk factors for VTE as shown in Figure 2-2.

FIGURE 2-2: INDIVIDUAL PATIENT-RELATED RISK FACTORS FOR VTE

- Active cancer or cancer treatment
- Active heart or respiratory failure
- Acute medical illness
- Age over 60 years
- Antiphospholipid syndrome
- Behcet's disease
- Central venous catheter in situ
- Continuous travel of more than 3hours approximately 4weeks before or after surgery
- Immobility (for example, paralysis or limb in plaster)
- Inflammatory bowel disease (for example Crohn's disease or ulcerative colitis)
- Myeloproliferative diseases
- Nephrotic syndrome
- Obesity (body mass index $\geq 30 kg/m^2$)
- Paraproteinaemia
- Paroxysmal nocturnal haemoglobinuria
- Personal or family history of VTE
- Pregnancy or puerperium
- Recent myocardial infarction or stroke
- Severe infection
- Use of oral contraceptives or hormonal replacement therapy
- Varicose veins with associated phlebitis
- Inherited Thrombophilias for example:
  - High levels of coagulation factors (for example, Factor VIII)
  - Hyperhomocysteinaemia
  - Low activated protein C resistance (for example, Factor V Leiden)
  - Protein C, S and antithrombin deficiencies
  - Prothrombin 2021A gene mutation

2.3 MORTALITY, MORBIDITY, PREVENTION AND TREATMENT

2.3.1 MORTALITY AND MORBIDITY

Death occurs in approximately 6% of DVT cases and 12% of PE cases within one month of diagnosis (White, 2003). Early mortality after VTE is strongly associated with presentation as PE, advanced age, cancer and underlying cardiovascular disease. The impact of VTE is highlighted by the fact that some 10% of hospital deaths may be attributed to PE (MacDougall et al, 2006).

For people aged 45 years or older, Cushman et al (2004) found a 28-day case-fatality rate of 11% after a first VTE and 25% for cancer-associated thrombosis. Cancer was the only factor independently associated with 28-day fatality (RR = 5.2; 95% CI: 1.4-19.9).

Ageno et al (2006) estimated survival after one year following VTE as 63.6%, after five years as 53.5% and after eight years as 47.5%.

These data generally concord and enable survival and mortality rates to be estimated as in Table 2-1.

TABLE 2-1: SURVIVAL AND MORTALITY AFTER VTE (%)

	Survival			Mortality		
Time from index	DVT	PE	VTE	DVT	PE	VTE
1 year	85.4%	47.7%	63.6%	14.6%	52.3%	36.4%
2 years	82.2%	45.6%	61.1%	3.2%	2.1%	2.5%
3 years	79.0%	43.6%	58.6%	3.2%	2.1%	2.5%
4 years	75.8%	41.5%	56.0%	3.2%	2.1%	2.5%
5 years	72.6%	39.4%	53.5%	3.2%	2.1%	2.5%
6 years	70.1%	37.8%	51.5%	2.5%	1.6%	2.0%
7 years	67.7%	36.1%	49.5%	2.5%	1.6%	2.0%
8 years	65.2%	34.5%	47.5%	2.5%	1.6%	2.0%

Source: Access Economics based primarily on Ageno et al (2006) and, in turn, on Heit et al (1999).

Morbidity from VTE for survivors can be substantial. Complications after DVT can include persistent oedema (swelling), pain, purpura (bleeding into the skin), increased skin pigmentation, eczematoid (eczema-like) dermatitis, pruritus (itchiness), ulceration, and cellulitis (bacterial infection just below the skin). All of these complications result from the impaired return of blood through the veins of the lower leg to the heart and are known as *post-phlebitic syndrome* or *post-thrombotic syndrome.* Most complications occur weeks to months after the initial blood clot although ulceration of the skin can occur months to years after the blood clot. Patients diagnosed with acute recurrent venous thrombosis may be treated with anticoagulants for life and may suffer considerable mental anguish. Hirsch and Hoak (1996:2212) summarise:

> *DVT can be a chronic disease. Patients who survive the initial episode of DVT are prone to chronic swelling of the leg and pain because the valves in the veins can be damaged by the thrombotic process, leading to venous hypertension. In some instances skin ulceration and impaired mobility prevent patients from leading normal, active lives. In addition, patients with DVT are prone to recurrent episodes. In those instances in which DVT and PE develop as complications of a surgical or medical illness, in addition to the mortality risk, hospitalisation is prolonged and healthcare costs are increased.*

2.3.2 PREVENTION

Prevention of VTE is commonly referred to as 'prophylaxis', which in a hospital setting involves use of one of more pharmacologic or mechanical modalities. The main methods are low-dose heparin, low molecular weight heparin (LMWH), elastic stockings, intermittent pneumatic compression (IPC) and warfarin. Heparin and warfarin are anticoagulant pharmaceutical therapies. IPC comprises the use of inflatable garments wrapped around the legs, inflated by a pneumatic pump. The pump provides intermittent cycles of compressed air, which alternately inflates and deflates the chamber garments, enhancing venous return.

The United Kingdom (UK) developed guidelines (National Collaborating Centre for Acute Care, 2007) for implementation based on extensive literature review of cost effective prophylactic methods to reduce VTE risk in surgical inpatients, recommending:

- patients are assessed to identify risk factors for developing VTE;

- healthcare professionals give patients verbal and written information before surgery about the risk of VTE, signs and symptoms of DVT and PE and the effectiveness of prophylaxis;
- inpatients having surgery are offered thigh-length[2] graduated compression/anti-embolism stockings from the time of admission to hospital unless contraindicated (eg, in patients with established peripheral arterial disease or diabetic neuropathy);
- patients should be shown how to wear the stockings correctly by healthcare professionals trained in their use, and use should be monitored and assistance provided if not being worn correctly;
- IPC or foot impulse devices may be used as alternatives or in addition to graduated compression/anti-embolism stockings while in hospital;
- in addition to mechanical prophylaxis, patients at increased risk of VTE because they have individual risk factors and patients having orthopaedic surgery should be offer LMWH, while Fondaparinux may be used as an alternative to LMWH as indicated;
- LMWH or Fondaparinux should be continued for four weeks after hip fracture surgery;
- regional anaesthesia (which reduces the risk of VTE compared to general anaesthesia) should be considered for individual patients in addition to any other planned method of thromboprophylaxis;
- healthcare professionals should encourage patients to mobilise as soon as possible after surgery and inform patients that the immobility associated with continuous travel of more than three hours in the four weeks before or after surgery may increase the risk of VTE;
- hydration and leg exercises/physiotherapy/massage are also commonly used as management strategies although there is less evidence available regarding the beneficial impacts of these practices; and
- healthcare professionals should advise patients to consider stopping combined oral contraceptive use four weeks before elective surgery.

The National Institute of Clinical Studies (NICS) in Australia has identified the prevention of VTE in hospitals as a priority in improving patient safety. NICS is committed to training and supporting participating hospital teams to ensure that effective prevention strategies are embedded into every day clinical practice in participating health services. The program aims to:

- reduce the number of DVT and PE cases in hospitalised patients;
- improve systematic assessment and documentation of VTE risk status (eg, in patient notes);
- improve the use and documentation of appropriate prophylaxis in patients at risk of VTE;
- increase awareness of VTE prevention measures and strategies across disciplines;
- increase the number of hospitals with VTE prophylaxis policies in place; and
- increase the use of evidence based guidelines and recommendations to support best practice VTE prophylaxis in hospitalised patients.

[2] The guidelines elaborated that knee-length stockings may be used if thigh-length stockings are inappropriate for a particular patient eg, for reasons of compliance. The stocking compression profile should be equivalent to the Sigel profile, and approximately 18 mmHg at the ankle, 14 mmHg at the mid-calf and 8 mmHg at the upper thigh.

2.3.3 DIAGNOSIS AND MANAGEMENT

Clinical diagnosis of DVT can be difficult because many potentially dangerous thrombi do not totally obstruct the veins nor produce inflammation of the vessel wall and therefore produce minimal clinical manifestations (swelling, pain, discolouration, the palpable cord of a thrombosed vein, oedema, warmth and superficial venous dilation). Also, none of the signs and symptoms is unique to DVT. Other conditions to differentially diagnose include muscle strain or tear, superficial thrombophlebitis, lymphangitis, lymph oedema, cellulitis and post-phlebitic syndrome.

The standard diagnostic test for DVT of the lower extremities is duplex ultrasound. There are other diagnostic tests including plethysmography and magnetic resonance venography.

The standard diagnostic test for PE is computed tomography pulmonary angiography. Diagnosis of PE also includes clinical signs and symptoms (shortness of breath, localised chest pain aggravated by inspiration and hemoptysis, hypotension, syncope, and peripheral circulatory failure), consideration of risk factors (including presence of DVT) – potentially using chest radiograph, arterial blood gas measurements and electrocardiogram. Lung imaging may also include a ventilation perfusion lung scan (Ramsay and Leeper, 2004).

Once diagnosed, treatment aims to prevent local extension of the thrombus and prevent it from embolising. This involves anticoagulant therapy with the need to manage the associated elevated risk of major bleeding. Venous interruption procedures may be indicated for VTE when anticoagulation is ineffective or unsafe. This may involve the insertion of intracaval devices such as filters or percutaneous balloons that maintain venous blood flow. Surgical removal (thrombectomy, pulmonary embolectomy) may be indicated for acute VTE; although it may be lifesaving, it is complicated by a high probability of acute recurrence and few hospitals have the facilities or personnel for this complex surgery. Diagnosis and treatment are complicated when the VTE arises in pregnant women.

Bleeding is by far the most common complication of anticoagulant therapy. Other complications include thrombocytopenia (which, paradoxically, can increase the risk for future thrombosis) and skin necrosis (Hirsch and Hoak, 1996).

2.4 ESTIMATING INCIDENCE RATES

2.4.1 LITERATURE EVIDENCE

Australian and international epidemiological literature regarding the occurrence and reoccurrence of VTE was used to develop a picture of VTE incidence patterns by age and gender.

- White (2003) found first-time incidence of VTE of around 100 people per 100,000 each year in the United States (US), **rising exponentially from less than 5 cases per 100,000 persons aged under 15 years old to around 500 cases (0.5%) per 100,000 persons at age 80 years**. Approximately one third of patients with symptomatic VTE manifest PE, while two thirds manifest DVT alone (ie, a ratio or **1:2 PE:DVT**).
- Ageno et al (2006) found the cumulative probability of having experienced a first thromboembolic event was 0.5% at age 50 years, 2.0% at age 60 years, 8.2% at age 75 years, and 10.7% at age 80 years.
- For people aged 45 years or older, Cushman et al (2004) found first-time VTE incidence in a two-site US study (n=21,680) of 192 per 100,000 person-years, with higher rates for men than women and increasing with age in both sexes.

- Silverstein (1998) found overall average age- and sex-adjusted annual incidence of VTE, in a Minnesota study over 1966 through 1990 (n=2218), of 117 per 100,000. This study found DVT incidence per 100,000 was lower (48) than PE (69) ie, a ratio or **1.44:1 PE:DVT**, with higher age-adjusted rates among males than females (130 versus 110 per 100,000 respectively). VTE incidence rose markedly with increasing age for both sexes, with PE accounting for most of the increase.
- A large 30-year US study (Heit et al, 2005b) found overall incidence of VTE (ie, including recurrent events) of 199.7 per 100,000 person-years, with the incidence of DVT three times higher than that of PE (151.8 versus 47.9 per 100 000) ie, a ratio of **1:3 PE:DVT**.

The population incidence rates derived from this information are presented in Table 2-2.

TABLE 2-2: INCIDENCE OF FIRST-TIME VTE (PE AND DVT) PER 100,000 PEOPLE, BY AGE

Age group	VTE	PE	DVT
35-39	29	10	19
40-44	40	14	26
45-49	55	19	36
50-54	75	26	49
55-59	104	36	68
60-64	143	49	93
65-69	196	68	129
70-74	270	93	177
75-79	372	129	244
80-84	513	177	336
85+	706	244	463

Source: Access Economics based on White (2003), Silverstein (1998), Cushman et al (2004) and Anderson (2003). VTE function estimated as VTE =20.909e0.3275x (x=age-groups 1-11).

The literature also provided information about recurrence rates.

- White (2003) found that, despite anticoagulant therapy, VTE recurs frequently in the first few months after the initial event, with a recurrence rate of around 7% at six months.
- For people aged 45 years or older, Cushman et al (2004) found a recurrence rate two years after a first VTE of 7.7% per year (95% CI: 4.5% to 10.9%).
- Ageno et al (2006) estimated the **cumulative recurrence after one year as 12.9%, after two years as 16.6%, after five years as 22.8% and after ten years as 30.4%**.

These data generally concord and enable recurrence rates to be estimated as in Table 2-3.

TABLE 2-3: VTE RECURRENCE AND CUMULATIVE RECURRENCE

Time from index	Recurrence	Cumulative recurrence
1 year	12.9%	12.9%
2 years	3.7%	16.6%
3 years	2.1%	18.7%
4 years	2.1%	20.7%
5 years	2.1%	22.8%
6 years	1.5%	24.3%
7 years	1.5%	25.8%
8 years	1.5%	27.4%
9 years	1.5%	28.9%
10 years	1.5%	30.4%

Source: Access Economics based primarily on Ageno et al (2006).

2.4.2 INCIDENCE ESTIMATES FROM WESTERN AUSTRALIAN (WA) DATA

NICS (2005a) estimate from WA hospital data over 1999 to 2001 that VTE occurs in around **100 in 100,000** persons – predicting around 20,000 episodes per annum in acute hospitals in Australia of which **45% would be cases of PE**. Medical and surgical VTE each accounted for approximately 40% of total VTE, with primary VTE accounting for the remaining cases. Over half of secondary cases occurred as readmissions within three months of a medical or surgical admission and nearly 60% of these were for PE, whereas the 63% of cases of VTE occurring as a complication of VTE were for DVT.

> *The prevalence of VTE in all hospital admissions is 2 to 3 per 1000 but varies widely by principal diagnosis. The highest prevalence is found in cancer (9 per 1000 admissions) followed by musculoskeletal conditions and injuries (6 and 5 per 1000), cardiovascular disease (5 per 1000) and respiratory disease (4 per 1000) compared with less than 2 per 1000 in admissions for mental disorders, disorders of sense organs, digestive disorders, the genitourinary system and pregnancy and related conditions. Even greater heterogeneity is present within the principal disease groups.* (NICS, 2005a:5)

A summary of the WA data is presented in Table 2-4, showing an overall age standardised rate (for ages 15 and older) for all VTE of 117 per 100,000 for males and 137 per 100,000 for females, and for PE of 51 per 100,000 for males and 62 per 100,000 for females. The remainder are DVT events. For all VTE, 38% of events are designated as 'surgical', 41% as 'medical' and 21% as primary, while for PE the respective shares are 36%, 39% and 25%.

TABLE 2-4: VTE & PE INCIDENCE, WA 1999-2001, BY AGE & GENDER (PER 100,000 & % TOTAL)

Age	Rate per 100,000 population		Share of total by type		
	Male	Female	% Surgical	% Medical	% Primary
VTE					
15-54	56	72	36	34	30
55-64	149	159	39	39	22
65-74	271	319	39	42	19
75+	357	388	38	49	13
All ages	113	141	38	41	21
Age standardised	117	137			
Of which PE					
15-54	25	32	33	33	35
55-64	66	72	37	37	26
65-74	122	154	39	39	23
75+	149	169	39	47	14
All ages	50	63	36	39	25
Age standardised	51	62			

Source: NICS (2005a,b).

2.4.3 INCIDENCE ESTIMATES FROM AIHW HOSPITAL DATA

The AIHW define VTE according to the codes shown in Table 2-5 from the International Classification of Disease, tenth revision (ICD-10).

TABLE 2-5: ICD CODES FOR VTE EVENTS

ICD Code	Description
I26	Pulmonary embolism
I26.0	Pulmonary embolism with mention of acute coronary pulmonale
I26.8	Iatrogenic pulmonary embolism
I26.9	Pulmonary embolism without mention of acute coronary pulmonale
I63.1	Cerebral infarction due to embolism of pre-cerebral arteries
I63.4	Cerebral infarction due to embolism of cerebral arteries
I74	Arterial embolism and thrombosis
I82	Other venous embolism and thrombosis
I82.2	Embolism and thrombosis of vena cava
I82.3	Embolism and thrombosis of renal vein
I82.8	Embolism and thrombosis of other specified veins
I82.9	Embolism and thrombosis of unspecified vein

It was not immediately apparent to Access Economics why the AIHW include codes from I63 and I74 in the definition since these are arterial rather than venous[3]. These codes account for 3,558 separations or 26% of total 2004-05 VTE separations as defined by AIHW. However, there are also some ICD categories excluded from the AIHW definition, notably I80 *Phlebitis and thrombophlebitis* (7,041 separations) and I97 *Post procedural disorders of circulatory system, not elsewhere classified* (2,545 separations), which may include cases of VTE or its complications excluded from the AIHW coding definition, as well as some more minor

[3] It is also not clear why I63.1 and I63.4 are included but I63.3 *Cerebral infarction due to thrombosis of cerebral arteries* is excluded (ie, the embolism sub-codes are included but the thrombosis codes are not).

categories, such as I87 *Other disorders of the veins* (608 separations) and I98 *Other unspecified disorders of the circulatory system* (144 separations). Use of hospital separation data may also underestimate overall population incidence of VTE as some cases may not enter hospitals. There may be an issue in non-hospital (eg, aged care) populations of no formal diagnosis of VTE due to co-morbid medical conditions. As such, Access Economics has on balance accepted the AIHW official coding definition as potentially conservative overall.

Based on this VTE definition, estimates of incidence from the AIHW hospital morbidity data base (www.aihw.gov.au/cognos/cgi-bin/ppdscgi?DC=Q&E=/ahs/principaldiagnosis9899-0405) are provided in Table 2-6.

- In **2004-05 there were a total of 13,772 separations for VTE** – 5,075 for males and 8,697 for females.
- This represents a rate of **67.7 separations for VTE per 100,000 Australians** for all ages (ie, unlike WA, including children aged 0 to 15 where rates are very low) – 50.2 per 100,000 for males and 85.0 per 100,000 for females.
  - The AIHW rates for Australia are lower than the WA rates for people younger than 75 years, but higher for people over 75 years; differences may also reflect different years to some extent, in that better practices may have been adopted recently.
- Of these separations, **56% were for PE** (ie, the I26 codes), although the PE share was higher for males (65%) than for females (51%).
- The AIHW data thus suggest that **females have a higher rate of VTE at each age** (except 0-4 years) than males, and our **share of PE is relatively high** compared to other countries and compared to WA, suggesting there may be more prophylactic avoidance of PE that can be realised in the eastern states, South Australia and the Northern Territory.

TABLE 2-6: AIHW VTE SEPARATIONS BY AGE AND GENDER, RATE PER 100,000 AND % PE

Age group	Separations			Rate per 100,000			%PE		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0-4	12	5	17	1.9	0.8	1.3	0%	20%	6%
5-9	3	3	6	0.4	0.5	0.5	0%	0%	0%
10-14	2	5	7	0.3	0.7	0.5	0%	20%	14%
15-19	28	65	93	3.9	9.5	6.6	61%	58%	59%
20-24	42	206	248	5.7	29.2	17.2	50%	53%	53%
25-29	85	195	280	12.3	28.9	20.5	65%	55%	58%
30-34	153	262	415	20.4	34.6	27.5	74%	57%	63%
35-39	174	319	493	23.8	43.1	33.5	82%	56%	65%
40-44	277	310	587	36.2	40.2	38.2	71%	61%	66%
45-49	289	479	768	39.9	65.2	52.6	72%	56%	62%
50-54	378	489	867	57.0	72.8	64.9	71%	56%	63%
55-59	465	577	1,042	74.4	93.1	83.7	66%	60%	63%
60-64	531	639	1,170	111.4	136.6	123.9	68%	52%	59%
65-69	552	783	1,335	144.5	201.4	173.2	67%	56%	60%
70-74	616	1,055	1,671	205.6	323.4	267.0	66%	46%	53%
75-79	651	1,207	1,858	259.4	400.7	336.5	57%	47%	50%
80-84	494	1,093	1,587	304.3	459.2	396.4	61%	48%	52%
85+	323	1,005	1,328	319.0	473.1	423.3	54%	41%	44%

Total	**5,075**	**8,697**	**13,772**	**50.2**	**85.0**	**67.7**	**65%**	**51%**	**56%**

The AIHW hospital morbidity data were used in this report as they were considered most representative of VTE in Australia overall, since this was the only comprehensive dataset covering all jurisdictions and age groups available. These rates were applied to population data to estimate cases in 2008 (next section), noting they may be conservative relative to the WA data. A final point to note is that in 2008, the 2004-05 data were the most recent available.

2.5 NEW CASES IN AUSTRALIA IN 2008

Incidence rates from the previous section were applied to population data from the Access Economics demographic model. This model uses 2006 Census data from the ABS to project the population by year of age, gender and location for future years. The year 2008 was used in this report and the 2004-05 VTE separation rates from Table 2-6 were applied to these 2008 population data. The implicit assumption is that there is no change in the intervening years in the age-gender incidence rates for VTE, due to any changes in risk factors or prophylaxis over that period.

Table 2-7 and Figure 2-3 present the estimated number of cases of VTE, DVT and PE by age group and gender for 2008.

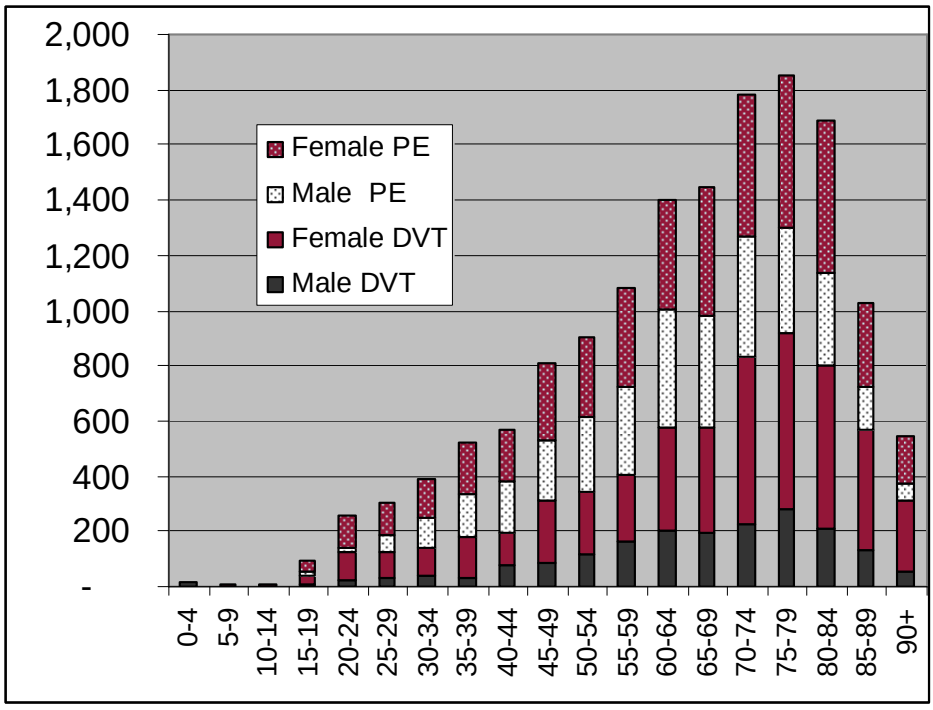
- In **2008 there were an estimated 14,716 cases of VTE** – 5,466 males and 9,250 females.
- This represents a rate of **70 separations for VTE per 100,000 Australians** for all ages – 52 per 100,000 for males and 87 per 100,000 for females.
  - The rate has increased by two per 100,000 since 2004-05 due to demographic ageing.
- Of these cases, **8,253 were estimated for PE and 6,462 were estimated for DVT** and:
  - 6,335 (43.0%) were people of working age (15-64 years);
  - 30 (0.2%) were children aged up to 15 years;
  - 3,232 (22.0%) were aged 65-74; 3,544 (24.1%) were aged 75-84; and 1,575 (10.7%) were aged 85+.

TABLE 2-7: CASES OF DVT, PE AND VTE, BY AGE AND GENDER, 2008

	DVT			PE			VTE		
	Males	Females	Total	Males	Females	Total	Males	Females	Total
0-4	12	4	16	-	1	1	12	5	17
5-9	3	3	6	-	-	-	3	3	6
10-14	2	4	6	-	1	1	2	5	7
15-19	12	28	40	18	40	57	29	68	97
20-24	22	100	122	22	114	136	44	214	258
25-29	32	94	126	59	114	174	91	208	300
30-34	38	106	144	107	139	247	145	245	390
35-39	34	149	183	151	190	341	185	338	523
40-44	76	117	193	191	183	374	268	300	568
45-49	87	221	308	219	283	502	306	504	810
50-54	115	224	339	280	288	567	394	511	906
55-59	160	243	404	318	362	680	478	605	1,083
60-64	202	370	572	430	398	827	632	768	1,400
65-69	198	375	573	405	469	874	603	844	1,447
70-74	228	606	834	437	514	951	664	1,120	1,784
75-79	282	637	919	378	557	935	660	1,194	1,854
80-84	213	588	801	335	554	889	548	1,142	1,690
85-89	130	440	569	155	303	458	285	742	1,028
90+	53	255	308	63	176	239	116	431	547
Total	**1,898**	**4,564**	**6,462**	**3,568**	**4,685**	**8,253**	**5,466**	**9,250**	**14,716**
Rate/100,000	**18**	**43**	**31**	**34**	**44**	**39**	**52**	**87**	**70**

Source: Access Economics estimates based on AIHW hospital separations and ABS demographic data.

FIGURE 2-3: CASES OF DVT, PE AND VTE, BY AGE AND GENDER, 2008



Source: Access Economics estimates based on AIHW hospital separations and ABS demographic data.

3. HEALTH SYSTEM EXPENDITURES

After setting the scene with a description of the health expenditure impacts of VTE abroad, this chapter estimates Australian health system expenditures on VTE based on top-down hospital expenditure and overall health expenditure data from the AIHW using the DCIS (Disease Costs and Impacts) methodology. Relativities between inpatient costs and other health system costs are estimated based on relativities from Access Economics' 2005 report for the National Heart Foundation on *The Shifting Burden of Cardiovascular Disease*.

3.1 HEALTH SYSTEM IMPACTS OF VTE OVERSEAS

VTE results in a major burden to the health care system, affecting both medical and surgical patients alike.

- MacDougall et al (2006) analysed medical and pharmaceutical claims data for US patients with a DVT or PE diagnosis between 1997 and 2004, comparing them with matched controls (n=26,958). Patients with DVT, PE or both had higher annual direct medical costs during and after the event of US$17,512, US$18,901 and US$25,554 respectively, compared with US$680 in the control group.
- In a recent retrospective cohort study in two large US health care plans, the mean total reimbursed costs associated with VTE incidence were US$7,712 (median: US$3,131) for a DVT event, rising to US$12,200 for a combined DVT and PE event (median: US$6,678). This study also showed that patients who experienced recurrent DVT, PE, or both incurred an additional mean total health care cost of US$12,326 per event (Bullano et al, 2005).
- In a study of health care charges in patients who had undergone orthopaedic surgery and subsequently developed DVT or PE, it has been shown that the average inpatient costs were twice those for a patient without DVT or PE. The mean total inpatient cost of care was estimated to be US$9,345 for the post-orthopaedic patient with no thromboembolic complications compared with US$17,114 for a patient with post-operative DVT and US$18,521 for a patient with post-operative PE (Ollendorf et al, 2002).

3.2 AUSTRALIAN HOSPITAL INPATIENT COSTS

Direct financial costs to the Australian health system comprise the costs of running hospitals and nursing homes (buildings, care, consumables), general practitioner and specialist services reimbursed through Medicare and private funds, the cost of prescribed and over-the-counter pharmaceuticals (Pharmaceutical Benefits Scheme and private), allied health services, research and 'other' direct costs (such as health administration).

There are essentially two ways of estimating health cost elements.

- **Top-down:** Data may be able to provide the total costs of a program element and then allocate those costs by disease. The AIHW estimates health system expenditure by disease or disease group, eg cardiovascular disease, of which peripheral vascular disease (PVD) is a component.
- **Bottom-up:** Data may be available for the number of people with a disease who experience a cost impact from the disease ('n') and the average cost impact. The product is the total cost eg, the number of medical specialist visits to treat VTE in a year multiplied by the average cost of a specialist visit.

It is generally more desirable to use top-down national datasets in order to derive national cost estimates, rather than extrapolate bottom-up data from smaller partial datasets. Using top-down estimates can be problematic for VTE as data are very limited. However, hospital inpatient data are available on a top-down basis and were provided through a special data request to the AIHW for the year 2004-05 from their disease expenditure database for the ICD codes for the events shown previously in Table 2-5.

Results are shown in Table 3-1, with hospital inpatient costs of $71.04 million in 2004-05.

TABLE 3-1: HOSPITAL INPATIENT EXPENDITURE ON VTE, 2004-05 ($)

Age	I26	I63	I74	I82	Total
0-4	0	0	21,912	62,775	84,687
5-9	0	0	23,824	1,962	25,786
10-14	0	0	5,024	13,354	18,378
15-19	69,196	0	39,083	30,426	138,705
20-24	115,892	34,666	58,162	67,285	276,005
25-29	335,890	29,032	74,199	82,448	521,569
30-34	615,808	62,003	130,471	37,293	845,575
35-39	723,265	48,155	58,018	55,905	885,342
40-44	977,788	170,866	221,793	92,047	1,462,493
45-49	1,071,081	131,570	300,069	110,487	1,613,208
50-54	1,394,663	198,937	359,696	120,236	2,073,532
55-59	1,680,365	414,285	547,668	56,220	2,698,539
60-64	2,073,722	449,858	685,518	100,532	3,309,629
65-69	2,235,808	608,242	606,001	93,448	3,543,499
70-74	2,416,509	564,551	640,347	118,401	3,739,808
75-79	2,444,455	1,183,909	826,919	84,502	4,539,785
80-84	2,002,455	704,996	682,302	51,085	3,440,838
85+	1,350,034	488,102	651,443	20,614	2,510,192
Total males	***19,506,929***	***5,089,170***	***5,932,448***	***1,199,021***	***31,727,568***
0-4	47,370	0	1,114	12,797	61,281
5-9	0	0	0	0	0
10-14	1,205		7,622	2,985	11,813
15-19	203,054	25,892	5,435	53,077	287,459
20-24	477,858	37,364	11,136	57,321	583,680
25-29	468,271	18,413	82,955	4,904	574,542
30-34	790,867	37,516	147,924	63,814	1,040,121
35-39	892,447	26,015	104,352	113,425	1,136,239
40-44	915,654	38,940	129,665	135,658	1,219,916
45-49	1,314,150	94,742	224,497	110,989	1,744,378
50-54	1,510,360	130,055	213,525	97,307	1,951,247
55-59	1,858,735	126,336	217,173	147,563	2,349,807
60-64	1,952,179	230,619	251,891	153,366	2,588,055
65-69	2,612,717	259,229	388,190	120,151	3,380,286
70-74	3,158,006	627,960	476,672	92,884	4,355,521
75-79	3,603,695	933,861	881,116	42,918	5,461,591
80-84	3,894,073	1,134,522	1,035,853	55,638	6,120,086
85+	3,372,101	1,313,852	1,609,626	153,150	6,448,729
Total females	***27,072,742***	***5,035,316***	***5,788,745***	***1,417,948***	***39,314,751***
Total persons	**46,579,671**	**10,124,486**	**11,721,193**	**2,616,969**	**71,042,319**

Source: AIHW special data request. Includes estimates for separations from public and private hospitals for acute and non-acute hospitalisations. I26 includes I26.0 I26.8 I26.9. I63 includes I63.1 I63.4. I74 includes I74.0 I74.1 I74.2 I74.3 I74.4 I74.5 I74.8 I74.9. I82 includes I82.3 I82.3 I82.8 I82.9

These data were converted to 2008 prices using health price inflation from AIHW (2007:13, Table 5) for the year 2004-05 to 2005-06 (3.9%), which was the rate ascribed to continue

through to 2008. The **total hospital inpatient expenditure in 2008 on VTE was thus estimated as $81.2 million.**

3.3 OTHER HEALTH SYSTEM EXPENDITURES

In addition to hospital inpatient costs, other health system expenditure incurred as a result of VTE includes non-admitted (outpatient) expenditure, out-of-hospital expenditure (including general practitioner services, imaging, pathology and medical specialists), pharmaceutical costs (prescription and over-the-counter) and other costs – including allied health professionals such as physiotherapists, research and 'unallocated' health costs – ie, capital, community and public health, health administration, aids and appliances.

Estimates for direct health system costs are derived in Australia by the AIHW from an extensive process developed in collaboration with the National Centre for Health Program Evaluation for the DCIS. The approach measures health services utilisation and expenditure (private and public) for specific diseases and disease groups in Australia. The DCIS methodology has been gradually refined over the 1990s to now estimate a range of direct health costs from hospital morbidity data, case mix data, *Bettering the Evaluation and Care of Health* (BEACH) data, the National Health Survey and other sources. AIHW (2005) provides a summary of the main results of estimates of health expenditures by disease and injury for the year 2000-01. The advantage of a top-down methodology is that cost estimate for the various diseases will be consistent, enhancing comparisons and ensuring that the sum of the parts does not exceed the whole (total health expenditure in Australia).

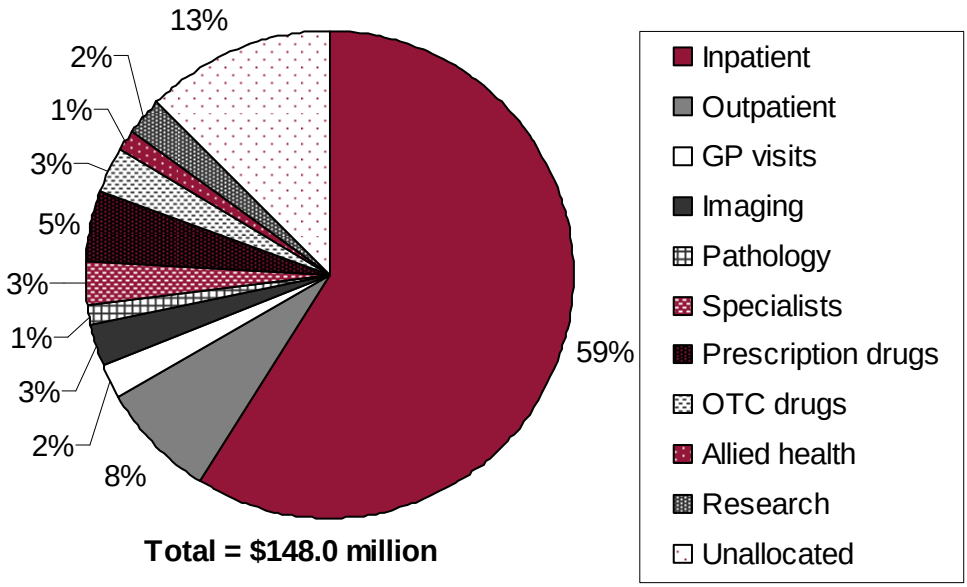
The AIHW include only 87.5% of total recurrent health expenditures in their estimates of expenditure by disease and injury, referred to as 'allocated' health expenditure. The 'unallocated' remainder includes capital expenditures, expenditures on community health (excluding mental health), public health programs (except cancer screening), health administration and health aids and appliances.

The proportions of health costs borne by each party are based on AIHW (2007:118, Table A3) data on health system costs borne by each party – the Australian Government (42.9%), state and territory governments (24.9%), individuals (17.4%) and others (14.9%).

Although the AIHW does not estimate other health system expenditures for VTE per se, there are estimates for PVD. For PVD, the proportion of hospital inpatient costs represent 67.4% of the allocated health expenditure (see Access Economics, 2005a:75, Table B-17), and it is likely to be a similarly high proportion for VTE since many of the same conditions are included. As such, the VTE estimate of hospital inpatient expenditure was factored up by 1/67.4% in order to estimate allocated expenditures and then by 1/87.5% to include the unallocated component. Cost per case as calculated in 2004-05 was inflated by health cost inflation of 3.9% per annum (AIHW, 2007) and applied to the 2008 number of incident cases, by age and gender.

Total health system costs for 2008 were thus estimated as $148.0 million, with component shares broadly as depicted in Figure 3-1.

FIGURE 3-1: HEALTH SYSTEM EXPENDITURE ON VTE, 2008 (% TOTAL)



Source: Access Economics based on AIHW special data request and Access Economics (2005a).

Health expenditure on VTE per case, by age and gender, is shown in Table 3-2, noting that because the hospital separation and cost data both include recurrent VTEs, the annual data reflect the cost per case.

Health expenditure was $10,007 per case of VTE in 2008 on average, higher for males ($12,128 per case) than for females ($8,770 per case).

TABLE 3-2: HEALTH EXPENDITURE PER CASE ON VTE, BY AGE AND GENDER, 2008 ($)

Age group	Males	Females	Total
0-4	13,691	23,777	9,817
5–14	17,136	2,865	4,923
15–24	11,493	6,236	4,311
25–34	11,144	6,854	4,905
35–44	10,099	7,267	4,980
45–54	10,723	7,407	5,162
55–64	11,703	7,878	5,658
65–74	12,097	8,165	5,712
75-84	13,522	9,769	6,492
85+	15,077	12,448	7,713
All ages	**12,128**	**8,770**	**10,007**

Source: Access Economics based on AIHW special data request and Access Economics (2005a).

4. PRODUCTIVITY AND OTHER FINANCIAL COSTS

In addition to health system costs, VTE also imposes a number of other important financial costs on society and the economy, including the following.

- **Productivity losses** of people with VTE comprise those from premature mortality, lower employment participation and/or absenteeism.
- **Carer costs** comprise the value of care services provided in the community primarily by informal carers and not captured in health system costs.
- **Other costs** comprise the cost of aids, home modifications and other pertinent financial costs not captured elsewhere.
- **Transfer costs** comprise the DWL associated with government transfers such as taxation revenue forgone, welfare and disability payments.

This chapter focuses mainly on the productivity costs, in line with our brief. Production is lost when people with VTE are unable to work because they die prematurely from the VTE or because, after the event, they may retire early or work less than they otherwise would. Access Economics adopts a human capital approach to measurement of productivity losses in developed countries. Associated with productivity losses are 'deadweight' costs, which refer to the costs of raising additional taxation revenues. Although forgone taxation is a transfer, not a real cost (so should not be included in the estimation of total costs) it is still worthwhile to estimate as it helps understand how the total costs of VTE are shared between the taxpayer, the individual and other financiers.

4.1 PRODUCTIVITY LOSSES FROM PREMATURE DEATH

4.1.1 NUMBER OF DEATHS

The ABS and AIHW do not separately report the number of deaths attributable to VTE. ABS (2008) reports 394 deaths in 2005 from PE (ICD code I26) and 304 in 2006. The same publication reports deaths for codes I63, I74 and I82 (with no further disaggregation provided) for 2005 of 1,073, 41 and 17 (912, 39 and 20 for 2006). However, these data do not accord with the epidemiological data, which show a much higher mortality rate in general[4] – for example, for PE the mortality rate for 2005 relative to the hospital separation data (394 deaths/ 7,734 separations) suggests only 5% mortality, whereas the epidemiological literature suggests one-year mortality of 52.3% (recall Table 2-1). It is not clear what is causing this discrepancy. There may be coding errors in the ABS data eg, coding to more general cardiovascular codes particularly when the embolus is not diagnosed in the population, compared to where it is tracked in the epidemiological data. Particularly in older people, death certificates may not indicate VTE as a cause as it is not looked for in this group. Even the epidemiological data may be conservative compared to autopsy data. However, although a VTE event may be a cause of death in a person with cancer, there is also the element of attribution – the extent to which the cancer and its treatment 'caused' the death relative to the VTE event that precipitated. The epidemiological data may thus overestimate deaths for this reason. Given that there may be both overestimation and underestimation risk in the epidemiological data, but there are unlikely to be coding errors, these data have been used to estimate the number of deaths from VTE in this report.

[4] No specific mortality rates were identified from the WA data, however.

Deaths are estimated for the cases of VTE occurring in 2008 using the survival and recurrence data from Table 2-1 and Table 2-3. Those who have a VTE event in 2008 either die from the event (36.4% during the year, based on the mortality rates for DVT and PE combined[5] – ie, **5,285 deaths from VTE in 2008**) or, if they survive, die from other causes based on the age-gender profile and overall mortality rates (283 deaths) or remit (ie, no longer have further impacts of VTE), while the remainder (12.9% or 1,898 people) have a recurring event. In 2009 the case mortality rate falls to 2.5% so 47 more people die of the original cohort due to the 2008 VTE, while 55 die from other causes. Recurrence falls to 3.7% so 70 people still have impacts in 2010. The pattern continues until there are no further people alive with recurrent symptoms and at this equilibrium 8,971 (61%) have remitted, **5,406 (37%) died due to the VTE** and 339 (2%) died due to other causes in 2012.

Five and a half thousand deaths is a large number – some 4.2% of deaths in Australia each year. However, this estimate triangulates well with overseas estimates. For example, in the UK – with a population three times Australia's – VTE is estimated, according to the *British Medical Journal*, to cause the deaths of 'more than 25,000 patients each year, more than the combined deaths from breast cancer, AIDS, and road traffic injuries' (Coombes, 2005). This suggests the problem is possibly some 50% worse in the UK than in Australia. Similarly, in the US an estimated 300,000 deaths occur each year due to VTE (Moll and Mackman, 2008; Heit et al, 2005a). Relative to population, this is four times the VTE death rate estimated here for Australia.

> *A study was conducted by researchers from several institutions including Mayo Clinic and University of Massachusetts Medical School, to investigate the prevalence of DVT and its often fatal complication, pulmonary embolism (PE), which together are commonly referred to as venous thromboembolism (VTE). Findings revealed that more than 600,000 people in the US suffer from non-fatal VTE events each year (DVT, n=376,365; PE, n=237,058). There are almost 300,000 fatal VTE events each year (296,370), and only seven percent of those who died were diagnosed and treated. Almost 60 percent of the fatal events followed undetected VTE (174,115). Additionally, approximately one-third of VTE events were not related to extended in-hospital immobilization, while two-thirds resulted from extended in-hospital immobilization.*[6] National Alliance for Thrombosis and Thrombophilia (2005).

4.1.2 CALCULATING THE PRODUCTIVITY LOSSES FOR THOSE WHO DIE

For people who die from VTE events, the NPV of future lifetime earnings lost was estimated (with a discount rate of 3%) from the age-gender profile of deaths together with derivation of the expected retirement age and data on wage inflation, average weekly earnings (AWE) and percentage employed for each age-gender group (Table 4-1). The AWE measure reflects all earnings (full and part time, all sectors, ordinary time and overtime).

[5] This is conservative since it is based on a lower share of PE in total VTE events than appears to be the case in Australia.

[6]

In total, the **productivity losses due to premature death are estimated as $1.366 billion** in 2008.

Of these, $770.4 million was lost productivity due to male deaths and $595.6 million due to female deaths.

4.1.3 SEARCH AND HIRING COSTS

There are additional productivity losses associated with premature deaths from VTE, relating to the need to bring forward the search and hiring costs for replacement workers. These are estimated as the number of people with VTE who die prematurely (by age and gender) multiplied by their chance of being employed multiplied by the search and hiring cost brought forward three years (the search and hiring cost was estimated as 26 weeks at AWE and the three year bring forward reflects average staff turnover rates in Australia).

In 2008, **additional search and hiring costs are estimated at $2.0 million** for people with VTE, based on the present value of bringing forward three years of average cost of staff turnover (26 weeks at AWE).

TABLE 4-1: REMAINING LIFETIME EARNINGS, 2008

Age (years)	Probability of being employed (%)	Expected retirement age if employed (years)	AWE ($2008)	Expected remaining lifetime earnings ($2008 NPV)	Productivity loss from premature death ($2008m)
Males					
0-4	0.0%	63	0	1,266,068	6.1
5-9	0.0%	63	0	1,367,277	1.6
10-14	0.0%	63	0	1,476,577	1.2
15-19	55.8%	63	317	1,594,615	18.4
20-24	85.2%	63	691	1,673,907	28.5
25-29	89.9%	63	1,008	1,647,400	58.2
30-34	90.3%	63	1,211	1,532,510	86.1
35-39	90.6%	63	1,314	1,357,296	97.8
40-44	89.4%	63	1,314	1,141,641	119.9
45-49	90.0%	63	1,322	913,034	110.1
50-54	86.0%	63	1,303	661,838	102.6
55-59	72.8%	64	1,242	409,440	76.3
60-64	50.8%	65	1,117	195,807	47.7
65-69	20.7%	68	863	56,891	12.9
70-74	5.9%	72	863	12,743	3.1
75-79	0.0%	77	863	0	-
80-84	0.0%	82	863	0	-
85-89	0.0%	87	863	0	-
90+	0.0%	92	863	0	-
Total Males					**$770.4**
Females					
0-4	0.0%	60	0	688,187	1.4
5-9	0.0%	60	0	743,201	0.9
10-14	0.0%	60	0	802,612	1.6
15-19	58.9%	60	230	866,773	23.2
20-24	78.8%	60	592	899,116	75.3
25-29	74.8%	60	800	843,945	68.8
30-34	68.7%	60	846	748,399	71.9
35-39	70.8%	60	819	649,900	86.6
40-44	75.0%	60	790	544,005	64.2
45-49	77.4%	60	822	426,042	84.5
50-54	68.7%	61	810	286,896	57.4
55-59	52.7%	62	774	158,191	37.2
60-64	28.1%	64	676	59,672	17.7
65-69	8.5%	68	517	12,714	4.1
70-74	1.3%	72	517	1,723	0.7
75-79	0.0%	77	517	0	-
80-84	0.0%	82	517	0	-
85-89	0.0%	87	517	0	-
90+	0.0%	92	517	0	-
Total Females					**$595.6**
Total VTE					**$1,366.0**

Sources: ABS 6105.0 for employment rates by age and gender, ABS 6310.0 for AWE by age and gender, ABS 6345.0 for wage inflation from 2006 and calculations by Access Economics. * The older age groups are zero reflecting 0.0% employment in these groups.

4.2 OTHER PRODUCTIVITY LOSSES

4.2.1 REDUCED WORKFORCE PARTICIPATION AND ABSENTEEISM

According to the AIHW hospital morbidity database, the average length of stay (ALOS) for PE in 2004-05 was 11.1 days and 5.6 days for ICD code I82 (which was judged to best represent DVT). Although ALOS in hospital does not represent the total time off work, it is used as a conservative estimate of sick leave required for those who work, adopting a weighted average (56% PE, 44% DVT) of 8.7 days off for those workers who do not die. Who bears the cost of temporary time off work is based on ABS 6342.0 which shows the proportion of paid sick leave for males is 75.9% and for females is 69.7% (ie, those proportions are borne by the employer, and the remainder by the employee).

> The **total cost of absenteeism due to VTE was estimated as $8.8 million in 2008**, of which $7.4 million was estimated to be borne by the employer and $1.4 million by the employee.

It is also possible that VTE reduces workforce participation rates for workers who do not die, but decide to retire early as a result of the event or reduce their working hours. However, Access Economics was unable to locate robust data on such reduced workforce participation, so this potential cost has been conservatively excluded in this report.

4.2.2 CARERS' LOST PRODUCTIVITY

Carers are people who provide informal care to others in need of assistance or support. Most informal carers are family or friends of the person receiving care. Carers may take time off work to stay with people with VTE while they are in hospital, accompany survivors to medical appointments and/or care for them at home while they completely recover from the event. Carers may also take time off work to undertake many of the unpaid tasks that the person with VTE would do if they had not experienced the event and were able to do these tasks.

Informal care is distinguished from services provided by people employed in the health and community sectors (formal care) because the care is generally provided free of charge to the recipient and is not regulated by the government.

While informal care is provided free of charge, it is not free in an economic sense, as time spent caring is time that cannot be directed to other activities such as paid work, unpaid work (such as housework or yard work) or leisure. As such, informal care is a use of economic resources.

There are three potential methodologies that can be used to place a dollar value on the informal care provided.

- **Opportunity cost** is the value of lost wages forgone by the carer.
- **Replacement valuation** is the cost of buying a similar amount of services from the formal care sector.
- **Self-valuation** is what carers themselves feel they should be paid.

Although the ABS Survey of Disability, Ageing and Carers Access does not supply information on the cost of care for people with morbidity resulting from VTE, Petersen et al (2003) provides data from the UK on the relativity between the value of informal care and the value of productivity costs for a survivor of a cardiovascular event (1.1:1). Applying this ratio to the productivity costs estimated above (excluded premature mortality costs), provided an

estimate of the **associated opportunity cost of carers' labour of $11.8 million in 2008**, which was then allocated by age and gender on the basis of incident cases.

4.3 TAXATION REVENUE FORGONE

It is important to make the economic distinction between real and transfer costs.

- **Real costs** use up real resources, such as capital or labour, or reduce the economy's overall capacity to produce goods and services.
- **Transfer payments** involve payments from one economic agent to another that do not use up real resources eg, a disability support pension or taxation revenue.

Reduced earnings due to reduced workforce participation, absenteeism and premature death also have an effect on taxation revenue collected by the Government. As well as forgone income (personal) taxation, there will also be a fall in indirect (consumption) tax, as those with lower incomes spend less on the consumption of goods and services.

Personal income tax forgone is a product of the average personal income tax rate (18.3%) and the forgone income. With VTE and lower income, there will be less consumption of goods and services, with the indirect taxation rate estimated as 15.1%. These average taxation rates are derived for 2008 from the Access Economics macroeconomic model and are applied to both the productivity losses of the person with VTE and those of their carer (since the latter were based on an opportunity cost approach).

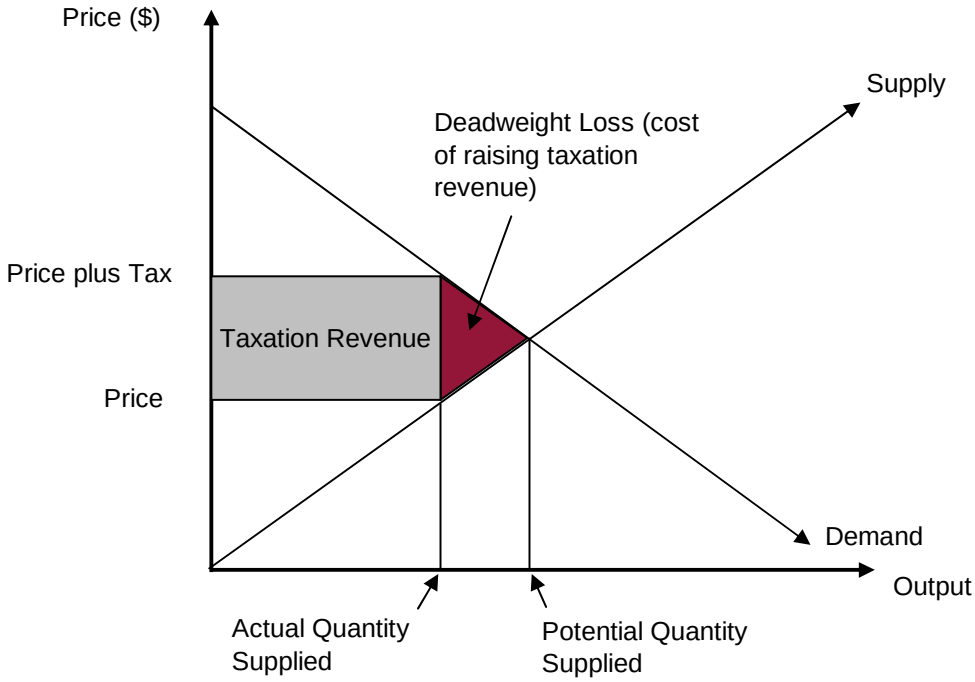
Around $464 million in lost potential tax revenue was estimated to be incurred in 2008, $460 million due to the lost productivity of people with VTE and $4 million from the reduced productivity of their informal carer.

4.4 DEADWEIGHT LOSSES (DWLS)

Lost taxation revenue is considered a transfer payment, rather than an economic cost per se. However, raising additional taxation revenues does impose real efficiency costs on the Australian economy, known as **deadweight losses (DWLs)**. This is because transfer payments (Government payments/services and taxes), in shifting consumption power from one group of individuals to another in society, creates distortions and inefficiencies in the economy.

DWL is the loss of consumer and producer surplus, as a result of the imposition of a distortion to the equilibrium (society preferred) level of output and prices. Taxes alter the price and quantity of goods sold compared to what they would be if the market were not distorted, and thus lead to some diminution in the value of trade between buyers and sellers that would otherwise be enjoyed (Figure 4-1).

FIGURE 4-1: DWL OF RAISING TAXATION REVENUE



Administration of the taxation system costs around 1.25% of revenue raised (derived from total amounts spent and revenue raised in 2000-01, relative to Commonwealth department running costs). Even larger DWLs arise from the distortionary impact of taxes on workers' work and consumption choices. These distortionary impacts are estimated to be 27.5% of each tax dollar collected (Lattimore, 1997 and used in Productivity Commission, 2003:6.15-6.16, with rationale). Altogether the DWL is 28.75% of the value of the taxation forgone.

Welfare payments made to people who are no longer working must, in a budget-neutral setting, also be funded by additional taxation. However, the scope of this report does not estimate welfare transfers associated with VTE.

The total extra tax dollars required to be collected include:

- the taxation revenue lost as a result of VTE and its impacts ($464 million - $460 million for the people themselves and $4 million for their carers); and
- the value of government services provided (comprising in this case the Government-funded component of health system costs, $100 million[7] in 2008).

[7] $148.0 million in health costs multiplied by 67.8% borne by governments (Commonwealth and state/territory).

Access Economics estimates that around **$162 million in deadweight loss is incurred in 2008**, due to the additional taxation required to replace that forgone due to lost productivity of people with VTE (Table 3-1).

TABLE 4–2: TAXATION REQUIREMENT AND DWL DUE TO VTE, 2008

Average personal income tax rate*	18.3%
Potential personal income tax lost	$254 million
Average indirect tax rate*	15.1%
Potential indirect tax lost	$210 million
Total potential tax revenue lost	$464 million
Government funding of health expenditure	$100 million
Total financing required due to VTE	**$564 million**
DWL proportion	28.75%
DWL from additional taxation	**$162 million**

* Source: Access Economics macroeconomic model (2008).

4.5 OTHER FINANCIAL COSTS

Estimating other financial costs that may be associated with VTE events is beyond the scope of this brief and, in any case, these costs are likely to be very minor relative to productivity losses, health system expenditures and the burden of disease. However, one cost is included here, as it is not insubstantial given the mortality burden associated with VTE: this is the cost of funerals.

The 'additional' cost of funerals borne by family and friends of people with VTE is based on the additional likelihood of death associated with VTE (Section 4.1.1) in the period that the person experiences it. However, some patients (particularly older patients) would have died during this time anyway. Eventually everyone must die and thus incur funeral expenses – so the true cost is the cost brought forward (adjusted for the likelihood of dying anyway in a given year). The Bureau of Transport Economics (2000) calculated a weighted average cost of a funeral across all States and Territories, to estimate an Australian total average cost of $3,200 per person for 1996, or **$4,254 per person who died in 2008** (based on inflation averaging 2.4% per annum over the period).

The **bring forward of funeral costs** associated with premature death for people with VTE was estimated at around **$22.5 million in 2008.**

4.6 SUMMARY OF PRODUCTIVITY AND OTHER FINANCIAL COSTS

In total, **the non-health related financial costs of VTE were estimated to be around $1.57 billion in 2008**. The lion's share of these costs (87%) was the productivity losses associated with premature death from VTE events.

TABLE 4–3: SUMMARY OF OTHER FINANCIAL COSTS OF VTE, 2008

Cost component	$ million	% share
Premature death	1,366.0	86.8%
Search and hiring costs	2.0	0.1%
Absenteeism	8.8	0.6%
Carer costs	11.8	0.8%
Funeral costs	22.5	1.4%
DWL	162.2	10.3%
Total productivity and other costs	**1,573.3**	**100.0%**

5. BURDEN OF DISEASE

The main cost of VTE is the loss of healthy life that it entails. Access Economics adopts 'burden of disease' methodology in order to quantify this substantial cost component. This methodology was developed by the World Health Organization, the World Bank and Harvard University to comprehensively measure mortality and disability from diseases, injuries and risk factors in 1990, projected to 2020 (Murray and Lopez, 1996). The approach is non-financial, where loss of wellbeing and premature mortality are measured in terms of Disability Adjusted Life Years (DALYs), with 0 representing a year of perfect health and 1 representing death (the converse of a QALY or 'quality-adjusted life year' where 1 represents perfect health)[8]. Section 5.1 uses mortality estimates from the previous chapter and a disability weight for VTE based on the literature review, to estimate DALYs lost due to VTE.

In Section 5.2, the 'willingness to pay' literature is used to convert the burden of disease as measured in DALYs to a financial estimate of the cost of suffering and premature death from VTE. This approach emerges from studies of the economics of life saving that have given rise to estimates of the value of a 'statistical' life (VSL) in the context of health, environmental and occupational health and safety policy, transport and airspace regulation. Access Economics has recently undertaken a large scale review for an Australian Government department of an appropriate Value of a Statistical Life Year (VSLY) to apply in decision making in an Australian context and this parameter value is utilised in the conversion.

5.1 DISABILITY WEIGHTS AND THE BURDEN OF DISEASE

The disability weight for VTE events was derived from Ozanne and Esserman (2004: Table 2 – Costs and utilities) as 0.30. This is similar to the disability weight for peripheral arterial disease cases of 0.248 from Mathers et al (1999) and for PVD in Begg et al (2007:166) of 0.243 for men and 0.257 for women. The Ozanne and Esserman estimate was preferred as it was for VTE whereas any of the other estimates would have been a proxy.

5.1.1 YEARS OF LIFE LOST DUE TO DISABILITY (YLDS)

The duration of disability from a VTE event was assumed to be four weeks on average based on the UK guidelines (National Collaborating Centre for Acute Care, 2007). Based on this duration, the disability weight outlined above and the total number of people surviving VTE, the YLDs for VTE were calculated (Table 5–1 by gender), for the year 2008.

In total, YLDs for VTE were an estimated **218 DALYs** in 2008.

TABLE 5–1: ESTIMATED YLDS LOST DUE TO VTE, 2008 (DALYS)

	Survivors	Disability weight by duration	YLD
Males	3,499	0.023	81
Females	5,932	0.023	137
Total	**9,431**	**0.023**	**218**

Source: Access Economics based on Ozanne and Esserman (2004).

[8] The QALY is also based on a subjective assessment of wellbeing, while the DALY is based on the assessment of an expert group.

5.1.2 YEARS OF LIFE LOST DUE TO PREMATURE DEATH (YLLS)

Based on the mortality calculations outlined in Section 4.1.1 above, it was estimated that there are around **5,285 deaths in 2008 due to VTE**. YLLs have been estimated from the age-gender distribution of deaths by the corresponding YLLs for the age of death in the Standard Life Expectancy Table (West Level 26) with a discount rate of 3.0% and no age weighting.

In total, YLLs for VTE were an estimated **78,190 DALYs** in 2008.

YLLs are shown in Table 5-2, together with YLDs and total DALYs. The YLL component is 99.7% of the total burden of disease estimated.

TABLE 5-2: ESTIMATED YLLS LOST DUE TO VTE, 2008 (DALYS)

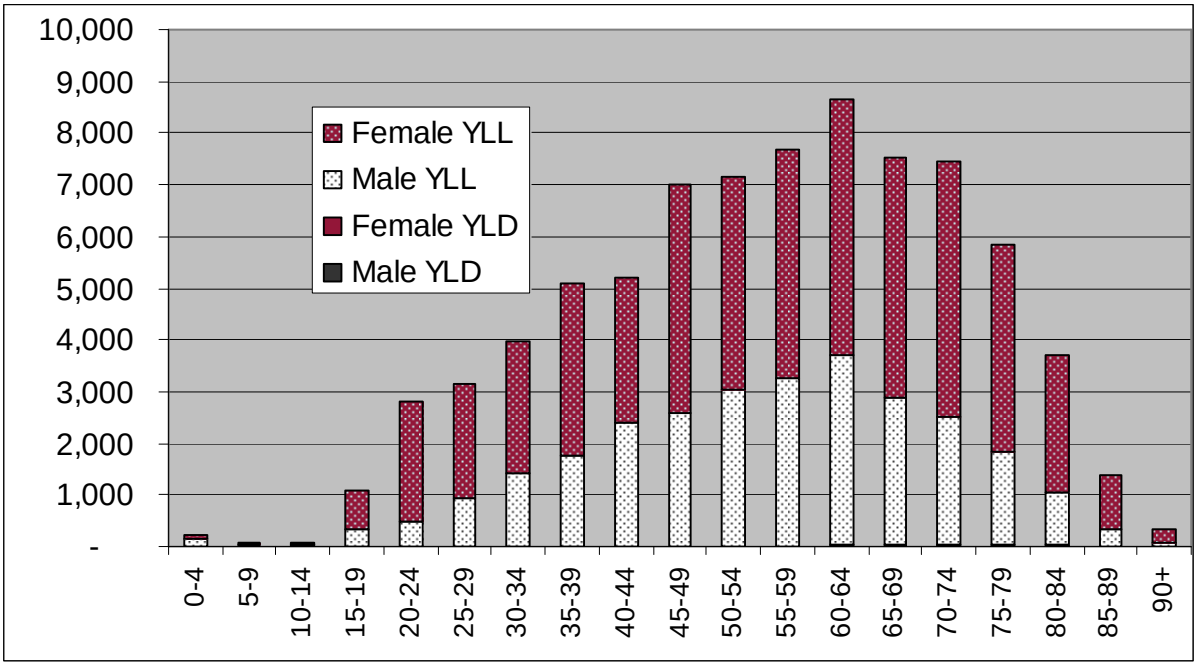
	YLL	YLD	DALYs
Males	28,550	81	28,630
Females	49,641	137	49,778
Total	**78,190**	**218**	**78,408**

5.1.3 TOTAL DALYS DUE TO VTE

The overall loss of wellbeing due to VTE was estimated as **78,408 DALYs** in 2008.

Figure 5-1 illustrates the YLD and YLL components by age and gender. The greatest impact of VTE is in middle age, reflecting deaths and more YLLs lost per death with younger age. Women aged 45-64 years accounted for nearly one quarter of the total DALY burden.

FIGURE 5-1: LOSS OF WELLBEING DUE TO VTE (DALYS), BY AGE AND GENDER, 2008



Note: Female and male YLDs are difficult to see as they are such a small proportion of the total.

5.2 THE VALUE OF THE BURDEN OF DISEASE

5.2.1 THE VALUE OF A STATISTICAL LIFE YEAR (VSLY)

In the past, many economists and policy makers argued that it was not possible to place a value on human life. Despite the difficulties in measurement, most economists and public policy makers recognise that, given the scarcity of resources for public projects and the consequent need for efficient allocation, if such valuations are not made explicitly then they will be made implicitly through decisions about which projects proceed and the funding accorded to competing projects.

The terminology 'statistical' life evolved in an attempt to distinguish the value of the life of an anonymous or unknown individual from the life of a known or particular person, since identified lives are sometimes perceived to be of more value than unidentified ones.[9] While there are different definitions based on different approaches to measurement that could be discussed in more detail, it is more important to note that the value of a unit (year) of healthy life is the relevant variable for decision-making.

The Value of a Statistical Life (VSL) can be measured using different approaches including traditional productivity approaches and 'willingness to pay' (WTP) approaches.

Productivity approaches to measuring the VSL or VSLY are based on the expected earnings of the individual (lost production).

- Frictional approaches are appropriate to measure productivity losses in the short term or in situations of a relatively large unemployment pool.
- Human capital approaches are appropriate in the longer term in economies like Australia operating at near full employment.

However, the loss of human life is viewed as more than earnings, incorporating both the value of unpaid work and the utility value of leisure. As such, the human capital valuation is a lower bound on the VSLY.

To take account of the value of unpaid work and leisure, a hybrid or mark-up approach has been adopted in some cases where the value is estimated as 30% or 40% of the value of earnings. Other early approaches to valuing life included the discounted consumption approach, the implicit value approach, the insurance value approach and the court award approach.

Willingness to pay (WTP) approaches to valuing human life have been the focus of the literature on the economics of life saving since the 1960s. WTP assumes that a person's utility depends on their income and their health, although the complexities of the interactions are not always taken into account. The person's WTP, with their available income, to avoid a risk to their healthy life (including a certain risk) can then be translated mathematically into an estimate of their VSL/VSLY. There are two empirical methods of determining VSL/VSLY using WTP:

- stated preference valuation (contingent valuation or choice modelling) methods; and
- revealed preference (hedonic) valuation methods.

[9] We note that in a policy setting, anonymous valuation may not always be the correct perspective from which to make an assessment – eg, when target populations are small. The terminology may thus not be appropriate.

Stated preference methods do not infer values from actual real world decisions, but are hypothetical. Revealed preference studies are generally considered superior to measure individual WTP as they are based on real world empirical, binding market transactions. Compensating (hedonic) wage studies, for instance, use information on people's job choices to estimate WTP for job risk changes.

A literature search conducted by Access Economics (2008) identified VSL estimates from 244 'western' studies (17 Australian and 227 international studies) between 1973 and 2007. Estimates were analysed by sector, country, methodology and age of study, with simple analysis as well as meta-analysis performed. Converted into 2006 Australian dollars, VSL estimates ranged from $0.1 million to $117 million, with a mean of $9.4 million and a median of $6.6 million. Sector-specific medians ranged from $3.7 million to $8.1 million. A meta-analysis yielded an average VSL of $6.0 million, with a range of $5.0 million to $7.1 million based on exclusion sensitivity analysis.

Based on an extensive review of international literature, Access Economics (2008) recommends a VSL of $6.0 million (with $8.1 million as an upper bound and $3.7 million as a lower bound due to the great variability across studies). Using a real discount rate of 3% (which aligns generally with discount rates used in Australian and international studies discounting healthy life and the current AIHW practices) over an estimated 40 years remaining life expectancy, this equates to an average VSLY in 2006 dollars of $252,014. Inflating the 2006 VSLY value to 2008 dollars by multiplying it by two years of inflation (2.9% in each year, from the Access Economics Macroeconomic model) results in a base case of $266,843 with lower and upper bounds of $164,553 and $360,238.

5.2.2 GROSS VALUE OF THE BURDEN OF DISEASE

Multiplying the number of DALYs by the VSLY ($266,843) provides an estimate of the gross dollar value of the loss of wellbeing due to VTE. Sensitivity analysis at the upper and lower bounds from the previous section is provided in brackets below due to the uncertainties involved in estimating the VSLY.

The estimated gross cost of lost wellbeing from VTE is $20.92 billion ($12.90-28.25 billion) in 2008. This reflects the very high estimate of mortality burden of VTE in the community.

5.2.3 NET VALUE OF THE BURDEN OF DISEASE

Bearing in mind that the wage-risk studies underlying the calculation of the VSL take into account all known personal impacts – suffering and premature death, lost wages/income, out-of-pocket personal health costs and so on – the estimate of $20.92 billion should be treated as a 'gross' figure. However, costs specific to VTE that are unlikely to have entered into the thinking of people in the source wage/risk studies should not be netted out (eg, publicly financed health spending, lost income after tax). The results after netting out are presented in Table 5–3.

TABLE 5–3: NET COST OF LOST WELLBEING, $ MILLION, 2008

Gross cost of the burden of disease	**20,923**
Less production losses net of tax	911
Less health costs borne out-of-pocket	25
Net cost of the burden of disease	**19,986**

The net cost of lost wellbeing due to VTE was estimated to be $19.99 billion ($11.97-27.31 billion) in 2008.

6. SUMMARY AND COMPARISONS

This final chapter summarises costs, by type and by who bears them, and compares the incidence, health system expenditures, productivity losses and burden of disease from VTE with other national health priority areas. The seven areas currently regarded as priorities are: cardiovascular disease (of which VTE is a part); diabetes mellitus; cancer; mental health; injuries; musculoskeletal disease including arthritis; and asthma. Comparisons are also made with other aggregates where relevant, such as financial costs relative to gross domestic product (GDP).

6.1 SUMMARY OF COSTS

In 2008, the **financial cost of VTE was $1.72 billion** (0.15% of GDP) (Table 6–1). Of this:

- 1.38 billion (80.0%) was productivity lost primarily due to premature death of Australians with VTE;
- 162 million (9.4%) was the efficiency loss (DWL) from taxation forgone and government health expenditures;
- 148 million (8.6%) was direct health system expenditure
- 22 million (1.3%) was bring-forward of funeral costs; and
- 12 million (0.7%) was the value of the informal care for people with VTE.

Additionally, **the value of the lost wellbeing (disability and premature death) was a further $19.99 billion**.

TABLE 6–1: VTE, TOTAL COSTS BY TYPE OF COST AND BEARER, AUSTRALIA, 2008 ($ MILLION)

Cost item	Indi-viduals	Family/ Friends	Federal Government	State Government	Employers	Society/ Other	Total
Burden of disease	**19,986**	**0**	**0**	**0**	**0**	**0**	**19,986**
Health system	25	0	63	37	0	22	148
Productivity	911	0	460	0	6	0	1,377
Informal carers	0	8	4	0	0	0	12
DWLs	0	22	0	0	0	0	22
Other indirect	0	0	0	0	0	162	162
Total financial costs	**936**	**31**	**527**	**37**	**6**	**184**	**1,721**
Total	**20,923**	**31**	**527**	**37**	**6**	**184**	**21,708**

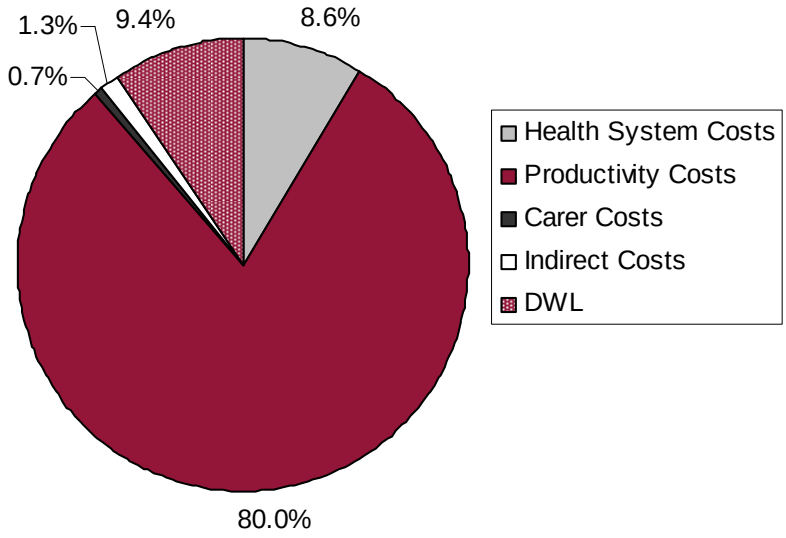
In per capita terms, this amounts to a **financial cost of $116,970 per person** with VTE in 2008. Including the value of lost wellbeing, the **cost approaches $1.5 million per person** (Table 6–2).

TABLE 6–2: VTE, COSTS BY TYPE OF COST AND BEARER, AUSTRALIA, 2008 ($ PER CAPITA)

Cost item	Indi-viduals	Family/ Friends	Federal Government	State Government	Employers	Society/ Other	Total
Burden of disease	**1,358,187**	**0**	**0**	**0**	**0**	**0**	**1,358,187**
Health system	1,732	14	4,309	2,505	0	1,495	10,055
Productivity	61,889	0	31,249	0	423	0	93,561
Informal carers	0	536	269	0	0	0	805
DWLs	0	1,528	0	0	0	0	1,528
Other indirect	0	0	0	0	0	11,021	11,021
Total financial costs	**63,622**	**2,077**	**35,827**	**2,505**	**423**	**12,516**	**116,970**
Total	**1,421,808**	**2,077**	**35,827**	**2,505**	**423**	**12,516**	**1,475,157**

The shares by each type of financial cost are illustrated in Figure 6-1, while the financial cost shares by bearer are shown in Figure 6-2.

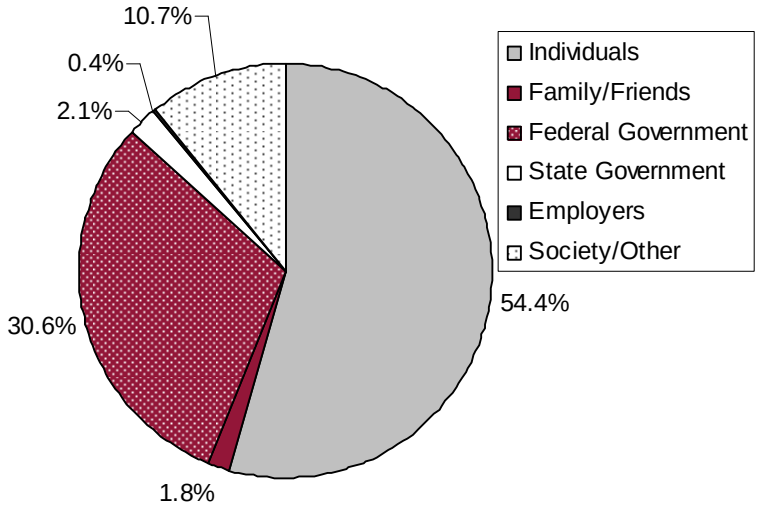
FIGURE 6-1: FINANCIAL COSTS OF VTE, BY TYPE OF COST (% TOTAL)



Individuals with VTE bear 54% of the financial costs, and their families and friends bear a further 2%. Federal government bears around one third (31%) of the financial costs (mainly through taxation revenues forgone). State governments bear 2% of the costs, while employers bear less than 1% and the rest of society bears the remaining 11%.

If the burden of disease (lost wellbeing) is included, individuals bear 96% of the costs and Federal government bears 2%, with other entities in society together sharing the remaining 2%.

FIGURE 6-2: FINANCIAL COSTS OF VTE, BY BEARER (% TOTAL)



6.2 COMPARISONS

This section compares VTE with National Health Priority Areas (NHPAs) and, as appropriate, with other cardiovascular conditions. The seven NHPAs are cancer, cardiovascular disease, musculoskeletal diseases, mental disorders, diabetes, asthma and injuries.

6.2.1 PREVALENCE AND MORTALITY COMPARISONS

Compared to some other health conditions such as arthritis, asthma or diabetes, VTE is relatively low in prevalence, affecting around 14,716 Australians in 2008 (0.07% of the population). However, VTE is more common than the most common types of cancer, and nearly as common as multiple sclerosis, stroke and road traffic accidents (Table 6–3).

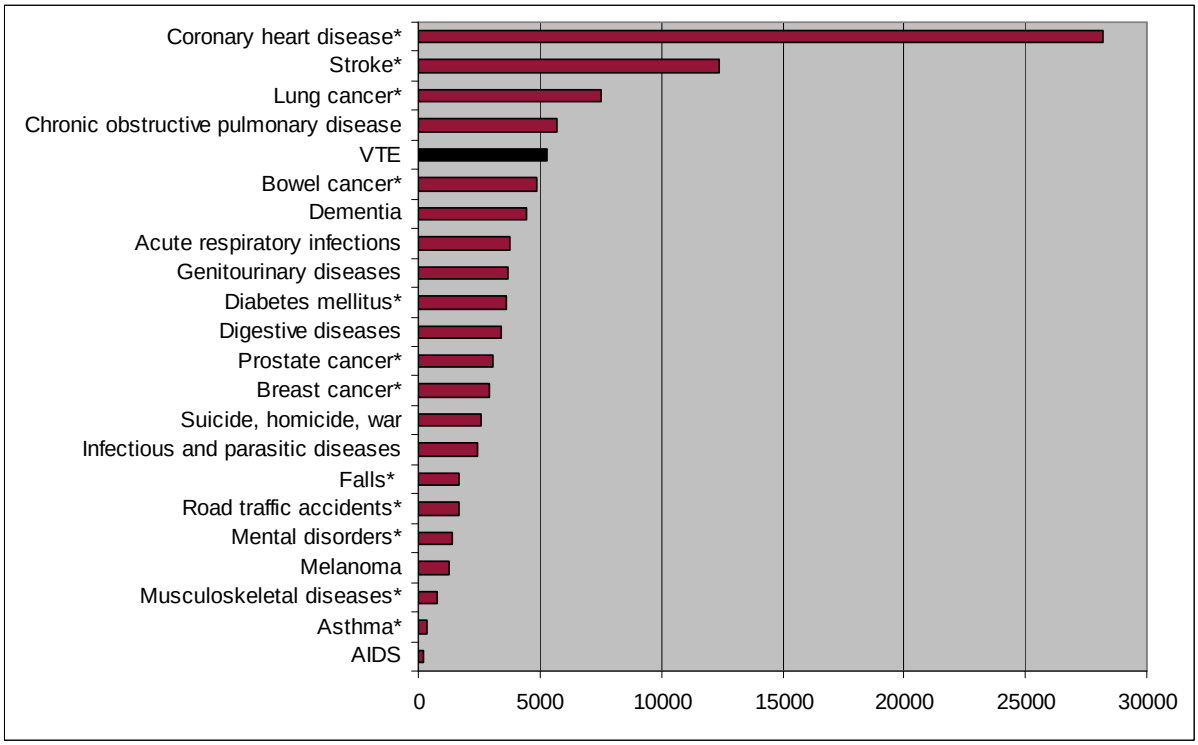
TABLE 6–3: VTE, PREVALENCE COMPARISONS WITH OTHER CONDITIONS

	Number of Australians
Prostate cancer*	11,899[d]
Breast cancer*	12,359[d]
Bowel cancer*	13,552[d]
VTE	**14,716[a]**
Multiple sclerosis	16,081[b]
Stroke*	19,627[d]
Road traffic accidents*	25,381[d]
Appendicitis	26,170[d]
Type I diabetes*	97,440[c]
Dementia	167,378[c]
Coronary heart disease*	309,726[c]
Type II diabetes*	1,073,459[c]
Asthma*	1,356,620[c]
Arthritis*	3,848,304[e]

[a] Access Economics (this report) for the year 2008. [b] Access Economics (2005b) for the year 2005. [c] Begg et al (2007) for the year 2003. [d] As (c), but incident cases. [e] Access Economics (2007) for the year 2007. * NHPAs.

- In terms of mortality VTE causes more deaths than all transport accidents and falls combined. It is a bigger killer than bowel or breast cancer and over 40 times more deadly than AIDS (Figure 6-3).

FIGURE 6-3: COMPARISON OF DEATHS BY SELECTED CAUSES, 2003



Source: Begg et al (2007) except for VTE (this report) for 2008. *=NHPAs.

- There were an estimated 70,799 hospital separations due to death in 2004-05 (AIHW, 2006) – VTE deaths thus represent some 7% of all deaths in Australian hospitals. This compares to being 0.2% of total hospital separations.[10]

6.2.2 COST COMPARISONS

Cost comparisons are undertaken in terms of costs per capita, since otherwise prevalence dominates the profile. Table 6–4 compares costs for 16 conditions studied by Access Economics in recent years, ranked from highest to lowest in terms of financial cost per annum per person. The table shows VTE to be second only to muscular dystrophy on a financial cost per case basis at $116,970 per person per annum. If the heavy dollar value of the burden of disease cost from premature mortality is included, VTE ranks most costly overall (noting that it uses a higher VSLY than in previous studies).

[10] Total hospital separations in 2004-05 were 7,018,850 (AIHW, 2006).

TABLE 6–4: VTE, TOTAL COST COMPARISONS WITH OTHER CONDITIONS ($ BILLION, $/CAPITA)

Year of study	Condition	Financial costs ($bn)	$burden of disease ($bn)	Total cost (current $bn)	Prevalence	Financial cost $ per person pa	Total cost $ per person pa
2007	Muscular dystrophy	0.4	1.0	1.4	3,457	$125,832	$415,100
2008	**VTE**	**1.7**	**2.4**	**3.9**	**14,716**	**$116,970**	**$1,475,157**
2005	Cancer*	11.2	83.4	94.6	123,600	$90,615	$765,372
2002	Schizophrenia*	1.8	n/a	n/a	37,233	$48,344	n/a
2007	Cerebral palsy	1.5	2.4	3.9	33,797	$43,431	$115,099
2002	Dementia	6.6	n/a	n/a	162,000	$40,741	n/a
2005	Multiple sclerosis	0.6	1.34	1.94	16,081	$37,333	$120,683
2003	Bipolar disorder*	1.6	n/a	n/a	99,099	$16,145	n/a
2004	Vision loss	5.0	4.8	9.9	480,000	$10,417	$20,625
2004	Sleep disorders#	6.2	4.1	10.3	1,200,000	$5,167	$8,583
2004	Restless legs syndrome	1.4	9.7	11.1	280,338	$4,994	$39,595
2004	Cardiovascular disease*	14.2	93.9	109.1	3,185,900	$4,457	$34,245
2007	GORD & PUD^	9.7	7.2	16.9	2,181,400	$4,447	$7,747
2001	Osteoporosis*	7.5	n/a	n/a	1,913,900	$3,919	n/a
2005	Hearing loss	11.7	11.3	23.0	3,545,231	$3,300	$6,488
2007	Arthritis*	12.2	11.7	23.9	3,848,304	$3,170	$6,211

Source: Past Access Economics reports available on **www.accesseconomics.com.au**
^Gastro-oesophageal reflux disease and peptic ulcer disease. # Obstructive sleep apnoea, insomnia, periodic limb movement disorder and narcolepsy. * NHPAs.

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