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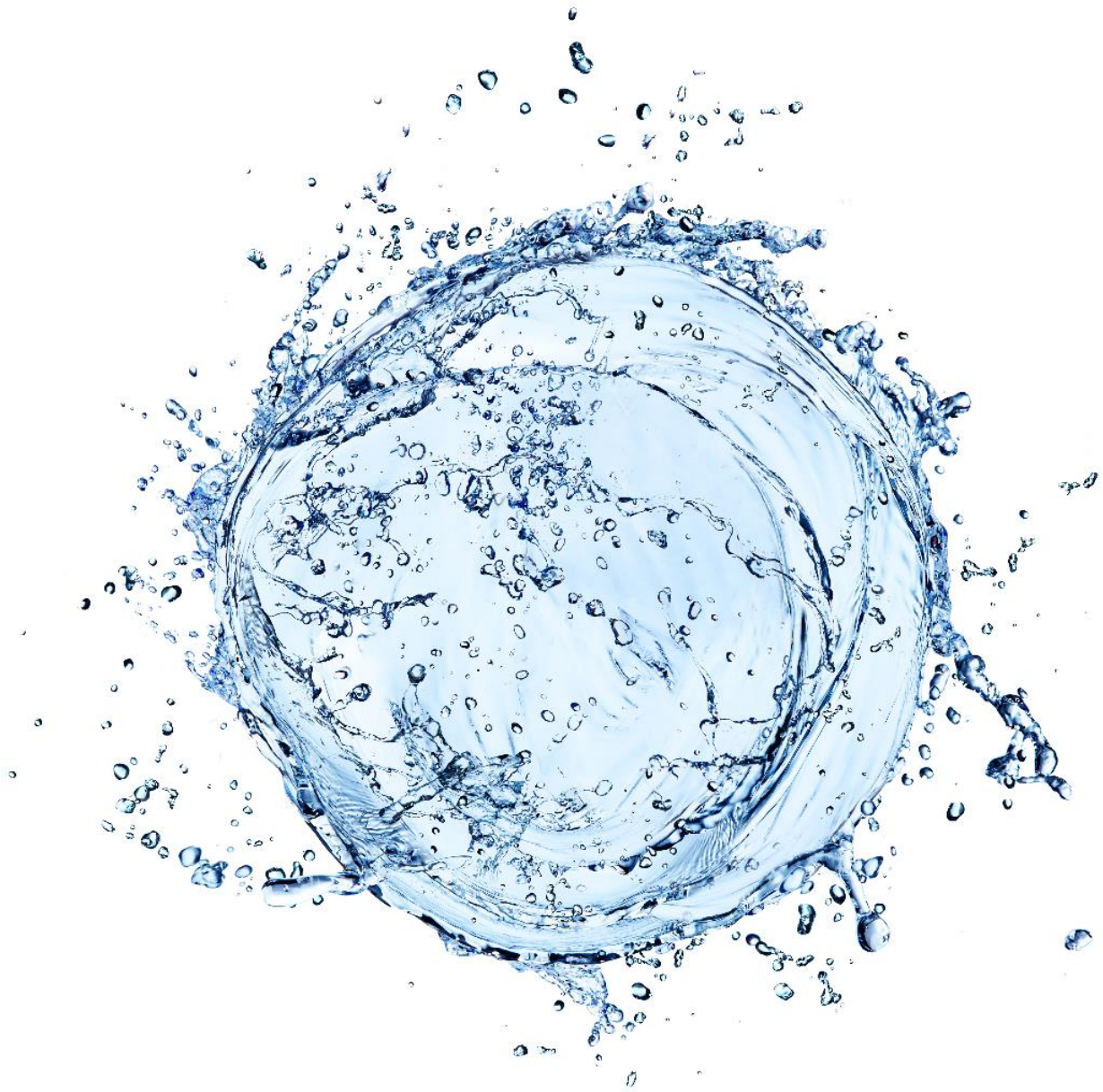

The cost of pain in Australia

Painaustralia

March 2019

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Acknowledgement

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Glossary

Acronym	Full name
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
AHS	Australian Health Survey
AIHW	Australian Institute of Health and Welfare
AWE	average weekly earnings
BEACH	Bettering the Evaluation and Care of Health
CED	Commonwealth Electoral Division
CPG	Chronic Pain Grade
DALY	disability adjusted life year
ePPOC	Electronic Persistent Pain Outcomes Collaboration
FTE	full time equivalent
GBD	Global Burden of Disease
GCCSA	Greater Capital City Statistical Areas
GDP	gross domestic product
GP	general practitioner
ICD-10	International Classification of Disease – Tenth Revision
NHMRC	National Health and Medical Research Council
NHS	National Health Survey
NSA	Northern Sydney Area
NSW	New South Wales
NT	Northern Territory
PBS	Pharmaceutical Benefits Scheme
QALY	quality adjusted life year
QLD	Queensland
SA	South Australia
SDAC	Survey of Disability, Ageing and Carers
TAS	Tasmania
TCR	Targeted Call for Research
UK	United Kingdom
US	United States of America
VIC	Victoria
VSL	value of a statistical life
VSLY	value of a statistical life year
WA	Western Australia
YLD	year of healthy life lost due to disability
YLL	year of life lost due to premature mortality

Foreword by Painaustralia

We've known for some time that chronic pain pervades all levels of our society. The lived experience of pain seems to know no boundaries. Time and time again we hear stories of how chronic pain has fundamentally changed the life trajectory of a young Australian, or imposed disability on a previously healthy older Australian.

Hearing the stories and knowing what living with pain is like at an individual level, is one kind of understanding. Having the data to show how pain impacts our Australian community is another, and is so crucial to driving genuine policy reform.

In examining the economic costs of pain, this report reveals so much about the true impact of pain in Australia. We now know:

- 3.24 million Australians are living with chronic pain;
- Those living with pain are more likely to be female and of working age;
- Their pain is restricting the activities they can undertake and the work they can do;
- Chronic pain costs Australia $73.2 billion dollars each year including $48.3 billion in lost productivity; and
- Chronic pain has a detrimental impact on quality of life – costing our society an estimated $66.1 billion dollars each and every year.

If our policy framework to treat pain doesn't change, then the annual cost of pain in Australia will rise from $139.3 billion to an estimated $215.6 billion by 2050. This cannot and should not be allowed to happen.

The findings of this report are an important step forward in improving our knowledge about pain in Australia. Having a better understanding of the way chronic pain impacts our communities enables us to better meet the implicit challenges, the unmet need, and the lives that are being diminished by a lack of appropriate healthcare and policy response to pain.

The evidence shows us the urgent need to improve the lives of millions of Australians living with pain. We know what needs to be done. Now we must take action and make these improvements. The path forward has been set with the National Strategic Action Plan for Pain Management, which at the time of publication, sits with the Federal Government for review and consideration.

It is my sincerest hope that this revealing and important evidence base will compel national action regarding the way we respond to pain. In a country like Australia, we must do better for the millions of people in pain. Anything less is unacceptable.

We are grateful to Seqirus for its funding support to make this report possible. Our thanks also go to Associate Professor Malcolm Hogg and Professor Stephan Schug for their skilled insights and expertise that guided this report's development, to Deloitte Access Economics for the quality of analysis contained in this report, and to Parker & Partners for their support in bringing this report to fruition.

Carol Bennett, Chief Executive Officer, Painaustralia

Executive summary

Key findings

- 3.24 million Australians were living with chronic pain in 2018. 53.8% are women and 68.3% are of working age.
- For the majority (56%) of Australians living with chronic pain, their pain restricts what activities they are able to undertake.
- The total financial cost of chronic pain in Australia in 2018[1] was estimated to be $73.2 billion, comprising:
  - $12.2 billion in health system costs;
  - $48.3 billion in productivity losses; and
  - $12.7 billion in other financial costs, such as informal care, aids and modifications and deadweight losses.
- People with chronic pain also experience a substantial reduction in their quality of life, valued at an additional $66.1 billion.
- The costs of chronic pain are expected to increase from $139.3 billion in 2018 to $215.6 billion by 2050 in real 2018 dollars (in the absence of changes to treatment or prevalence rates, and assuming that unit costs remain constant in real terms).
- An extension of best practice care to Australian patients could lead to substantial savings and better health outcomes.
  - A roll out of a pain specialist-designed and led national GP training program could save $209 million in overdose related costs for $45 million in upfront costs; the benefit cost ratio in the first year would be 4.6 to 1.
  - Doubling current levels of access to multidisciplinary care could reduce health system costs by $3.7 million (net of the $70 million in intervention costs), with a benefit cost ratio of 4.9 to 1 from the perspective of society.
  - On the basis of available evidence, prescribing atypical opioids rather than conventional opioids has the potential to save as many as 249 lives per year in Australia. The intervention could save Australia $1.4 billion in financial ($301.9 million) and wellbeing ($1.1 billion) costs, which is likely to outweigh the costs of an intervention to change prescribing patterns. However, more robust evidence is urgently needed – such as that which could be provided by a National Health and Medical Research Council Targeted Call for Research project.

Background

Chronic pain affects more than 3.2 million Australians. Chronic pain, also called persistent pain, is pain that continues for more than three months after surgery, an injury, as a result of disease, or from another cause.

For those who experience chronic pain, the pain can be debilitating and have an adverse effect on work, sleep, and relationships. Individuals with chronic pain may also commonly experience comorbidities such as depression, sleep disturbance and fatigue.

These comorbidities often contribute to worse health, societal and financial outcomes – for example, major depression in patients with chronic pain is associated with reduced functioning, poorer treatment response, and increased health care costs (Karapetyan et al, 2017).

Prevalence

In the 2011-12 Australian Health Survey (AHS), 15.4% of Australians aged 15 years or older report living with chronic pain. The prevalence of chronic pain is higher for women (16.9%) than it is for men (15.0%). The prevalence rates from the AHS (obtained from Miller et al, 2017), were applied to Australian Bureau of Statistics (ABS) population data to estimate the total prevalence of chronic pain in Australia in 2018. It was estimated that:

- 3.24 million Australians were living with chronic pain, of whom 1.50 million were male and 1.74 million were female;
- 2.21 million Australians of working age were living with chronic pain, representing more than 68% of the total;
- the prevalence of chronic pain will increase to 5.23 million Australians (16.9%) by 2050; and
- by 2050, 2.95 million Australians living with chronic pain will be limited in the activities (e.g. mobility, self care, or work) they can undertake as a result of their pain, compared to 1.80 million people today.

Costs of chronic pain

The total financial costs associated with chronic pain were estimated to be $73.2 billion in 2018[1], which equates to $22,588 per person with chronic pain. In the absence of any changes to health system treatments, prevalence rates, or real costs per person, the costs of chronic pain are expected to rise from $139.3 billion in 2018 to $215.6 billion by 2050 in real 2018 dollars.

The costs associated with chronic pain in Australia in 2018 are summarised by cost component in Table i, and by age and gender in Chart ii.

Health system costs make up 16.7% of financial costs, accounting for $12.2 billion. Of this expenditure, $2.7 billion was paid by Australians in out-of-pocket costs to manage their chronic pain. Governments paid for 66.7% of total health expenditure, while individuals and other funding sources respectively contributed 22.1% and 11.2% to the total. Hospitalisations accounted for $3.7 billion of total health expenditure, followed by out-of-hospital expenses ($1.3 billion), and pharmaceuticals ($1.1 billion).

Productivity costs make up the largest share of total financial costs (66.0%) while deadweight losses – the costs associated with the act of taxation, which creates distortions and inefficiencies in the economy – account for 10.3%. Other financial costs such as aids and modifications and informal care account for the remaining 6.9%. It was estimated that individuals bore 36.0% of total financial costs, followed by governments (35.1%), employers (12.3%), society (12.7%) and family or friends (3.9%).

Chronic pain was associated with 340,384 disability adjusted life years (DALYs) in Australia in 2018, which, using the value of a statistical life year (VSLY) to enumerate DALYs in dollar terms, represents a cost of $66.1 billion. Chronic pain was estimated to be associated with 6.8% of the total burden of disease and 6.5% of total health system expenditure.

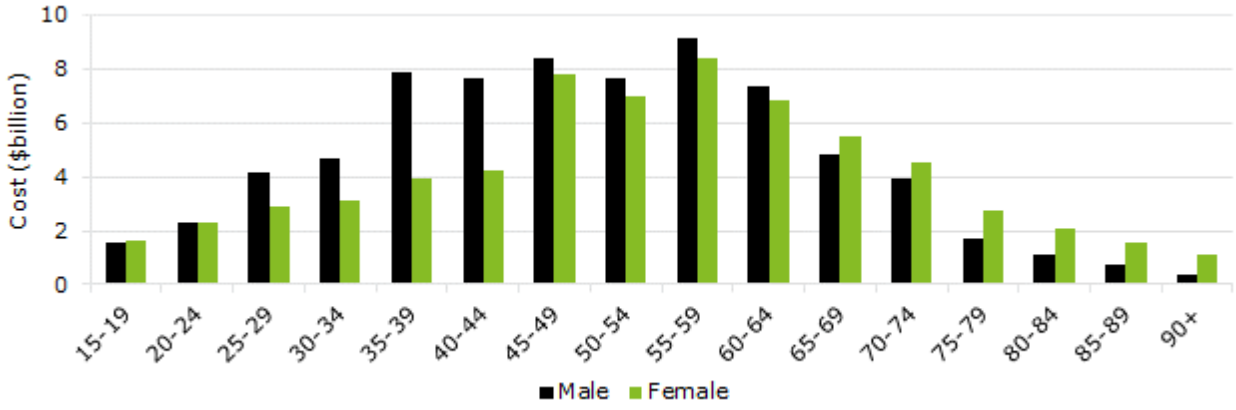
Table i Total costs associated with chronic pain, Australia 2018

Cost component	Total cost ($bn)	Per person ($)	Proportion (%)
Health system	12.23	3,771	8.8
Reduced employment	36.18	11,161	26.0
Absenteeism	3.17	979	2.3
Presenteeism	8.99	2,773	6.5
Informal care	4.51	1,390	3.2
Aids and modifications	0.57	176	0.4
Deadweight losses	7.58	2,338	5.4
Total financial costs	**73.22**	**22,588**	**52.6**
Loss of wellbeing (non-financial)	**66.10**	**20,391**	**47.4**
Total costs	**139.33**	**42,979**	**100.0**

Source: Deloitte Access Economics analysis.

[1] In this report, 2018 is used to refer to the 2017-18 financial year, unless otherwise indicated.

Chart i Total costs associated with chronic pain by age and gender, Australia 2018, $ billions



Source: Deloitte Access Economics analysis.

The costs associated with chronic pain were highest in New South Wales (NSW) (31.9%), followed by Victoria (VIC) (25.5%), Queensland (QLD) (20.0%) and Western Australia (WA) (10.7%) with other jurisdictions accounting for 12.0%. Approximately 33.8% of costs occur outside of the capital cities of Australia. Costs are comparable with the share of population living in each area (e.g. state or territory, or capital cities).

Cost of opioid misuse

Opioids are chemical substances with morphine like attributes that are commonly used for pain relief, although they have addiction potential and can cause associated problems of dependence including serious adverse events or death through overdose. There is also an increased risk when opioids are used to manage pain alongside other drugs (including sedatives and alcohol). Currently in Australia, there are more deaths associated with prescription opioids than heroin, cocaine, or other illicit drugs. In 2017-18, 823 Australians are believed to have lost their lives as a result of prescription opioid misuse. Opioids can be broken into two categories – conventional opioids and atypical opioids.[2] The majority of the deaths were likely due to conventional opioids (735), even when conservatively estimating the deaths due to atypical opioids (88). Overall, these deaths cost Australia $4.7 billion, comprising $1.0 billion in financial losses (forgone future income), and $3.7 billion in reduced wellbeing.

Cost effectiveness of various interventions

Based on a previous intervention by NPS MedicineWise, a **specialist-designed and led education program for general practitioners (GPs)** should result in around a 25% improvement in best-practice chronic pain management by GPs. From that same program, on a pro-rata basis, **extending the program to apply group training sessions for GPs nationally would cost around $45.2 million upfront**. Assuming a similar impact to interventions by the Centers for Disease Control to reduce opioid prescription volumes in the US, an Australian campaign should reduce such volumes here by around 6% and prevent around 47 opioid-related deaths annually. Using the value required by the Commonwealth Government for a life saved ($4.5 million) this represents a social benefit of $209.0 million, which constitutes a **benefit to cost ratio of 4.6 to 1 in the first year**. The benefits of the program would diminish in subsequent years, but it would still prove a highly cost effective intervention.

Multidisciplinary pain management interventions were found to **be superior to standard treatment** of pharmaceutical and invasive care for chronic pain management. The intervention improved quality of life, as measured by quality adjusted life years (0.03 QALYs saved per person), and was cheaper in terms of health expenditure (by $226 per person). Multidisciplinary care also improved work attendance, reducing absenteeism by an additional seven days per person per year compared to standard care. Doubling access to multidisciplinary care could be achieved for an outlay of $69.7 million and, when accounting for reductions in

[2] Atypical opioids differ from conventional opioids as they do not rely exclusively on mu-receptor agonism for their analgesic effect (or pain relief). As a result, they have different effects and different adverse effects including toxicity and abuse potential compared with conventional opioids (Schug, 2018).

health expenditure and productivity losses, and associated gains in wellbeing, would result in a **benefit to cost ratio of 4.9 to 1.**

This report also presents emerging evidence that prescribing atypical opioids rather than conventional opioids could offer benefits in Australia. On the basis of available evidence, prescribing atypical opioids rather than conventional opioids has the potential to save as many as 249 lives per year in Australia. The intervention could save Australia $1.4 billion in financial ($301.9 million) and wellbeing ($1.1 billion) costs, which is likely to outweigh the costs of an intervention to change prescribing patterns. However, more robust evidence is urgently needed to consider how to translate clinical findings into practice – such as that which could be provided by a National Health and Medical Research Council (NHMRC) Targeted Call for Research (TCR) project.

Other research into alternative strategies to reduce the burden of the opioid crisis in Australia should also be considered. For example, while typically seen as a high cost alternative, neuromodulation treatment (e.g. spinal cord stimulation) can substantially reduce pain levels, and can be used to successfully taper opioid medication. Neuromodulation treatment has been found to be highly cost effective for patients with severe disabling pain (see Hoelscher et al, 2017). Similarly, interventional pain therapies and opioid dose reduction programs may also be effective ways to reduce the burden of opioid misuse in Australia.

1 Background

Deloitte Access Economics was commissioned by Painaustralia to establish the local and Australia wide socioeconomic impact of pain, and to conduct a cost effectiveness analysis of three health interventions that could reduce the impact of pain on the health system in Australia. In this report, evidence has been presented to demonstrate the burden of chronic pain in Australia, including health system, productivity and carer costs, other financial costs and the loss of wellbeing.

The rest of this chapter provides a brief overview of chronic pain, its causes, comorbidities and treatment pathways. The chapter also outlines the methods used to estimate the costs of chronic pain in Australia. The structure of the report is then set out as follows:

- Chapter 2 provides an overview of the prevalence of chronic pain in Australia, including severity, regional analysis and projections of the prevalence of pain to 2050;
- Chapters 3, 4, 5 outline the costs of chronic pain, including health system expenditure, productivity losses and other financial costs, and the loss of wellbeing, respectively;
- Chapter 6 provides the costs associated with chronic pain for various geographies and also projects the national costs into the future;
- Chapter 7 estimates the costs of opioid misuse in Australia, focusing on the costs of hospitalisations and deaths due to prescription opioid poisonings; and
- Chapter 8 presents the results of three cost effectiveness analyses for interventions that may effectively reduce the burden of chronic pain in Australia.

1.1 Definition

The International Association for the Study of Pain (1986) defined pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (International Association for the Study of Pain, 1986). Linton (2005) further added that pain is expressed in behaviour. These definitions characterise pain as a subjective experience, meaning that there is no 'objective' measure. Pain contains both sensory and emotional aspects (Painaustralia, 2018a).

Pain may be either nociceptive pain, or neuropathic pain, or contain elements of both. Nociceptive pain is caused by damage to body tissue and is usually described as a sharp, aching, or throbbing pain. It may be caused by a number of factors, including injury, surgery, arthritis, osteoporosis or musculoskeletal conditions (Willis, 1985). Alternatively, neuropathic pain occurs following damage to the nervous system itself and associated sensations are often described as burning or shooting pains such as numb, tingling, or sensitive skin (Treede et al, 2008; Painaustralia, 2018b).

The relationship between the extent of tissue damage and sensory experience of pain is variable, and as such the size of an injury is not an appropriate guide to the degree of pain that someone is experiencing (Hammer et al, 2018). The interpretation of nociceptive signals is influenced by many factors, including past experiences of pain, beliefs, and the situation (Painaustralia, 2018c). This is captured by the 'bio-psycho-social' model of pain assessment and management, which recognises physical, psychological and environmental components of pain and their interactions (Heigl et al, 2015; Kamper et al, 2015).

Further, the subjective and ongoing nature of pain leads to a wide degree of variation in observed pain intensity, pain persistence, and pain-related disability and recency of onset among those who experience pain. Pain can also be viewed in terms of the length of time that pain persists, with the impact of pain becoming more significant as the duration of pain becomes longer. Painaustralia (2018a) classify pain into three categories:

- **Acute pain** is considered a normal, time-limited response to trauma, surgery, or other noxious experiences, and usually only lasts while the injury or damage heals. If it is poorly managed, it can lead to more serious health issues, including chronic pain.
- **Chronic pain**, also called persistent pain, is pain that "persists beyond normal tissue healing time, which is assumed to be three months" (Merskey, 1986). Although chronic pain can be a symptom of other

disease, it may occur without a clear reason and be a disease in its own right, characterised by changes in the central nervous system.
- **Cancer pain** can occur in patients anywhere from the early to advanced disease stage. In cancer survivors, chronic pain is often a severe and debilitating side effect of treatment.

For the purpose of this report, only chronic pain including chronic cancer pain is considered. For those who experience chronic pain, it can often be debilitating and have an adverse effect on work, sleep, social activities and relationships (Painaustralia, 2018d). The most common forms of chronic pain can be characterised as follows (Treede et al, 2015):

- chronic primary pain is pain in one or more locations that persists or recurs for longer than three months, and is associated with significant emotional distress or functional disability and is not better explained by another chronic pain condition;
- chronic cancer pain includes pain caused by the cancer itself and pain that is caused by cancer treatment;
- chronic post-surgical and post-traumatic pain develops after a surgical procedure or a tissue injury and persists at least three months;
- chronic neuropathic pain is caused by a lesion or disease of the somatosensory nervous system – the system that relays sensations detected in peripheries via pathways to the brain – and may be spontaneous (as a painful response to a normally non-painful stimulus) or evoked (as an increased response to a painful stimulus);
- chronic headache and orofacial pain that occurs on at least 50% of days during a three month period;
- chronic visceral pain is persistent or recurrent pain that originates from the internal organs of the head and neck region and the thoracic, abdominal, and pelvic cavities; and
- chronic musculoskeletal pain, which is defined as persistent or recurrent pain that arises as part of a disease process directly affecting bones, joints, muscles, or related soft tissues.

A number of grading classifications have been established to help qualitatively order pain severity. One such model is the Chronic Pain Grade (CPG), which incorporates a consideration of pain in three dimensions: persistence (duration), intensity, and disability (Von Korff et al, 1990). The CPG is a seven-item instrument that includes subscale scores for characteristic pain intensity, disability score and disability points (Von Korff et al, 1992). This leads to a calculation of the overall severity of chronic pain, which allows pain to be classified into one of four hierarchical categories according to severity or interference:

- **Grade I** – low disability-low intensity;
- **Grade II** – low disability-high intensity;
- **Grade III** – high disability-moderately limiting; and
- **Grade IV** – high disability-severely limiting.

The CPG has been validated by various international studies and found to be an acceptable, valid and reliable instrument for assessing the presence and severity of chronic pain (Penny et al, 1999).

1.2 Causes of chronic pain

There are many underlying causes of chronic pain, although it is not possible to always determine the precise cause of pain. Chronic pain may occur due to persistent stimulation of nociceptors in areas of ongoing tissue damage, for example due to osteoarthritis. Frequently, however, chronic pain is often linked to maladaptive changes in the central nervous system, psychological factors, and environmental changes which persist long after the tissue damage that initially triggered the onset of pain has been resolved (Costigan et al, 2009).

Many people, especially older Australians, have more than one long-term health condition, so it can be difficult to isolate which conditions are associated with the most pain. Common chronic pain syndromes include:

- back and leg pain;
- central pain syndromes;
- cancer;
- chronic post-surgical pain;
- complex regional pain syndrome;
- fibromyalgia;
- migraine and headache;
- myofascial pain syndrome;

- neuropathic (nerve) pain;
- orofacial pain;
- pelvic pain, including endometriosis;
- phantom limb pain;
- post-herpetic neuralgia;
- sciatica; and
- musculoskeletal conditions - conditions of the bones, joints, muscles and connective tissues, including arthritis, osteoarthritis, osteoporosis and gout.

Chronic pain was found to be a common experience characterising many of these conditions, as reported in a study by Van der Windt et al (2008) and summarised in Table 1.1.

Table 1.1 Percentage of people with condition who experience chronic pain

Condition	Experiences chronic pain (%)
Headache	66.3
Abdominal problems	67.3
Back pain	80.6
Shoulder pain	79.3
Neck pain	76.6
Hand/wrist problems	82.9
Hip/knee problems	54.7
Ankle/foot problems	61.0

Source: adapted from van der Windt et al (2008)

The electronic Persistent Pain Outcomes Collaboration (ePPOC) program measures outcomes in pain services across Australia and New Zealand. The program found that the most common pain site is the back (44.6% of patients), followed by the arm/shoulder and the abdomen, respectively at 10.9% and 10.4% of patients (Tardif et al, 2018). Of people who experienced pain, 42.9% of patients experienced pain for more than five years. The most common precipitating events are reported in Table 1.2.

Table 1.2 Events precipitating pain, Australia 2018

Event	Percentage of people
Injury	36.7
No obvious cause	17.5
Medical condition other than cancer	10.8
After surgery	10.3
Motor vehicle accident	10.2
Cancer	1.6
Other	12.9

Source: Adapted from Tardif et al (2018).

1.3 Comorbidities and associations

Chronic pain particularly affects older people, females, and those with lower socioeconomic status and poorer health status (Andersson et al, 1993; Von Korff et al, 1990). Chronic pain can have an adverse effect on an individual's mood, physical functioning, and social relationships. Individuals with chronic pain can also experience depression, sleep disturbance and fatigue.

Chronic pain and mental health problems, particularly depression, commonly occur together. Major depression in patients with chronic pain is associated with reduced functioning, poorer treatment response and increased health care costs (Karapetyan et al, 2017). High rates of generalised anxiety disorder, post-traumatic stress disorder and substance misuse are also reported in people with chronic pain (Finan et al, 2013). Moreover, suicide is reported to be two to three times higher in those suffering chronic pain compared to the general population, and it is associated with depression (Hooley et al, 2014). This may be due to opioid-related deaths, but there is a lack of research in this area. Multidisciplinary pain management has the potential to reduce these deaths, although further understanding of the patients most at risk is needed.

In a US study using a representative, community-based sample of 1,179 people, Miller and Cano (2009) found that approximately 35% of participants with chronic pain also had depression. Based on analysis of the 2014-15 National Health Survey (ABS, 2015), the prevalence of major depression was found to be 1.6 times higher in those reporting arthritis.

Similarly, Bair et al (2003) conducted a literature review to examine the comorbidity between pain and depression, and found a comorbidity rate of 18% in population-based settings, 27% in primary care clinics, and 52% in pain clinics.

There are several ways that pain and major depression may be associated (Holmes et al, 2013):

- the psychological and physical distress of persistent pain may precipitate an episode of major depression for an individual;
- depression may be a precursor to, and contribute to, an individual's experience of pain by lowering their level of pain tolerance; and/or
- chronic pain and major depression may both be associated with a common underlying process, such as a neurological illness or fibromyalgia.

Tardif et al (2018) also review the most common comorbidities with chronic pain among patients presenting to a pain specialist, and their findings are summarised in Table 1.3. The reported comorbidity for chronic pain and depression or anxiety is estimated at 44.6% of patients, which is within the range of estimated values from the international literature. People who are presenting to a pain specialist are more likely to be experiencing more severe pain, and for this reason, the estimate may not be appropriate to apply to all people with chronic pain.

Table 1.3 Comorbidities associated with chronic pain, Australia 2018

Comorbidity	Percentage of patients
Depression or anxiety	44.6
Osteoarthritis and degenerative arthritis	29.3
High blood pressure	25.1
Diabetes	12.5
Heart disease	8.4
Rheumatoid arthritis	7.3
Ulcer or stomach disease	7.3
Lung disease	5.4
Stroke or neurological condition	5.3
Anaemia or other blood disease	4.7
Cancer	4.3
Kidney disease	3.1
Other medical problems	31.1

Source: Adapted from Tardif et al (2018).

1.4 Treatment pathways

The best way to manage pain is increasingly considered to be holistic and overarching (Painaustralia, 2018b). The International Association for the Study of Pain Taskforce on Multimodal Pain Treatment developed definitions in late 2017 to clarify the various approaches to treating chronic pain:

- **unimodal treatment** is defined as a single therapeutic intervention to resolve pain; for example, the application of exercise treatment by a physiotherapist;
- **multimodal treatment** is defined as the concurrent use of separate therapeutic interventions with different mechanisms of action within one discipline to target pain; for example, the use of opioids by a physician combined with the use of non-steroidal anti-inflammatory drugs and orthosis for pain control by a physician;
- **multidisciplinary treatment** is defined as multimodal treatment provided by practitioners from different disciplines; for example, the prescription of an anti-depressant by a physician alongside exercise treatment from a physiotherapist, and cognitive behavioural treatment by a psychologist. All the professions working separately with their own therapeutic aim for the patient; and
- **interdisciplinary treatment** is defined as multimodal treatment provided by a multidisciplinary team collaborating in assessment and treatment using a shared biopsychosocial model and goals. E.g. the prescription of an anti-depressant by a physician alongside exercise treatment from a physiotherapist, and cognitive behavioural treatment by a psychologist, all working closely together with regular team meetings (face to face or online), agreement on diagnosis, therapeutic aims and plans for treatment and review.

The discipline of pain medicine was recognised as a medical speciality in 2005 and there are currently 316 active fellows of the Faculty of Pain Medicine in Australia. Pain specialists provide holistic care that includes prescribing medication, coordinating rehabilitative services, performing pain relieving procedures, counselling patients and families, directing a multidisciplinary team that often includes psychological and psychiatric services, cooperating with other healthcare professionals, and liaising with public and private agencies (Painaustralia, 2018b).

Pharmacological treatments can be effective in reducing symptoms but are not always necessary and may not be sufficient alone to improve an individual's ability to function. In a sample of Australians presenting to specialist pain management clinics, 56% of patients were taking opioid medication on more than two days per week (Tardif et al, 2018; Blanchard et al, 2017). There are concerns that over-reliance on pharmacological treatments can lead to poorer functional outcomes and substance-related problems (Martell et al, 2007).

Opioids are chemical substances with morphine like attributes that are commonly used for pain relief. Opioids have addiction potential and can cause associated problems of dependence (Schug, 2018).

Opioids are not all the same and can be broken into two categories – conventional opioids and atypical opioids. Atypical opioids differ from conventional opioids as they do not rely exclusively on mu-receptor agonism for their analgesic effect (or pain relief). As a result, they have different effects and different adverse effects including toxicity and abuse potential compared with conventional opioids. With atypical opioids, these differences may result in improved outcomes and reduced risks for individual patients and society as a whole (Schug, 2018).

1.5 Estimating the costs of chronic pain in Australia

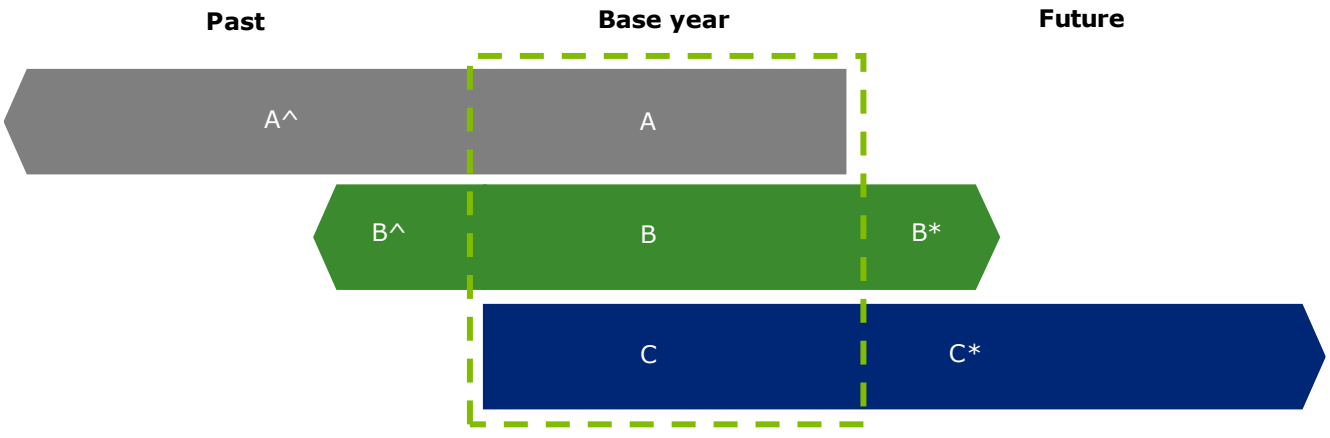
This section describes the approach taken to estimate the costs of chronic pain in Australia, and outlines some of the key economic terms, how costs are borne by members of society, and some of the underlying methodology presented throughout the following chapters. Specific methodologies for each of the costs associated with chronic pain are outlined further in the chapter where they are discussed.

The costs of chronic pain in Australia were estimated for the year 2018 using a prevalence approach to cost estimation. A prevalence approach measures the number of people with chronic pain at a point in time, and estimates the costs incurred due to chronic pain for a given year (e.g. 2018). Figure 1.1 demonstrates the conceptual approach to measuring the cost of chronic pain using a prevalence approach.

- Case a represents someone whose onset of chronic pain occurred in the past and has incurred costs up to the year in question, where the associated lifetime costs include A^ + A.
- Case b represents someone whose onset of chronic pain was in the past and has incurred costs up to the year in question and into the future, where the associated lifetime costs include B^ + B + B*.
- Case c represents someone whose onset of chronic pain occurred in the base year, and they have costs now and in the future, with lifetime costs of C + C^.

Using a prevalence approach, costs in 2018 relating to cases a, b, and c are all included, with total annual cost equal to A, B and C. Costs in all other years are excluded, except for where the cost may be brought forward if a person dies prematurely due to their chronic pain (e.g. lost lifetime earnings).

Figure 1.1 Conceptual approach to measuring annual costs of chronic pain



Source: Deloitte Access Economics.

The broad types of costs associated with chronic pain included in this report are:[3]

- **financial costs to the Australian health system**, which include the costs of running hospitals and residential aged care facilities, GP and specialist services reimbursed through Medicare and private funds,

[3] Cost of illness methodology would typically include administrative costs and other financial costs associated with government and non-government programs such as respite programs, community palliative care, and any out-of-pocket expenses – e.g. formal care, and transport and accommodation costs associated with receiving treatment. These costs were excluded from the scope of the report as it was expected the costs would be relatively minor.

the cost of pharmaceuticals and of over-the-counter medications, allied health services, research and other health system expenditures (such as health administration).

- **productivity costs** which include reduced workforce participation, reduced productivity at work, loss of future earnings due to premature mortality, and the value of informal care (lost income of carers).
- **transfer and other costs** comprise the deadweight losses, or reduced economic efficiency, associated with the need to raise additional taxation to fund provision of government services and the brought forward funeral costs due to premature mortality.
- **wellbeing costs** which are the costs associated with pain, suffering and premature death[4] that result from chronic pain, measured in terms of the years of life (or healthy life) lost using the burden of disease methodology.

The costs of chronic pain are borne by different individuals or sectors of society. Understanding how the costs are shared helps to make informed policy and healthcare decisions regarding interventions. While people with chronic pain are most severely affected by the condition, other family members and society also face costs as a result of chronic pain.

From the employer's perspective, work loss or absenteeism can lead to costs such as higher wages (i.e. accessing skilled replacement short-term labour) or alternatively lost production, idle assets and other non-wage costs. Employers might also face costs such as rehiring and retraining due to premature mortality.

Australian governments typically bear costs associated with the health system and community services (noting there are also out of pocket expenditures and other payers). The analysis in this report shows the first round impacts on government and employers. No second round or longer term dynamic impacts are modelled (i.e. changes in wages or labour market outcomes associated with the economic burden of chronic pain).

Any future costs ascribed to chronic pain for the year 2018 were estimated in net present value terms to reflect the value of utility today rather than in the future. Taking inflation, risk and positive time preference into consideration, a real discount rate of 3% is traditionally used in discounting healthy life, and is also used in discounting other cost streams in this report, for consistency.[5]

It is possible to estimate each of these costs using a top down or bottom up approach. The top down approach provides the total costs of a program element (e.g. the health system). A bottom up approach provides estimates of the number of cases incurring each cost, along with the average cost. The product is the total cost. A top down approach using national datasets can be more desirable to ensure that the sum of parts is not greater than the whole.

In this report, the top down approach has been used to estimate health system costs, which was then validated with bottom up estimates where sufficient data were available. A bottom up approach was used to estimate productivity losses, other financial costs and loss of wellbeing due to chronic pain in Australia.

It is important to note that this report estimates the costs associated with chronic pain. Costs where other underlying conditions (e.g. arthritis) are the cause of chronic pain have been attributed to chronic pain. Similarly, for productivity losses and other financial costs, the costs are associated with chronic pain – for example, the difference in employment rates for people with and without chronic pain were used to estimate the reduced employment costs of chronic pain. Many of the costs of chronic pain will therefore overlap with other health conditions due to both comorbidity and the underlying condition itself (e.g. both depression and arthritis).

1.6 Overview of international cost estimates

Internationally, chronic pain has been found to be a very expensive condition. Gaskin & Richard (2012) found that the total financial costs of chronic pain in the US were $635 billion in 2010 dollars, which was greater

[4] Typically includes premature death, although it was considered that there was insufficient evidence to include mortality due to chronic pain in this study.

[5] Generally, the minimum option that one can adopt in discounting expected healthy life streams is to set values on the basis of a risk free assessment about the future that assumes future flows would be similar to the almost certain flows attaching to a long-term Government bond. Another factor to consider is inflation (price increases), so that a real rather than nominal discount rate is used. If there is no positive time preference, the real long term government bond yield indicates that individuals will be indifferent between having something now and in the future. In general, however, people prefer immediacy, and there are different levels of risk and different rates of price increases across different cost streams.

than the annual costs of heart disease ($309 billion), cancer ($243 billion), and diabetes ($188 billion). After converting to Australian dollars, and adjusting for inflation and population differences, that would translate to $80 billion for Australia in 2018.

These productivity impacts may not all be due to chronic pain directly. In the United States of America (US), prescription opioid misuse – nearly all for pain - caused over $10 billion in absenteeism, presenteeism and participation impacts in 2011 (Birnbaum et al, 2011). As in the US, opioid prescription for chronic pain has increased 15 fold in 20 years in Australia – with no reduction in patient reported pain prevalence (Holliday et al, 2017).

Breivik et al (2013) provides a review of the economic costs associated with pain based on a review of recent studies. They reported that the cost of pain is somewhere between 3% and 10% as a proportion of gross domestic product (GDP), which would be approximately $55.3 billion to $184.2 billion in Australia in 2018.

Liedgens et al (2016) conducted a burden of illness study for neuropathic pain in Europe, covering health system and other financial costs across France, Germany, Italy, Spain and the United Kingdom (UK). In 2018 Australian dollars (adjusted for purchasing power parity and CPI), the cost of neuropathic pain ranged from $22,148 per person in France to $33,504 per person in Germany.

Lalonde et al (2014) undertook an evaluation of the health system and productivity costs associated with chronic non-cancer pain (defined as > six months duration) in primary care patients in Canada. In 2018 Australian dollars, cost of pain was estimated to be $22,790 per person.

2 Prevalence

Pain is arguably the most subjective of physical conditions. As there are no objective diagnostic criteria, there are a number of definitions of chronic pain. The definitions typically vary based on duration, although research has also defined chronic pain based on underlying conditions (e.g. all Australians with arthritis and chronic back pain). Prevalence rates vary substantially according to the definition employed. A targeted literature review was undertaken to estimate the prevalence of chronic pain in Australia.

Key findings

- Chronic pain affects 3.24 million Australians in 2018, of whom 53.8% are women and 68.3% are of working age.
- For the majority (56%) of Australians living with chronic pain, their ability to undertake activities is restricted by their pain.
- The prevalence of chronic pain will increase to 5.23 million people (16.9%) by 2050, with the chronic pain of 2.95 million Australians expected to limit the activities they can undertake.

2.1 Prevalence of chronic pain in Australia

As noted in chapter 1, the International Association for the Study of Pain defines chronic pain as "pain which persists beyond normal tissue healing time, which is assumed to be three months" (Merskey, 1986). In Australia, the ABS' National Health Survey (NHS) defines long-term conditions as those which last six months or longer. However, as Fayaz et al (2016) note, chronic pain prevalence estimates based on a duration of six months or more tend to be considerably lower than those based on a duration of three months or more.

Appendix A provides a brief overview of prevalence sources that were considered for use in this report. Data from Miller et al (2017), who reported on the 2011-12 AHS, were used to inform the prevalence of chronic pain in Australia in 2018. The AHS data was considered to be the most robust, nationally representative source available at the time of writing the report.[6]

While data from Miller et al (2017) were used in this report, it is important to note that the prevalence varies greatly depending on the definition of pain. For example, the prevalence of acute pain is substantially higher than chronic pain, with close to 70% of Australians reporting that they experienced bodily pain during the last four weeks (ABS, 2015).

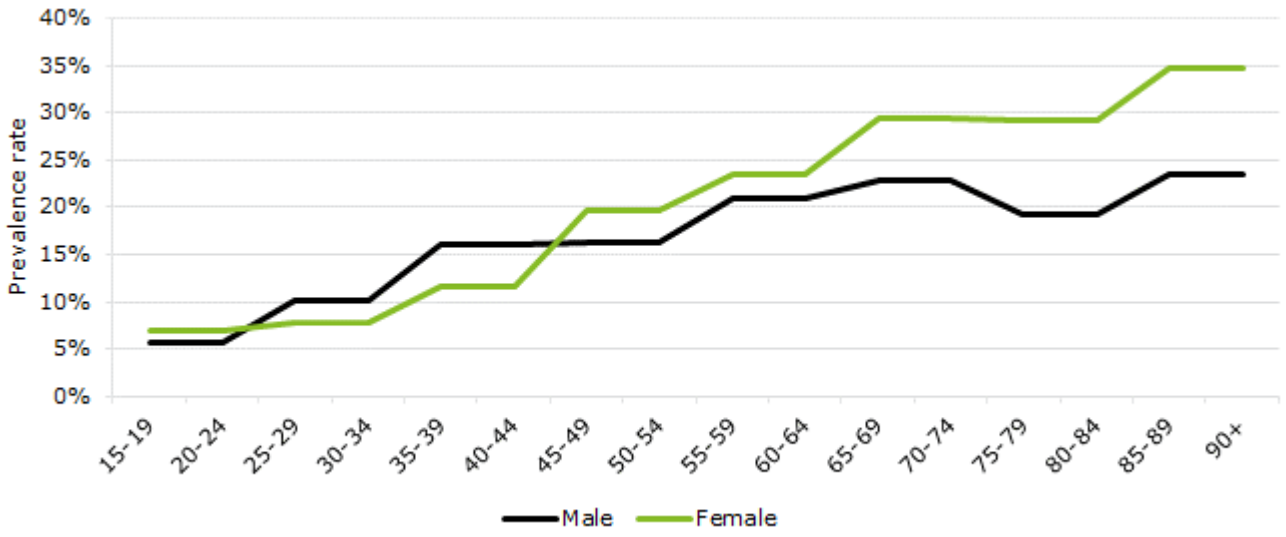
Similarly, the eligible or target population can substantially alter the prevalence estimate. For example, GP cohorts tend to have higher prevalence rates than studies in the community. Henderson et al (2013) estimated that the prevalence of chronic pain in the population of patients attending GPs was 15.7% after adjusting for visit frequency. Fayaz et al (2017) also considered GP cohorts and estimated that the prevalence of chronic pain in the UK was 43% (additional details are supplied in Appendix A). Miller et al (2017) note "differences in inclusion criteria in the study of general practice patients require these results to be considered stand-alone" from general population studies.

2.1.1 Prevalence of chronic pain in 2018

Based on Miller et al (2017) an estimated 12.7% of the Australian population live with chronic pain, increasing to 15.4% in Australians aged 15 years or older. The prevalence of chronic pain increases with age, and is generally higher for women (16.9%) than it is for men (15.0%) for Australians aged older than 15 years.

[6] The 2014-15 National Health Survey also captured data on chronic pain in Australia; however, the data can only be accessed by submitting a special request to the ABS, which could not be made available at this time.

Chart 2.1 Prevalence of chronic pain or discomfort



Source: Miller et al (2017).

Prevalence is comparable between genders until around ages 60-64, where women start to have higher rates of chronic pain compared to men. The AHS does not include data on chronic pain in children, so this report does not consider prevalence for younger cohorts – although there are a range of conditions that still cause chronic pain in children; for example, juvenile arthritis. While the data excludes children, prevalence of chronic pain in this group is reported to be low (ABS, 2016a).

The prevalence rates from the AHS (obtained from Miller et al, 2017), were applied to ABS population data to estimate the total prevalence of chronic pain in Australia. Table 2.1 summarises the prevalence of chronic pain in Australia for 2018 by age and gender group. In Australia in 2018, approximately:

- 3.24 million Australians were living with chronic pain, of whom 1.50 million were male and 1.74 million were female;
- 2.21 million Australians of working age were living with chronic pain, representing slightly more than 68% of all Australians living with chronic pain; and
- 1.03 million older Australians (65 years and over) were living with chronic pain, with rates almost twice as high as the working age population.

Table 2.1 Prevalence of chronic pain, 2018

Age	Prevalence rate (%)			Prevalence ('000s)		
	Male	**Female**	**Person**	**Male**	**Female**	**Person**
15-19	5.7	6.9	6.3	43.8	50.5	94.3
20-24	5.7	6.9	6.3	50.6	58.7	109.3
25-29	10.1	7.8	8.9	93.9	72.8	166.7
30-34	10.1	7.8	8.9	92.8	73.3	166.1
35-39	16.0	11.6	13.8	137.6	100.5	238.1
40-44	16.0	11.6	13.8	127.5	93.6	221.1
45-49	16.3	19.6	18.0	133.9	168.0	301.9
50-54	16.3	19.6	18.0	123.1	153.1	276.2
55-59	20.8	23.4	22.2	156.3	182.9	339.2
60-64	20.8	23.4	22.2	138.0	163.6	301.6
65-69	22.9	29.3	26.2	136.0	181.3	317.3
70-74	22.9	29.3	26.2	114.0	151.2	265.3
75-79	19.3	29.2	24.5	64.2	107.6	171.8
80-84	19.3	29.2	24.7	42.2	77.6	119.8
85-89	23.4	34.7	30.1	29.7	63.7	93.3
90+	23.4	34.7	31.0	15.0	44.8	59.8
Total (15+)	**15.0**	**16.9**	**16.0**	**1,498.5**	**1,743.2**	**3,241.8**

Source: Deloitte Access Economics analysis based on Miller et al (2017).

2.1.2 Projected prevalence of chronic pain in Australia

The prevalence of chronic pain was estimated to increase from 3.24 million Australians in 2018 to 5.23 million people by 2050. It was estimated that 2.39 million Australian men and 2.85 million Australian women would live with chronic pain by 2050.

Given that chronic pain is associated with ageing, it was also estimated that the prevalence would increase over the same period from 16.0% to 16.9% of Australians aged 15 years or older by 2050 (Table 2.2). The projected prevalence of chronic pain by age and gender is shown in Table 2.3.

Table 2.2 Prevalence of chronic pain by gender, number ('000s) and rate (%), 2020 to 2050

Gender	Prevalence (%)				Prevalence ('000s)			
	2020	**2030**	**2040**	**2050**	**2020**	**2030**	**2040**	**2050**
Male (15+)	15.1	15.3	15.4	15.6	1,554.7	1,839.0	2,111.1	2,378.6
Female (15+)	17.0	17.5	17.9	18.2	1,810.7	2,172.8	2,533.3	2,854.7
Person (15+)	**16.1**	**16.4**	**16.7**	**16.9**	**3,365.4**	**4,011.8**	**4,644.4**	**5,233.3**

Source: Deloitte Access Economics analysis based on Miller et al (2017).

Table 2.3 Prevalence of chronic pain by age and gender, 2020 to 2050

Age	Male ('000s)				Female ('000s)			
	2020	**2030**	**2040**	**2050**	**2020**	**2030**	**2040**	**2050**
15-19	44.7	53.5	58.9	62.1	51.4	61.5	67.8	71.5
20-24	50.8	57.3	64.8	68.2	59.2	66.6	75.3	79.2
25-29	94.8	99.1	114.6	124.3	73.4	76.6	88.4	95.7
30-34	95.7	100.6	111.4	123.9	75.6	79.7	87.9	97.4
35-39	147.0	165.0	171.6	195.3	107.3	120.9	125.5	142.2
40-44	131.1	167.2	175.2	192.4	95.9	121.3	127.4	139.3
45-49	134.8	159.1	177.3	184.1	168.7	195.0	218.1	225.9
50-54	126.8	138.9	175.5	183.8	157.5	170.6	213.8	224.2
55-59	158.1	174.9	206.0	229.5	185.1	204.4	235.7	263.0
60-64	144.1	157.7	173.0	218.3	171.3	187.4	203.0	253.6
65-69	140.8	169.0	188.0	221.8	189.5	229.3	253.8	292.8
70-74	121.7	147.5	162.9	179.7	162.2	202.0	222.1	241.1
75-79	70.7	99.2	121.0	135.8	118.9	170.0	207.6	230.8
80-84	46.3	76.1	95.0	106.9	82.9	133.8	169.4	188.2
85-89	30.7	49.6	72.7	91.7	64.6	94.7	139.1	172.7
90+	16.6	24.4	43.2	60.9	47.3	59.0	98.5	137.2
Total (15+)	**1,554.7**	**1,839.0**	**2,111.1**	**2,378.6**	**1,810.7**	**2,172.8**	**2,533.3**	**2,854.7**

Source: Deloitte Access Economics analysis based on Miller et al (2017).

2.2 Severity of chronic pain

The severity of chronic pain felt by those experiencing it is believed to drive the need for care, including care and treatment pathways. For example, Lalonde et al (2014) found that total health care and productivity costs increase as the level of disability increases due to pain. Similarly, a person with chronic pain who is limited in activities (e.g. mobility, self care, or work) is much more likely to need assistance with informal care, and to be out of the workforce, than someone who is not limited in activities.

The severity classification of chronic pain considered within this report has been based on the Survey of Disability, Ageing and Carers (SDAC), which includes two levels of chronic pain. These are:

- has chronic or recurrent pain or discomfort, and is limited in activities; and
- has chronic or recurrent pain or discomfort, but is not limited in activities.

In the SDAC, 57.1% of people with chronic pain report that their pain limits the activities that they can undertake. The severity generally increases with age (with the exception of younger age groups, such as those below 20 years old).

In the 2011-12 AHS, 69.5% of Australians with chronic pain report moderate to very severe pain in the last 4 weeks, with 27.7% and 2.7% reporting very mild to mild pain and no pain, respectively (Miller et al, 2017). These rates are reasonably comparable with the SDAC measure, although moderate to very severe pain is slightly higher than for people reporting any limitations due to their pain (57.1%).

Severity of pain is also commonly reported using CPG scores and self-rated measures of severity. Blyth et al (2003) reported that 37.1%, 33.5%, 15.3% and 14.1% were grade I through grade IV, respectively. These distributions are also similar to the severity of pain in Australians presenting to a GP with chronic pain; Henderson et al (2013) observed 25.2%, 37.1%, 28.3% and 9.4% in each grade, respectively. It is noted that

reported pain is likely to be more severe among people presenting to a GP compared to people in the general population as chronic pain may influence the decision to seek care.

Table 2.4 Distribution of chronic pain severity in Australian community and GP cohorts

Source	Grade I (%)	Grade II (%)	Grade III (%)	Grade IV (%)
Henderson et al, 2013	25.2	37.1	28.3	9.4
AIHW[7], 2010	23.6	37.8	29.6	9.0
AIHW, 2009	26.7	36.5	27.2	9.7
AIHW, 2008	30.6	37.2	25.5	6.6
AIHW, 2006	30.0	37.0	23.2	9.8
Elliot et al, 1999	48.7	24.4	11.1	15.8
Blyth et al, 2003	37.1	33.5	15.3	14.1

Source: as noted.

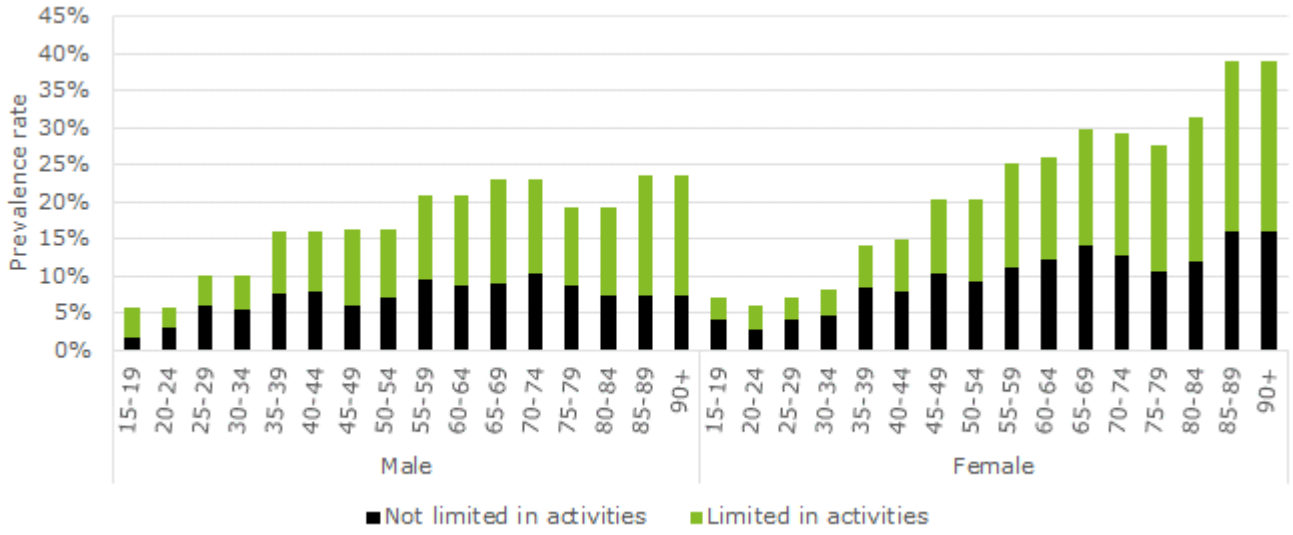
The severity of pain differs by age and gender. Elliot et al (1999) report age and gender distributions separately for a cohort of people presenting to GPs with chronic pain in the UK. In their data, they found that 18% of people aged 25 to 34 years old with chronic pain were either grade III or grade IV compared to 44% of people aged 75 years or older with chronic pain. Similarly, females were more likely to report more severe pain, with 29% reporting grade III or grade IV compared to 24% of males with chronic pain.

The severity distribution from the SDAC (ABS, 2016a) was applied to the rates from Miller et al (2017) to estimate the prevalence of chronic pain by severity in Australia. Chart 2.2 summarises the prevalence of chronic pain in Australia for 2018 by age, gender and severity group. In Australia in 2018:

- 1.45 million Australians were living with chronic pain, but were not limited in the activities they could undertake;
- 1.80 million Australians were living with chronic pain, and were limited in the activities they could undertake; and
- the rate of chronic pain that is limiting for Australians was similar for males and females – approximately 55% for both groups.

[7] Australian Institute of Health and Welfare.

Chart 2.2 Severity of chronic or recurring pain in Australia



Source: Deloitte Access Economics analysis based on ABS (2016).

The severity of chronic pain was expected to reduce slightly over the period to 2050, with 2.95 million Australians expected to be limited in the activities they can take part in by 2050, compared to 1.80 million Australians today. However, the proportion of Australians living with chronic pain that limits their activities was expected to increase from 7.2% to 7.9% by 2050.

Table 2.5 Prevalence by severity, 2018 to 2050

Severity	Prevalence ('000s)					Prevalence (%)				
	2018	**2020**	**2030**	**2040**	**2050**	**2018**	**2020**	**2030**	**2040**	**2050**
Not limited in activities	1,446.2	1,500.1	1,772.2	2,037.0	2,284.6	5.8	5.8	5.9	6.0	6.1
Limited in activities	1,795.5	1,865.4	2,239.6	2,607.4	2,948.7	7.2	7.2	7.5	7.7	7.9
Total	**3,241.8**	**3,365.4**	**4,011.8**	**4,644.4**	**5,233.3**	**13.0**	**13.0**	**13.4**	**13.8**	**14.0**

Source: Deloitte Access Economics.

2.3 Regional analysis

Across Australia, there is considerable variation in the prevalence of chronic pain. These differences were explored in detail in the SDAC where the prevalence of chronic pain was adjusted for differences across states/territories and greater capital city versus balance of state (defined using the ABS' Greater Capital City Statistical Areas, or GCCSA), age and gender.

The prevalence of chronic pain was lower in the Northern Territory (NT), Western Australia (WA) and the Australian Capital Territory (ACT) compared to New South Wales (NSW) (the reference state), while South Australia (SA) had higher prevalence of chronic pain. These relationships existed even when adjusting for demographic differences of the underlying populations. Similarly, the prevalence of chronic pain was higher in regional areas (defined using GCCSA) compared to capital cities, even when adjusting for demographic differences of the underlying populations.

2.3.1 Prevalence of chronic pain by jurisdiction and remoteness area

For the geospatial analysis, rates by age and gender were applied to differences in the underlying demographics to estimate prevalence by region. Appendix A provides more detail on the methodology used to

estimate the prevalence of chronic pain in each region (nationally, states/territories, urban/regional, and for Commonwealth Electoral Divisions).

The prevalence by state/territory and remoteness area are shown in Table 2.6. In 2018:

- NSW was estimated to represent close to one third (32.0%) of all cases of chronic pain, followed by VIC (25.5%) and QLD (19.9%), largely in line with the larger underlying population in those areas; and
- 65.6% of Australians with chronic pain live in urban areas compared to 34.4% in regional areas. This divide was expected to increase to 70.3% by 2050.

Table 2.6 Prevalence by state/territory and remoteness area

Location	Prevalence ('000s)					Prevalence (%)				
State/territory	**2018**	**2020**	**2030**	**2040**	**2050**	**2018**	**2020**	**2030**	**2040**	**2050**
NSW	1,038.0	1,070.1	1,234.3	1,385.9	1,519.0	13.1	13.2	13.6	14.0	14.2
VIC	825.8	857.7	1,025.5	1,191.2	1,344.2	12.9	13.0	13.4	13.8	14.1
QLD	645.1	673.7	823.9	973.7	1,117.8	12.8	12.9	13.3	13.6	13.8
SA	238.5	244.5	274.7	300.4	320.0	13.6	13.7	14.1	14.5	14.6
WA	341.0	361.1	470.5	588.4	708.8	12.6	12.6	13.0	13.4	13.8
TAS	73.6	75.1	82.1	86.4	87.9	14.0	14.2	14.7	15.1	15.3
NT	28.3	29.5	35.4	41.5	47.4	11.2	11.2	11.6	11.9	12.0
ACT	51.6	53.8	65.4	77.0	88.2	12.3	12.4	12.8	13.1	13.4
Remoteness area										
Urban	2,126.2	2,215.8	2,696.2	3,193.2	3,679.1	12.6	12.7	13.0	13.4	13.7
Regional	1,115.5	1,149.6	1,315.5	1,451.2	1,554.2	13.7	13.8	14.4	14.8	15.0
Total	**3,241.8**	**3,365.4**	**4,011.8**	**4,644.4**	**5,233.3**	**13.0**	**13.0**	**13.4**	**13.8**	**14.0**

Source: Deloitte Access Economics analysis.

2.3.2 Prevalence by Federal electorate

The regional model was also used to estimate the prevalence of chronic pain for each Commonwealth Electoral Division now, and into the future.

Table 2.7 summarises the top 10 electorates in terms of total prevalence, which is driven by both underlying age and gender rates, and the size of each electorate. Sydney (NSW) was estimated to have the most Australians living with chronic pain in 2018, followed by Sturt (WA) and Bruce (VIC). There are some differences to the top electorates over time, with Bruce (VIC) moving higher and Sturt (SA) declining. Data for all electorates is available in Appendix B.

Table 2.7 Top 10 electorates by prevalence in 2018

Electorate	Prevalence ('000s)					Prevalence (%)				
	2018	2020	2030	2040	2050	2018	2020	2030	2040	2050
Sydney, NSW	26.2	27.1	32.6	37.6	42.2	11.9	11.9	11.9	11.9	11.9
Sturt, SA	25.6	26.1	29.1	31.6	33.5	14.0	14.0	14.4	14.7	14.9
Bruce, VIC	25.3	26.5	32.0	37.5	42.7	12.6	12.7	13.3	13.8	14.1
Reid, NSW	24.9	26.0	31.6	36.9	41.7	12.5	12.6	13.0	13.3	13.5
Moncrieff, QLD	24.8	25.8	31.2	36.5	41.6	13.7	13.8	14.3	14.7	15.0
Adelaide, SA	24.8	25.5	29.0	31.8	34.0	13.1	13.1	13.3	13.4	13.4
Hotham, VIC	24.8	25.8	30.9	36.0	40.8	13.0	13.0	13.5	13.9	14.1
Grey, SA	24.7	25.2	27.4	29.1	30.3	14.1	14.2	14.7	15.2	15.5
Boothby, SA	24.6	25.1	28.2	30.7	32.5	14.1	14.1	14.4	14.6	14.6
Cowper, NSW	24.5	25.0	27.1	29.1	30.9	15.0	15.2	16.2	17.2	18.1
Australia	**3,241.8**	**3,365.4**	**4,011.8**	**4,644.4**	**5,233.3**	**13.0**	**13.0**	**13.4**	**13.8**	**14.0**

Source: Deloitte Access Economics analysis.

Table 2.8 summarises the top 10 electorates in terms of prevalence rates, which is driven by both underlying age and gender rates. Lyne (NSW) was estimated to have the most Australians living with chronic pain in 2018 relative to the size of its population, followed by Gilmore (NSW) and Richmond (NSW). It was expected that Gilmore (NSW) will overtake Lyne (NSW) with the highest rate of prevalence by 2050.

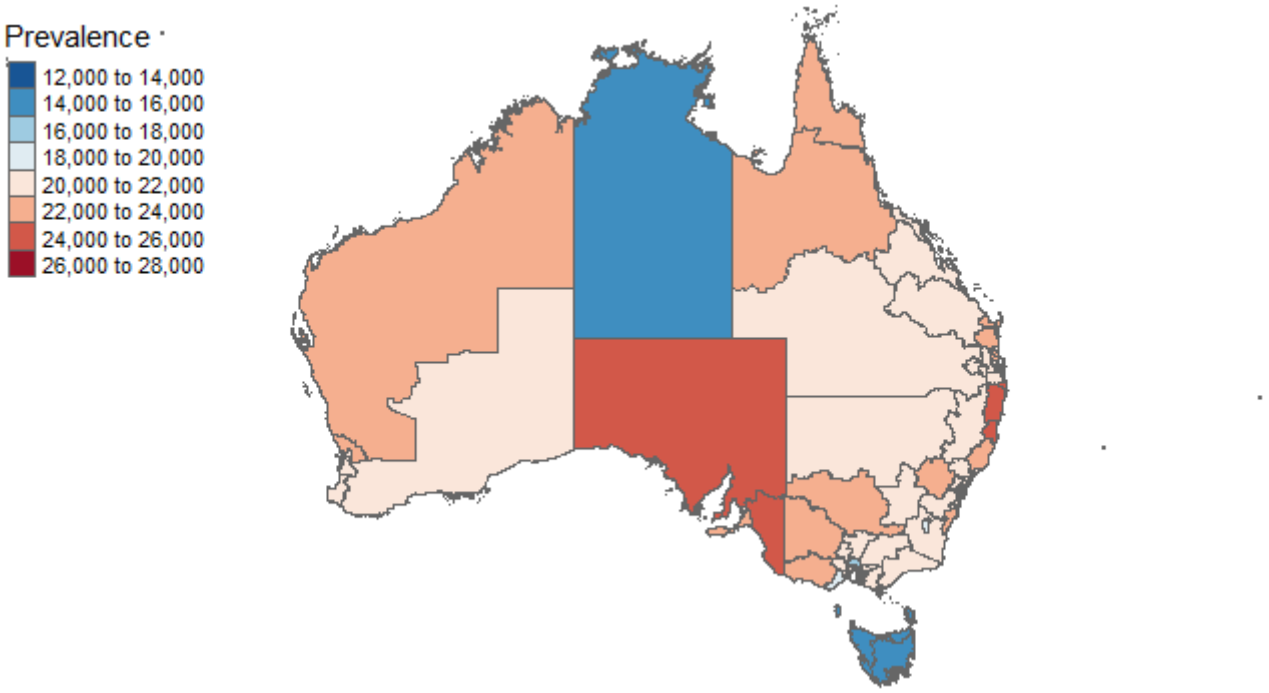
Table 2.8 Top 10 electorates by prevalence rate in 2018

Electorate	Prevalence ('000s)					Prevalence (%)				
	2018	2020	2030	2040	2050	2018	2020	2030	2040	2050
Lyne, NSW	23.1	23.6	25.9	28.2	30.2	15.6	15.8	16.9	17.9	18.7
Gilmore, NSW	23.8	24.1	25.5	27.0	28.5	15.6	15.9	17.0	18.2	19.2
Richmond, NSW	24.2	24.7	27.1	29.5	31.6	15.2	15.3	16.2	17.1	17.8
Flinders, VIC	22.2	23.1	27.1	31.1	34.8	15.1	15.3	16.0	16.8	17.4
Wide Bay, QLD	22.7	23.5	27.8	32.1	36.3	15.0	15.2	16.2	17.1	17.8
Cowper, NSW	24.5	25.0	27.1	29.1	30.9	15.0	15.2	16.2	17.2	18.1
Hinkler, QLD	22.5	23.4	27.9	32.4	36.7	15.0	15.1	15.9	16.6	17.1
Page, NSW	24.0	24.4	26.5	28.4	30.0	14.7	14.9	15.9	16.9	17.8
Monash, VIC	21.1	21.6	24.2	26.9	29.4	14.6	14.8	15.8	16.9	17.8
Mayo, SA	23.7	24.1	26.5	28.6	30.2	14.4	14.5	14.9	15.3	15.5
Australia	**3,241.8**	**3,365.4**	**4,011.8**	**4,644.4**	**5,233.3**	**13.0**	**13.0**	**13.4**	**13.8**	**14.0**

Source: Deloitte Access Economics analysis.

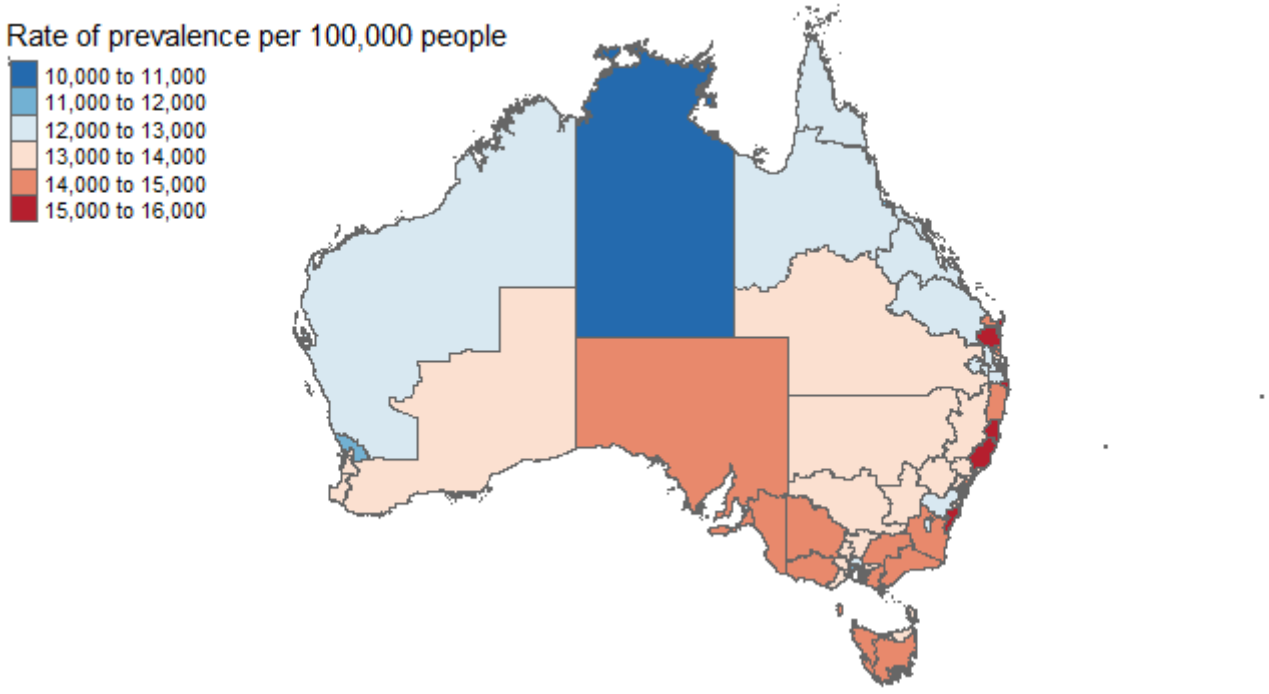
Figure 2.1 and Figure 2.2 provide maps showing the prevalence (number and %) of chronic pain across each electorate in Australia.

Figure 2.1 Prevalence of chronic pain by electorate in 2018



Source: Deloitte Access Economics analysis.

Figure 2.2 Prevalence of chronic pain per 100,000 population by electorate in 2018



Source: Deloitte Access Economics analysis.

3 Health system costs

Health system costs comprise the costs of running hospitals, GP and specialist services funded through Medicare and patient contributions, the cost of prescribed and over-the-counter pharmaceuticals, allied health services, research, residential aged care services, and 'other' costs such as health administration.

Health system costs in Australia are primarily paid for by governments, with individuals and their families contributing through out-of-pocket payments. Private health insurers and other payers (e.g. worker's compensation) also pay for health services.

Chronic pain is not limited to any one of the broad conditions included within the International Classification of Disease – Tenth Revision (ICD-10), and is instead associated with a range of the conditions. As such, it was not possible to estimate the cost of chronic pain as a condition in its own right and a top down approach was followed using data from the AIHW, consistent with the methods in Access Economics (2007).

Triangulation was conducted using a bottom up approach, where data permitted, including for the estimation of expenditure on GP services, pain specialists and other allied health professionals, surgical interventions, research, and pharmaceuticals. The summary of the triangulations is presented in Appendix A.

Regional based analysis was also conducted to add commentary on the variation in health care by region, including both presentation rates to GPs associated with chronic pain and the management practices of GPs. The management practices reviewed include the frequency with which medications were prescribed, imaging referrals and medical specialist referrals.

The following sections provide an overview of the health system costs due to chronic pain in Australia for 2018.

Key findings

- In 2018, $12.2 billion was spent on health care services associated with chronic pain in Australia, which represented 6.5% of total expenditure.
- Australians living with chronic pain paid $2.7 billion, or 22.1% (out-of-pocket) to manage their chronic pain, while Australian governments paid $7.9 billion, or 66.7%.
- Australians in rural and remote areas tend to experience higher rates of medication prescription and higher rates of pain management, likely due to higher prevalence rates and decreased access to appropriate pain management interventions.
- GPs in remote Medicare locals were less likely to refer Australians living with chronic pain to another health professional – the highest rates were recorded for metropolitan areas (18%), followed by regional areas (16%), and rural areas (13%).

3.1 Health system costs of chronic pain

The AIHW publishes information on allocated health system expenditure, including admitted patient hospital services, out-of-hospital medical services, prescription pharmaceuticals, optometric and dental services, community mental health services, and public health cancer screening. The most recent publically-available data was published for the 2008-09 financial year, and is organised by broad condition group based on ICD-10 classifications. In the ICD-10, chronic pain diagnoses are not systematically represented. The ICD-11 will be the first version to include chronic pain as a condition, where it is classified as chronic primary pain (chronic pain itself) or chronic secondary pain (pain that is a symptom of another underlying condition). In the coming years, increased use of this coding system, particularly in hospitals, will better define expenditure.

For this report, it was assumed that chronic pain is the main reason that people seek health care, which is driven by a range of underlying causes. By making this assumption, it is possible to associate health system expenditure incurred by Australians with chronic pain to their underlying condition.

To estimate health system expenditure associated with chronic pain, the following approach was used:

- first, the cost of all relevant broad conditions were estimated and converted to per person terms for 2018;
- next, the causes of pain and prevalent number of chronic pain cases were estimated for each broad condition group; and
- the allocated health system expenditure associated with chronic pain were estimated as the sum of health system costs for each condition multiplied by the number of people experiencing chronic pain within each condition; and
- adjustments were then made to include health expenditure components that were excluded from the AIHW disease expenditure series relied upon for this report – for example, other health practitioners, community health services, public health services, patient transport services, aids and appliances, administration, research, and aged care.

Additional details on the methods to estimate total health expenditure due to chronic pain are outlined in Appendix A.3.

3.1.1 Allocated and unallocated health expenditure associated with chronic pain

To estimate the allocated health expenditure associated with chronic pain in 2018, the cost of ICD-10 conditions per person (estimated in Appendix A.3) were multiplied by the number of prevalent cases of chronic pain associated with each condition (Appendix A.3). The total allocated health expenditure associated with chronic pain was estimated to be $6,475.2 million (Table 3.1).

Table 3.1 Allocated health system costs associated with chronic pain, Australia 2018

Condition	Cost of condition per person ($)	Cases with chronic pain	Costs ($m)
Injury	1,212	1,231,865	1,493.0
Cancer	18,813	51,868	975.8
Musculoskeletal	1,291	779,896	1,006.8
Mental health/behavioural	2,478	36,274	89.9
Gastrointestinal	4,463	33,251	148.4
Neurological	3,067	21,160	64.9
Infection	18,420	18,137	334.1
Circulatory (cardiovascular)	2,880	21,160	60.9
Genitourinary	6,907	18,137	125.3
Endocrine/hormonal	1,296	6,046	7.8
Respiratory	1,012	6,046	6.1
No clear reason/don't know	2,124	1,017,910	2,162.2
Total		**3,241,750**	**6,475.2**

Source: Deloitte Access Economics analysis based on AIHW (2014), ABS (2015), Institute for Health Metrics and Evaluation (2018).

The AIHW (2013) does not include expenditure on other health practitioners, community health services, public health, dental services, capital items, all non-benefit-paid pharmaceuticals, patient transport services, aids and appliances, administration and research. As such, it is necessary to adjust the allocated expenditure to account for these other health services. Using data from the AIHW (2018), it was estimated that the components included in AIHW (2013) account for 54.6% of total health expenditure, while 45.4% of total health expenditure was unallocated.

Thus, the allocated expenditure was multiplied by (1/0.546) to estimate total health system expenditure associated with chronic pain. It was estimated that an additional (unallocated) $5,386.8 million were spent on health services for chronic pain in Australia in 2018.

The allocated health system costs reported by the AIHW also does not incorporate an estimate of expenditure on residential aged care. Therefore the cost of residential care attributable to chronic pain has been separately estimated, since for many older people the need to manage such chronic pain is a precipitating risk factor for entry to such care.

Due to limitations in publically-available data in 2018 on those admitted to residential aged care attributable to chronic pain, it was assumed that the amount of residential aged care expenditure relative to allocated health system costs has remained the same as in the Access Economics (2007) report. Applying the proportion (5.6%) to allocated health system expenditure ($6,475.2 million) provided an estimated cost of $363.3 million for residential aged care associated with chronic pain.

A final note is that, due to aged care reforms, community care has increased relative to residential aged care, so this estimate is interpreted to be a conservative estimate of all aged care costs attributable to chronic pain.

3.1.2 Total health system and aged care costs associated with chronic pain

The total health system expenditure associated with chronic pain comprise an allocated component, an unallocated component, and aged care (Table 3.2). The total health system and aged care expenditure associated with chronic pain for Australia was estimated to be $12,225.3 million in 2018.

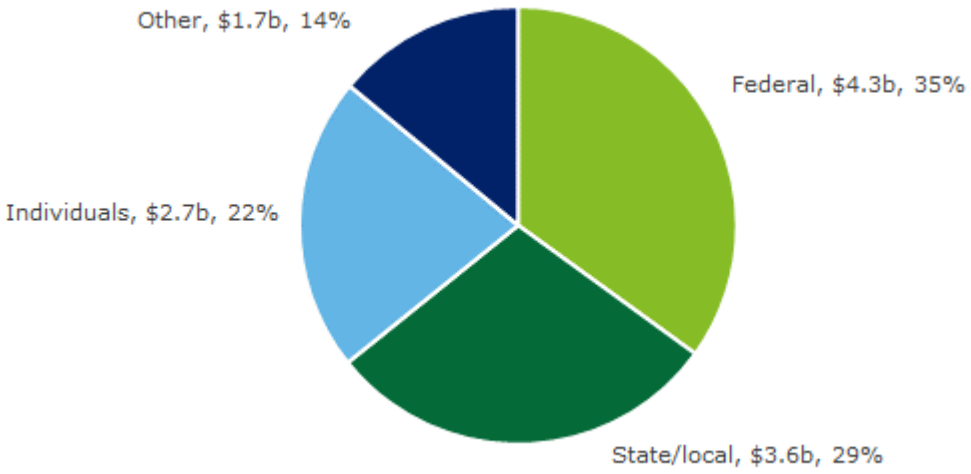
Table 3.2 Overall health system and aged care expenditure for chronic pain, Australia 2018

Category	Costs ($m)
Allocated expenditure	6,475.2
Unallocated expenditure	5,386.8
Total expenditure	11,862.0
Aged care	363.3
Total expenditure plus aged care	**12,225.3**

Source: Deloitte Access Economics analysis.

The proportion of health system and aged care costs incurred by each payer were derived from the AIHW's health expenditure series and the Aged Care Financing Authority (2017) annual report. Table 3.3 shows health system and aged care expenditure associated with chronic pain by type of cost and source of funds. This information is also presented in Chart 3.1.

Chart 3.1 Costs of chronic pain by source of funds, Australia 2018



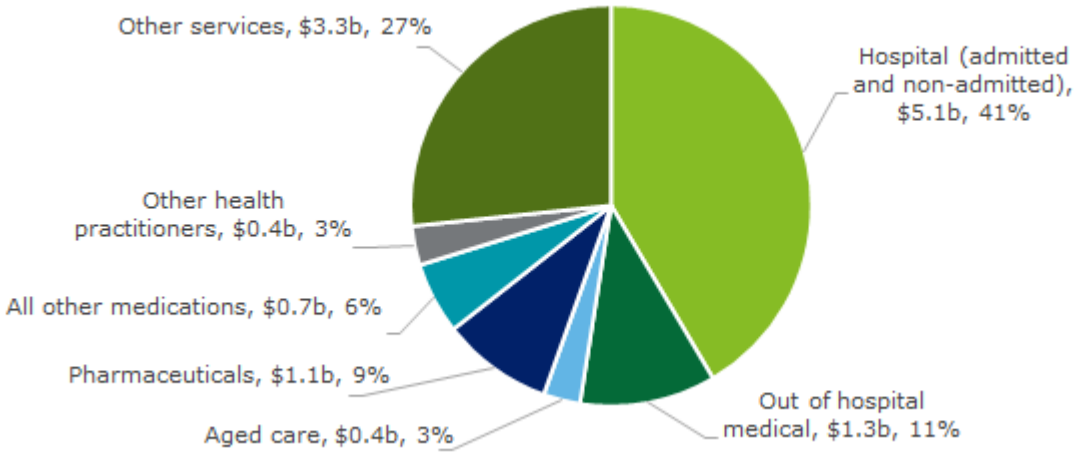
Source: Deloitte Access Economics analysis.

Table 3.3 Health system and aged care costs of chronic pain by type of cost and source of funds, Australia 2018, $ millions

Component	Federal	State/local	Individuals	Other	Total
Hospital	1,379.1	1,528.9	175.3	652.3	3,735.6
Out of hospital medical	712.3	241.2	254.4	133.3	1,341.2
Aged care	252.2	-	96.8	14.2	363.3
Other services	114.6	0.3	124.5	64.0	303.5
Pharmaceutical	552.8	-	536.8	5.3	1,095.0
Conventional opioids	203.0	-	110.6	-	308.6
*Atypical opioids**	110.6	-	39.8	-	150.3
Other medications	239.3	-	391.4	5.3	636.0
Unallocated	1,263.9	1,806.5	1,474.1	842.2	5,386.8
Non-admitted hospital services	*282.0*	*354.8*	*18.8*	*39.9*	*695.5*
Other health practitioners	*145.7*	*0.4*	*158.3*	*81.4*	*385.8*
Community health and other	*69.3*	*495.6*	*16.4*	*14.2*	*595.4*
Public health	*87.4*	*87.7*	*1.4*	*10.1*	*186.6*
All other medications	*45.0*	-	*654.1*	*7.4*	*706.5*
Dental services	*103.3*	*57.0*	*399.0*	*132.4*	*691.6*
Patient transport services	*20.8*	*190.8*	*29.2*	*21.8*	*262.6*
Aids and appliances	*57.8*	-	*195.3*	*55.5*	*308.6*
Administration	*152.1*	*60.8*	*1.5*	*100.1*	*314.6*
Research	*294.2*	*57.8*	*0.2*	*24.3*	*376.5*
Capital expenditure	*6.3*	*501.6*	-	*355.0*	*863.0*
Total	**4,275.0**	**3,577.0**	**2,662.0**	**1,711.4**	**12,225.3**

Source: Deloitte Access Economics analysis. Note: 'other services' refer to allocated expenditure on services such as cancer screening and community mental health, which are not elsewhere included; 'community health and other' refer to unallocated expenditure on population-based health initiatives such as prevention programs. 'all other medications' refer to non-prescribed medications that are not covered by the Pharmaceutical Benefits Scheme (PBS). * includes expenditure on buprenorphine, tapentadol and tramadol.

Chart 3.2 Costs of chronic pain by type of cost, Australia 2018



Source: Deloitte Access Economics analysis.

3.2 Regional analysis of health care for chronic pain

Recent evidence has suggested that health care varies widely across regions for Australians with chronic pain. The management practices of GPs have an important impact on the patient's overall quality of life, and any differences in management practices may have substantial effects on the patient's health outcomes and experience of chronic pain. Due to the nature of publically-available data, most of the commentary in this section uses arthritis and chronic back pain as a proxy for chronic pain.

The analysis in this section has been based on the AIHW's (2018) My Healthy Communities, which reports a range of health service data for Medicare Local areas.[8]

Pain management practices are summarised by state and territory and by remoteness in Table 3.4. The highest rates of referrals for imaging and to other health practitioners were observed in the ACT, while the lowest rates were observed in TAS. Medications were most commonly prescribed to manage pain in TAS.

Table 3.4 GP pain management practices by state and territory, Australia 2018

	Australia	Urban*	Regional*	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
Number of GPs per 100,000 population	96.5	101.2	93.8	100.1	98.2	101.2	99.6	78.9	89.1	77.8	72.9
Pain managed at consult^ (%)	5.1	4.7	5.4	5.1	5.2	4.8	5.2	5.2	7.0	4.0	4.0
Medication (%)	68.4	67.6	69.1	68.8	68.4	68.2	67.8	65.7	74.0	-	65.0
Referral (%)	14.9	14.7	15.1	15.4	13.9	15.8	14.3	14.0	11.0	-	19.0
Imaging (%)	13.5	13.4	13.7	14.5	11.6	13.8	11.8	14.3	12.0	-	16.0

Source: Deloitte Access Economics analysis based on AIHW (2018). * Urban and regional classifications were defined using the ABS' GCCSA, except for number of GPS per 100,000 population, where urban and regional was defined using the ABS' remoteness area structure (urban refers to major cities of Australia, and regional to all other areas). ^ Percentage of GP consultations in which arthritis or chronic back pain was managed.

The following sections explore variations in pain management practices in greater detail.

[8] For the purposes of regional mapping, data from the Social Health Atlases of Australia (Phidu, 2018) were used to map Medicare Local areas to ABS regions, which were then converted to electorates.

3.2.1 GP presentations for chronic pain

The number of presentations for chronic pain varies widely based on geographic location, with an overall presentation rate estimated at 18.5% of all GP encounters in 2018 (Henderson et al, 2013). Data presented by the AIHW (2018) reports that among Australians who visit the GP at least once in a year, the percentage of people who had arthritis, chronic back pain or both of these conditions ranged from 16% to 18% in metropolitan areas, 20% to 21% in regional areas, and 16% to 20% in rural areas.

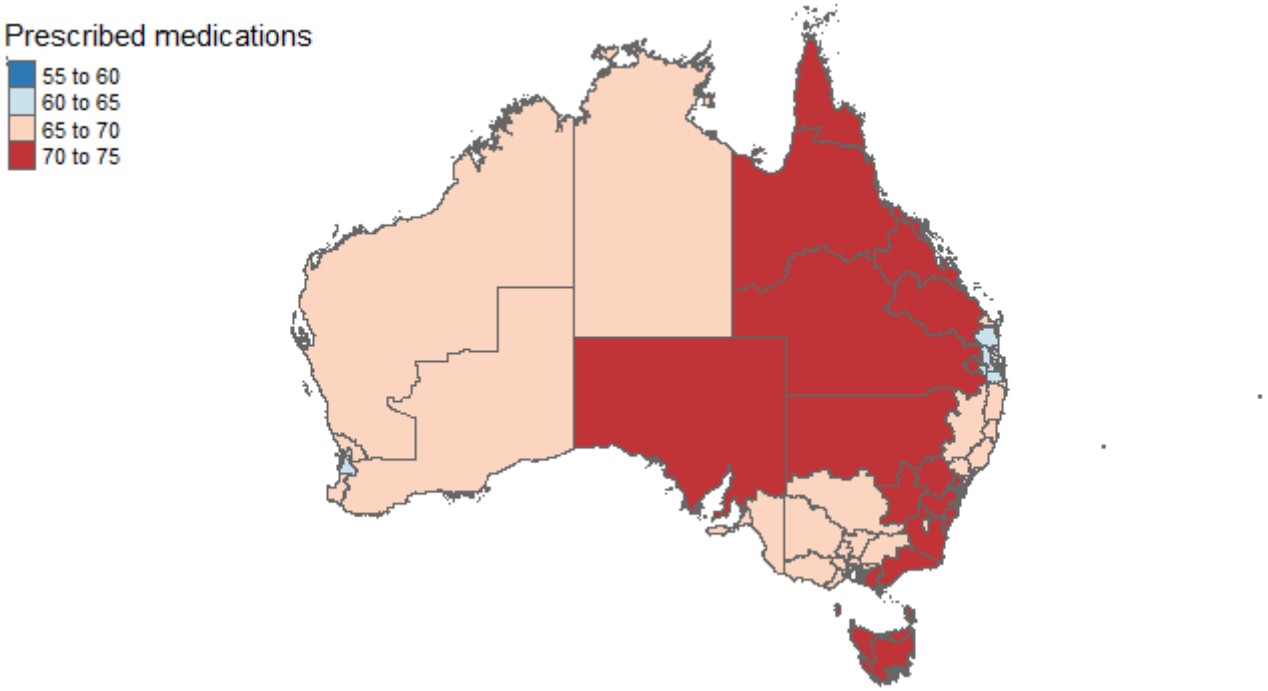
Differences in these rates by location may in part be explained by the availability of GPs in an area – for example, there are more GPs available in major cities (101.2 GPs per 100,000 Australians) compared with 61.4 GPs per 100,000 Australians in very remote areas (Department of Health, 2018).

3.2.2 GP management

GPs manage arthritis or chronic back pain in about one-fifth of all consultations. Within GP presentations, common forms of pain management included prescribing a medication, referral for diagnostic imaging, and referral to a medical specialist.

Nationwide, medications were used to manage chronic pain in an average 68.4% of GP consultations involving someone attending for pain management. In terms of Medicare Local regions, the highest rates were experienced in rural areas (72%), followed by regional areas (68%) and with the lowest rates recorded in metropolitan areas (65%).

Figure 3.1 Proportion of encounters where medications were prescribed and chronic pain was managed, by electorate

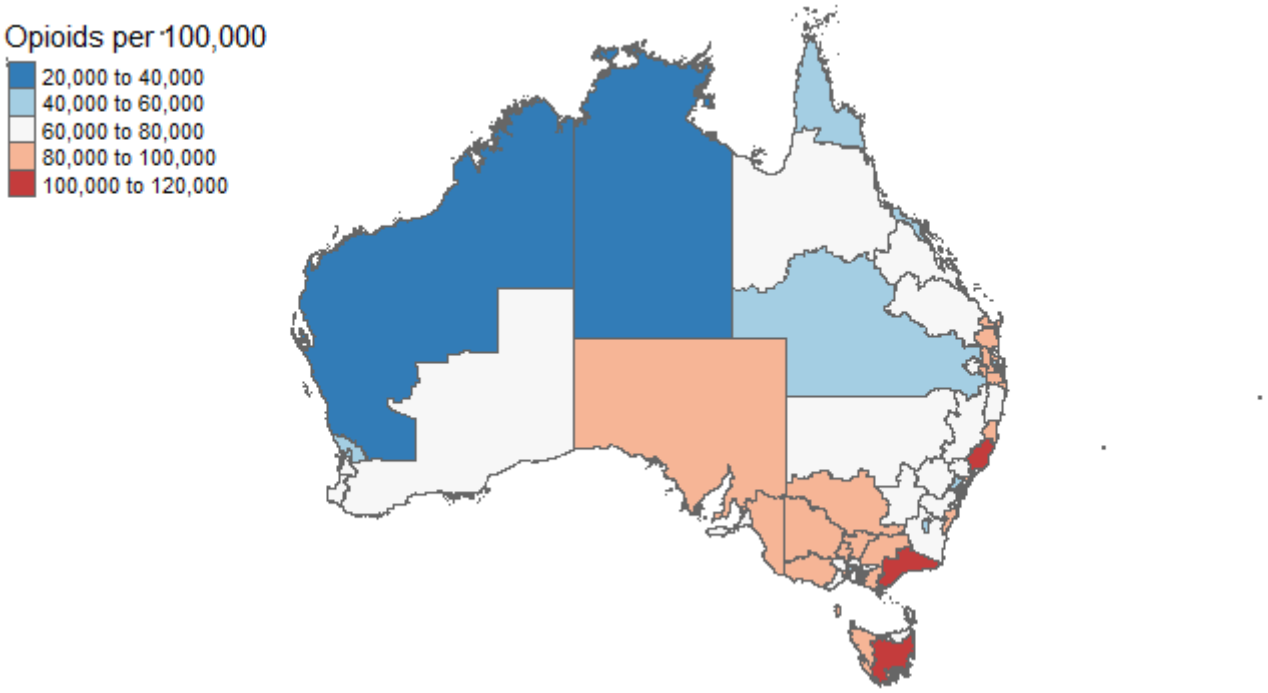


Source: Deloitte Access Economics analysis based on AIHW (2018).

The number of opioid prescriptions across Australia were estimated based on data supplied by the Australian Commission on Safety and Quality in Health Care (2015).

The national age standardised prescription rate per 100,000 people was found to be 55,481. This was highest in TAS (73,981) and SA (64,538). The lowest rates were recorded in the NT (38,504) and the ACT (45,580). Geographically, the lowest rate was found for remote locations (41,043) which was 26.0% below the national average. The low rate of prescribing for remote areas may be a function of lower levels of GP presentations in these areas.

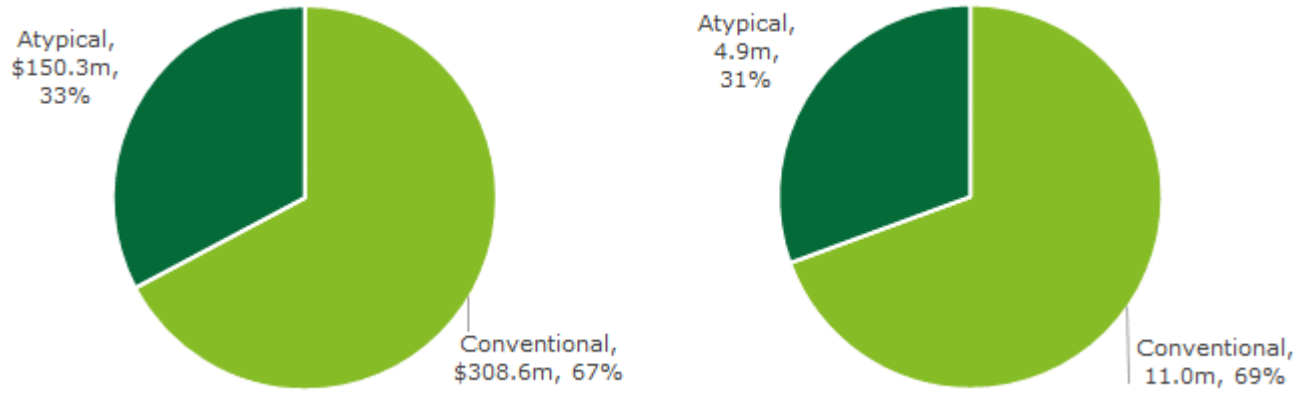
Figure 3.2 Opioid prescriptions per 100,000 population by electorate, 2013-14



Source: Deloitte Access Economics analysis based on the Australian Commission on Safety and Quality in Health Care (2015).

Nationally, data from the Department of Health (2018b) show that approximately 67% of expenditure on opioids across all clinical settings, rather than just for chronic pain, is for conventional opioids such as codeine, oxycodone, morphine and fentanyl. The remaining 33% is for atypical opioids, including tramadol, buprenorphine and tapentadol. The same data show that there were 11.0 million prescriptions for conventional opioids and 4.9 million prescriptions for atypical opioids as shown in Chart 3.3.

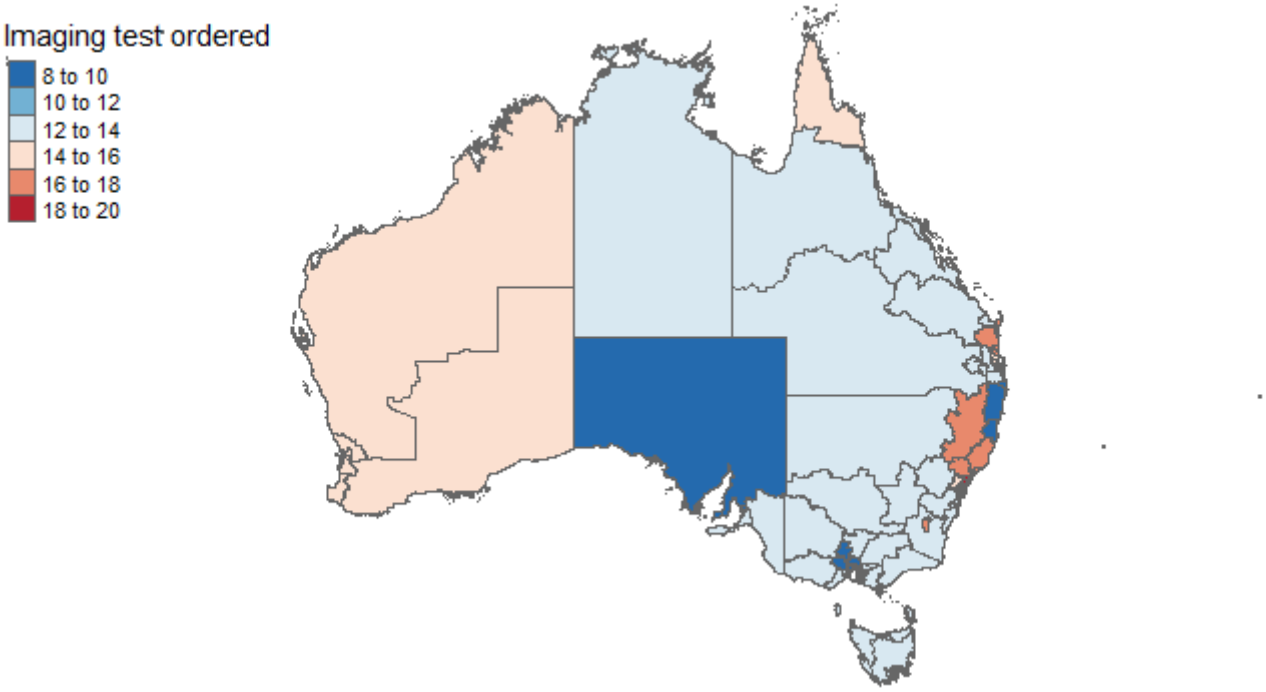
Chart 3.3 Expenditure (LHS) and prescriptions (RHS) for typical and atypical opioids in Australia, 2018



Source: Department of Health (2018b).

On average, 1 in 7.4, or 13.5% of patients who presented to a GP across Australia were referred for diagnostic imaging. Analysis for Medicare Local Regions reflects a mixed trend with little obvious deviation across geographic stratification. In both regional and capital city areas, the average imaging referral rate across states and territories ranged between 12% and 16%; however, there was greater variability in pain management in regional areas.

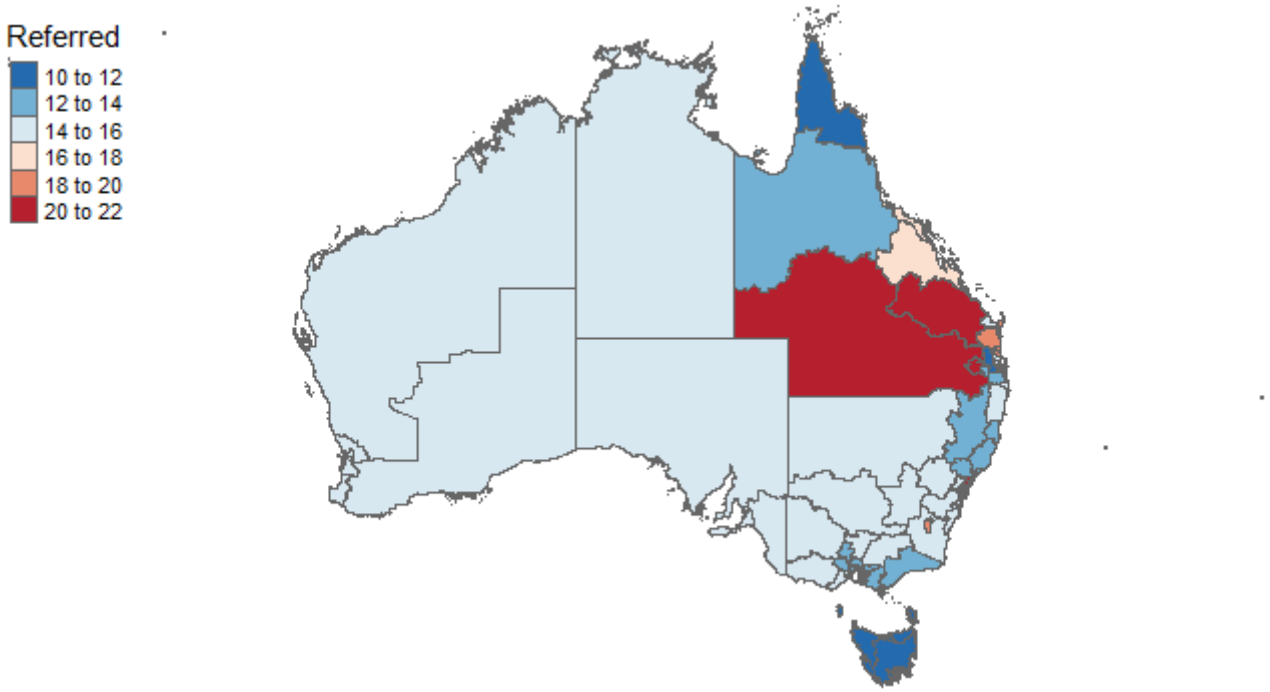
Figure 3.3 Proportion of encounters where imaging tests were ordered and chronic pain was managed, by electorate



Source: Deloitte Access Economics analysis based on AIHW (2018).

Referral to another health professional took place in an average of 14.9% of GP consultations in which chronic pain was managed – or 1 in 6.7 consultations. Referrals were generally highest in capital city areas, recording a rate on average 0.17% higher (or 1.6% higher in relative terms). For Medicare Local regions, there was a consistent trend in referrals to a health professional declining as regions became more remote – the highest rates were recorded for metropolitan areas (18%), followed by regional areas (16%), and finally the lowest rates were in rural areas (13%).

Figure 3.4 Proportion of people referred to another health professional where chronic pain was managed, by electorate

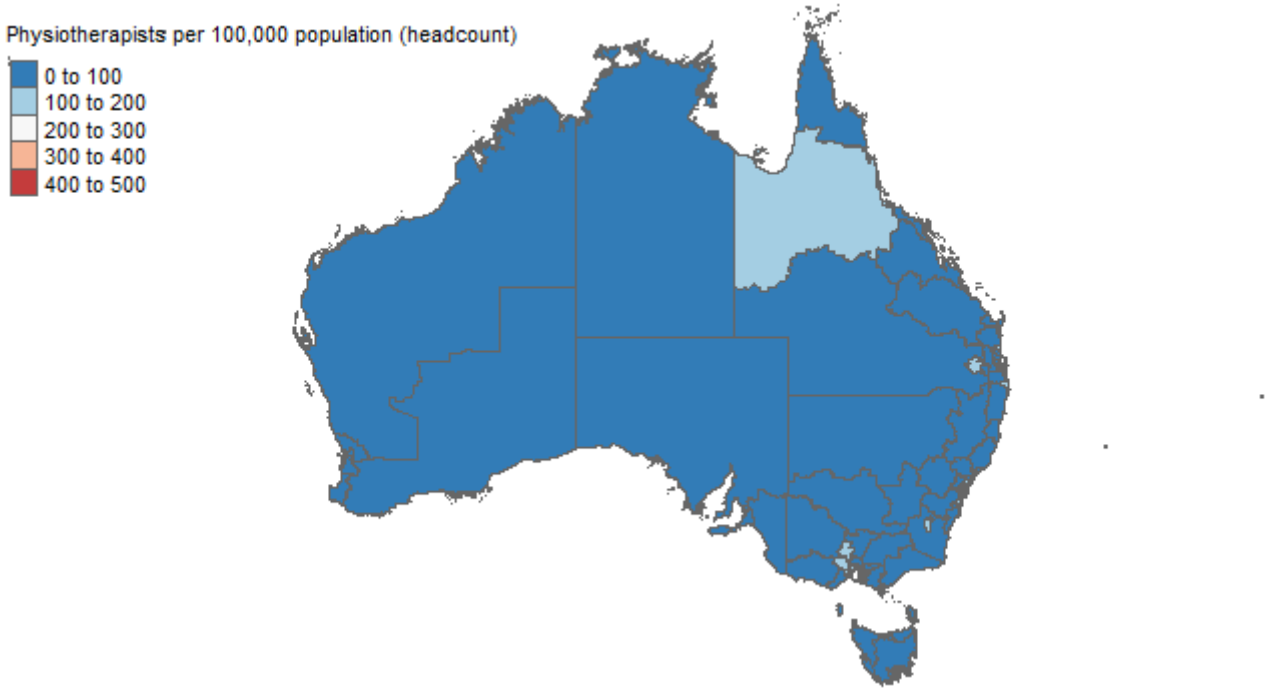


Source: Deloitte Access Economics analysis based on AIHW (2018).

3.2.3 Access to allied health professionals

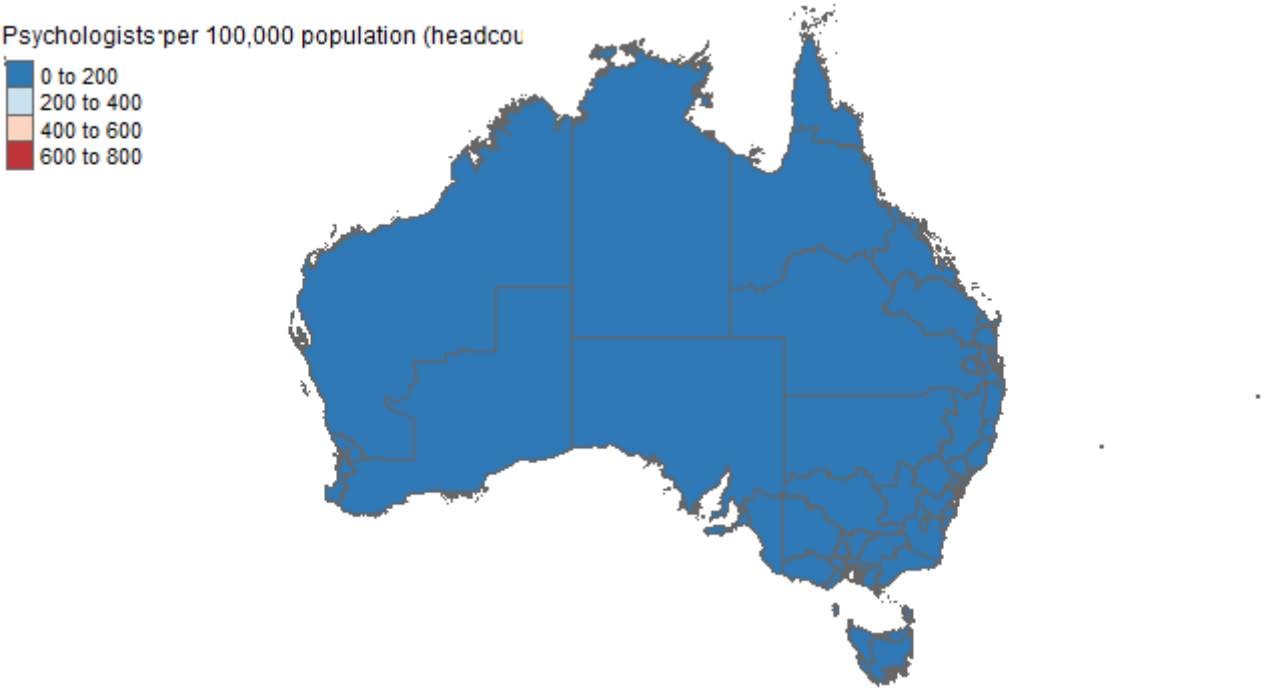
Management practices are also likely influenced by the availability of allied health professionals in a given area. While it was not possible to associate these data with utilisation of service by people with chronic pain, regional areas tend to have lower availability of physiotherapists per capita than urban areas as shown in Figure 3.5. Similarly, regional areas tend to have lower availability of psychologists per capita than urban areas as shown in Figure 3.6.

Figure 3.5 Availability of physiotherapists in 2016, by electorate



Source: Deloitte Access Economics analysis based on Department of Health (2017).

Figure 3.6 Availability of psychologists in 2016, by electorate



Source: Deloitte Access Economics analysis based on Department of Health (2017).

3.2.4 Summary of pain management practices

Pain management practices vary across Australia. Australians living in rural and remote areas tend to experience higher rates of medication prescription and higher rates of pain management – the latter reflecting higher prevalence rates in regional areas.

The analysis revealed two clear trends: (1) Australians living in locations with higher opioid utilisation per capita were referred to other health professionals less frequently, and (2) Australians living in locations with higher referral rates per consultation where pain was managed had greater access to other health professionals (e.g. physiotherapists and psychologists), which was also associated with lower opioid utilisation per capita. More research is needed to confirm which factors most strongly predict care pathways, and how outcomes for Australians living with chronic pain are different by location. For example, reduced access to pain centre services in rural areas (Hogg et al, 2012) may directly influence opioid prescribing and allied health access issues in rural areas.

4 Other financial costs

This chapter sets out the approach used to estimate other financial costs of chronic pain in Australia including, productivity losses, informal care costs, costs of aids and modifications, welfare, and efficiency losses that result from increased taxation rates. These other financial costs are outlined in the following sections.

Key findings

- The cost of chronic pain is not limited to the health system – other financial costs totalled $61.0 billion in 2018.
- Productivity losses associated with chronic pain were estimated to be $48.3 billion, or on average $21,830 for every Australian (15-64 years old) living with chronic pain.
- Productivity losses account for 79% of other financial costs associated with chronic pain in Australia in 2018, which was followed by deadweight losses (13%), informal care (7%) and aids and modifications (1%).
- Australians living with chronic pain bore 39% of these other financial costs, followed by government (29%), employers (15%), society (12%) and their families (5%).

4.1 Productivity costs

Chronic pain has a negative impact on an individual's wellbeing, ability to function, ability to engage in work and engage with their families, friends and communities.

The productivity costs of pain are significant in terms of reduced workforce participation, absenteeism and presenteeism.

A human capital approach was adopted to estimate the productivity losses associated with chronic pain in Australia. The human capital approach involves calculating the difference in employment or production between people with chronic pain and that of the general population, multiplied by average weekly earnings (AWE).

The four potential productivity losses associated with chronic pain include:

- reduced workforce participation, which is classified as early retirement or other workforce withdrawal;
- temporary absenteeism where a worker may be unwell more often and required to take time off work, while remaining in the workforce;
- presenteeism, or lower productivity at work, where a worker produces less due to lower capacity to work; and
- premature mortality, where a person who dies early due to chronic pain would no longer receive future income streams (in discounted net present value terms).

4.1.1 Reduced workforce participation

Chronic pain may result in reduced employment either through disadvantages in job-seeking (for example difficulty in searching for work or keeping a job due to frequent absences) or self-selection out of the labour force. This can lead to significant productivity losses in the form of lost wages and other costs to the individual, such as reduced social engagement. For example, Turk (2002) reports that one in eight unemployed people in the UK state that their unemployment was due to back pain.

A scan of relevant literature was conducted to estimate the impact of chronic pain on workforce participation.

- Langley et al (2010) estimated the impact of pain on labour market status using data from the 2008 National Health and Wellness Survey conducted in the UK, France, Spain, Germany and Italy. The survey comprised 53,524 people with and without pain, and respondents were asked to indicate the cause of their pain. Langley et al (2010) reported on employment impacts for people who had mild, moderate and severe pain over a one-month period, after excluding some respondents who only had conditions that may

represent acute pain. Langley et al (2010) found that severe daily pain reduced the probability of being employed full time by 19.8 percentage points (from 42.6% to 22.8%). The level of reduced participation was found to increase with the level of pain experienced – for example, people with mild, moderate and severe daily pain were 0.918 (not significant), 0.612 and 0.350 times as likely to participate in the labour force as people without pain. On average, 40.4% of people with pain were employed compared to 50.6% of people without pain.[9] Langley et al (2010) also provided data on the impact of chronic pain on absenteeism and presenteeism (discussed in sections 4.1.2 and 4.1.3).

- Blyth (2001) used survey data from 17,496 people in the 1998 NSW Health Survey. On average, 42.4% of people with chronic pain were employed compared to 55.7% of people without chronic pain. It was found that chronic pain was associated with an 11.9 and 1.4 percentage point decrease in full time and part time work, respectively. These rates were not adjusted for sociodemographic variables such as age, gender or income.
- McNamee (2014) used the Household, Income and Labour Dynamics in Australia Survey (2000-2010) (sample size of approximately 90,000 observations) to show differences in employment rates between those with and without chronic pain. On average, 32.0% of people with chronic pain were employed compared to 67.0% of people without chronic pain. These rates were not adjusted for sociodemographic variables.
- The SDAC (ABS, 2016a) also records the labour force status of people with and without chronic pain in Australia. In the SDAC, approximately 53.6% of people of working age (defined as 15-64 years old) with chronic pain are employed compared to 76.7% of people without chronic pain. From analysis of the underlying data, it was estimated that chronic pain is associated with a 30.1% reduction in employment, which was slightly higher for men than for women. The impact of chronic pain was also assessed by age and gender (Chart 4.1).

Results from these studies are summarised in Table 4.1.

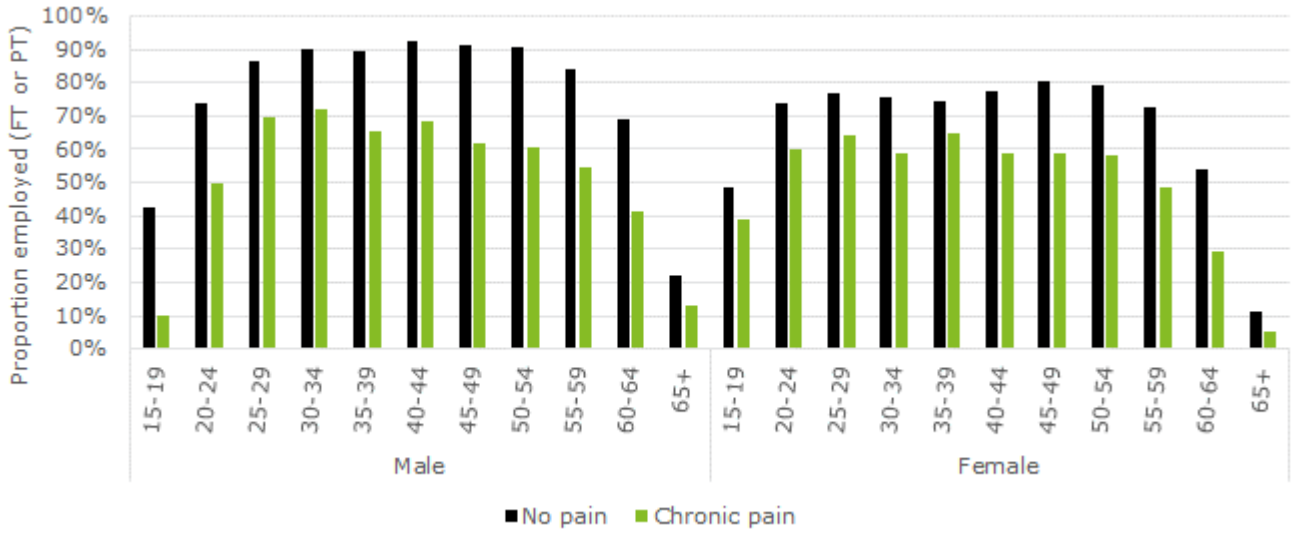
Table 4.1 Employment status for people with and without chronic pain

Source	Chronic pain (%)			No chronic pain (%)			Relative reduction (%)		
	FT	**PT**	**Total**	**FT**	**PT**	**Total**	**FT**	**PT**	**Total**
Langley et al (2010)	34.9	5.6	40.4	44.5	6.1	50.6	-21.7	-9.0	-20.2
Blyth et al (2001)	30.9	11.5	42.4	42.8	12.9	55.7	-27.8	-10.9	-23.9
McNamee et al (2014)	-	-	32.0	-	-	67.0	-	-	-52.2
ABS (2016)*	33.0	20.7	53.6	51.8	24.9	76.7	-36.4	-16.9	-30.1
Average^	**32.9**	**12.6**	**42.1**	**46.4**	**14.6**	**62.5**	**-28.6**	**-12.3**	**-31.6**

Source: as noted. FT = employed full time; PT = employed part time; Total = employed full time or part time. * the employment gap (-23.1%) is consistent with the SDAC surveys conducted by the ABS in 2003 (-23.3%), 2009 (-22.0%), and 2012 (-24.0%). ^ the average total employment rate does not equal the sum of the FT and PT rates as data were not available in McNamee et al (2014).

[9] Langley et al (2010) removed some conditions that may be acute by nature – for example, Langley et al (2010) removed respondents who indicated they had only experienced menstrual pain, migraine, dental pain or headache in the one-month period. Although chronic pain is formally defined as pain which has lasted at least 3 months, the definition used in Langley (2010) (pain lasting at least 1 month) is likely to be more conservative for estimating reduced employment associated with chronic pain. Pain levels (severe, moderate, mild) have been self-reported. Langley (2010) controls for age, gender, education level, income level, body mass index, current smoker status, alcohol use, and Charlson comorbidity index.

Chart 4.1 Employment rates of Australians with and without chronic pain



Source: Deloitte Access Economics analysis of the ABS (2016).

To estimate the costs of reduced employment associated with chronic pain the relative reduction in employment was derived from the SDAC using age and gender specific rates. The relative reduction was then applied to Australian general population employment rates (ABS, 2018a) and AWE (ABS, 2018b) by age and gender. Reduced employment associated with chronic pain was estimated to cost $36.2 billion in 2018, or $16,338 per working age Australian living with chronic pain.

4.1.2 Absenteeism

Australians with chronic pain may be temporarily absent from paid employment due to their pain. Absenteeism is measured as the average number of days per year that an employee takes off work as a result of their chronic pain.

A targeted literature review was conducted to estimate the impact of chronic pain on absenteeism.

- Langley et al (2010) estimated the impact of chronic pain on absenteeism using the Work Productivity Activity and Impairment Scale.[10] It was found that mild, moderate and severe daily pain were associated with a 1.202, 2.735 and 8.429 times greater odds of absenteeism relative to no pain respectively, after controlling for a range of covariates such as age, sex, race, education and annual income.[11] On average, it was estimated that people with pain lost an additional 5.1% of work time compared to people without pain.
- Stewart et al (2003) estimated the impact of chronic pain on absenteeism using data from the 2001-2002 American productivity survey of 28,902 working adults in the US. Stewart et al (2003) found that people with conditions of chronic pain[12] were absent for an extra 1.12 hours in the two weeks preceding the study

[10] The Work Productivity Activity and Impairment Scale measures presenteeism using the question: "during the past seven days, how much did your problem affect your productivity while you were working?". The questionnaire also provides the following guidance: "think about days you were limited in the amount or kind of work you could do, days you accomplished less than you would like, or days you could not do your work as carefully as usual". Due to the question, it was assumed that the presenteeism impact only applies on days people worked with pain, which was derived based on the NSA pain study.

[11] Langley (2010) reports odds ratios from an ordered logistic regression with the estimated percentage of worktime lost in the last 7 days due to ill health as the dependent variable. The odds ratios can be combined with the average productivity loss from the no pain group to approximate the impact of productivity by severity; however, deriving the estimates based on the odds ratios provided results that were higher than the average level impact from the unadjusted model. This unintuitive result may be due to missing data on some people, or the estimation approach used by Langley (2010). As such, the unadjusted model from Langley et al (2010) has been used in this report.

[12] Conditions included arthritis, back and other musculoskeletal conditions, but excluded pain due to headaches.

interview after controlling for a number of covariates such as age, sex, race, education and annual income. The additional hours corresponds to 3.2% of worktime in a week for the average employee.[13]

- Kawai et al (2017) conducted a community-population study of people in Olmsted County, Minnesota – a region in the US with a population of approximately 150,000 people. Kawai et al (2017) reported on data from 591 people with chronic pain and 150 without chronic pain. On average, people with chronic pain were absent from work for an additional 0.74 hours per week – 0.99 hours per week compared to 0.25 hours per week – which equates to 2.1% of potential work time.
- Blyth et al (2003a) used data from the NSA Pain Study and estimated that chronic pain is associated with 9.8 days of absenteeism per year for men and 8.2 days for women – an average of 9.0 days per year, which equates to 3.7% of potential work time.

The findings from the literature are summarised in Table 4.2. On average, Australians with chronic pain were estimated to be absent from work for an additional 8.6 days per year compared to people without chronic pain.[14]

Table 4.2 Absenteeism due to chronic pain

Source	Proportion of worktime lost (%)	Days lost per week	Days lost per year
Langley et al (2010)	5.1	0.24	12.3
Kawai et al (2017)	2.1	0.10	5.1
Blyth et al (2003a)	3.7	0.17	9.0
Stewart et al (2003)	3.2	0.15	7.8
Average	**3.6**	**0.16**	**8.6**

Source: Deloitte Access Economics analysis.

To estimate the costs of absenteeism associated with chronic pain the average additional days absent from work was then applied to Australian general population employment rates and AWE by age and gender. Additional costs were also included for management time associated with the absence from work and the overtime premium to maintain work output.[15] Absenteeism associated with chronic pain was estimated to cost $3.2 billion in 2018, or $1,433 per working age Australian living with chronic pain.

4.1.3 Presenteeism

Presenteeism refers to reduced productivity while an employee is at work, but suffering from pain. Presenteeism is measured as the average number of hours per day that an employee loses to reduced performance or impaired function as the result of their condition. Presenteeism is not as easily measured as absenteeism, but it has the potential to incur significant costs to employers by reducing the quality and efficiency of work produced by employees.

A targeted literature review was conducted to estimate the impact of chronic pain on presenteeism.

- Langley et al (2010) estimated the impact of chronic pain on presenteeism using the Work Productivity Activity and Impairment Scale. It was found that mild, moderate and severe daily pain were associated with 1.879, 3.493 and 7.319 times greater odds of absenteeism relative to no pain respectively, after controlling for a range of covariates such as age, sex, race, education and annual income. On average, it was estimated that people with pain lost an additional 11.6% of work output compared to people without pain.

[13] Based on the average weekly hours worked per week in Australia, which is approximately 34.66 hours per week.
[14] Previously Access Economics (2007) had used data from the Northern Sydney Area Pain Study (1998) as analysed in Blyth et al (2003a) to estimate the impact of chronic pain on absenteeism. However, due to the significant uncertainty in estimates, an extremely conservative approach was taken and absenteeism was excluded from the analysis. Given that more recent estimates have substantially lower uncertainty (and much larger samples), the average across all studies has been used in this report.
[15] On average, the costs of manager time and the overtime premium increase the cost of absenteeism by 58% compared to AWE alone.

- Stewart et al (2003) estimated the impact of chronic pain on presenteeism using the 2001-2002 American productivity survey. Stewart et al (2003) found that people with conditions of chronic pain reported that their productivity while at work was reduced by 4.19 hours in the two weeks preceding the interview compared to people without chronic pain after controlling for a number of covariates such as age, sex, race, education and annual income. The reduction in hours equates to 12.1% of work time.
- Kawai et al (2017) conducted a community-population study of people in Olmsted County, Minnesota. Kawai et al (2017) reported on data from 591 people with chronic pain and 150 without chronic pain. On average, the productivity of people with chronic pain was reduced by 2.94 hours compared to people without chronic pain, which equates to 8.5% of potential work time.
- Blyth et al (2003a) using data from the Northern Sydney Area Pain Study and estimated that chronic pain is associated with 11.9 days of reduced productivity (presenteeism) in a six-month period, which equates to 9.9% of potential work time.

The estimates of the impact of pain on productivity from these studies are summarised in Table 4.3.

Table 4.3 Presenteeism due to chronic pain

Source	Proportion of worktime lost (%)	Days lost per week	Days lost per year
Langley et al 2010	11.6	0.53	27.9
Kawai et al 2017	8.5	0.39	20.4
Blyth 2003	9.9	0.46	23.8
Stewart 2003	12.1	0.56	29.1
Average	**10.5**	**0.49**	**25.3**

Source: Deloitte Access Economics analysis.

To estimate the costs of presenteeism associated with chronic pain the average additional reduction in productivity while at work was then applied to Australian general population employment rates and AWE by age and gender. Presenteeism associated with chronic pain was estimated to cost $9.0 billion in 2018, or $4,059 per working age Australian living with chronic pain.

4.1.4 Productivity losses associated with chronic pain

Productivity losses for people with chronic pain were estimated to be $48.34 billion. Of the productivity losses, reduced employment accounted for $36.18 billion (75%), and absenteeism and presenteeism accounted for $3.17 billion (6%) and $8.99 billion (19%), respectively. The magnitude of these costs are large, and highly impactful for people with chronic pain. On average, productivity losses were estimated to be $14,912 per person with chronic pain, or $21,830 per working age (15-64 years) person with chronic pain. The results are shown in Table 4.4.

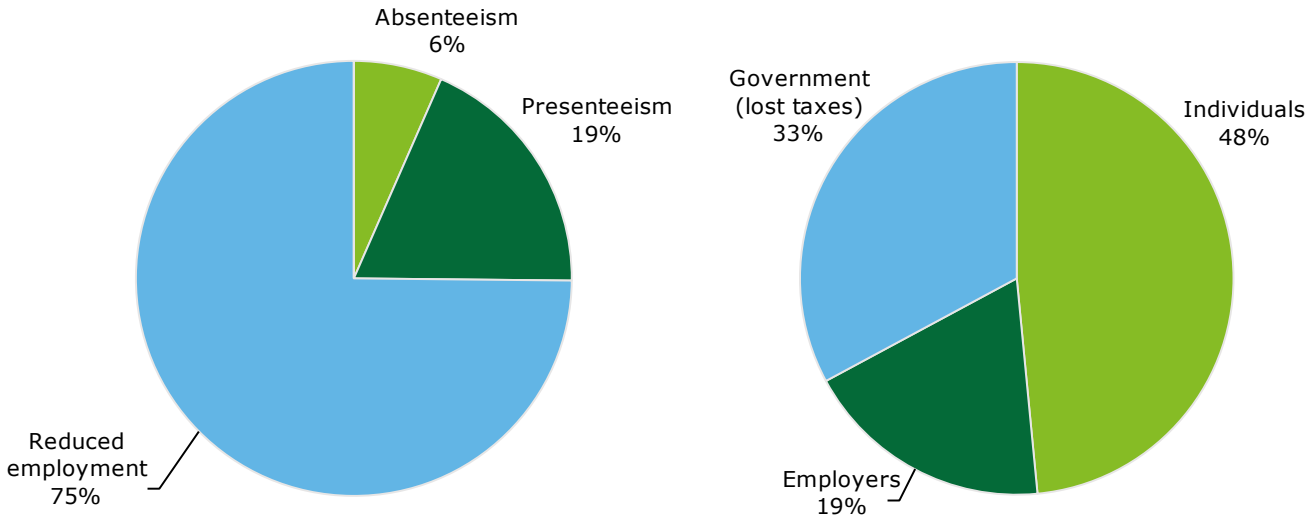
Table 4.4 Productivity costs associated with chronic pain

Component	Cost ($bn)	Cost per person ($'000s)	Cost per person of working age ($'000s)
Reduced employment	36.18	11,161	16,338
Absenteeism	3.17	979	1,433
Presenteeism	8.99	2,773	4,059
Total	**48.34**	**14,912**	**21,830**

Source: Deloitte Access Economics.

Of the total costs, 48% is borne by individuals, 33% is borne by government and 19% is borne by employers as shown in Chart 4.2.

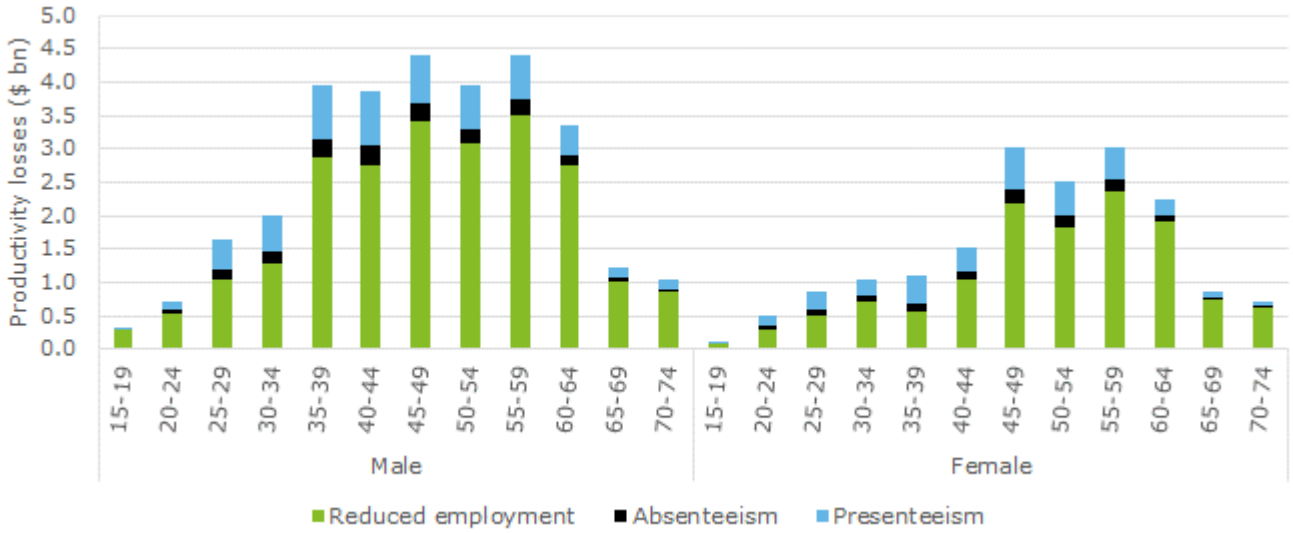
Chart 4.2 Productivity costs by component (LHS) and payer (RHS)



Source: Deloitte Access Economics analysis.

The productivity costs by age, gender and component are shown in Chart 4.3. The relative costs of chronic pain associated with absenteeism and presenteeism are generally higher in younger age groups – reflecting the lower impact of reduced employment in young ages. That said, the costs of reduced employment make up more than 50% of the productivity costs for each group.

Chart 4.3 Productivity costs by age, gender and component



Source: Deloitte Access Economics analysis.

4.2 Informal care costs

Carers are people who provide care to others in need of assistance or support. An informal carer provides this service free of charge and does so outside of the formal care sector. An informal carer will typically be a family member or friend of the person receiving care, and usually lives in the same household as the recipient of care. People can receive informal care from more than one person.

While informal carers are not paid for providing this care, informal care is not free in an economic sense. Time spent caring involves forfeiting time that could have been spent on paid work, or undertaking leisure time

activities. As such, informal care can be valued as the opportunity cost associated with the loss of economic resources (labour) and the loss in leisure time valued by the carer. To estimate the dollar value of informal care, the opportunity cost method measures the formal sector productivity losses associated with caring, as time devoted to caring responsibilities is time which cannot be spent in the paid workforce.

To estimate the costs of informal care for Australians with chronic pain, it was necessary to estimate the proportion of people with chronic pain receiving support from an informal carer, and also the additional hours of care that are provided to Australians with chronic pain.

The SDAC is the best available source on informal care provision available in Australia. The average care requirement for those with chronic pain requiring care was 28.5 hours, compared to an average care requirement of 15.9 hours in the comparator group (people requiring care, but without disabilities caused by chronic pain and no known health conditions).[16] Using this data, it was estimated that 12.9% of people with chronic pain receive informal care from a primary carer. For people receiving informal care for chronic pain, it was estimated that an additional 12.6 hours of care is provided each week (654 hours annually), which is equivalent to 274 million hours of care.

Informal carers were assumed to have approximately the same age and gender distribution as the person with chronic pain. This assumption is important in valuing the carer's opportunity cost of time, which was calculated based on the weighted AWE (ABS, 2018b) and the chance of being employed (ABS, 2018a). On average, the opportunity cost of a carer's time was estimated to be $16.44 per hour. Thus, the total costs of informal care for Australians with chronic pain was estimated to be $4.51 billion in Australia in 2018, which equates to $1,390 per person with chronic pain.

4.3 Aids and modifications costs

Chronic pain has the potential to restrict a person's ability to conduct activities of daily life such as eating, shopping, preparing meals, showering and doing day-to-day home cleaning. As a result, some people with chronic pain may require aids and devices to assist them in carrying out these tasks. These aids and modifications are in addition to those included in the health system – for example, an aid and modification supplied by the health system might include pill dispensers or neck braces. Aids to assist with activities of daily living generally include mobility related aids such as canes or walking frames, and chairs or stools for showering or bathing.

Australians with chronic pain may also require modifications to their home, such as adding handrails and ramps in order to ensure that they can safely conduct activities of daily living. Results from the ABS SDAC (2016) shows that of those who reported chronic or recurring pain or discomfort:

- 18.0% used self care aids compared to 1.1% in the general population living without chronic pain;
- 18.1% used mobility aids compared to 0.8% in the general population living without chronic pain; and
- 12.2% made modifications to their homes compared to 1.2% in the general population living without chronic pain.

To estimate the total cost of aids and modifications for chronic pain, the number of aids and modifications used by Australians with chronic pain, relative to Australians without chronic pain was estimated. The difference in utilisation was then multiplied by an estimated indicative cost using price catalogue data from the NDIS.[17] The cost of managing incontinence was derived based on Deloitte Access Economics (2011).[18]

While some equipment and modifications require large outlays but are depreciated over a number of years, others need to be replaced more regularly. It was assumed that devices in heavy use (eating, dressing and

[16] As the cohort of patients with chronic pain tends would likely require some degree of care due to old age or other factors, analysis needs to consider what level of informal care would be required in the absence of chronic pain. To capture this background care requirement, the care requirements for people without disabilities due to chronic pain and no significant health conditions were estimated and used as a comparator group for those experiencing chronic pain.
[17] Note: Many aids and modifications, offered under the National Disability Insurance Scheme currently do not have listed prices as price regulation no longer applies. To overcome this, prices from catalogues previous catalogues have been used. As many items appear within product categories, median prices have been calculated in cases where an indicative product is not available.
[18] It was estimated that 13.3 incontinence pads are used per week, on average. It was assumed that incontinence pads cost $1 each.

continence aids) need to be replaced on an annual basis, while most other devices have a three year lifespan, with the exception of larger expenses such as wheel chairs, which have been assumed to have a life of 5 years. As home modifications tend to be one-off investments, a life of 20 years has been assumed.

The estimated excess use of each aid and modification, the unit cost per year and the total cost of aids and modifications for Australians with chronic pain are shown in Table 4.5. Overall the cost of aids and equipment for Australians with chronic pain was estimated to be $572.1 million in Australia in 2018, or $176 per person with chronic pain.

Table 4.5 Estimated use and costs of aids and modifications for Australians with chronic pain

Aid / modification	Unit Cost ($)	Product life (years)	Unit cost ($ per year)	Excess proportion using (%)	Items ('000s)	Total cost ($ million)
Self care aids						
Eating aids	100	1	100	2.3	75	7.5
Showering or bathing aids	575	3	192	12.7	412.9	79.1
Dressing aids	145	1	145	4.2	135.4	19.6
Toileting aids	130	3	43	8.1	261.6	11.3
Managing incontinence	694	1	694	6.9	222.7	154.4
Total self care						*272*
Mobility aids						
Canes	20	3	7	1.8	57	0.4
Walking stick	20	3	7	7.8	254.3	1.7
Crutches	80	3	27	0.9	28.1	0.8
Walking frame	113	3	38	7.9	257.4	9.7
Wheelchair or scooter	4,650	5	930	6.1	197.1	183.3
Specially modified car or car aid	850	3	283	0.3	9.8	2.8
Other mobility aids	779	3	260	10.7	347.1	90.1
Total mobility aids						*288.6*
Home modifications						
Home modifications	638	20	32	11.0	357.3	11.4
Total aids and modifications						**572.1**

Source: Deloitte Access Economics analysis, based on SDAC (2016), NDIS (2014).

4.4 Deadweight losses

Transfer payments represent a shift of resources from one economic entity to another, such as raising taxes from the entire population to provide welfare payments to Australians with chronic pain. Transfer costs are important when adopting a whole-of-government approach to policy formulation and budgeting. Publically funding costs means the government must effectively increase tax revenue to achieve a budget neutral position. Alternatively, if all chronic pain could be avoided, the government would not need to raise as much tax revenue.

The act of taxation creates distortions and inefficiencies in the economy, so transfers also involve real net costs to the economy, known as deadweight losses. Imposing taxes on a market reduces the efficiency of resource allocation within that market because it changes the price of those goods or services being taxed. For example, an increase in income tax rates will increase the relative price of work compared to leisure and

therefore create a disincentive to work. Similarly businesses may be discouraged from operating in Australia if company tax rates were too high.

Accordingly, although taxation transfers are not real costs of themselves they have been estimated, along with public funding of health care to calculate the cost associated with a loss in allocative efficiency. The following sections outline the reduced taxation revenue available to government and deadweight losses associated with taxation required to fund public healthcare.

4.4.1 Welfare payments

Data regarding the number of Australians on income support payments was sourced from the Department of Social Services through a special data request. The most commonly received work related welfare benefit was the Disability Support Pension, which 9,174 Australians were receiving in 2018. There were also 2,235 Australians with chronic pain receiving NewStart Allowance and 114 people receiving Sickness Allowance with a main condition of chronic pain.[19] The average payments in 2018 across all recipients were $21,718, $13,759 and $16,848, respectively, so the total cost of welfare payments to Australians with chronic pain was estimated to be $231.9 million.

However, some of these Australians would have ordinarily received welfare payments, which must be netted out to estimate the additional welfare payments due to chronic pain. In Australia, the general 'reliance' on income support has been estimated to be 12% (Tseng and Wilkins, 2003); the welfare payments were factored down by this amount. After adjusting for the reliance on welfare, the total value of welfare payments in Australia for people with chronic pain was estimated to be $201.4 million.

There are also two main income support measures available to primary carers of Australians with chronic pain, including the Carer Payment and Carer Allowance. In addition, some carers may also be eligible for the Carer Supplement. Data from the Department of Social Services (special request) indicated that 5,774 and 10,077 Australians received the Carer Payment and Carer Allowance for Australians with chronic pain, respectively. The average payments in 2018 across all recipients were $19,642 and $3,608, so the total cost of welfare payments to carers of Australians with chronic pain was estimated to be $149.8 million in 2018.

The total cost of welfare payments associated with chronic pain was therefore estimated to be $360.5 million in Australia in 2018.

4.4.2 Taxation revenue

Reduced earnings from lower employment participation and lower output result in reduced taxation revenue collected by the Government. As well as forgone income taxation, there would also be a fall in indirect (consumption) taxes, as those with lower incomes spend less on the consumption of goods and services. Lost taxation revenue was estimated by applying an average personal income tax rate and average indirect taxation rate to lost earnings.

The average rates of taxation were derived by dividing net income tax and net indirect tax by the taxable income. This method was also used to derive the average company tax rate, which was then applied to lost company earnings (through reduced output). Again, net tax for companies was divided by the total taxable income for companies. The respective tax rates used in the calculation of deadweight losses were:

- 23.4% average personal income tax rate, and 12.6% average indirect tax rate; and
- 22.9% average company tax rate.

Applying these tax rates to the total productivity impacts (including informal care costs), the total lost individual income was estimated to be $14.84 billion (including lost carer taxes), while the total lost company revenue was estimated to be $2.67 billion in Australia in 2018.

4.4.3 Deadweight loss of taxation payments and administration

To estimate the deadweight loss due to lost taxation revenue (given an assumption of no change in spending), taxes were assumed to be maintained by taxing either individuals or companies more as necessary (to replace

[19] The number of people receiving welfare payments may be low as chronic pain is recorded as a condition on its own. For example, it is possible that an individual could receive welfare due to chronic pain, while it may be recorded as a mental health condition in the database.

the lost tax from either stream). Each tax in the economy imposes various burden on the efficiency of society. Analysis by KPMG (2010) and Cao et al (2015) report the marginal burden of various government taxes (both State and Commonwealth). Briefly:

- income tax has been estimated to impose a burden of $0.25 for every $1 raised;
- company tax has been estimated to impose a burden of $0.50 for every $1 raised;
- goods and services tax has been estimated to impose a burden of $0.19 for every $1 raised;

State taxes were estimated to impose a burden of $0.45 for every $1 raised based on the respective shares of revenue raised through major state taxes including gambling, insurance, motor vehicle taxes, payroll tax and stamp duties (KPMG, 2010; ABS, 2016b).

It is important to consider state and territory taxes because the states and territories pay for a proportion of health services. Based on the 2017-18 Federal Budget (Commonwealth of Australia, 2017), approximately 69% of state and territory health expenditure is paid for by state and territory taxes, while the remaining 31% is paid for by transfers from the Commonwealth. Thus, the relevant burden imposed by taxation to pay for state and territory health expenditure is allocated to both income taxes, and the weighted state and territory taxes. Weighted by the revenue raised:

- reduced income for individuals results in a 23.7% efficiency loss;
- reduced income for employers results in a 50.8% efficiency loss;
- welfare payments and Commonwealth health expenditure result in a 29.0% efficiency loss; and
- state health expenditure results in a 37.8% efficiency loss.

Table 4.6 shows the estimated reduced income and health expenditure payments, the applied efficiency loss of raising taxation, and the resulting deadweight losses associated with chronic pain in 2018. All rates of efficiency loss include a 0.8% administrative loss which covers expenses of administering taxation (Australian Taxation Office, 2016). The total deadweight losses associated with chronic pain were estimated to be $7.58 billion in Australia in 2018.

Table 4.6 Deadweight losses due to chronic pain in Australia in 2018

Cost component	Total cost ($bn)	Rate of efficiency loss (%)	Resulting deadweight loss ($bn)
Welfare payments	0.36	29.0	0.10
Commonwealth health expenditure	4.27	29.0	1.24
State health expenditure	3.58	37.8	1.35
Lost consumer taxes	13.21	23.7	3.14
Lost company taxes	2.67	50.8	1.36
Lost carer taxes	1.62	23.7	0.39
Total	**25.72**	**-**	**7.58**

Source: Deloitte Access Economics analysis.

4.5 Summary of other financial costs

Overall, the total cost of chronic pain outside the health system was estimated to be $61.0 billion in Australia in 2018, or $18,817 per Australian with chronic pain.

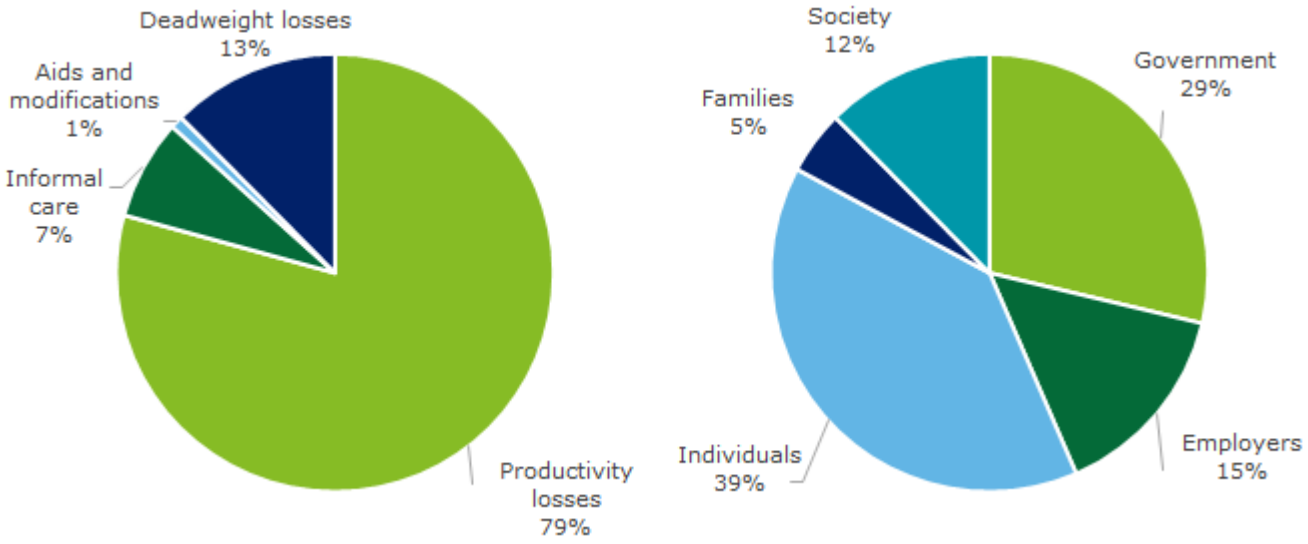
Table 4.7 Other financial costs due to chronic pain in Australia in 2018

Cost component	Total cost ($bn)	Cost per person ($)
Productivity losses	48.34	14,912
Informal care	4.51	1,390
Aids and modifications	0.57	176
Deadweight losses	7.58	2,338
Total	**61.00**	**18,817**

Source: Deloitte Access Economics.

Productivity losses account for 79% of other financial costs associated with chronic pain in Australia in 2018. Productivity losses were followed by deadweight losses (13%), informal care (7%) and aids and modifications (1%). It was estimated that individuals bore 39% of other financial costs, which was followed by government (29%), employers (15%), society (12%) and families (5%) as shown in Chart 4.4.

Chart 4.4 Other financial costs by component (LHS) and payer (RHS)



Source: Deloitte Access Economics.

5 Loss of wellbeing

There are substantial wellbeing losses due to chronic pain. For example, lower back pain is the leading cause of disability in Australia and musculoskeletal conditions are responsible for close to 10% of the total burden of disease (AIHW, 2016).

This chapter adopts the burden of disease methodology to quantify the impact of chronic pain on wellbeing. The approach is non-financial, where pain, suffering and premature mortality are measured in terms of DALYs.

Key findings

- Chronic pain was estimated to cost Australians 340,384 DALYs (only YLDs) in 2018, which represents 6.8% of the total burden of disease in Australia.
- The total cost associated with the loss of wellbeing was estimated to be $66.1 billion by converting DALYs to a dollar value using the VSLY. This is a non-financial cost.

5.1 Valuing life and health

The burden of disease methodology was developed by the World Health Organization and is a comprehensive measure of mortality and disability from conditions for populations around the world. The burden of disease methodology is a non-financial approach, where life and health can be measured in terms of DALYs. DALYs include both years of life lost due to premature death (YLLs) and years of healthy life lost due to disability (YLDs).

Disability weights are assigned to various health states, where zero represents a year of perfect health and one represents death. Other health states are given a weight between zero and one to reflect the loss of wellbeing due to a particular condition. For example, a disability weight of 0.2 is interpreted as a 20% loss in wellbeing relative to perfect health for the duration of the condition.

The burden of disease as measured in DALYs can be converted into a dollar figure using an estimate of the value of a statistical life (VSL). The VSL is an estimate of the value society places on an anonymous life. The Department of the Prime Minister and Cabinet (2014) provided an estimate of the 'net' VSLY (that is, subtracting financial costs borne by individuals). This estimate was $182,000 in 2014 dollars, which inflates to around $194,202 in 2018 dollars for the VSLY using the Consumer Price Index.

5.2 Mortality

Recent evidence suggests that chronic pain is associated with excess mortality (see Smith et al, 2014; Macfarlane, 2017). However, given the borderline significance of the results, and that neither the AIHW or Global Burden of Disease include mortality due to conditions such as low back pain, mortality has also been excluded from the analysis in this report.

5.3 Wellbeing costs

As noted, DALYs comprise both YLDs and YLLs – the latter was excluded from this study. The YLDs associated with chronic pain were estimated by applying a representative disability weight to the prevalence of chronic pain.

To estimate the disability weight, data were collected from the Global Burden of Disease (GBD) study; the disability weights from the GBD are also used by the AIHW in the Australian Burden of Disease study. The GBD provides disability weights for severity of chronic pain, and estimated severity distributions. Data were collected for low back pain, neck pain, rheumatoid arthritis, osteoarthritis. Severity splits from the GBD were then used to derive a representative disability weight for each condition. The disability weights are 0.121, 0.109, 0.251 and 0.067 for back pain, neck pain, rheumatoid arthritis and osteoarthritis, respectively. Arthritis was further aggregated using prevalence estimates for Australia from the GBD; the disability weight for arthritis is 0.083.

In the SDAC, data are available on the main condition for people who report having chronic pain. The major single cause of chronic pain in people living in the community is back pain (27.6%), followed by arthritis and related problems (21.4%), and long term injuries (7.5%). Other conditions are reported as the main condition by 43.5% of people with chronic pain.

The disability weights were combined with prevalence data from the SDAC to estimate a representative disability weight for people with chronic pain. The disability weight used in this study was estimated to be 0.105, which reflects a 10.5% loss in wellbeing relative to perfect health.

Table 5.1 Disability weight for people with chronic pain

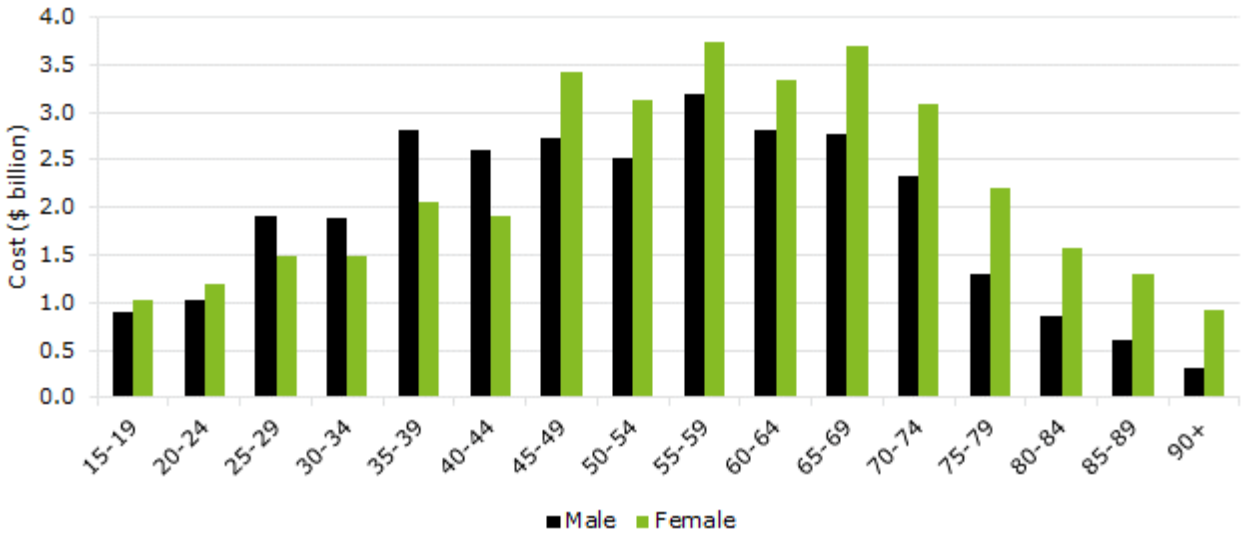
Main condition for people with chronic pain	Prevalence ('000s)	% of chronic pain	Disability weight
Arthritis	526.4	21.4	0.083
Back pain	677.2	27.6	0.121
Head injury, lower body injury, post-surgical injury or upper body injury	184.3	7.5	0.109*
Total / weighted average	**2,454.5**	**56.5**	**0.105**

Source: Deloitte Access Economics analysis. * the disability weight for injuries was based on the average disability weight for back and neck pain in the GBD.

The disability weight was multiplied by the prevalence of chronic pain in Australia to estimate the YLDs associated with chronic pain. Overall, it was estimated that 340,384 DALYs (only YLDs) were associated with chronic pain in Australia in 2018.

Converting the DALYs to a dollar estimate using the VSLY, the total cost associated with the loss of wellbeing was estimated to be $66.10 billion in Australia in 2018. DALYs were estimated to be slightly higher in females than in men, largely reflecting the greater prevalence in older age groups (both in rate and number).

Chart 5.1 Loss of wellbeing associated with chronic pain in Australia



Source: Deloitte Access Economics analysis.

These results compare reasonably well relative to the AIHW's Australian Burden of Disease Study in 2011 and the IHME's GBD study (looking at estimates for Australia in 2016) (AIHW, 2016; AIHW, 2017; IMHE, 2018). In 2011, the AIHW estimated that low back pain caused 164,000 DALYs, and all musculoskeletal conditions caused a little over 521,000 DALYs. The GBD estimates suggest that there were 314,000 DALYs due to low

back pain in Australia in 2016, with a further 112,000 DALYs due to neck pain. The GBD estimated that there were more than 712,000 DALYs due to musculoskeletal conditions in Australia in 2016.

The total DALY rate for all conditions in Australia in 2011 was applied to the 2018 population to estimate that there were 5.04 million DALYs due to all conditions in 2018. Chronic pain would be associated with approximately 6.8% of the total burden of disease in Australia.

6 Regional analysis and projections

This chapter estimates the costs associated with chronic pain for various geographies and also projects the national costs into the future.

Key findings

- NSW leads the way in the costs of chronic pain ($43.6 billion), followed by VIC ($34.8 billion), QLD ($27.3 billion) and WA ($14.6 billion).
- Of the Australians living with chronic pain, 65.6% live in urban areas with associated financial costs of $48.9 billion and $43.4 billion of non-financial costs due to reduced wellbeing.
- The costs of chronic pain in the average Federal electorate were estimated to be $922.7 million, of which health system costs account for $81.0 million and $437.8 million is a non-financial cost due to the loss of wellbeing.
- The costs of chronic pain in Australia are expected to rise from $139.3 billion in 2018 to $215.6 billion by 2050 in real 2018 dollars, assuming that there are no changes to treatment or prevalence rates, and that costs remain constant in real terms.

6.1 Regional analysis

For the geospatial analysis, average costs for each cost component by age and gender were applied to the prevalence in each area to estimate the costs associated with chronic pain by region. Appendix A provides more detail on the methodology used to estimate the prevalence of chronic pain in each region (nationally, state/territories, urban/regional, and for Commonwealth Electoral Divisions). While there would be regional differences in the risk factors for chronic pain, and the treatment of chronic pain (i.e. higher or lower health system utilisation in regions), the cost estimates provide an indication of the size of the problem for each area.

The costs associated with chronic pain by state/territory and remoteness area are shown in Table 6.1. Largely, the costs represent the population share in each region. In 2018, the costs associated with chronic pain were highest in NSW ($43.6 billion), followed by VIC ($34.8 billion), QLD ($27.3 billion) and WA ($14.6 billion). Of the Australians living with chronic pain, 65.6% live in urban areas with associated financial costs of $48.9 billion and $43.4 billion of non-financial costs due to reduced wellbeing.

Table 6.1 Costs of chronic pain by component, state/territory and remoteness area, 2018

Location	Health system ($m)	Productivity ($m)	Other financial ($m)	DALYs ($m)	Total cost ($m)	DALYs (`000s)
State/territory						
NSW	3,897.6	15,308.3	4,032.4	21,165.9	44,404.2	109.0
VIC	3,117.2	12,297.5	3,223.6	16,839.1	35,477.4	86.7
QLD	2,443.7	9,706.1	2,528.7	13,154.1	27,832.5	67.7
SA	886.2	3,411.6	914.1	4,862.4	10,074.3	25.0
WA	1,297.5	5,286.5	1,353.0	6,952.6	14,889.6	35.8
TAS	272.4	1,036.2	280.1	1,500.1	3,088.8	7.7
NT	112.8	495.7	119.0	577.8	1,305.3	3.0
ACT	197.9	800.6	205.2	1,051.2	2,254.9	5.4
Remoteness area						
Urban	8,089.6	32,405.4	8,386.0	43,356.3	92,237.2	223.3
Regional	4,135.7	15,937.1	4,270.0	22,746.9	47,089.7	117.1
Total	**12,225.3**	**48,342.5**	**12,655.9**	**66,103.2**	**139,327.0**	**340.4**

Source: Deloitte Access Economics analysis.

The top 10 Federal electorates in terms of total cost are summarised in Table 6.2. The estimates are driven by both underlying age and gender rates, and the size of each Federal electorate. Sydney (NSW) was estimated to have the highest costs of chronic pain in Australia in 2018 ($1,190.1 million), followed by Sturt (SA) ($1,097.9 million) and Bruce (VIC) ($1,084.3 million). The costs of chronic pain in the average Federal electorate were estimated to be $922.7 million, of which $81.0 million relates to health system expenditure and $437.8 million is a non-financial cost due to the loss of wellbeing. Data for all electorates is available in Appendix B.

Largely, the Federal electorates with the highest costs are those with the highest number of Australians living with chronic pain – e.g. Sydney, Sturt and Bruce are the top three Federal electorates for both number of Australians living with chronic pain and the costs of chronic pain in 2018.

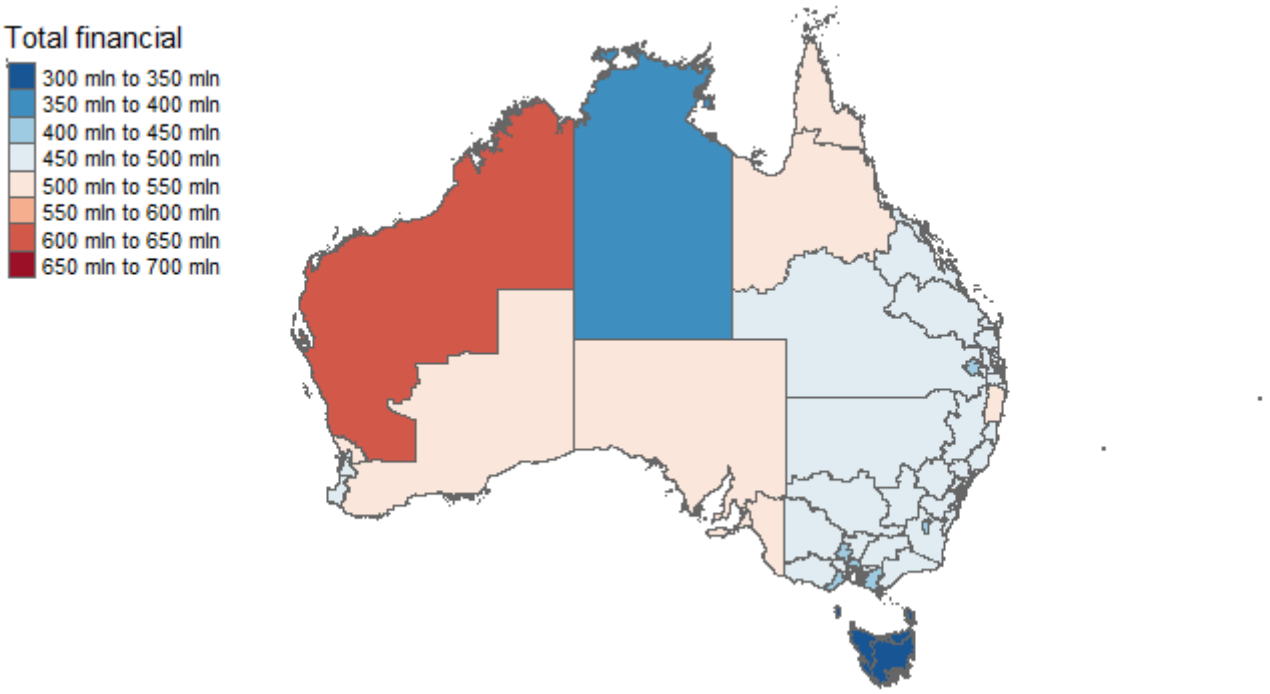
Table 6.2 Top 10 Federal electorates by total cost of chronic pain in 2018

Electorate	Health system ($m)	Productivity ($m)	Other financial ($m)	DALYs ($m)	Total cost ($m)	DALYs ('000s)
Sydney, NSW	103.6	444.4	108.7	533.4	1,190.1	2.7
Sturt, SA	96.2	385.1	99.8	516.8	1,097.9	2.7
Bruce, VIC	95.1	383.6	98.7	506.8	1,084.3	2.6
Reid, NSW	91.3	411.8	98.2	479.7	1,081.0	2.5
Moncrieff, QLD	92.4	382.1	97.0	494.7	1,066.1	2.5
Adelaide, SA	94.0	350.2	96.4	521.6	1,062.1	2.7
Hotham, VIC	93.8	363.6	96.4	505.8	1,059.6	2.6
Grey, SA	91.4	385.6	96.4	485.4	1,058.7	2.5
Boothby, SA	92.7	357.9	95.5	506.1	1,052.2	2.6
Cowper, NSW	95.5	374.7	96.1	482.3	1,048.6	2.5
Australia	**12,225.3**	**48,342.5**	**12,655.9**	**66,103.2**	**139,327.0**	**340.4**
Average	**81.0**	**320.1**	**83.8**	**437.8**	**922.7**	**2.3**

Source: Deloitte Access Economics analysis.

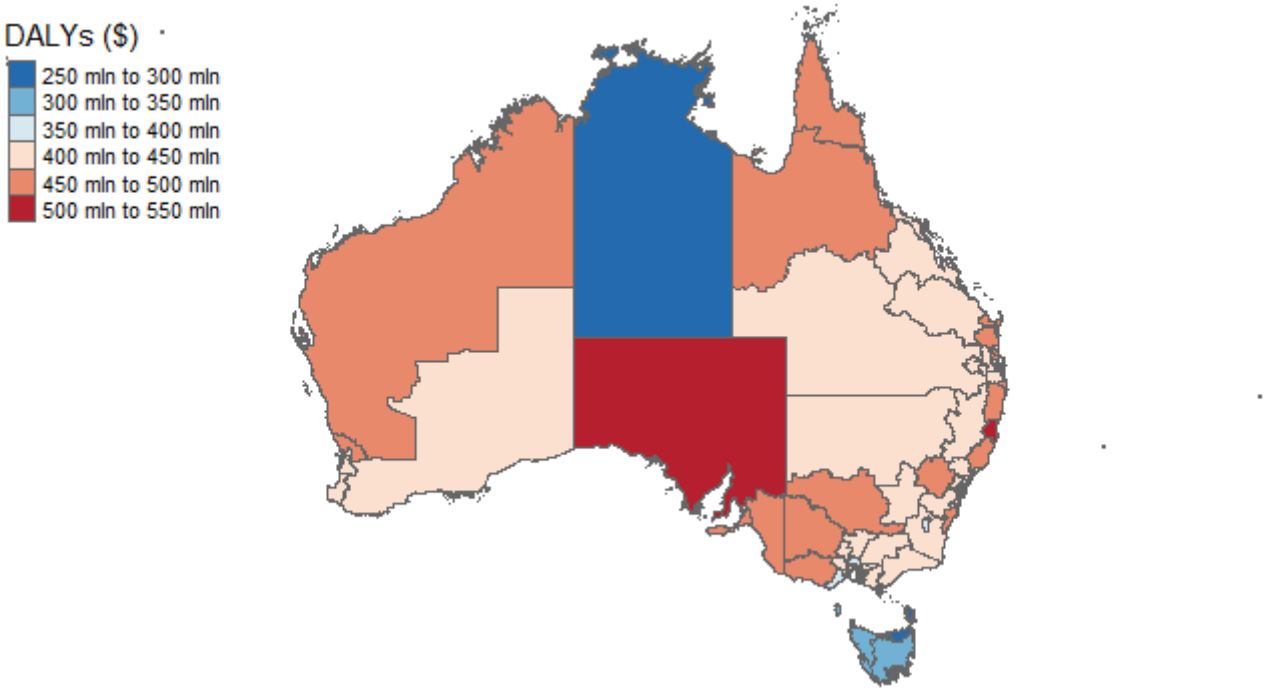
Figure 6.1 and Figure 6.2 provide maps showing the total financial cost and loss of wellbeing associated with chronic pain by electorate in 2018. Red areas indicate higher costs and blue areas indicate lower costs.

Figure 6.1 Total financial cost associated with chronic pain by Federal electorate in 2018



Source: Deloitte Access Economics analysis.

Figure 6.2 Total loss of wellbeing associated with chronic pain by Federal electorate in 2018



Source: Deloitte Access Economics analysis.

6.2 Cost projections

Chronic pain imposes large costs on Australians and our society overall. Given the ageing population and increasing rates of many chronic conditions, it is expected that the costs associated with chronic pain will continue to rise into the future, albeit at a slower rate over time (due to expected gains in healthy life).

The average costs per person with chronic pain for each cost component (health system, productivity, other financial and loss of wellbeing) were applied to changes in prevalence to estimate the expected costs of chronic pain in each year to 2050. The unit costs were held constant over time, meaning that the costs do not change in real terms.

The costs of chronic pain are expected to rise from $139.3 billion in 2018 to $215.6 billion by 2050 in real 2018 dollars, assuming that there are no changes in health system treatments at a broad level or specifically for chronic pain. Similarly, the estimates do not reflect any expected increase or reduction in the prevalence rate for each age and gender group.

Table 6.3 Projected costs of chronic pain in Australia by cost component, 2018 to 2050, real $2018 billions

Cost component	2018	2020	2030	2040	2050
Health system cost	12.23	12.64	14.89	17.09	19.08
Productivity losses	48.34	49.74	56.51	63.48	70.27
Informal care	4.51	4.68	5.58	6.46	7.27
Other financial costs	8.15	8.41	9.72	11.04	12.28
DALYs	66.10	68.63	81.80	94.70	106.71
Total	**139.33**	**144.10**	**168.49**	**192.77**	**215.62**

Source: Deloitte Access Economics analysis.

7 Opioid harm

Chronic pain is a complex and costly issue, and different treatment strategies are required to address the burden of chronic pain in Australia. Further research is needed in a number of areas to identify the safest and most effective ways to reduce this burden. One of these research areas should address optimal pharmacological management of chronic pain in Australia.

There is mounting evidence around the increasing harm and side effects of commonly prescribed pain management medications. Opioid misuse has been labelled a major health crisis in Australia and internationally (Schug, 2018), and there are increasing calls to address opioid misuse within treatment for chronic pain. This chapter explores some of the broad harms associated with opioid misuse in Australia, including the costs of hospitalisations and deaths due to opioid misuse, and costs of treatment for dependence.

For section 8.3, we were also asked to explore the role of atypical opioids in optimising pharmacological management of chronic pain. The purpose of this chapter is to summarise the emerging evidence and provide a basis for future research in this field. The evidence in this chapter informs the modelling in section 8.3, which estimates the potential benefits of using atypical opioids in Australia. However, there is a need for more robust evidence to explore the role of atypical opioids in optimising pharmacotherapy for chronic pain.

We note these limitations upfront for a number of reasons:

- The complexities of chronic pain make it difficult to untangle the effects of particular health interventions for patients. As outlined in section 1.3, chronic pain and mental health problems, particularly depression, commonly occur together. Major depression in patients with chronic pain is associated with reduced functioning, poorer treatment response and increased health care costs (Karapetyan et al, 2017). High rates of generalised anxiety disorder, post-traumatic stress disorder and substance misuse are also reported in people with chronic pain. At the same time, opioids may be linked to depression in people with chronic pain (Mazereeuw et al, 2018). Harms from opioid misuse commonly occur due to concurrent use with other medications and drugs, for example, with benzodiazepines or alcohol. A history of mental health problems, and any form of drug abuse are key risk factors for opioid misuse (Schug 2018), and therefore its associated harms.
- In the past other drugs have been seen as a safer alternative to opioids, however these alternatives may also carry risks. For example, it has been suggested that pregabalin, an anti-epileptic used to treat neuropathic pain, saw an increase in prescribing because there was a desire among clinicians to prescribe safer alternatives to opioids (Goodman and Brett, 2017). Recently, Crossin et al (2019) identified that rates of pregabalin misuse-related ambulance attendances in Victoria have increased substantially since 2012 when pregabalin was first listed on the PBS. Crossin et al (2019) concluded that limiting dispensing of the drug may reduce the risks associated with its misuse.
- There is not yet sufficient, robust evidence to measure the impact of prescribing atypical opioids more broadly, although there has been a large increase in the use of tapentadol, seemingly without an increase in the harms typically associated with conventional opioids.

Importantly, opioid misuse can only be addressed in the context of multimodal and interdisciplinary approaches to the management of chronic pain. There is a clear need for more targeted and specialised pain management services to address the growing burden of pain in Australia (see section 8.1), with emphasis on active treatment strategies that lead patients to self-efficacy and self-management (Schug, 2018). Pharmacological treatment strategies can be used to help support these goals, but treatment is complex and the needs of each individual patient must be considered.

It is important to note that optimising pharmacological management of chronic pain with atypical opioids is only one option to help reduce the burden of opioid misuse in Australia, if supported by future evidence. Policies to taper opioid doses to a lower level can also be effective in improving pain severity, functioning and mood (NPS MedicineWise, 2016). Other options may include the continued implementation of surveillance programs such as real-time prescription monitoring in Victoria, or the Federal Government's Prescription Monitoring Programme (section 7.1), although evaluation of these programs is needed in Australia. Finally,

greater access to a broader range of treatments may be effective: for example, new advances are being made in a number of areas such as neuromodulation therapy, which provides cost effective, continuous pain relief to eligible patients for many years.[20]

Key findings

- There are a range of complex issues that can lead to opioid misuse, including but not limited to, prescribing patterns, patient characteristics, and the availability of alternative non-pharmacological treatments for chronic pain.
- There is a potential role for atypical opioids in optimising pharmacological management of chronic pain. This chapter summarises emerging evidence in this area.
- There were an estimated 3,011 hospitalisations for prescription opioid misuse in 2017-18, costing $13.4 million. An estimated 10,756 Australians received pharmacotherapy for prescription opioid misuse, costing $60.2 million.
- Prescription opioid misuse caused an estimated 823 deaths in 2017-18. Overall, these deaths cost Australia $4.7 billion, comprising $964.5 million in productivity losses, $79.0 million in deadweight losses and $3.7 billion in reduced wellbeing.

7.1 Harms of opioid misuse

Between 2010-11 and 2014-15, the rate of prescriptions for opioid analgesics in Australia increased from 36,900 prescriptions dispensed per 100,000 population to 45,600 prescriptions dispensed per 100,000 population (AIHW, 2018a). This represented a 24% increase, which was largely driven by a 60% increase in oxycodone scripts. The rising use of prescription opioids has also been accompanied by increasing misuse, with the National Drug Strategy Household Survey (AIHW, 2017) reporting that the misuse of opioids increased from 3.6% to 4.8% between 2013 and 2016.

Opioids are chemical substances with morphine like attributes that are commonly used for pain relief, although they have addiction potential and can cause associated problems of dependence including serious adverse events or death through overdose. There is also an increased risk when opioids are used to manage pain alongside other drugs including sedatives and alcohol. In Australia, there are currently more deaths associated with prescription opioids than with heroin, cocaine, or other illicit drugs (AIHW, 2018).

Opioids affect the brain in similar ways to heroin, attaching to opioid receptors throughout the brain and spinal cord triggering feelings of euphoria and wellbeing and reducing the patient's perception of pain (Tackett, 2018). However, the body can build tolerance to the effect of opioids over time, leading many patients to seek higher doses of the drug in order to achieve the same level of pain relief (Tackett, 2018). Dependence on higher doses of an opioid may lead to opioid addiction, creating a higher risk of overdose. Conventional opioids have a higher risk of abuse than atypical opioids. Atypical opioids differ from conventional opioids as they do not rely exclusively on mu-receptor agonism for their analgesic effect (or pain relief). As a result, they have different effects and different adverse effects including toxicity and abuse potential compared with conventional opioids (Schug, 2018).

There are a number of adverse events associated with conventional opioid use. It has been shown that patients with higher morphine equivalent doses have higher rates of adverse events. Adverse events range from vomiting, dizziness and nausea to severe events of respiratory depression which are a substantial cause of opioid related morbidity (Faria et al, 2018; Van der Schier et al, 2014). The debilitating nature of many of these adverse events can reduce an individual's ability to function in society, and reduce the quality of life that the person is able to lead (Busse et al, 2018).

Harms to individuals flow through the rest of the economy. In the US, health system costs represent 44.9% of total financial costs of opioid misuse and include medical and drug costs, substance abuse treatment, prevention and research costs (Birnbaum et al, 2011). Losses within the workplace represent 45.9% of costs associated with opioid misuse (Birnbaum et al, 2011). A further 9.2% of total costs fall on the criminal justice

[20] Kapural et al (2015) shows that spinal cord stimulation can offer sustained pain relief over a period of two years. Some trials of neuromodulation have indicated that patients can maintain adequate pain relief for up to 20 years (Nissen et al, 2018).

system, including legal costs, the use of correctional facilities and the loss of property due to crime associated with opioid misuse (Birnbaum et al, 2011).

In Australia, the majority of the burden results from accidental poisonings (63%) and opioid dependence (29%) (AIHW, 2018a). The majority of poisonings require treatment in hospital (for admitted patients) or in the emergency department (for non-admitted patients), and there are additional services provided by the Alcohol and Other Drug Treatment Services including counselling, education, rehabilitation and withdrawal management (AIHW, 2018a). The prevalence of opioid misuse places strain on the affected individual through loss of functioning and wellbeing, on the health system through increased admissions and emergency department presentations, and on the economy through lost wages and employment.

There is some evidence that doctor shopping[21] may be linked to the harms of opioid misuse. For example, among people who had recently used prescription medications in Australia, around 5.5% of those who had used benzodiazepines, and 2.6% of those who had used opioid analgesics obtained the drug by doctor shopping (AIHW, 2018a).

The harms of opioid misuse are more likely to occur for patients engaged in doctor shopping when compared with the general patient cohort. For example, Chenaf et al (2018) conducted a study of prescription opioid analgesic use in France and estimated that those engaged in doctor shopping behaviour had a 73.7% increased likelihood of dying when compared with people who use opioids, but do not doctor shop.

Doctor shopping has prompted a range of policy responses among state and territory jurisdictions. For example, legislation has been enacted in Victoria to give prescribing doctors the ability to check a real-time register of the patient's prescribed medication history prior to dispensing a medication (Choahan, 2018). Additionally, the Federal Government has implemented the Prescription Shopping Programme, which provides a monthly list of people that may be doctor-shopping to GPs. While ongoing evaluation of these programs is still needed, a broader policy response to opioid misuse may be more effective at reducing the harms of opioid misuse, given the relatively low prevalence of doctor shopping. For example, discontinuation from long term opioid therapy may also be an effective strategy, with a recent study by McPherson et al (2018) finding that patients who discontinued therapy did not experience an increase in pain intensity, and some patients observed benefits from discontinuing therapy. McPherson et al (2018) recommended that discontinuation of opioid therapy should be supported with appropriate education and a multidisciplinary team to ensure that the patients' pain and psychosocial needs are adequately managed.

7.2 Hospitalisations due to opioid misuse

Opioid poisonings can be caused by a range of circumstances, including taking more than prescribed, combining opioids with other sedative substances, loss of tolerance, or a change in health status. Some treatment for acute opioid poisoning and overdose is provided in hospitals to admitted patients or by emergency departments and general practitioners to non-admitted patients.

To estimate the costs of hospitalisations due to opioid poisonings, both the number of separations and the average cost of each separation were calculated. The AIHW (2018a) provides the most recent publically available data on the number and rates of opioid use, opioid poisonings, opioid dependence and other harms sorted by a range of categories including principal and/or additional diagnosis for the 2016-17 financial year. The separation data was combined with data from IHPA's 2015-16 National Hospital Cost Data Collection to estimate the costs of hospitalisations due to opioid poisonings.

7.2.1 Number of hospitalisations

Data on the total number of hospitalisations from the AIHW is split into methadone, natural and synthetic opioid categories. In 2016-17, the AIHW recorded 2,910 hospitalisations (excluding heroin, opium, methadone and other and unspecified opioids) where opioids were listed as the principal diagnosis.

Data from Murphy et al (2018) was used to distinguish between hospitalisations caused by conventional or atypical opioids. Murphy et al (2018) detailed the number of hospitalisations reported to poison centres in the

[21] Doctor shopping is defined as seeing multiple treatment providers, either during a single illness episode or to procure prescription medications illicitly (Sansone and Sansone, 2012).

United States from 2010-16 for opioids, including tramadol, oxycodone, hydrocodone, morphine, tapentadol, oxymorphone, and hydromorphone.[22]

The hospitalisation rate for tramadol and tapentadol was 0.15 per 1,000 prescriptions and 0.21 per 1,000 prescriptions, respectively. The hospitalisation rate (0.16 per 1,000 prescriptions) for buprenorphine was derived by weighting the hospitalisation rates for tramadol and tapentadol by the number of prescriptions for each in 2016-17. After weighting, the hospitalisation rate was estimated to be 0.20 per 1,000 prescriptions for conventional opioids, and 0.16 per 1,000 prescriptions for atypical opioids.

The total number of hospitalisations in 2017-18 was then estimated by multiplying the hospitalisation rates per 1,000 prescriptions in 2016-17 by the number of conventional and atypical opioid prescriptions in 2017-18. Thus, it was estimated that there were 3,011 hospitalisations due to prescription opioids (approximately 500,000 additional opioids were prescribed in 2017-18 than in 2016-17, so the number of hospitalisations was estimated to increase from 2,910 to 3,011). Of these hospitalisations, 786 resulted from atypical opioids with the remaining 2,225 caused by conventional opioids.

Table 7.1 Hospitalisation rates, by opioid type

Opioid type	Hospitalisation rate per 1,000 prescriptions, 2016-17	Prescriptions (millions), 2017-18	Hospitalisations, 2017-18
Conventional	0.20	11.0	2,225
Atypical	0.16	4.9	786
Total	**-**	**15.9**	**3,011**

Source: Deloitte Access Economics analysis based on Murphy et al (2018), AIHW (2018a), and PBS data.

7.2.2 Cost of an average hospitalisation

The representative costs of opioid poisonings in Australian hospitals were estimated based on data published by IHPA (2018), which reports average costs for a range of AR-DRG procedures. The AR-DRG codes V63Z, X62A, X62B, X64A, and X64B[23] represent procedures used to treat opioid poisonings in hospital.[24] The weighted average cost of these procedures was used as the representative cost of an opioid poisoning for both hospital visits and emergency department visits due to opioid poisonings. In order to estimate the cost in 2017-18 terms, it was assumed that the price increased in line with health inflation data published by the AIHW (2018). The cost of a representative hospitalisation in 2017-18 was calculated to be $4,450.

[22] It is noted that the total number of hospitalisations presented in Murphy is a significant underestimate when compared to hospitalisation data presented in the CDC (Annual surveillance report of drug-related risks and outcomes, 2017). Thus the hospitalisation data from Murphy was adjusted to reflect total hospitalisations in the US (as reported by the CDC) and then divided by the total number of prescriptions in the US. This resulted in a hospitalisation rate per 1,000 prescriptions in the US which was then applied to the Australian data.

[23] V63Z – Opioid use and dependence
X62A – Poison/Toxic Eff Drugs, Majc
X62B – Poison/Toxic Eff Drugs, Minc
X64A – Other Injuries, Poison & Toxic Effects, Majc
X64B – Other Injuries, Poison & Toxic Effects, Minc

[24] It is possible that multiple procedures may be used to treat opioid poisonings, although this was not allowed for in the analysis.

Table 7.2 Estimated cost of hospitalisation due to opioid poisoning, 2015-16

AR-DRG code	Number of separations, 2015-16	Cost per separation, 2015-16 ($)	Estimated cost per procedure, 2017-18 ($)
V63Z	867	6,588	6,908
X62A	10,089	8,934	9,368
X62B	28,188	2,715	2,847
X64A	1,641	8,343	8,748
X64B	5,919	2,055	2,155
Weighted average		**4,244**	**4,450**

Source: IHPA (2018) and Deloitte Access Economics analysis.

7.2.3 Results

To estimate the cost of hospitalisations due to prescription opioid misuse, the number of hospitalisations (3,011) was multiplied by the average cost of hospitalisation ($4,450). The total cost of hospitalisations due to opioid poisonings was an estimated $13.4 million. These costs are set out in Table 7.3.

Table 7.3 Cost of hospitalisations due to opioid misuse in Australia, 2017-18

Opioid type	Number of hospitalisations	Total cost of hospitalisations ($m)
Conventional	2,225	9.9
Atypical	786	3.5
Total	**3,011**	**13.4**

Source: Deloitte Access Economics modelling.

7.3 Pharmacotherapy for opioid misuse

The risk of opioid dependence and misuse arises from both drug overdose and the morbidity and injury that result from misuse of opioids, as well as increased transmission of blood-borne viruses when these pharmaceutical opioids are injected. Drug dependence is a complex condition involving social, psychological and biological components.

Pharmacotherapy is well established in Australia, as in many parts of the world, as an effective treatment for opioid dependence. For those experiencing problematic use of prescription opioids and over-the-counter codeine containing analgesics, detoxification and abstinence-based treatments may be effective. Maintenance therapies may also be utilised to assist clients to successfully manage physical dependence.

Pharmacotherapy treatment for opioid dependence involves providing a consistent oral or sublingual dose of a legally obtained, longer-lasting opioid. In Australia, three medications are registered for long-term maintenance treatment for opioid dependent people (AIHW, 2018b):

- methadone;
- buprenorphine; and
- buprenorphine-naloxone.

These opioids are useful for pharmacotherapy because:

- they exhibit cross-tolerance with other opioids, enabling them to be substituted for abused opioids; and
- they are long-acting, enabling daily or less frequent dosing than short-acting pharmaceutical opioids.

According to the National Guidelines for Medication-Assisted Treatment of Opioid Dependence (Gowing et al, 2014), the goal of the first month of pharmacotherapy is to safely achieve an adequate dose of medication, stabilise the patient's opioid use, and to address co-existing conditions. Patients will then be subject to ongoing clinical review and maintenance thereafter.

The National Guidelines for Medication-Assisted Treatment of Opioid Dependence (Gowing et al, 2014), indicate that most patients should generally be reviewed at least once a month until stabilised by a clinician involved in medication-assisted treatment of opioid dependence. Additionally, more frequent reviews are required early in the treatment, during periods of instability, or during withdrawal attempts.

Estimating the cost of pharmacotherapy associated with opioid misuse associated with chronic pain involved two steps: (1) estimating the number of people on pharmacotherapy for prescription opioid use; and (2) estimating the cost of this pharmacotherapy. The following subsections set out the approach taken to estimate the cost of pharmacotherapy associated with chronic pain in Australia in 2017-18.

7.3.1 Number of people on pharmacotherapy

The AIHW reports on annual jurisdictional point studies to measure the number of people accessing pharmacotherapy for the treatment of opioid dependence. This data is published in the National Opioid Pharmacotherapy Statistics (NOPSAD) collection, which stratifies clients by factors including dosing point, location, age, gender, and the opioid drug of dependence. It was estimated that there were 10,756 clients receiving pharmacotherapy in 2017-18 on any given day due to prescription medication for chronic pain management.[25]

The number of clients receiving pharmacotherapy was disaggregated further into those for atypical opioid dependence and those for conventional opioid dependence, based on the reported opioid drug of dependence (AIHW, 2018b). For the 'other pharmaceutical opioids' category reported in the NOPSAD data publication, it was assumed that the relative distribution of atypical opioids and conventional opioids was consistent with the relative number of scripts distributed.[26] Pharmacotherapy for opioid addiction includes the use of an atypical opioid (buprenorphine), which is available as a patch formulation and is less likely to lead to pharmacotherapy.

The overall number of people receiving pharmacotherapy as a result of chronic pain, stratified by atypical and conventional opioids, is summarised in Table 7.4.

Table 7.4 Number of people receiving pharmacotherapy on a given day in 2017-18, stratified by opioid class

Opioid type	Number of people receiving pharmacotherapy
Atypical	2,824
Conventional	7,932
Total	**10,756**

Source: AIHW (2018b), Pharmaceutical Benefits Scheme (2018), Deloitte Access Economics' analysis.

7.3.2 Average cost of pharmacotherapy

In a study commissioned by the Australian National Council on Drugs (ANCD), Chalmers et al (2009; 2012) developed a system dynamics model of the Australian pharmacotherapy maintenance system in order to estimate the economic cost of pharmacotherapy.

The system dynamic model captures people who commence pharmacotherapy, as well as those who complete pharmacotherapy, alongside the initial number of people on pharmacotherapy. Chalmers et al (2009; 2012) assumed the average length of stay was 7 months in public clinics, 12 months in GP services, and 3 months in prisons. The average length of time between episodes of treatment was assumed to be 12 months. Their

[25] The AIHW (2018b) reported that a total of 49,792 clients were receiving pharmacotherapy on a given day in 2016-17. To calculate the amount of people receiving pharmacotherapy attributable to prescription opioid use for the treatment of chronic pain, clients receiving treatment for dependence on illicit drugs including heroin and opium were excluded from the analysis. Clients dependent on methadone were also excluded from analysis. Additionally, it was assumed that if a client was receiving treatment for a prescription medication, the medication type would be recorded in official statistics. As such, clients receiving treatment for a 'not stated' drug type were also excluded from the analysis. Data from 2016-17 was grown in line with the trend growth rate over the five preceding years to estimate the number of clients in 2017-18 terms.

[26] Note that atypical opioids have a lower risk of abuse (Schug 2018), and are therefore likely to represent less than their share of pharmacotherapy. As such, the estimated number of people receiving pharmacotherapy for prescription atypical opioid dependence may be overstated.

analysis was based on publically-available information published by the AIHW, and on raw data from the Australian National Evaluation of Pharmacotherapies for Opioid Dependence.

Chalmers et al (2009; 2012) estimated a monthly cost of $11.7 million, or $4,459 per person per year, in 2006-07 terms. The costs of pharmacotherapy included medication costs, and prescribing and dispensing costs. The costs from Chalmers et al (2009; 2012) were inflated using annual health inflation data published by the AIHW (2018), so that the average cost of pharmacotherapy for opioid dependence in Australia was calculated to be $5,599 per person per year in 2017-18.

7.3.3 Estimated cost of pharmacotherapy from opioid misuse in Australia

The annual costs of pharmacotherapy were estimated by multiplying the average cost of pharmacotherapy per person per year ($5,599) by the estimated number of people receiving treatment on any given day (10,756). The total cost was estimated to come to $60.2 million per annum. The total cost of pharmacotherapy for atypical opioids represents about 26% of total prescription-related pharmacotherapy costs, which is less than their share of prescriptions in Australia in 2017-18 (approximately 31%). In part, this likely represents the reduced risk of abuse with atypical opioids compared to conventional opioids.

Table 7.5 Total cost of pharmacotherapy in Australia from prescription opioid misuse, 2017-18

Opioid class	Number of patients	Total cost ($m)
Atypical	2,824	15.8
Conventional	7,932	44.4
Total	**10,756**	**60.2**

Source: Deloitte Access Economics analysis.

The number of patients receiving pharmacotherapy may be underestimated as many persons with addiction to prescription opioids are not managed through addiction programs, but rather contained on prescription opioids. There is a need for improved access to addiction services and treatments to help manage addiction (e.g. moderate to high dose buprenorphine is only available through the federally funded pharmacotherapy program).

7.4 Deaths due to opioid misuse

Deaths due to opioid misuse reduce the wellbeing of Australians and impose significant burden of disease costs. Premature death also imposes productivity losses, including the loss of lifetime earnings for the individuals (and forgone tax revenue for government) and search, hiring and training cost for employers that need to replace workers sooner than they otherwise would have needed to.

7.4.1 Estimate of deaths

A key consideration in this analysis is the number of deaths that occur due to use of atypical and conventional opioids separately, as it informs the modelling conducted in section 8.3.

There is limited data available estimating the death rate of individual drugs. Data on deaths from the AIHW (2018a) is categorised by total number of deaths from synthetic opioids, natural opioids or from methadone. To categorise this data as typical and atypical deaths, estimations were made for deaths caused from atypical drugs (buprenorphine, tapentadol and tramadol) and the residual was assigned as 'conventional'. The following sources and assumptions were used to derive deaths due to atypical opioids.[27]

- Roxburgh et al (2016) was used to calculate the death rate associated with buprenorphine. Roxburgh et al (2016) provides the number of pharmaceutical opioid overdose deaths by opioid type from 2001-12. The deaths for buprenorphine were aggregated over 2010-12 (to remove some variability in the data). It was estimated that buprenorphine caused an average of 5.66 deaths per year over 2010-12. These numbers

[27] It is important to note that these deaths likely do not occur in isolation. As previously mentioned in chapter 7, deaths due to prescription opioids likely occur when used concurrently with other drug types, including sedatives and alcohol. However, these deaths represent cases where the drug is listed as the primary cause of death.

were then adjusted to reflect the total number of deaths that occurred in 2016.[28] After the adjustment it was estimated buprenorphine caused 10 deaths in 2016.

- Roxburgh et al (2016) did not present data on deaths caused by tapentadol, and globally, data is limited. Data from the United States indicates that deaths caused by tapentadol are close to zero. The state of West Virginia recorded one death due to tapentadol in 2015, while Virginia noted there were less than 20 deaths due to tapentadol (without providing an actual number) and Pennsylvania recorded three deaths in 2016. However, as a conservative assumption, the number of deaths from tapentadol was set equal to those caused by buprenorphine. It is also noted that tapentadol only entered the Australian market in 2013 and thus the effect of the drug on mortality may not yet be concluded.
- An estimation for deaths caused by tramadol was derived using Dasgupta et al (2016). Dasgupta et al (2016) presented the rate of deaths per 10,000 patients for fentanyl. As the only synthetic opioids are fentanyl (a conventional opioid), tapentadol and tramadol, the deaths for tramadol were calculated as the residual after solving for fentanyl deaths. Using AIHW (2018a) data on persons using fentanyl it was concluded that 162 persons died from fentanyl. The AIHW data listed 208 deaths from synthetic opioids, and thus the residual deaths after removing fentanyl and tapentadol was 62 deaths associated with tramadol.
- Thus, in total, there were an estimated 82 deaths from atypical opioids in 2015-16, representing a death rate of 0.018 per 1,000 prescriptions. The remaining 702 deaths were due to conventional opioids, representing a death rate of 0.067 per 1,000 prescriptions.

The death rates per 1,000 prescriptions were multiplied by the number of prescriptions in 2017-18 to estimate the number of deaths in 2017-18 – there were an estimated 735 deaths due to conventional opioids and 88 deaths due to atypical opioids.

Table 7.6 Deaths by opioid type

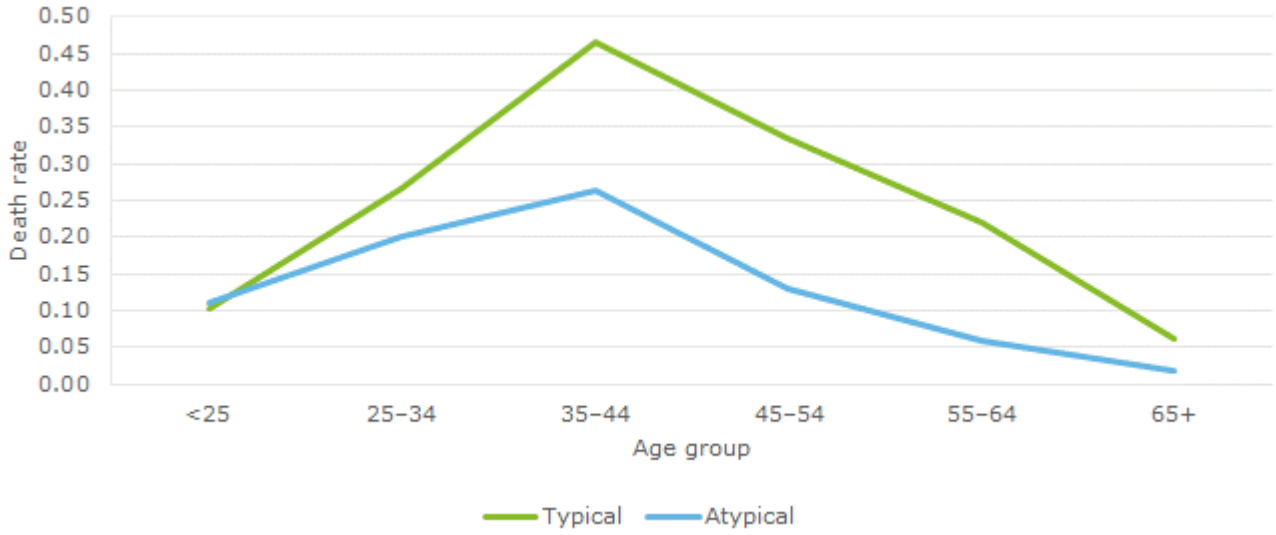
Opioid type	Deaths, 2015-16	Prescriptions, 2015-16 (millions)	Deaths per 1000 prescriptions	Prescriptions, 2017-18 (millions)	Deaths, 2017-18
Conventional	702	10.53	0.067	11.01	735
Atypical	82	4.51	0.018	4.85	88
Total	**784**	**15.13**		**15.87**	**823**

Source: Deloitte Access Economics analysis based on AIHW (2018a) and PBS data.

It should be noted that the discrepancy between the conventional and atypical death rates is significant. In both the conventional and atypical opioid groups, the death rate was highest in the 35-44 years age group. It is also evident that the death rate for atypical opioids is lower than the death rate for conventional opioids in most age groups (Chart 7.1).

[28] It was assumed that the number of deaths from buprenorphine had increased in line with deaths caused by all opioids.

Chart 7.1 Age distribution of opioid deaths per 1,000 persons using



Source: Based on AIHW (2018a) and Deloitte Access Economics analysis.

7.4.2 Productivity losses

In addition to the other indirect costs, there are also productivity losses from premature mortality due to opioid-related deaths.

Mortality rates for atypical and conventional opioid poisonings were calculated from Table 7.6 and were applied to the 2017-18 prescription rates to estimate the number of deaths due to each opioid type poisonings. The age and gender distribution of the total number of deaths was obtained from the AIHW (2018a), and applied to the estimated deaths in 2017-18.

The productivity lost due to premature deaths was then calculated by multiplying the estimated number of deaths by the expected lifetime earnings (in discounted NPV terms) by age and gender group that would be expected to occur for the general population had the individual not died early.

The total cost associated with premature mortality was estimated to be $1.04 billion in 2017-18, or $1.3 million per person who dies from prescription opioid poisoning. Table 7.7 shows the estimated productivity impacts by opioid type. Conventional prescription opioids account for the majority of the costs from premature mortality loss in Australia, due to the higher number of deaths.

Table 7.7 Premature mortality losses from conditions attributed to prescription opioid type, 2017-18

Opioid type	2017-18 ($m)	Cost per death ($m)
Atypical	121.1	1.4
Conventional	922.4	1.3
Total	**1,043.5**	**1.3**

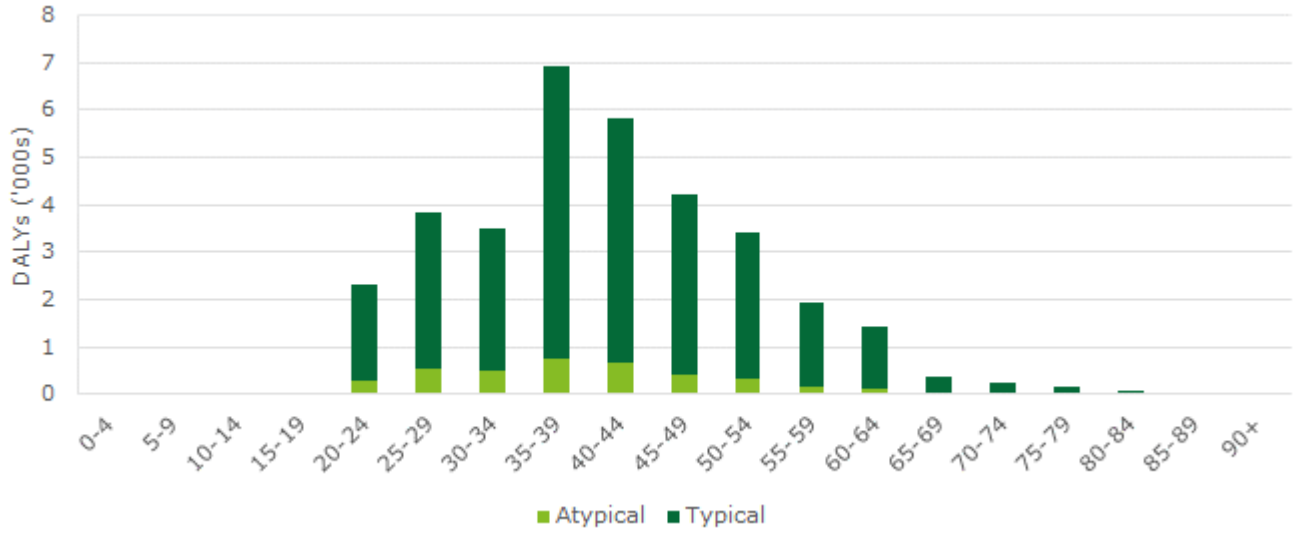
Source: Deloitte Access Economics analysis.

7.4.3 Wellbeing losses

YLLs are derived from age gender mortality rates multiplied by expected years of life remaining for each age-gender group, using life expectancy tables from AIHW (2016b). Atypical and conventional opioid poisonings caused 3,902 YLLs and 30,790 YLLs respectively, with a combined total of 34,692 YLLs. As there is no morbidity associated with the deaths, the number of YLLs is equivalent to the DALYs.

As noted in section 5, the DALY approach is not financial. A monetary conversion involves applying the value of a statistical life year (VSLY) for someone without health conditions to the total number of DALYs estimated for a particular condition. The VSLY of $194,202 for 2017-18 was applied to the number of DALYs to estimate the loss of wellbeing due to opioid overdose deaths in Australia, allowing for a 3% discount rate on years of life in the future. The loss of wellbeing due to atypical and conventional opioid poisonings was $0.4 billion and $3.3 billion, respectively, and the total loss of wellbeing was $3.7 billion.

Chart 7.2 DALYs due to opioid overdose deaths in Australia, 2017-18



Source: Deloitte Access Economics analysis.

Table 7.8 DALYs from prescription opioid poisonings in Australia, 2017-18

Gender	Atypical opioids ('000s)	Conventional opioids ('000s)	Total ('000s)	Atypical opioids ($m)	Conventional opioids ($m)	Total ($m)
Male	2.7	21.0	23.7	277.3	2,210.7	2,488.0
Female	1.2	9.8	11.0	127.7	1,069.2	1,196.9
Person	**3.9**	**30.8**	**34.7**	**405.0**	**3,279.9**	**3,684.9**

Source: Deloitte Access Economics analysis.

8 Interventions

This chapter assesses two promising interventions to combat chronic pain. These are:

- increased access to multidisciplinary pain management practices; and
- a pain specialist-led education program for GPs.

This chapter also presents emerging evidence that prescribing atypical opioids rather than conventional opioids could offer benefits in Australia, and as such there is a Targeted Call for Research (TCR) to provide funding for this important and time-critical issue.

Most people with chronic pain will first present to their GP – as noted in section A.1.5, around one fifth of all GP presentations in Australia involve chronic pain. However, evidence suggests that GPs are not well equipped to deal with chronic pain (section 8.2). Pain specialists are well trained to deal with chronic pain, but are very few in number – only 316 for the whole country (section 1.4). A possible approach is for specialists to design and deliver pain management courses for GPs. Such an education program could provide comprehensive evidence on available treatments, and help reduce the burden of opioid prescriptions on Australian society.

Effective management for complex cases requires multidisciplinary teams. Currently, there is a shortage of resources in this area, with median waiting times for pain centres exceeding 100 days; further, they are significantly higher for publicly funded and rural services compared to those within the private health sector (Hogg et al, 2012). While the AHS shows that 15.4% of the population have chronic pain, Hogg et al (2012) report that just 0.18% of the population are treated by chronic pain services. That is, only around one in every 100 people with chronic pain receive multidisciplinary care. An updated assessment of wait times (Australian Pain Society, 2019, unpublished) confirms prolonged wait times for access to pain management services despite state-based initiatives in NSW and QLD, specifically for those in rural areas.

The evidence in this chapter (section 8.1) suggests that multidisciplinary pain management interventions are both cheaper and more effective than standard (GP led) treatment. This means that, in the long term, governments may save on health expenditure by funding such centres now.

This chapter also presents evidence that atypical opioids may offer substantial benefits to Australia through a reduced risk of opioid dependence and overdose-related death. However, while the evidence looks promising, it is limited. There is a need for more robust evidence that considers the effect of switching people using conventional opioids to atypical opioids, and given the large number of people who die every year in Australia from prescription opioids, the need for this research is urgent. The NHMRC's TCR program provides up to $5 million for such important and time-critical issues in health.[29]

Painaustralia's forthcoming National Strategic Action Plan for Pain Management will cover a range of research priorities, including optimal prescribing strategies and translational research.[30] The evidence presented in section 8.3 should naturally be considered alongside other translational research requirements.

[29] https://nhmrc.gov.au/funding/find-funding/targeted-and-urgent-calls-research.
[30] https://www.painaustralia.org.au/media/newsletters/issue-80/greg-hunt-backs-national-pain-action-plan.

Key findings

- Doubling Australians' access to multidisciplinary care to treat chronic pain could be achieved with a $70 million per year investment. Greater access to multidisciplinary care could deliver $3.7 million in savings to the health system (net of intervention costs) while reducing absenteeism ($65 million) and improving wellbeing ($203 million in QALYs gained). Overall, the benefit to cost ratio was estimated to be 4.9 to 1.
- A nation-wide outreach program to train GPs in pain management could be delivered for $45 million per year, which could result in a 25% improvement in best practice chronic pain management by GPs. By reducing opioid prescriptions, and related overdoses, the program could save around $209 million from overdoses prevented, representing a benefit to cost ratio of 4.6 to 1.
- On the basis of available evidence, prescribing atypical opioids rather than conventional opioids has the potential to save as many as 249 lives per year in Australia. The intervention could save Australia $1.4 billion in financial ($301.9 million) and wellbeing ($1.1 billion) costs, which is likely to outweigh the costs of an intervention to change prescribing patterns. However, more robust evidence is urgently needed – such as that provided by a Targeted Call for Research project.

8.1 Multidisciplinary care

A review of Victorian Pain Services commissioned by the Victorian Department of Health (Aspex Consulting, 2009) estimated that pain specialist services would require at least doubling, and preferably tripling, to provide a minimally acceptable service. Doubling access to pain specialists is an important first step, which would provide Australians living with chronic pain far greater access to multidisciplinary pain management.

Multidisciplinary care is an intervention designed to provide comprehensive treatment to patients living with chronic pain. These programs bring together a combination of health professionals to accurately assess the patient's condition and to prescribe an appropriate treatment plan designed to deliver the best health outcomes for the patient.

Multidisciplinary care for chronic pain generally involves a pain specialist leading a team of health professionals such as a physiotherapist, psychologist, occupational therapist, social worker and/or nurse to treat chronic pain. Treatment tends to involve four aspects (Jeffery et al, 2011):

- Medical therapy: considers the patients physical wellbeing and is used to manage the patient's medications.
- Behavioural therapy: responsible for the psychosocial aspects of patient's care, including cognitive and operant behavioural therapy, and may also have an educational component.
- Physical reconditioning: includes physical therapy, graduated activity exposure and job analysis and reconditioning.
- Education: focuses on improving self-management, home exercise training and ergonomic training.

8.1.1 Care pathway

Generally, a physician will evaluate a patient in the first instance and will make a diagnosis and establish a treatment plan. Lambeek et al (2007) described a representative 12 week pain management program, which begins with the first consult where a treatment plan is created. After this, the patient's occupational physician is contacted to achieve a common plan. At this point the patient's medical specialist, GP, physical therapist and occupational therapist are contacted. Follow up consultations are provided in weeks 6 and 12 with the entire multidisciplinary team remaining in contact throughout the process. The program ends as soon as a lasting return to work is established, or after the conclusion of the 12 weeks.

8.1.2 How effective is multidisciplinary care

There is consistent evidence that the introduction of a multidisciplinary program is cost effective. Gatchel and Okifuji (2006) estimate a saving of $8,100 per patient, and savings of $356,288 per person over a patient's

lifetime compared to conventional medical treatment. Hattem et al (2006) report that interdisciplinary treatment groups have cost-utility ratios ranging from $57,627/QALY to $75,885/QALY, on average.[31]

Return to work: A significant outcome for patients seeking treatment for chronic pain is the ability for them to return to work. Lambeek et al (2007) identifies this as the primary concern for chronic pain patients. Gatchel and Okifuji (2006) suggest return to work rates average 66% following multidisciplinary pain management programs as opposed to only 27% for conventional medical treatments. This represents a 39% improvement on return to work rates. Haldorsen et al (2002) found that return to work improved to 55% when multidisciplinary treatment is offered compared to 37% for ordinary treatment. These studies suggest that multidisciplinary pain management programs are likely to improve a patient's ability to return to work.

Pain reduction: On average, multidisciplinary pain management programs deliver a 20%-30% pain reduction for patients. This level of pain reduction is comparable to pain relief through conventional means (using opioids) which yield an average pain reduction of 30% (Gatchel and Okifuji, 2006). Oslund et al (2009) found pain severity at the one year follow up was reduced by 21% from the initial level of pain, which suggests a greater ability to undertake usual routines.

Emotional outcomes: Oslund et al (2009) found that emotional distress significantly decreased from pre-treatment to post treatment through the use of multidisciplinary pain programs, ranging from 37%-45%. Oslund et al (2009) found that these distress levels could increase again after returning to normal life due to work and life stressors, which should be monitored.

8.1.3 Multidisciplinary pain management intervention modelling

Andronis et al (2016) conducted a systematic review of studies on the cost effectiveness of non-pharmacological and non-invasive alternatives to the standard treatment of drugs and/or surgery. Andronis et al (2016) summarised cost per QALY data for 25 interventions, and found that all of the interventions were either highly cost effective (60% of interventions) compared to standard treatment, or they conferred net benefits with an associated improvement in wellbeing (40% of interventions) – that is, they dominated standard treatment.[32]

Unfortunately, no Australian studies were available with most studies from the UK or Canada. These do offer some compatibility with Australia given the similarity of the health systems. Of the studies in Andronis et al (2016), eight considered multidisciplinary pain management interventions, which are summarised in Table 8.1. The median follow up period across the studies was 12 months.

[31] A QALY is a measure of the stock of health, with 1 representing perfect health, and 0 representing death.
[32] The World Health Organization defines an intervention as highly cost effective if it saves one QALY for less than per capita GDP. See http://www.who.int/bulletin/volumes/93/2/14-138206/en/. A dominant intervention is one that is both more effective (in QALYs) and cheaper than standard treatment.

Table 8.1 Selected multidisciplinary interventions for chronic pain

Study	Country	Interventions	Sample size	Follow up (months)	Outcomes
Henchoz et al (2010)	Switzerland	Functional multidisciplinary rehabilitation plus 3 month exercises	105	12	QALYs, absenteeism
Hollinghurst et al (2008)	UK	Exercise, posture and movement training and behavioural counselling	579	12	QALYs, absenteeism
Lamb et al (2010)	UK	Physiotherapists, nurses, psychologists and OT	701	12	QALYs
Loisel et al (2002)	Canada	CBT, OT, physiotherapy and education	104	77	absenteeism
Rogerson et al (2010)	US	CBT and physiotherapy	994	12	QALYs
Schweikert et al (2006)	Germany	Usual care plus CBT	409	6	QALYs
UK BEAM (2004)	UK	Usual care plus manipulation and exercise	1,287	12	QALYs
Whitehurst et al (2007)	UK	physiotherapy plus bio-psychosocial care	402	12	QALYs

Source: as noted. Note: In all cases control is usual care. (Some studies also compared various interventions against each other, but those are not included.) OT = occupational therapy, CBT = cognitive behavioural therapy.

8.1.3.2 Health system costs

On average, health system expenditure under the intervention arm (including the cost of the intervention) was slightly less (3.6% or $226 over approximately 12 months) than under the control arm.

- All figures have been converted to current Australian dollars using purchasing power parity at the time of the study, and updated for Australian inflation since that time.
- Loisel et al (2002) has higher costs in both arms; this is probably due to a much longer follow up (six years). In those studies where direct intervention costs were identified, they were relatively large. In such cases, it could be expected that the ensuing net health expenditure benefits might take more than a year to recoup the initial intervention outlay. As most cases of chronic pain last for several years, it is likely that long-term net benefits would be higher than those at 12 months. This also implies that there were similarly large offsetting reductions in other health care expenditure.

Table 8.2 Health system expenditure of multidisciplinary interventions for chronic pain ($)

Study	Intervention	Control	Difference
Henchoz et al (2010)	833	579	254
Hollinghurst et al (2008)	673	153	520
Lamb et al (2010)	1,082	577	506
Loisel et al (2002)	11,923	15,335	-3,413
Rogerson et al (2010)	9,651	9,763	-112
Schweikert et al (2006)	6,249	6,012	237
UK BEAM (2004)	1,427	1,049	379
Whitehurst et al (2007)	451	627	-176
Average	**4,036**	**4,262**	**-226**

Source: as noted.

8.1.3.3 QALYs

Multidisciplinary care can effectively improve wellbeing for patients with chronic pain relative to conventional treatments - the average improvement across the studies was 0.03 QALYs over 12 months, which represents a 5.5% improvement.

Regarding incremental cost effectiveness ratios, two of the interventions (Rogerson et al, 2010; Schweikert et al, 2006) dominated treatment as usual – that is, the interventions saved money compared to treatment as usual and improved wellbeing for patients. The average incremental cost effectiveness ratio for the other studies was $12,522, which is considered highly cost effective by World Health Organization criteria (an intervention that costs less than $72,000 per QALY is considered highly cost effective).[33]

- The implicit assumption behind trials that only show QALYs at follow up is that QALYs were equal in both arms at baseline – some explicitly state that this is the case. Overall, for those studies which did present QALYs at baseline, this is not an unreasonable assumption.
- Using the VSLY method required for use in Commonwealth regulatory analysis, the value of a QALY saved is currently $194,202.[34] Thus savings in QALYs per case under multidisciplinary pain management interventions are worth $6,381 (=$194,202 * 0.03).

Table 8.3 QALY outcomes of multidisciplinary interventions for chronic pain

Study	Measure	Intervention	Control	Difference	ICER ($/QALY)
Henchoz et al (2010)	Change	0.03	0.02	0.01	28,251
Hollinghurst et al (2008)	Change	-	-	0.05	10,399
Lamb et al (2010)	Levels	0.70	0.60	0.10	4,586
Rogerson et al (2010)	Change	0.16	0.10	0.06	Dominant
Schweikert et al (2006)	Levels	0.40	0.40	0.00	Dominant
UK BEAM (2004)	Levels	0.65	0.62	0.03	11,517
Whitehurst et al (2007)	Levels	0.76	0.78	-0.02	8,006
Average				**0.03**	

Sources: as noted. Note: Loisel et al (2002) not included as no QALY measures. Hollinghurst et al (2008) only report expenditure relative to control. ICER = incremental cost effectiveness ratio.

8.1.3.4 Absenteeism

On average, multidisciplinary pain management interventions resulted in seven fewer missed workdays per year than treatment as usual. Against the average under control arms – 13.6 days – this represents a saving of almost half (47%).

According to Safe Work Australia (2018), the average workers' compensation costs of a day off work due to illness or injury was $393 in 2014-15. Adjusting for inflation, that is $416 in 2018. Thus the average multidisciplinary pain management intervention for chronic pain also saves $2,975 in workers' compensation costs.

- As with health expenditure, the implicit assumption for those not reporting absenteeism levels at baseline is that these were the same under both arms. From those trials which record both, this is not unreasonable.
- Inclusion of Loisel et al (2002) may overstate the efficacy of lowering absenteeism, as it was an early intervention designed to prevent acute pain becoming chronic pain. On the other hand, this may also illustrate that the best use of multidisciplinary pain management interventions is to prevent chronic pain occurring in the first place.

[33] Australian GDP per capita in 2017 was $71,971. https://www.ceicdata.com/en/australia/sna08-gross-domestic-product-and-gross-domestic-product-per-capita-by-state/gdp-per-capita

[34] https://www.pmc.gov.au/sites/default/files/publications/Value_of_Statistical_Life_guidance_note.pdf

Table 8.4 Work days missed under intervention and control arms

Study	Measure	Intervention	Control	Difference
Henchoz et al (2010)	Change	-6.1	-7.0	0.9
Hollinghurst et al (2008)	Levels	2.0	6.6	-4.6
Loisel et al (2002)	Levels			-11.0
Rogerson et al (2010)	Change	7.1	22.9	-15.8
Schweikert et al (2006)	Levels	11.4	16.6	-5.2
Average				**-7.1**

Source: as noted. Note: Lamb et al (2010) UK BEAM (2002) and Whitehurst et al (2007) not included as no absenteeism measures. Loisel et al (2002) only report absenteeism relative to control.

8.1.3.5 Summary

On average, multidisciplinary pain management interventions are 3.6% cheaper than treatment as usual, and they also save 5.5% more QALYs. Hence they dominate treatment as usual, meaning that they both save money and improve wellbeing compared to treatment as usual. In addition, they reduce days off work by 47%. In total, each case diverted from standard treatment to multidisciplinary treatment could save the Australian community $9,582.

Table 8.5 Financial and wellbeing outcomes under intervention and control arms

Type of benefit	Intervention	Control	Difference ($)
Health expenditure ($)	4,036	4,262	226
QALYs	0.033	*	6,381
Days off work	-7.14	*	2,975
Total			**9,582**

Source: Deloitte Access Economics analysis. Note "*" not able to include, as some studies only reported results net of control.

8.1.4 Increasing multidisciplinary centres in Australia

8.1.4.1 Costs of increasing multidisciplinary care

Burke et al (2015) surveyed 68 multidisciplinary pain centres and reported average fulltime equivalent (FTE) staffing levels by profession (Table 8.6). Using average salary rates from Payscale.com[35] for the average of around 8 staff, the annual wages bill would be $0.63 million. AIHW data shows that for Australia public hospitals, the ratio of other costs to salaries is around 0.78 to 1.[36] Applying that ratio, the average centre would have $0.49 million in other costs, for a total of $1.13 million in annual running costs. As Burke et al (2015) showed that the average centre treated 514 patients, this translates to a cost of $2,195 per patient.

- At face value, this is only around half the average of costs reported for international interventions. However, there are two adjustments that should be made to compare these on a like for like basis. First, the Canadian study (Loisel et al, 2002) had a much longer follow up period than the others. If these costs are annualised they become slightly lower than those derived from Burke et al. Second, while most Western countries have similar health systems - for example health expenditure per capita differs between Australia and the UK or Canada by only around 5% - the US is very different. In 2017, US health expenditure per person was 225% of that in Australia.[37] So arguably, costs in the US study (Rogerson et al, 2010) should be halved to compare to Australia. Once these adjustments are made, the average cost

[35] https://www.payscale.com/index/AU/Job
[36] https://www.aihw.gov.au/reports/hospitals/ahs-2016-17-hospital-resources/data
[37] https://data.oecd.org/healthres/health-spending.htm

for the international multidisciplinary patients is $2,191 per annum, which is almost identical to Australian costs derived from Burke et al.

Table 8.6 Average resourcing and costs for Australian multidisciplinary pain centres

Type of benefit	FTE per centre	Salary per FTE	Costs per centre
Medical	2.1	$126,200	$265,000
Psychiatry	0.2	$123,800	$25,000
Nursing	1.5	$59,200	$89,000
Physiotherapy	1.1	$64,700	$71,000
Clinical Psychology	1	$75,400	$75,000
Occupational Therapy	0.5	$61,200	$31,000
Administrative	1.7	$45,800	$78,000
Total Staff	**8.1**		**$634,000**
Other costs			$494,000
Total Costs			**$1,128,000**

Source: Burke et al (2105), Payscale.com, AIHW

A review of Victorian Pain Services commissioned by the Victorian Department of Health (Aspex Consulting, 2009) estimated that service delivery would require at least doubling, and preferably tripling, to provide a minimally acceptable service. Hogg et al (2012) reported that 31,779 patients were seen nationally by pain management services. To double this amount would require an outlay of $69.7 million (equals 31,779 times $2,195).

- This could perhaps be most easily achieved by allowing specialist pain management physicians to generate and extend multidisciplinary care plans through Medicare Chronic Disease Management Plans.[38]

8.1.4.2 Benefits of increasing multidisciplinary care

It is a little difficult conceptually to convert a cost effectiveness analysis into a cost benefit analysis if the intervention both costs less than standard treatment and produces higher benefits. However, this can be achieved by treating the diverted costs from standard care as a saving.

Transferring 31,779 patients from standard care to multidisciplinary care may reduce total health expenditure by $3.7 million – that is, the cost of the intervention ($69.7 million) is outweighed by benefits from reduced health expenditure of the intervention compared to treatment as usual ($73.4 million). So, from the perspective of the Australian health system, the benefit to cost ratio is 1.05 to 1.[39]

However, multidisciplinary pain management also improves wellbeing and reduces productivity losses compared to treatment as usual. The gain in QALYs would be worth a further $202.8 million[40] and the potential absenteeism savings could be worth $64.6 million to the Australian community.[41]

The total benefits of greater access to multidisciplinary pain management in Australia would be approximately $340.8 million, while the total costs would be approximately $69.7 million. **The benefit to cost ratio was estimated to be 4.9 to 1.**

[38] Painaustralia's forthcoming National Action Plan will contain a number of detailed strategies for extending access to appropriate pain services. However, unfortunately they were not finalised in time to incorporated in modelling for this report.
[39] Net savings of $3.7m equals 0.055 times $69.7m.
[40] Equals 31,779 times $6,381 in QALYs per person, as in Table 8.5.
[41] Assuming that the same share of people treated in multidisciplinary care centres are of working age (68%) as in the national population with chronic pain, then there would be an extra 21,708 people between the ages of 15 to 54 now receiving multidisciplinary care (see Table 2.1). Multidisciplinary pain management could reduce productivity losses associated with absenteeism by $2,975 per person (see Table 8.5).

Table 8.7 Costs and benefits of doubling access to multidisciplinary pain centres in Australia

Impact	$ millions
Reduced health expenditure	73.4
Gain in QALYs	202.8
Reduced productivity losses (absenteeism)	64.6
Total benefits	**340.8**
Total costs	**69.7**

Source: Deloitte Access Economics analysis.

8.2 A specialist-led pain education program for GPs

Pain specialists have a high level of training and experience that places them in the best position to accurately diagnose and treat a patient experiencing chronic pain. Their unique specialties include:

- performing specialised tests to diagnose chronic pain conditions;
- appropriately prescribing and managing medications for unique conditions at varying levels of severity;
- conducting procedures like nerve blocks and spinal injections; and
- coordinating additional care, including physical and psychological therapy or rehabilitation.

Along with the above, pain specialists are capable of providing education and leadership within multidisciplinary teams, and of supporting other health care professionals in treating patients with severe chronic pain.

8.2.1 Potential benefits of pain specialists supporting GPs

Pain specialists provide a service that normal primary care physicians are not well versed in. Chronic pain is not widely provided at university as an area of study, and there is evidence to suggest that graduating primary care physicians have not learnt the necessary skills to deal with chronic pain cases (Wan, 2014). Thus pain specialists can provide education to other primary care providers as to how to best treat chronic pain. This could upskill local primary care providers and help to establish clear care pathways for chronic pain patients.

While such education should reduce the number of patients prescribed with medications, should pain medication be found necessary alongside allied health care, it should also provide insight into the most appropriate treatments available – for example, the availability of newer atypical opioids with different mechanisms of action that deliver a lower risk of abuse and toxicity (see section 8.2.2) for more detail. Such training can be provided through outreach support programs or online resources.

8.2.2 Lack of pain training for GPs and over prescribing of opioids

There are concerns regarding the adequacy of training for primary care physicians in pain management, which together with time constraints for primary practice, hampers their ability to evaluate and follow up patients with complicated chronic pain (van Zee, 2009). The uncertainty surrounding diagnosis has led to opioid medicine being overprescribed by primary care physicians (van Zee, 2009). Inappropriate prescribing is most likely to occur where GPs are unaware of alternative care pathways, the different medications available, or know that access to pain centres can take years in urban areas and is unavailable at all in rural areas.

However, despite the lack of evidence to support long-term opioid use, GPs tend to default to opioid treatment. Opioid use to treat chronic non-cancer pain has changed from a rare prescription 20 years ago to now making up 86% of the entire opioid market (Henning, 2015). There has been a fifteen-fold increase in opioid prescribing in Australia between 1992 and 2012 – without any change in the prevalence of patient-reported pain (Holliday et al, 2017). The number of opioid related poisonings, overdoses and deaths are equally on the rise. In 2016, 784 Australians died as a result of opioid overdoses attributable to pharmaceutical opioids, or a combination of pharmaceutical opioids and pharmaceutical opioids together with heroin. Most commonly, these events were associated with conventional opioids such as morphine, methadone, oxycodone, fentanyl, pethidine, as well as codeine, and tramadol (National Drug and Alcohol Research Centre, 2018).

- Opioids are chemical substances with morphine like attributes that are commonly used for pain relief, although they have addiction potential and can cause associated problems of dependence. However, they are not all the same, and can be broken into two categories – conventional opioids and atypical opioids. Atypical opioids differ from conventional opioids as they do not rely exclusively on mu-receptor agonism for their analgesic effect (or pain relief). As a result, they have different effects and different adverse effects including toxicity and abuse potential compared with conventional opioids. With atypical opioids, these differences may result in improved outcomes and reduced risks for individual patients and society as a whole (Schug, 2018).
- The benefits of opioid use in treating chronic pain is limited. A 2009 trial of opioids used to treat chronic knee and hip pain found that the small to moderate beneficial effects are outweighed by the large increases in the risk of adverse events (Freynhagen et al, 2013).

8.2.3 Modelling of GP training interventions

NPS MedicineWise was founded in 1998 as part of an Australian Government shift in health policy to address issues to reduce the cost of medicines to the PBS by providing clinically reviewed independent information about medicines to doctors, pharmacists and other health professionals

In 2015, NPS MedicineWise launched an accredited educational visiting program *Chronic pain: opioids and beyond* (NPS MedicineWise, 2017). The program saw 9,484 unique health professionals participating, including 7,257 GPs, 1,247 pharmacists and 728 nurses. The program aimed to assist doctors and other healthcare professionals consolidate their knowledge on chronic pain management, current guidelines and practices. The program highlighted the importance of the role of non-pharmacological and non-opioid treatment options as well as the benefits of agreed management plans.

Twelve months after program launch, more than 2,000 GPs across Australia were invited to complete an online survey to identify changes in their knowledge and practice regarding the management of chronic non-cancer pain in primary care.[42] GPs from all States and Territories completed the survey. Most GPs had been practising for more than 20 years and were employed in larger practices with three or more GPs. Numbers were divided approximately evenly between GPs had who participated in a 1-1 educational visit (44%) and in a group-based visit (56%). A comparison group, who had not participated in an educational visit, completed a control survey.[43]

8.2.3.1 Benefits of GP education interventions

The program exceeded NPS MedicineWise's expectations. On average, 12 months after the intervention, participants report on average a 25% higher level of actions that were in line with best practice management of chronic pain and / or reducing opioid prescriptions (Table 8.8).

- In some cases, such as discussing opioid contracts or pain management plans, participants were almost twice as likely (87% and 90% respectively) to undertake best practice actions as were controls. Less than a third of controls (29% and 30% respectively) reported using these actions.
- At the other end of the scale, participants reported no improvement versus controls on discussing non-pharmacological therapy strategies, and were 6% less likely to discuss adverse effects of pain management. However, in both cases, compliance by control GPs was very high (90% and 94%) respectively.

[42] https://www.nps.org.au/news/evaluation-gp-survey-results-for-chronic-pain-program
[43] A comparator is needed as it is possible that GPs who chose to participate in the program did so because they had less knowledge of pain management than a representative GP.

Table 8.8 Best practice chronic pain management at 12 months follow up, NPS MedicineWise participants versus control

Action	Outcome
Discuss adverse effects of pain management and management thereof	-6%
Discuss use of non-pharmacological therapy strategies to assist pain management	0%
Discuss realistic expectation of pain relief	3%
Explain the need for engagement in active self-management strategies	4%
Discuss limited evidence for use of opioids in chronic pain and the potential for long-term medicine-related harms	6%
Taper the use of opioids and implement an alternative treatment plan if the patient's treatment goals are not met	11%
Assess whether the patient is achieving their pain management goals on opioid therapy	14%
Use an oral modified-release formulation or transdermal preparation	15%
Discuss individual goals of therapy	20%
Develop a pain management plan	23%
Regularly review using the 5As to assess if ongoing opioid therapy is needed	35%
Discuss developing a pain management plan	36%
Discuss use of an opioid contract	87%
Discuss use of a pain diary to chart pain	90%
Average	**25%**

Source: NPS MedicineWise.

There are some other Australian studies with results that are similar to NPS MedicineWise.

- The Western Victoria Primary Health Network (Martin, 2018) developed a six-hour active learning module on prescribing drugs of dependence in general practice. This resulted in the number of GPs counselling patients about the risks of opioid use increasing from 65% to 92%. After completing the module, all participants used physiotherapy, mental health support or occupational therapy in pain management, compared to only 66% beforehand. The proportion using chronic care plans increased four-fold, from 15% before hand to 61% afterwards. However, there were no controls for this study, and similar rates of improvement in the NPS MedicineWise intervention were far greater than their results compared to controls.
- Holliday et al (2017) conducted an Australian education intervention for registrars. While the intervention resulted in significant improvements in knowledge and competencies, the authors found that this did not translate into improved practices. While there was a 26% reduction in prescribing opioids for new patients, there was no reduction in overall prescribing rates, although rates for existing patients did remain below the average for Australian GPs. However, the authors noted that pressure on registrar to conform to their supervisor's approach is an identified barrier to quality prescribing.

None of these studies provide a direct link between increased best practice pain management by GPs and decreased volume of opioids prescribed. Conversely, there are some Australian studies that show feasible ranges for changes in opioid prescribing – but without linking them to an intervention.

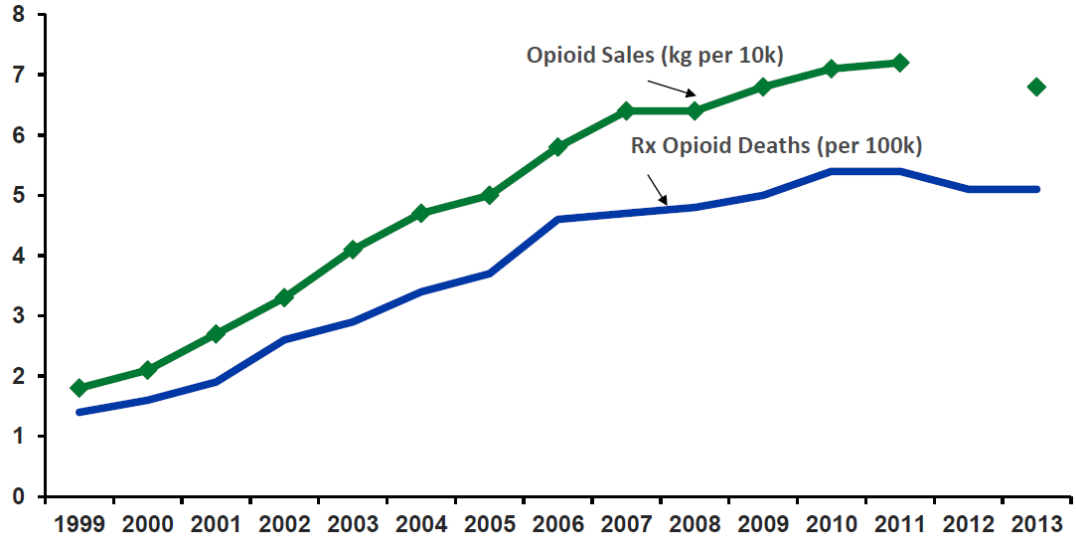
- The ePPOC reports on data from 47 pain treatment centres across Australia and New Zealand (Blanchard et al, 2017). They report that on referral to service, 56% of patients were taking opioid medication on more than two days a week. Of those patients who successfully completed a course of treatment, 35% were no longer taking opioid medications more than twice a week. While a multidisciplinary treatment centre would be expected to have greater impacts than a GP with a few hours of training by a pain specialist, and there were no controls, this does provide a comparable real world result.

- The Family Medicine Research Centre (2015) reports that GP management of chronic pain enables 5.4% of patients to cease using pain medicine. Although this figure was lower than the number for whom GP management led to increased dosages (6.6%).
- To find studies linking interventions and prescription outcomes it is necessary to turn to US sources.
- Fox et al (2013) report on a performance improvement intervention (n=668) that resulted in a 29% reduction in the number of hospital patients being prescribed opioids for pain at 12 months follow up[44]. However, while this is useful in as much as it is similar figure to the NPS MedicineWise results, it does specify whether it was chronic or acute pain, or what the changes to total volumes of opioids were, and it may not be possible to generalise from one hospital to GPs nationwide.

The US Centers for Disease Control (Bohnert et al, 2018) have just released an analysis of their own 2016 campaign to reduce opioid prescribing rates in that country. This exercise is particularly useful as its measured outcome is the change in the national volume (kilograms per 10,000 persons per year) of opioids which, unlike GP actions, or numbers of patients using painkillers, is directly correlated with opioid deaths. The authors attribute a 5.9% annual reduction in opioid volumes to the CDC intervention.

As Kolodny et al (2015) note "The correlation between opioid sales and opioid pain reliever overdose deaths is striking" (Figure 8.1).

Figure 8.1 Rates of prescription opioid sales and deaths in the US



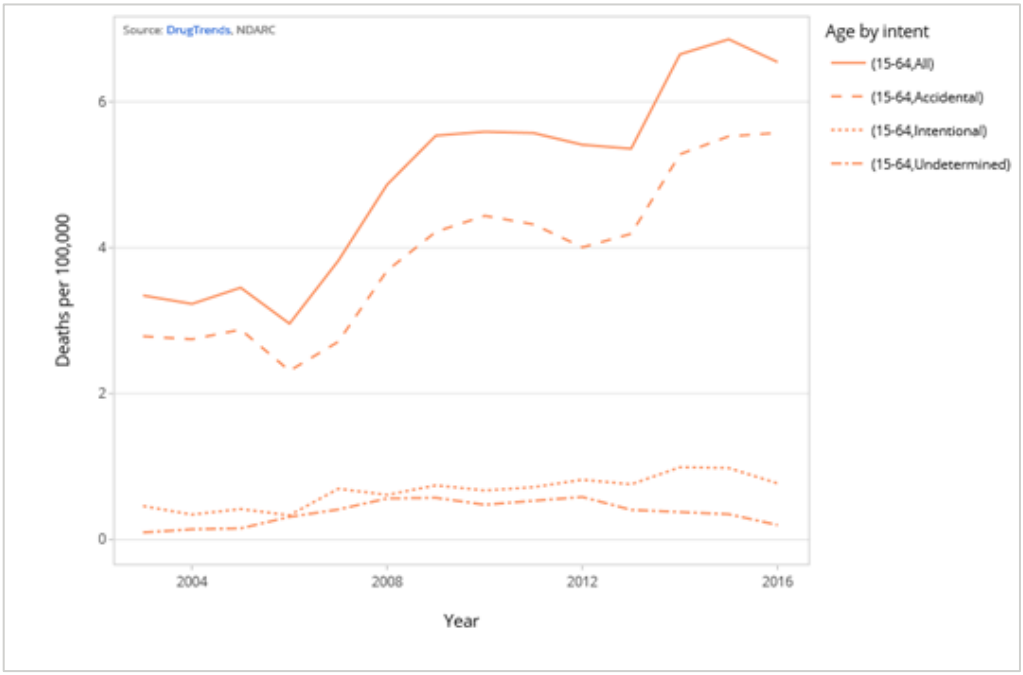
Source: Centers for Disease Control.

Thus, it would be reasonable to assume that a 5.9% reduction in prescription opioid volumes would also lead to a 5.9% reduction in opioid deaths.

To put this into perspective, 784 Australians died as a result of opioid overdoses attributable to pharmaceutical opioids, or a combination of pharmaceutical opioids and pharmaceutical opioids together with heroin in 2016.[45] Thus if an Australian program were as effective as its US counterpart, it could be expected to result in around 47 fewer opioid deaths.

[44] The study did not identify whether the pain was chronic or acute, but many cases of prescription opioid dependence begin with acute pain prescription (https://www.uptodate.com/contents/prescription-of-opioids-for-acute-pain-in-opioid-naive-patients).
[45] https://ndarc.med.unsw.edu.au/resource/opioid-amphetamine-and-cocaine-induced-deaths-australia-august-2018

Figure 8.2 Opioid induced deaths in Australia, 2004 to 2016



Source: National Drug and Alcohol Research Centre (2018).

While there are many harms from opioid dependence, ranging from lower productivity through to a range of comorbidities, the single greatest harm caused by opioids is death. The Commonwealth Government requires that the VSL used in regulatory analysis is $4.48 million.[46] That is, each opioid death prevented by GP education interventions is worth $4.48 million to society.

8.2.3.2 Costs of GP education interventions

As a private company (albeit Government funded) NPS MedicineWise does not publish details of what its programs cost. However, Deloitte Access Economics (2014) reports that in 2013 NPS MedicineWise's Quality Use of Medicine program spent $22.6 million on educational interventions that engaged 22,349 health professionals. This translates to a cost of $1,013 per participant in 2013, or updated for inflation, $1,122 per participant now.

The Medical Board of Australia reports that there are 40,352 GPs in Australia in 2018.[47] While that may seem like a large number to reach, it is less than the number of health professionals who participate in NPS MedicineWise programs biennially. On a pro-rata basis, extending NPS MedicineWise's previous chronic pain and opioids program to cover all Australian GPs should cost $45.3 million. Conservatively, these costs will likely be incurred annually, to ensure that all GPs have access to contemporary training going forward.

8.2.3.3 Cost benefit analysis

At a value of $4.5 million per saved life, the 46.6 expected lives saved from a nationwide GP education program would be worth $209.0 million. Against the expected upfront costs of $45.3 million, this is a benefit to cost ratio of 4.6 to 1.

The benefit to cost ratio could be higher than this – for example, in section 8.1, multidisciplinary pain management was estimated to reduce health expenditure, net of intervention costs. It is likely that reductions in opioid prescribing are offset by greater access to other treatments (e.g. multidisciplinary care), although the net change in health expenditure was not considered for this intervention. In any case, such a program is likely to be highly cost effective from the perspective of the Australian community.

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[46] $4.2 million in 2014 dollars, updated for inflation to current values. https://www.pmc.gov.au/sites/default/files/publications/Value_of_Statistical_Life_guidance_note.pdf

[47] https://www.medicalboard.gov.au/news/statistics.aspx

Advice from Painaustralia indicates that the Faculty of Pain Management, in conjunction with the Royal Australian College of General Practitioners, has developed Better Pain Management, which is an online GP and specialist education program to improve pain management. The program was funded by government, but has ongoing costs and has not been formally evaluated. Such a program could represent an opportunity for ongoing government funding to improve community based GP management of pain conditions, at relatively low cost to participants (approximately $300).

8.3 Modelling of atypical opioids intervention

As discussed in sections 8.1 and 8.2, the first-best response would be to place far more people into multidisciplinary pain centres rather than just giving them opioids. However, while there are current alternatives, ranging from non-pharmacological pain management strategies through to implantable devices, the dearth of multidisciplinary centres means that many patients with severe disabling pain will continue to be prescribed opioids for their chronic pain.

The available evidence suggests that newer atypical opioids are as effective as conventional opioids at pain management, no worse regarding side effects, and have substantially lower mortality rates. This section models the potential economic benefits that could accrue under a scenario where a greater proportion of prescription opioids were atypical rather than conventional. However, while this analysis shows that many lives could be saved every year by such a switch, it also shows that there is not yet sufficient evidence to recommend such a change as yet. Pain management centres in Western Australia are increasingly prescribing atypical opioids, and their share of prescriptions has risen from 23% in 2014 to 33% in 2018.[48] This should enable robust scientific research into the benefits of atypical opioids in Australian real world settings in the near future.[49]

The atypical opioids - buprenorphine, tramadol and tapentadol - have different effects, a lower risk of abuse and lower toxicity when compared to conventional opioids (Schug, 2018). In this section, an intervention has been modelled that targets prescriptions that are being dispensed to persons who are frequently dispensed opioids (Lalic et al, 2018).

The aim of the intervention is to reduce the number of opioid related deaths and hospitalisations within a group of people who are potentially at a high risk of abusing or developing dependence. In a real world setting, the proposed intervention would be a form of opioid rotation, a method currently supported in the 2017 Canadian guidelines for opioids for chronic non-cancer pain. Opioid rotation involves the switching of a patient's opioid prescription where patients are experiencing persistent pain and/or problematic adverse events under their current prescription (CADTH, 2017).

The benefit of atypical opioids derives from their different mechanisms of action. Atypical opioids differ from conventional opioids as they do not rely exclusively on mu-receptor agonism for their analgesic effect (or pain relief). As a result, they have different effects and different adverse effects including toxicity and abuse potential compared with conventional opioids (Schug, 2018). At low doses, both conventional and atypical opioids may provide the same analgesic effect. At higher doses buprenorphine is known to have a 'ceiling' effect beyond which the risk of respiratory depression does not increase. The result is that buprenorphine can be given in higher doses with fewer adverse events than would be seen in conventional, full agonist opioids (Schug, 2018). Tramadol also has significantly lower risk of respiratory depression than conventional opioids (Schug, 2018).

Despite the potential for fewer adverse events, atypical opioids do not remove the dangers associated with addiction and can still be abused. For example, the National Survey on Drug Use and Health reported that 2 million Americans aged 12 or over had used tramadol for non-medical purposes in 2012.[50]

8.3.1 AIHW report on opioid harm in Australia

In 2018, the AIHW released their report titled *Opioid harm in Australia and comparisons between Australia and Canada.* The purpose of the report was to address rising concerns of opioid abuse and provide a comprehensive summary of opioid use and its harmful effects in Australia. The report found that 3.1 million

[48] Based on analysis of Medicare statistics data (Department of Human Services, 2018).
[49] Results from clinical trials in laboratories do not always carry over when translated into actual clinical practice.
[50] https://drugabuse.com/tramadol/is-addictive/

Australians had 1 or more opioid prescriptions in 2016-17. The total number of opioid deaths in 2016 was 1,119, an increase from 439 deaths in 2006. Furthermore, the total number of hospitalisations with opioid poisoning as the principal diagnosis has increased by 25% over a ten year period.

In Australia, the rate of opioid prescriptions increases by age, from 757 per 100,000 population among those under 15 to 182,691 per 100,000 persons aged 65 and over. Among those persons, females averaged 5.2 prescriptions over 12 months whilst males averaged 4.6 prescriptions. Oxycodone was the most prescribed drug with over 5,400,000 prescriptions, representing a 30% increase in prescriptions since 2012-13. Codeine, fentanyl, methadone and morphine all experienced reductions in prescriptions dispensed.

Of the 1,119 opioid-related deaths in 2015-16, 992 involved pharmaceutical opioids, and 784 were estimated to be from opioids used to manage chronic or acute pain (methadone was excluded from the analysis and accounted for 208 deaths). The pharmaceutical opioids are grouped by type (naturally derived opioids, synthetic opioids, methadone or other/unspecified) which prevents calculation of deaths caused by specific opioids. Naturally derived opioids were responsible for 550 deaths, methadone for 208 deaths and synthetic opioids for 234 deaths.

The AIHW's report classifies opioids as either synthetic or naturally derived (AIHW, 2018a). Methadone is not reported in the present analysis as it is mostly used for pharmacotherapy. Heroin and opium were also excluded from the analysis. The opioids buprenorphine, tramadol and tapentadol are classified as atypical opioids (Schug et al, 2018) with the remaining opioids forming the conventional group. Table 8.9 outlines each opioid and its respective classification.

Table 8.9 Opioids classification by type

Pharmaceutical opioid	Type	Conventional/atypical
Codeine	Naturally derived	Conventional
Morphine	Naturally derived	Conventional
Oxycodone	Naturally derived	Conventional
Hydromorphone	Naturally derived	Conventional
Fentanyl	Synthetic	Conventional
Buprenorphine	Naturally derived	Atypical
Tramadol	Synthetic	Atypical
Tapentadol	Synthetic	Atypical

Source: AIHW (2018a), Schug et al (2018).

8.3.2 Safety and effectiveness

It is noted that the current analysis only provides a proxy for the safety of atypical opioids through an examination of national databases on overdoses. The patient's personal interactions with particular opioids is not captured in the current analysis unless that person is hospitalised or dies. It is likely that transitioning patients from conventional to atypical opioids may change their experience of minor to moderate adverse events and impact on their general wellbeing. Although opioid rotation is advocated (see Canadian guidelines for opioids for chronic non-cancer pain, 2017), there are also dangers associated with withdrawal (see Lintzeris et al, 2018) present during the rotation period. Further research is needed in this area to make a conclusion on possible changes to safety and efficacy resulting from such an intervention.

For example, as noted in Chapter 7, pregabalin was thought until recently to be non-addictive. No evidence of euphoria was found in clinical trials during its development. However, in the real world, Crossin et al (2018) found that ambulance call-outs associated with the misuse of pregabalin have increased tenfold in Victoria since 2012. Two thirds of this was due to compounding effects from use with other sedatives.

Safety

Studies suggest that the atypical opioids experience similar rates of adverse events to those expected with conventional opioid usage, although the profile of adverse events can be quite different. For example, all three

atypical opioids are less likely to cause constipation, which is a major adverse effect of the long term use of conventional opioids (Schug, 2018). Tapentadol also had the lowest rate of major medical adverse effects, hospitalisations and serious adverse effects of all opioids on the US market (Murphy et al, 2018).

It should be noted that the patient studies from which the data was collected operate in more controlled environments than when these drugs are used in the real world. The result of this is fewer deaths from overdose or from use alongside other substances which distorts the results from real life data. As such, the data presented has not been used to inform the inputs for the death rate or hospitalisation rate.

- Tramadol is typically recommended for the treatment of moderate to severe pain (Faria et al, 2018). Tramadol intoxication is typically present 4 hours after administration, for doses of 500mg or above. For doses greater than 800mg, the risk of coma and respiratory depression increases, particularly exacerbated alongside use of other psychoactive substances (Faria et al, 2018). The main complications of tramadol include serotonin syndrome, respiratory depression, seizure, nausea and vomiting (Faria et al, 2018). In one study 91% of patients experienced one or more adverse events (tiredness, dry mouth, dizziness, sweating, constipation, nausea or voiding dysfunction) with a total of 44% of patients withdrawing from medication as a result of adverse events (Norrbrink et al, 2009). No deaths were recorded for the study duration of 4 weeks. In a review of clinical effectiveness the Canadian Agency for Drugs and Technologies in Health (CADTH) identified one systematic review which showed that adverse events were higher in tramadol compared with placebo (nausea: 11.9% versus 3.3%, dizziness: 6.3% versus 1.3% and somnolence 6.3% versus 1.3%).
- Tapentadol is also recommended for the treatment of moderate to severe pain (Faria et al 2018). The most common side effects include nausea, vomiting, dizziness, headache and somnolence (Faria et al, 2018). Afilado et al (2010) reported a 75.9% incidence of adverse events (compared to 61.1% adverse events with placebo and 87.4% with oxycodone) over a 15 week period. No serious adverse events or deaths were recorded in this study. In a review of post marketing safety data on tapentadol Stollenwerk et al (2018) identified more than 10,000 cases concerning tapentadol from the Grunenthal global safety database. 57.5% of subjects experienced adverse drug reactions. Most of these side effects were considered to be typical side effects under opioid treatment, concluding that tapentadol was well tolerated by adult patients including the elderly (Stollenwerk et al, 2018). Tapentadol was reported in 16 deaths, 10 of which were likely the cause of administering tapentadol together with other illicit substances and 3 cases where the patient likely died from their underlying disease (cancer patients). In a comparison or the risk of opioid abuse between tapentadol and oxycodone, Cepeda et al (2013) concluded that tapentadol has a 65% lower chance of being abused. The international Federation of Pharmaceutical Manufacturers and Associations (IFPMA) reported in a critical review of tapentadol that most cases of adverse events in phase II and III clinical trials were classified as mild or moderate. No deaths were reported (IFPMA, 2014).
- Steiner et al (2011) studied the safety of buprenorphine transdermal systems for chronic lower back pain. The study reported that the adverse events recorded were similar to those expected with opioid agonists. During the 84 day double blind phase, 11 SAEs were recorded for buprenorphine (9 for oxycodone). No deaths related to buprenorphine were recorded during the study period. Pergolizzi et al (2017) concluded that the incidence of SAEs due to buprenorphine were small regardless of age. In a comparison to methadone, Auriacombe et al (2001) reported that the death rate of buprenorphine is three times smaller, with a death rate per patient of 0.0002. This conforms with the CADTH review of the clinical effectiveness of buprenorphine which drew conclusions that buprenorphine has a lower likelihood of causing respiratory depression (compared to fentanyl and morphine) which is a leading cause of opioid deaths (CADTH, 2017, van der Schier et al, 2014).

Effectiveness

The comparative benefits of all opioids in terms of pain reduction were derived from Busse et al (2018). This study conducted a systematic review of RCTs of opioids for chronic non-cancer pain. Using the data from 96 RCTs Busse et al (2018) concluded that opioid use is associated with reduced pain compared with placebo. For the purposes of the present analysis, 63 of the studies used in Busse et al (2018) were categorised by trial type (atypical or conventional) to compare the relative effectiveness of conventional and atypical opioids. Weighting the trials results by sample size, atypical opioids improve pain by 1.51 units (on a 10 point visual analogue scale) whereas conventional opioids improve pain by 1.68 units, suggesting that conventional and atypical opioids have comparable pain relief depending on their indication and target population.

However, no studies were identified that demonstrate the impact on the patient's pain reduction when they are transferred from conventional to atypical opioid prescriptions. Additional problems arise when considering a patient's willingness to switch prescriptions if the likely effect is a reduction in pain relief (albeit alongside a reduction in the chances of a serious adverse event or death). The 2017 Canadian guidelines for opioids for chronic non-cancer pain suggest that there is substantial variability expected with a patients, reporting that patients are often willing to take on higher chances of addiction, overdose or death for marginal improvements in pain reduction. Accordingly, while the scenario modelled here considers switching a large number of people on long-term conventional opioids to atypical opioids, it may be easier to achieve this transition gradually, by only administering atypical opioids to new patients.

Evidence from Busse et al (2018) suggest that when used properly these drugs are at least as effective as conventional opioids, with a lower risk of adverse events (Schug, 2018). However, it is important to note that atypical opioids may not be appropriate for all patients, and there will be patients who respond better to conventional opioids both in terms of effectiveness and the number of adverse events. The proposed intervention would be to the disadvantage of these patients. Further research in this area is warranted to capture the additional impacts that this intervention would have upon the number of adverse events experienced and the overall levels of pain reduction patient's experience.

8.3.3 Modelling

There were more than 11 million prescriptions for conventional opioids in 2017-18 (AIHW, 2018a). For the modelling, a hypothetical intervention was considered where people who persistently use conventional opioids are switched to atypical opioids.

According to Lalic et al (2019) there are 3 million people using opioids each year, of whom 1.17 million were classified as people who persistently use opioids (those persons who had received a prescription in 7 of the last 12 months). Further, Lalic et al (2018) estimated that 2.6% of people initiated on opioids go on to persistently use opioids.[51]

Conservatively it is assumed that the 1.17 million patients each receive 7 prescriptions per year. Furthermore, Lalic et al (2018) concluded that 32.5% of initial prescriptions were for atypical opioids. Using this data, **it was estimated that 5.1 million scripts could be replaced with atypical opioids**. In reality, it would take many years to change prescribing patterns by this magnitude, and it is likely the change will happen slowly by initiating people on atypical opioids, where pharmacological pain management is warranted; however, for the purposes of this analysis, it was assumed that the scripts could be replaced in one year.

As noted in section 7.2 and section 7.4, the deaths and hospitalisation rates differ by type of opioid. The rates are reproduced in Table 8.10. The effect of the intervention was considered by multiplying the number of scripts (5.1 million) by the difference in the hospitalisation and death rate. It was assumed that the relative strength of a conventional opioid prescription is equal to the strength of an atypical opioid prescription (when both are converted into oral morphine equivalents).

Table 8.10 Deaths by opioid type

Opioid type	Deaths per 1,000 prescriptions	Hospitalisation rate per 1,000 prescriptions
Conventional	0.066	0.20
Atypical	0.018	0.16

Source: Deloitte Access Economics analysis based on AIHW (2018a) and PBS data.

The cost of hospitalisations and deaths (calculated in section 7.2 and section 7.4 respectively) was then used to estimate the potential benefits of prescribing atypical opioids instead of conventional opioids in Australia, by averting deaths and hospitalisations due to opioid poisonings. The costs of opioid deaths and poisonings are reproduced in Table 8.11.

[51] In every year, there are also people who will no longer require opioid prescriptions (Per Sjogren et al, 2010).

Table 8.11 Productivity and wellbeing losses due to opioid-related deaths, 2017-18

Cost per death	Conventional	Atypical	Total
Productivity loss	1,192,197	1,265,456	1,200,123
DWL of productivity loss	97,675	103,679	98,324
Burden (DALYs)	41.94	43.43	42.10
Burden ($ value)	4,494,203	4,564,952	4,501,857

Source: Deloitte Access Economics analysis.

8.3.4 Results

The results from the modelled intervention suggest that atypical opioids may be superior to conventional opioids with regard to limiting patient deaths and hospitalisations, although the evidence is limited, and further research is required to determine if these benefits could be realised.

A summary of the results is provided in Table 8.12. The intervention has the potential to save 249 deaths and 206 hospitalisations. Most of the savings occur due to a reduction in the number of deaths; the total financial savings could be $301.9 million and the total gain in wellbeing could be $1.1 billion. Alternatively, the total financial and wellbeing savings could be $59 and $214 per script.

It was not possible to estimate the costs of a program that would result in a transition of this magnitude (i.e. changing 5.1 million scripts is likely to require a substantial investment); the main driver of cost is likely to derive from the need to educate GPs and hospitals (discussed in section 8.2) to change prescribing patterns. Moreover, atypical opioids are likely to have a higher cost per script than conventional opioids. In particular, tapentadol and buprenorphine can cost up to $12 and $25 more per script compared with conventional opioids. Finally, transitioning patients who are dependent on a conventional opioid may require pain addiction and pharmacotherapy services, which may not be adequate to handle the volume of patients that would be transitioned to atypical opioids under such an intervention.

The emerging evidence suggests optimising prescribing patterns may have the potential to save up to 250 lives a year, which calls for an urgent and thorough scientific investigation to verify whether this would in fact be the case, and to meet required evidentiary standards to enable such a change if it is so.

Table 8.12 Potential savings due to prescribing atypical opioids instead of conventional opioids

Prescribing scenario	Deaths	Hospitalisations	Financial costs ($bn)	Wellbeing losses ($bn)	Total costs ($bn)
No change to current prescribing	341	1,034	0.43	1.52	1.96
Prescribing atypical opioids	93	829	0.30	0.43	0.56
Potential savings	**249**	**206**	**0.30**	**1.10**	**1.40**

Source: Deloitte Access Economics modelling.

Other research into alternative strategies to reduce the burden of the opioid crisis in Australia should also be considered. For example, while typically seen as a high cost alternative, neuromodulation treatment (e.g. spinal cord stimulation) can substantially reduce pain levels, and can be used to successfully taper opioid medication. Neuromodulation treatment has been found to be highly cost effective for patients with severe disabling pain (see Hoelscher et al, 2017). Similarly, interventional pain therapies and opioid dose reduction programs may also be effective ways to reduce the burden of opioid misuse in Australia.

9 Conclusions

The burden of chronic pain in Australia is considerable and growing. This report found 3.2 million Australians were living with chronic pain. Treating chronic pain is costing our health system $12.2 billion each year, or $3,771 per Australian living with chronic pain. Australians living with chronic pain pay $2.7 billion out of their own pocket to manage their chronic pain.

Additionally, chronic pain costs our society in other ways.

Productivity costs make up the largest share of total financial costs (66.0%), while deadweight losses account for 10.3%. Other financial costs such aids and modifications and informal care account for the remaining 6.9%. It was estimated that individuals bore 36.0% of total financial costs, followed by governments (35.1%), employers (12.3%), society (12.7%) and family or friends (3.9%).

In addition to the substantial financial costs associated with chronic pain, 340,384 DALYs were due to chronic pain (or conditions causing it) in 2018, which, using the VSLY, is a cost of $66.1 billion. Based on data from the AIHW (2017; 2018), chronic pain was estimated to be associated with 6.8% of the total burden of disease in Australia, and 6.5% of total health system expenditure in Australia.

The total financial costs associated with chronic pain were estimated to be $73.2 billion in 2018, which equates to $22,588 per person with chronic pain. The costs associated with chronic pain in Australia in 2018 are summarised by cost component in Table 9.1. The costs by age and gender are summarised in Chart 9.1.

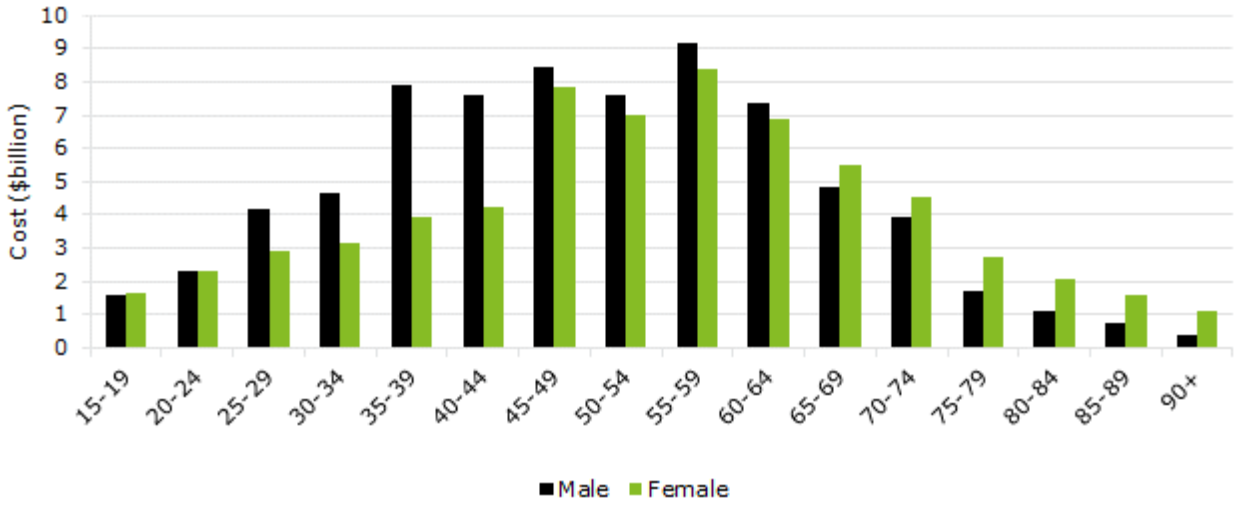
Table 9.1 Total costs associated with chronic pain, Australia 2018

Cost component	Total cost ($bn)	Per person ($)	Proportion of total (%)
Health system	12.23	3,771	8.8
Reduced employment	36.18	11,161	26.0
Absenteeism	3.17	979	2.3
Presenteeism	8.99	2,773	6.5
Informal care	4.51	1,390	3.2
Aids and modifications	0.57	176	0.4
Deadweight losses	7.58	2,338	5.4
Total financial costs	**73.22**	**22,588**	**52.6**
Loss of wellbeing (non-financial)	**66.10**	**20,391**	**47.4**
Total costs	**139.33**	**42,979**	**100.0**

Source: Deloitte Access Economics analysis.

For the geospatial analysis, average costs for each cost component by age and gender were applied to the prevalence in each area to estimate the costs associated with chronic pain by region. While there would be regional differences in the risk factors for chronic pain, and the treatment of chronic pain (i.e. higher or lower health system utilisation in regions), the cost estimates provide an indication of the size of the problem for each area. In line with share of population, the costs associated with chronic pain were highest in NSW (31.9%), followed by VIC (25.5%), QLD (20.0%) and WA (10.7%) with other jurisdictions accounting for 11.9%. Approximately 33.8% of costs occur outside of the capital cities of Australia.

Chart 9.1 Total costs associated with chronic pain by age and gender, Australia 2018, $ billions



Source: Deloitte Access Economics analysis.

The impact of chronic pain is expected to rise in the absence of any changes to health system treatments, or to prevalence rates. Within five years, 3.55 million Australians are expected to be living with chronic pain, which could cost our health system $13.3 billion per year (in real 2018 dollars, assuming that unit costs remain constant in real terms). By 2050, 5.23 million Australians are expected to be living with chronic pain, requiring $19.1 billion per year (in real 2018 dollars) in health funding. The total costs of chronic pain are expected to rise to $215.6 billion by 2050 (in real 2018 dollars).

Opioids are chemical substances with morphine like attributes that are commonly used for pain relief, although they have addiction potential and can cause associated problems of dependence including serious adverse events or death through overdose. There is also an increased risk when opioids are used to manage pain alongside other drugs (including sedatives and alcohol). Currently in Australia, there are more deaths associated with prescription opioids than heroin, cocaine, or other illicit drugs. In 2017-18, 823 Australians are believed to have lost their lives as a result of prescription opioid misuse. Opioids can be broken into two categories – conventional opioids and atypical opioids.[52] The majority of the deaths were likely due to conventional opioids (735), even when conservatively estimating the deaths due to atypical opioids (88). Overall, these deaths cost Australia $4.7 billion, comprising $1.0 billion in financial losses (forgone future income), and $3.7 billion in reduced wellbeing.

Cost effectiveness of interventions

Chapter 8 assessed two promising interventions to reduce the burden of chronic pain in Australia: specialists training GPs to use best practice alternatives to opioids for managing chronic pain, and multidisciplinary pain management interventions compared to standard care.

The evidence suggests both interventions have the potential to improve patient outcomes.

Based on a previous intervention by NPS MedicineWise, the education program should result in a 25% improvement in best-practice chronic pain management by GPs. Importantly, it has the potential to reduce opioid prescription volumes by around 6%, and prevent some 47 opioid-related deaths annually for upfront costs of $45 million. The avoided deaths represents a social benefit of $209.0 million, which constitutes a **benefit to cost ratio of 4.6 to 1**.

Multidisciplinary pain management is more effective than standard treatment. It improved quality of life (0.03 QALYs saved per person), and was cheaper to deliver in terms of health expenditure (saving $226 per person

[52] Atypical opioids differ from conventional opioids as they do not rely exclusively on mu-receptor agonism for their analgesic effect (or pain relief). As a result, they have different effects and different adverse effects including toxicity and abuse potential compared with conventional opioids (Schug, 2018).

per year). Multidisciplinary care also improved work attendance, reducing absenteeism by seven days per person per year compared to standard care. Overall, multidisciplinary pain management can save $9,582 per person per year.

Table 9.2 Financial and wellbeing outcomes per person under intervention and control arms

Type of benefit	Intervention	Control	Savings ($)
Health expenditure ($)	4,036	4,262	226
QALYs	0.033	*	6,381
Days off work	-7.14	*	2,975
Total			**9,582**

Sources: Deloitte Access Economics analysis. Note "*" not able to include, as some studies only reported results net of control.

Aspex Consulting (2009) estimated that access to multidisciplinary care would need to at least double in order to provide even a minimally acceptable level of service. Burke et al (2015) estimated that then existing centres could service 31,779 patients a year. Doubling access to multidisciplinary care could be achieved for an outlay of $69.7 million, which represents a **benefit to cost ratio of around 4.9:1**.

Table 9.3 Costs and benefits of doubling access to multidisciplinary pain centres in Australia

Impact	$ million
Reduced health expenditure	73.4
Gain in QALYs	202.8
Reduced productivity losses (absenteeism)	64.6
Total benefits	**340.8**
Total costs	**69.7**

Source: Deloitte Access Economics analysis.

Chapter 8 also presented emerging evidence that prescribing atypical opioids rather than conventional opioids could offer benefits in Australia. On the basis of available evidence, prescribing atypical opioids rather than conventional opioids has the potential to save as many as 249 lives per year in Australia. The intervention could save Australia $1.4 billion in financial ($301.9 million) and wellbeing ($1.1 billion) costs, which is likely to outweigh the costs of an intervention to change prescribing patterns. However, more robust evidence is urgently needed – such as that which could be provided by a TCR project.

Other research into alternative strategies to reduce the burden of the opioid crisis in Australia should also be considered. For example, while typically seen as a high cost alternative, neuromodulation treatment (e.g. spinal cord stimulation) can substantially reduce pain levels, and can be used to successfully taper opioid medication. Neuromodulation treatment has been found to be highly cost effective for patients with severe disabling pain (see Hoelscher et al, 2017). Similarly, interventional pain therapies and opioid dose reduction programs may also be effective ways to reduce the burden of opioid misuse in Australia.

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Appendix A Supplementary methods

This appendix provides an overview of alternate prevalence sources that were considered for use in this study, and summarises the methods that were used to project population data by age and gender for each region considered in this report.

A.1. Alternate prevalence sources

A.1.1. National Health Survey

The NHS is one of two national level health surveys run by the ABS that include chronic pain. Data for chronic pain are not available in either the free or subscriber versions of the NHS, but only by special data request from the ABS.

Deloitte Access Economics approached the ABS for such data from the current NHS, but it was not possible to obtain it during the timeframe for this report. This is unfortunate, as such NHS data would also allow examination of health service utilisation and medications taken by people with chronic pain. However, Miller et al (2017) obtained such from the 2011-12 NHS, and is used in this report.[53]

They found that the prevalence of chronic and recurring pain over a six month period was 15.4% for Australians aged over 15 years (14.6% of males and 16.1% of females). Prevalence increased with age for both sexes. Significantly more females reported moderate-to-very severe pain, both overall and within most age groups.

A.1.2. NSW Health Survey

The last estimate of the cost of pain in Australia, Access Economics (2007), used prevalence of chronic pain data from the 1997 NSW Health Survey. That data showed a prevalence of chronic pain for men of 17% and for women of 20%. However, that data is now over 20 years old and the NSW Health Survey does not appear to have reported on chronic pain prevalence since.[54]

A.1.3. South Australian Health Omnibus Survey

The South Australian Health Omnibus is an annual, face-to-face, cross-sectional whole-of-population multi-stage systematic area sampling survey. Originally a government population health planning tool, Omnibus is now run by a commercial research organisation. The Survey collected data on chronic pain in 2006, however it has not done so since. Further, data are only available organisations that pay for particular questions to be fielded in the Survey.[55]

Currow et al (2010) using the 2006 Omnibus Survey (n=2973), reported an overall prevalence of chronic pain that interfered with daily activities for three months or longer of 17.9%. Prevalence of pain that interfered extremely with activity was 5.0%. Prevalence in males was 17.0% and in females 18.8%. Prevalence increased with age, from 13.2% in people under 35, to 25.2% in those over 65.

Allen et al (2016) also used the 2006 Omnibus Survey (n=2969). They found 24.6% of respondents experienced an episode of pain that had lasted for more than three of the last six months, with 4.7% having pain that interfered extremely with day to day activities. Prevalence in males was 22.6% and in females 26.7%. Pain increased with age, from 14.1% in people under 25, to 32.4% in people over 75.

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[53] At that time, the National Health Survey was called the Australian Health Survey.
[54] Fifteen years later, the NSW Pain Management Taskforce reported that the 1997 survey data was still the best available (NSW Health, 2012). A search of the NSW Health Survey site (https://www.health.nsw.gov.au/surveys/Pages/default.aspx) shows no results for chronic pain since 2012.
[55] https://health.adelaide.edu.au/pros/docs/hos_prospectus2016.pdf

An interesting finding from Allen et al was a strong association between chronic pain and obesity in the South Australian population. Individuals identified as obese reported pain interfering with daily activities twice as frequently as the rest of the population. To the extent that obesity rates in 2015 had risen by 12.5% from 1995 levels, that could be expected to cause higher rates of chronic pain.

A.1.4. New Zealand Health Survey

The New Zealand Health Survey defines chronic pain' as pain that is present almost every day and has lasted, or is expected to last, more than six months. One in five adults (20%) experienced chronic pain in 2016/17, up from 17% in 2006/07.

Rates of chronic pain increase with age, from 8% in people aged 15–24 years to 35% for those aged 75 years and over. Rates of chronic pain had increased in all groups aged 55 years and over since 2006/07.

Rates of chronic pain were highest in Māori (23%) and European (22%) adults, intermediate in Pacific adults (14%) and lowest in Asian adults (11%). After adjusting for age and sex differences, Asian adults were less likely to experience chronic pain than non-Asian adults. As New Zealand has a higher of Indigenous people than Australia, but a smaller proportion of Asians, results should be broadly comparable.

Chronic pain affected 23% of adults living in the most deprived areas, compared with 17% of adults living in the least deprived areas. After adjusting for age, sex and ethnic differences, adults living in the most socioeconomically deprived areas were 1.7 times more likely to experience chronic pain than adults living in the least deprived areas.

A.1.5. Australian GP Data

Henderson et al (2013 and 2016) reported estimates of chronic pain prevalence among patients seeking medical treatment from a GP using Bettering the Evaluation and Care of Health (BEACH) data.

The 2013 study assessed data from 5,793 patients visiting 197 GPs in 2008-09. The prevalence of chronic pain was 19.2%. Prevalence increased with patient age, from under 2% in people younger than 14, to 36.2% in patients aged 75 years and older. Unlike most studies, prevalence did not differ among males (18.0%) and females (20.0%).

After adjusting for visit frequency, the estimated prevalence of chronic pain in the population of patients attending general practice was 15.7%. However, while these results are not dissimilar from other national level data in Australia, as Miller et al (2017) note "differences in inclusion criteria in the study of general practice patients require these results to be considered stand-alone" from general population studies.

The most commonly reported causal conditions were osteoarthritis (48.1%) and back problems (29.4%). For CPG pain severity, 25.2% were at Grade I (lowest); 37.1% were at Grade II; 28.3% at Grade III; and 9.4% at Grade IV (highest). Over 10% of chronic pain patients reported more than one causal condition.

Medication was used for pain management by 86.1% of patients, and one third also used non-pharmacological managements. One third of patients were taking opioids, most commonly those at the highest pain severity grades.

The 2016 study found a prevalence of 25.4% among patients attending 97 GPs in 2015. Prevalence in males (21.8%) was lower than that in females (27.7%). Prevalence of chronic pain in patients in the lowest half by socioeconomic status was considerably higher (30.8%) than in patients from the top half (21.6%). Pain was lowest in persons aged between 15 and 24 (3.4 case of chronic pain per 100 encounters) and highest in those 75 or older (47.8 cases per 100 encounters).

A.1.6. Household, Income and Labour Dynamics of Australia Survey

The Household, Income and Labour Dynamics of Australia Survey is an ongoing large survey of the Australian population that contains questions on chronic pain. McNamee and Mendolia (2014) examined 90,142 observations to estimate the impacts of chronic pain. While they did not find a high prevalence (5.9%) they did find that chronic pain is associated with poor health conditions, disability, decreased participation in the labour market and lower quality of life. Specifically, people with chronic pain would compensating income variation of around $730 per day to feel as well of as they would be without it.

A.1.7. Other developed countries

As with the range of estimates noted above for Australia, Fayaz et al (2016) observe "there is little consensus regarding the burden of pain in the UK". For example, they found that prevalence estimates based on a 3 month definition were considerably higher than those based on 6 month definitions.

From a meta-analysis of 7 studies, Fayaz et al estimated the prevalence of chronic pain in the UK at 43%. The authors also found a trend towards increasing prevalence with increasing age from 14.3% in 18–25 years old, to 62% in the over 75 age group. However, six of these seven studies were of GP patients, which are not representative of the general population.

From four studies, Fayez et al also estimate that between 10.4% and 14.3% of the population have chronic pain that is either moderately or severely limiting (CPG grades III and IV). They note that this is similar to Breivik et al (2006) who estimated a prevalence of 13% of the UK population in a survey of moderate to severe pain lasting six months or more.

There is evidence of an increase in chronic pain in the UK over time. An average prevalence rate of 40.8% was found across studies published between 1990 and 2000; 43.8% from studies published between 2000 and 2010; and 45.0% from studies published after 2010.

United States

The US Institute of Medicine (2011) reported that previous estimates of chronic pain in developed countries had ranged from 2% (Kohlmann, 1991) to 40% (Brattberg et al, 1989) with a median of 15%. Using data from the 2008 US Medical Expenditure Panel Survey (n=20,214) the Institute then produced an estimate at the very top of this range, of 40%.

However, while defining chronic pain as that lasting for more than three months, the questions used to proxy this were somewhat different to those usually employed in chronic pain studies:

- whether, during the past 4 weeks, pain interfered with normal work outside the home and housework (and if so, whether that pain was moderate or severe); or
- whether had experienced pain, swelling, or stiffness around a joint in the last 12 months; or
- had ever been diagnosed with arthritis; or
- had a disability that limited their ability to work.[56]

One useful feature of this study was that it related absenteeism to pain severity and disability. Persons with moderate pain missed 2.12 more days a year than those with none, and those with severe pain 2.61 more days than those with moderate pain. Persons with functional disability missed 3.26 more days than those without.

World Mental Health Survey

Tsang et al (2008) analysed the results of the World Mental Health Survey, which included questions on chronic pain with a sample size of 42,249 people across 18 countries. The age-standardised prevalence of chronic pain across developed countries was 37.3%. Again, prevalence increased with age and was higher among females.

However, as with the Institute of Medicine, proxies were used rather than measuring chronic pain directly. The respondents were asked if they had any of the following conditions in the prior twelve months:

- arthritis or rheumatism;
- chronic back or neck problems;
- frequent or severe headaches; or
- other chronic pain.

Global Burden of Disease

The Institute for Health Metrics and Evaluation's Global Burden of Disease shows that globally, chronic pain or conditions that cause it account for four of the top ten conditions by total morbidity burden. Chronic low back pain is the single greatest cause of YLDs, with more than 146 million YLDs. This represents an increase of

[56] The authors were aware that the functional disability variable might capture people with a functional disability but no chronic pain and so conducted sensitivity testing with and without this measure.

61% since 1990 (although with no significant change in age-standardised rates). By way of comparison, this is nearly three times as many YLDs as the second largest cause, major depressive disorder (51 million YLDs).

- Chronic neck pain is the fourth greatest cause (34 million YLDs).
- Migraine is sixth (28 million YLDs).
- Other musculoskeletal disorders is 10th (22 million YLDs).
- These four chronic pain conditions feature in the top 10 causes of YLDs both in developed countries and in developing countries.

A.2. Methodology to estimate prevalence by region

For this report, population projections were based on data from the ABS (2013), including regional projections by Greater Capital City Statistical Areas (GCSA), and by Statistical Area Level 2, which are small area regions that were used to compile projections for each Commonwealth Electoral Division. GCCSA areas were also used to classify projections into urban areas (capital city) and regional areas (balance of state).

Concordances from the ABS were used to align SA2 boundaries with both GCCSA and Commonwealth Electoral Division (CED) boundaries. The ABS has published a concordance of SA2 populations to CED and GCCSA areas. SA2 population data, by age and gender for 2016 were used to estimate the population of each area. Population projections by state and territory were used to project each areas population to 2050, where an error correction was applied equally to all electorates to ensure the total population in each year agreed with the state and territory, and national projections for each year by age and gender group.

The prevalence rates by age and gender were then applied to the population data for each region by age and gender to estimate the number of Australians affected by chronic pain in each year, now and into the future.

A.3. Methodology to estimate costs of conditions by cause of chronic pain

The following sections provide a brief overview of the approach taken to estimate the cost of each condition contributing to chronic pain. The average cost estimates and prevalence by cause from these sections are then used in the report to estimate total health system costs associated with chronic pain in Australia in 2018.

A.3.1. Cost of broad conditions associated with chronic pain

As set out in section 1.2, chronic pain is associated with a range of underlying conditions, including injury, cancer, musculoskeletal, mental health/behavioural, gastrointestinal, neurological, infection, circulatory (cardiovascular), genitourinary, endocrine/hormonal, and respiratory conditions.

The allocated health system costs of these conditions were estimated based on data published by the AIHW (2013) which reported 2008-09 expenditure by broad condition. To estimate the 2018 costs of each broad condition, it was assumed that the condition represents the same proportion of total health system costs in 2018 as it did in 2008-09. Total health expenditure was estimated at $112.8 billion in 2008-09 (AIHW, 2010) and $180.7 billion in 2016-17 (AIHW, 2018a), which was updated using average historical health inflation (AIHW, 2018).

To estimate the per person costs of each condition in 2018, prevalence data for the various disease areas were obtained from the 2014-15 NHS (ABS, 2015) or from the Global Health Data Exchange (Institute for Health Metrics and Evaluation, 2018). National population data from the ABS (2018) were used to adjust the estimated prevalence to 2018 terms. The cost of broad condition per person was then estimated by dividing the total costs of the condition by its estimated prevalence.

Table A.1 sets out the approach for estimating the cost of condition per person in 2018.

Table A.1 Total health system costs by broad condition, Australia

	Cost of condition, $m 2008-09	Proportion of health system cost (%)	Cost of condition, $m 2018	Prevalence of condition, 2018	Cost of condition per person, $ 2018
Injury	5,184.0	4.6	8,501.8	7,014,550	1,212
Cancer	4,862.0	4.3	7,973.7	423,836	18,813
Musculoskeletal	5,671.0	5.0	9,300.5	7,204,469	1,291
Mental health/behavioural	6,375.0	5.7	10,455.0	4,219,869	2,478
Gastrointestinal	4,076.0	3.6	6,684.7	1,497,762	4,463
Neurological	3,387.0	3.0	5,554.7	1,811,306	3,067
Infection	1,654.0	1.5	2,712.6	147,266	18,420
Circulatory (cardiovascular)	7,741.0	6.9	12,695.3	4,408,520	2,880
Genitourinary	3,453.0	3.1	5,662.9	819,941	6,907

Source: Deloitte Access Economics analysis based on AIHW (2013), AIHW (2018), ABS (2015), Institute for Health Metrics and Evaluation (2018), ABS (2018).

A.3.2. Cause of chronic pain

The cause of chronic pain across ICD-10 condition groups was estimated based on a combination of Tardif et al (2018) and Blyth et al (2003). Cause data was mostly obtained from Blyth et al (2003), with the percentage of chronic pain attributed to cancer (1.6%) taken from Tardif et al (2018). The addition of cancer was assumed to reduce cases of chronic pain caused by 'no clear reason/don't know' by a corresponding 1.6%.

Applying these rates to estimated total prevalence of chronic pain from section 2.1 allowed for the estimation of the number of chronic pain cases by underlying ICD-10 cause (Table A.2).

Table A.2 Causes of chronic pain by condition, Australia 2018

Condition	Proportion of chronic pain due to condition (%)	Prevalence
Injury	38.0	1,231,865
Cancer	1.6	51,868
Musculoskeletal	24.1	779,896
Mental health/behavioural	1.1	36,274
Gastrointestinal	1.0	33,251
Neurological	0.7	21,160
Infection	0.6	18,137
Circulatory (cardiovascular)	0.7	21,160
Genitourinary	0.6	18,137
Endocrine/hormonal	0.2	6,046
Respiratory	0.2	6,046
No clear reason/don't know	31.4	1,017,910
Total	**100.0**	**3,241,750**

Source: Deloitte Access Economics analysis, adapted from Blyth et al (2003) and Tardif et al (2018).

A.4. Bottom up estimation of health system costs

This section contains a more detailed analysis of bottom up estimates and the methods used in deriving them. The bottom up estimates were used to triangulate the top down estimates used in this report. Components modelled include other medical professionals, research and pharmaceuticals.

A.4.1. Expenditure on GPs associated with chronic pain

This section presents a bottom up triangulation of the health system costs associated with GP presentations for chronic pain. Publically-available data on the number of GP presentations as a proportion of total GP presentations was reviewed, and applied to the price and volume of GP presentations in order to estimate the total cost of GP presentations due to chronic pain.

Henderson et al (2013) provides a study on a subset of 197 GPs and 5,793 patients from the BEACH program, a continuous national cross-sectional survey of Australian general practice, in order to estimate the prevalence of chronic pain in GP presentations. The authors find a prevalence of chronic pain at GP encounters of 19.2% (1,113 out of 5,793 respondents) and report that of those presenting with chronic pain, 1,074 encounters were for pain management. Calculating this as a rate, Henderson et al (2013) estimate that 18.5% of encounters at GPs were for administering pain management to those with chronic pain.

Henderson et al (2016) follow a similar study approach, using a sample of 97 GPs between February and March 2015. From 2,848 encounters, the estimated prevalence of all chronic pain at GP encounters was 25.4% - which comprised 5.2% neuropathic pain and 20.2% nociceptive pain. The authors do not provide an estimate for those presenting to GPs specifically for pain management, and this rate may therefore include people with chronic pain presenting to GPs for some other condition.

Britt et al (2016) conducted a study of Australian GPs and their study can be used to calculate a presentation rate of chronic pain at 8.3% of all GP encounters. The presentation rate was triangulated against other estimates provided by Henderson et al (2013, 2016) and was found to likely understate the true presentation rate for chronic pain. The data reported by Britt et al (2016) does not explicitly refer to chronic pain.

Upon reviewing each of these potential approaches, Henderson et al (2013) was deemed the most appropriate study for purposes of the bottom up estimation of GP consultations due to chronic pain. This was assumed because Britt et al (2016) does not explicitly set out chronic pain cases and therefore is likely to understate the rate of encounters due to chronic pain, whilst Henderson et al (2016) does not adjust total encounters due to chronic pain to consider only those encounters where chronic pain was managed.

The rate reported by Henderson et al (2013) is also conservatively within the range reported by recent SAND abstracts, which provide a snapshot of GP presentations by condition in Australia based on the BEACH program (a continuous study monitoring the activities of GPs in Australia). For 2014-15, SAND abstract 234 reported that 25.4% of patients presenting to GPs had chronic musculoskeletal and/or nerve pain. This compares to a rate of 18.8% in SAND abstract 150 based on 2009-10 presentation, and 19.6% in SAND abstract 127 based on 2008-09 presentations data which are both estimates for chronic pain presentations.

Table A.3 Rate of GP presentations for chronic pain, Australia

Condition	Rate per 100 encounters
Henderson et al (2013)	18.5
Henderson et al (2016)	25.4
Britt et al (2016)	8.3

Source: Henderson et al (2013), and Henderson et al (2016).

The rate of GP encounters for chronic pain estimated from Henderson et al (2013) was applied to Medicare Statistics from the Department of Health's (2018a, 2018b) Summary Statistics by Broad Type of Service to estimate total GP consultations associated with chronic pain. There were estimated to be 25.04 million GP consultations associated with chronic pain in 2018.

The average cost of a GP service was calculated based on Medicare Statistics data. The average cost was derived using the total benefits provided for non-referred attendances ($6.16 billion), the number of services

(135.17 million), the proportion of services that were bulk billed (84.7%), and the average out of pocket cost ($36.50).

The average cost per consultation was estimated to be $51.13 in 2018 terms. This is calculated as the total benefits paid plus aggregated out-of-pocket expenditure, divided by the number of services delivered in 2017-18. However, patients may present to GPs with more than one problem, and therefore the entire cost is not directly attributable to chronic pain. The average cost ($51.13) was divided by the average number of problems (1.55) based on Britt et al's (2016) report into General Practice Activity in Australia. The cost per consultation attributable to chronic pain was therefore estimated to be $33.07 in 2018.

The total cost of GP consultations associated with chronic pain was then estimated by applying the cost per consultation ($33.07) to the estimated number of consultations due to chronic pain (25.04 million). The estimated cost came to a total of $828.2 million in 2018.

A.4.2. Expenditure on pain related health services

Where permitted by publically-available information, a bottom up approach was also used to triangulate costs of pain specialists, surgical interventions, and non-admitted patient care likely in outpatient clinics against the top down estimates.

Surgical intervention

For surgery, relevant items were identified from Medicare, and data was collected on the number of services delivered and the value of benefits paid in 2017-18. The following codes were deemed relevant, and based on their item descriptions it was assumed that the benefits paid related wholly to the treatment and management of chronic pain:

- Group 1 – Miscellaneous Therapeutic Procedures (14209, 14218, 14221);
- Group T7 – Regional or Field Nerve Blocks (18213-18298); and
- Group T8 – Surgical Operations (39013, 39100-39140, 39323).

Using benefits reported by Medicare Statistics as a basis for estimation, the cost of surgical intervention associated with chronic pain was estimated to be $64.4 million in 2018.

Non admitted patient care

A similar approach was followed to estimate the expenditure on non-admitted patient care likely in outpatient clinics associated with chronic pain. The national hospital cost data collection reports service categories relating to pain management, along with the number of services and total average cost per service, in 2015-16 terms (Independent Hospital Pricing Authority, 2018). These estimates were adjusted to 2018 terms using an estimate of health inflation and population growth respectively to adjust the price and volume of services delivered (Table A.4).

Table A.4 Non-admitted outpatient care expenditure associated with chronic pain (2018), Australia

Item	Services	Cost per service ($)	Total expenditure ($m)
1014 pain management interventions	7,317	299.90	2.2
2003 pain management	53,384	477.63	25.5
2030 rheumatology	122,232	383.37	46.9
Total			**74.6**

Source: Deloitte Access Economics modelling, based on Independent Hospital Pricing Authority (2018).

Pain specialists

Expenditure on pain specialists was estimated using data published by the Department of Health's (2018a) Medicare Statistics. Relevant Medicare items were identified, including 2799, 2801, 2806, 2814, 2824, and 2832 and the average price of these services calculated by dividing reported benefits paid by the volume of services delivered for the 2017-18 year as reported in Medicare Statistics. The average price of pain specialists was then calculated at $88.50 by weighting the price of each item by the number of services delivered.

The utilisation of pain specialists among people experiencing chronic pain was estimated using the rate provided by Henderson et al (2013) as a basis. The average annual frequency of service utilisation for pain specialists was estimated at 10.4 encounters using Tardif et al (2016) who provides an analysis of presentations to a subset of pain clinics. These figures were then multiplied by estimated prevalence from section 2.1 in order to calculate the total services associated with chronic pain (Table A.5). The total estimated value of health system expenditure on pain specialists comes to $110.4 million.

Table A.5 Health system expenditure on pain specialists associated with chronic pain, Australia 2018

Type	Cost of consultation ($)	Utilisation rate (%)	Frequency of utilisation	Total services associated with chronic pain	Total expenditure ($m)
Pain specialists	88.50	3.7	10.4	1,247,425	110.4

Source: Deloitte Access Economics modelling based on publically-available information.

Summary

Totalling these components yields an overall estimated value of $249.4 million for expenditure on pain-related health services associated with chronic pain. This is summarised in Table A.6, with the largest component being pain specialists at $110.4 million (44.3% of total), followed by non-admitted patient care at $74.6 million (29.9% of total).

Table A.6 Summary of expenditure on pain related medical services, Australia 2018

Medical service	Expenditure associated with chronic pain
Surgery	64.4
Non-admitted patient care	74.6
Pain specialists	110.4
Total	**249.3**

Source: Deloitte Access Economics modelling. Note: results may not sum to total due to rounding.

A.4.3. Expenditure on other allied health professionals

People with chronic pain are also likely to utilise other allied health services, such as acupuncture and physiotherapy. For this reason, a bottom up approach was used to estimate the expenditure on these services associated with chronic pain.

Relevant Medicare items were identified based on desktop research, and corresponding data was obtained on the number of services delivered and the value of benefits in 2017-18 from Medicare Statistics (Department of Human Services, 2018). The Medicare items included as a basis for estimation are summarised in Table A.7.

Table A.7 Medicare items used for bottom up analysis

Type	Medicare items
Acupuncture	173, 193, 197, 199
Physiotherapy	10960

Source: Department of Human Services (2018)

The average cost per attendance for each of these broad health service categories was estimated by dividing the benefits paid by the volume of services delivered for each of the relevant items, and then weighting by the number of services delivered to obtain an average. Henderson et al (2013) was used as a basis for estimating the rate of service utilisation among people specifically experiencing chronic pain. From their study, it was assumed that 12.6% of people with chronic pain use physiotherapy at least once, and 2.1% utilise acupuncture.

The average frequency of service utilisation for physiotherapy was determined using Niemesto et al (2005) and Lalonde et al (2014) as a basis. Lalonde et al (2014) provide a Canadian study on healthcare utilisation among patients reporting non-cancer pain for at least six months, recruited from community pharmacies. They estimate the frequency of physiotherapy utilise by pain severity level as summarised in Table A.8. Niemesto et al (2005) study a subset of patients with chronic low back pain and report an estimated average number of visits to physiotherapists with and without intervention over a 24-month period. These figures are averaged in order to obtain a representative measure.

Table A.8 Physiotherapy utilisation among those with chronic pain, visits per annum

Source	Mild	Moderate and severe	Overall
Lalonde et al (2014)	31.3	45.0	38.9
Niemesto et al (2005)			6.2
Average visits per annum			**22.5**

Source: Lalonde et al (2014), Niemesto et al (2005)

A similar approach was followed in order to estimate the frequency of acupuncture utilisation among people with chronic pain using Lalonde et al (2014) as a basis. Taking a prevalence-weighted average with the rates 4.7 visits per annum for mild pain and 4.1 visits per annum for moderate and severe pain, the average annual number of acupuncture visitations was estimated at 4.4 for those with chronic pain.

The overall number of people with chronic pain utilising these health services was calculated by applying the rates from Henderson et al (2013) to prevalence estimates calculated in section 2.1. To estimate the number of total encounters, the number of people who utilised these services was multiplied by the estimated annual frequency of utilisation. This figure was then multiplied by average cost in order to estimate the total cost of other allied health professionals associated with chronic pain. This is set out in Table A.9, and comes to a total estimate of $190.7 million in health expenditure for other allied health professionals associated with chronic pain for 2018.

Table A.9 Expenditure on other allied health professionals attributable to chronic pain, 2018

Type	Cost of consultation ($)	Utilisation rate (%)	Frequency of utilisation	Total services associated with chronic pain	Total expenditure ($m)
Acupuncture	48.19	2.1	4.4	517,383	24.9
Physiotherapy	53.41	12.6	22.5	3,104,300	165.8
Total					**190.7**

Source: Department of Human Services (2018a), Henderson et al (2013), Tardif et al (2018), Lalonde et al (2014), Niemesto et al (2005)

A.4.4. Medication expenditure

There are no publically-available data on the utilisation of medications to manage chronic pain in the general population cohort. To estimate the amount of medication expenditure resulting from chronic pain, a targeted review of the literature was conducted. From this targeted literature review, a number of methods have been used to estimate health system spending on medication for chronic pain management and the estimates calculated have been triangulated.

The types of drugs used to manage chronic pain were assumed from the analysis conducted by Henderson et al (2013) on patients presenting to GPs for pain management in Australia[57]. The cost for each of these broad drug types was then estimated for the 2018 year using date of supply data from the PBS (Department of Health, 2018b). The total cost estimate was then adjusted to reflect the proportion of these drugs used to

[57] Some drugs will be administered by specialists, although there are no data available. Similarly, a number of opioids were listed since 2013 and are therefore not listed in Table A.10. Thus, the data shown are not 100% representative of 2018 prescribing practice.

manage chronic non-cancer pain (43.9%) and malignant neoplasms (3.5%) from Harrison et al (2012). Due to a lack of publically-available information, it was assumed that the proportion of opioids used to manage chronic pain (47.4%) from Harrison et al (2012) applied across all relevant drug types. Sensitivity was also conducted assuming that 58.2% of all relevant drugs applied to chronic pain based on Harrison et al's (2012) estimated proportion attributable to all musculoskeletal conditions.

Table A.10 Medications expenditure associated with chronic pain management, Australia 2018

Medication	Total spending	Base case estimate for chronic pain	High scenario for chronic pain
Paracetamol	31.5	14.9	18.3
Codeine, combinations	64.8	30.7	37.7
Tramadol	45.5	21.6	26.5
Oxycodone	89.8	42.6	52.3
Buprenorphine	75.5	35.8	44.0
Morphine	23.6	11.2	13.7
Fentanyl	22.8	10.8	13.3
Meloxicam	36.0	17.1	21.0
Celecoxib	29.4	13.9	17.1
Diclofenac	10.8	5.1	6.3
Ibuprofen	5.7	2.7	3.3
Amitriptyline	32.0	15.2	18.6
Pregabalin	181.8	86.2	105.8
Gabapentin	3.4	1.6	1.9
Total	**652.5**	**309.3**	**379.7**

Source: Deloitte Access Economics modelling, Department of Health (2018). A number of opioids were listed since 2013 and are therefore not listed in the table. Thus, the data shown are not 100% representative of 2018 prescribing practice.

A.4.5. Research

Research expenditure is included within health system estimates as, in the absence of chronic pain, there would not be a need for any research into the condition. To estimate health research expenditure on chronic pain in Australia in 2018, this report utilised the National Health and Medical Research Council (NHMRC) grants database. The database outlines all NHMRC research grant funding between 2000 and 2014, and provides a description of the projects and key outcomes achieved (NHMRC, 2018a, 2018b).

Specifically, the following conditions from the database were assumed relevant to consider as part of the research expenditure on chronic pain:

- musculoskeletal - arthritis, rheumatic conditions, back pain, neck pain, osteoporosis, joint replacement, spine and lumber not elsewhere classified;
- pain and pain management - analgesics, chronic pain, cannabinoids, neuropathic pain, sensory pain, joint and musculoskeletal, pain management, palliative care;
- injury – chronic back pain, neck pain, spine and lumbar issues, wounds, joint replacement, spinal cord injury, sports related, vehicle accidents;
- arthritis and osteoporosis - osteoarthritis, osteoporosis, rheumatoid arthritis, spinal arthritis, viral arthritis.

From within these conditions, all studies were assumed to relate to chronic pain and screening on grant IDs was undertaken to avoid any double-counting. Since the final year for which the research database is available was 2014, the cost of research on chronic pain in 2014 was estimated and inflated to 2018 values using health inflation. The cost of health research cost of chronic pain in 2018 was estimated to be $57.4 million.

Appendix B Data for Federal electorates

Table B.1 Prevalence of chronic pain by Federal electorate in 2018

Electorate	Prevalence (`000s)					Prevalence (%)				
	2018	2020	2030	2040	2050	2018	2020	2030	2040	2050
Banks, NSW	22.1	22.9	26.5	29.9	32.8	13.4	13.5	14.2	14.8	15.3
Barton, NSW	24.1	25.0	29.7	34.2	38.2	12.8	12.9	13.3	13.7	13.9
Bennelong, NSW	23.2	24.1	28.3	32.2	35.7	12.9	12.9	13.4	13.8	14.0
Berowra, NSW	20.7	21.2	23.6	25.8	27.7	13.5	13.6	14.0	14.4	14.7
Blaxland, NSW	22.6	23.6	28.9	33.8	38.2	11.8	11.8	12.1	12.3	12.3
Bradfield, NSW	22.4	22.9	25.7	28.0	29.9	13.1	13.1	13.3	13.4	13.4
Calare, NSW	22.3	22.9	26.1	28.9	31.4	13.3	13.4	14.0	14.5	14.9
Chifley, NSW	20.9	21.8	26.1	30.1	33.7	11.4	11.5	12.0	12.3	12.5
Cook, NSW	20.7	21.4	25.1	28.5	31.5	13.7	13.8	14.3	14.7	14.9
Cowper, NSW	24.5	25.0	27.1	29.1	30.9	15.0	15.2	16.2	17.2	18.1
Cunningham, NSW	21.6	22.0	24.3	26.1	27.5	13.2	13.3	13.7	14.0	14.3
Dobell, NSW	22.0	22.5	24.8	26.9	28.6	13.7	13.8	14.4	15.0	15.4
Eden-Monaro, NSW	21.4	21.9	24.3	26.4	28.2	14.0	14.1	14.8	15.4	15.8
Farrer, NSW	23.4	24.1	27.3	30.2	32.8	13.8	13.9	14.8	15.5	16.0
Fowler, NSW	22.3	23.1	27.0	30.6	33.8	12.6	12.7	13.3	13.8	14.2
Gilmore, NSW	23.8	24.1	25.5	27.0	28.5	15.6	15.9	17.0	18.2	19.2
Grayndler, NSW	20.8	21.7	26.6	31.2	35.3	12.7	12.6	12.8	12.8	12.8
Greenway, NSW	21.2	22.3	27.2	31.9	36.2	11.6	11.7	12.2	12.5	12.7
Hughes, NSW	19.3	20.0	23.3	26.3	29.0	12.7	12.8	13.1	13.4	13.5
Hume, NSW	20.4	21.1	24.0	26.6	28.9	12.8	12.9	13.5	14.1	14.5
Hunter, NSW	21.7	22.2	24.7	27.1	29.2	13.3	13.4	14.0	14.6	15.0
Kingsford Smith, NSW	23.6	24.3	28.3	31.9	35.1	12.3	12.2	12.2	12.1	12.0
Lindsay, NSW	21.1	22.0	26.1	30.1	33.6	12.0	12.1	12.7	13.2	13.5
Lyne, NSW	23.1	23.6	25.9	28.2	30.2	15.6	15.8	16.9	17.9	18.7
Macarthur, NSW	20.3	21.1	24.7	28.1	31.0	11.8	11.9	12.4	12.8	13.0
Mackellar, NSW	21.8	22.4	25.5	28.2	30.5	13.6	13.7	13.9	14.1	14.2
Macquarie, NSW	20.2	20.8	24.0	26.8	29.3	13.5	13.6	14.0	14.3	14.5
McMahon, NSW	21.8	22.6	26.4	30.1	33.4	12.3	12.4	12.8	13.1	13.4
Mitchell, NSW	20.3	21.0	24.5	27.7	30.5	12.3	12.4	12.8	13.2	13.4
New England, NSW	21.7	22.1	24.8	27.2	29.2	13.6	13.6	14.2	14.6	14.9

Electorate	Prevalence (`000s)					Prevalence (%)				
	2018	2020	2030	2040	2050	2018	2020	2030	2040	2050
Newcastle, NSW	20.9	21.3	24.0	26.2	28.0	12.9	12.9	13.2	13.4	13.5
North Sydney, NSW	22.8	23.7	28.5	32.8	36.7	12.9	12.9	13.1	13.2	13.2
Page, NSW	24.0	24.4	26.5	28.4	30.0	14.7	14.9	15.9	16.9	17.8
Parkes, NSW	21.3	21.9	24.9	27.6	30.0	13.3	13.4	14.1	14.7	15.1
Parramatta, NSW	24.3	25.4	31.3	36.9	42.0	12.0	12.0	12.4	12.6	12.8
Paterson, NSW	21.7	22.4	25.9	29.1	32.0	13.4	13.6	14.4	15.2	15.8
Reid, NSW	24.9	26.0	31.6	36.9	41.7	12.5	12.6	13.0	13.3	13.5
Richmond, NSW	24.2	24.7	27.1	29.5	31.6	15.2	15.3	16.2	17.1	17.8
Riverina, NSW	21.7	22.3	25.0	27.5	29.7	13.5	13.7	14.5	15.3	15.8
Robertson, NSW	21.6	22.1	25.1	27.7	30.1	14.3	14.5	15.2	15.8	16.2
Shortland, NSW	21.2	21.7	24.5	26.8	28.8	14.0	14.1	14.8	15.3	15.7
Sydney, NSW	26.2	27.1	32.6	37.6	42.2	11.9	11.9	11.9	11.9	11.9
Warringah, NSW	21.0	21.8	26.3	30.3	34.0	12.9	12.9	12.9	12.9	12.8
Watson, NSW	23.1	24.0	29.2	34.1	38.5	12.1	12.1	12.5	12.7	12.8
Wentworth, NSW	21.1	21.8	26.5	30.5	34.3	12.8	12.7	12.7	12.6	12.4
Werriwa, NSW	21.1	21.9	25.9	29.6	32.9	11.6	11.7	12.1	12.4	12.6
Whitlam, NSW	21.6	22.0	23.5	25.0	26.2	13.8	13.9	14.8	15.7	16.4
Aston, VIC	22.2	23.1	27.4	31.8	35.8	13.4	13.6	14.2	14.9	15.4
Ballarat, VIC	20.8	21.6	25.5	29.4	32.8	13.4	13.5	14.3	15.0	15.6
Bendigo, VIC	20.6	21.2	24.0	26.9	29.4	13.7	13.8	14.6	15.4	16.0
Bruce, VIC	25.3	26.5	32.0	37.5	42.7	12.6	12.7	13.3	13.8	14.1
Calwell, VIC	20.1	21.1	25.7	30.4	34.7	11.3	11.4	11.9	12.3	12.6
Casey, VIC	21.1	22.0	26.3	30.6	34.5	13.2	13.3	13.8	14.3	14.6
Chisholm, VIC	24.4	25.2	29.9	34.5	38.8	13.2	13.2	13.5	13.8	14.0
Cooper, VIC	22.0	23.0	28.6	34.0	39.1	12.6	12.6	12.6	12.8	12.8
Corangamite, VIC	19.4	20.0	22.9	25.8	28.4	13.8	13.9	14.7	15.4	16.0
Corio, VIC	20.6	21.1	24.1	26.9	29.4	13.2	13.3	13.8	14.3	14.7
Deakin, VIC	22.0	22.9	27.8	32.6	37.0	13.3	13.3	13.8	14.2	14.5
Dunkley, VIC	21.5	22.4	27.2	31.9	36.2	13.1	13.1	13.5	13.9	14.1
Flinders, VIC	22.2	23.1	27.1	31.1	34.8	15.1	15.3	16.0	16.8	17.4
Fraser, VIC	23.4	24.4	29.5	34.7	39.5	12.7	12.8	13.4	13.9	14.3
Gellibrand, VIC	22.7	23.9	30.7	37.3	43.6	11.9	11.9	12.1	12.3	12.4
Gippsland, VIC	21.4	22.0	24.8	27.6	30.2	14.4	14.5	15.3	16.0	16.6
Goldstein, VIC	22.1	22.8	26.9	30.8	34.3	13.6	13.7	13.9	14.2	14.4
Gorton, VIC	20.5	21.6	27.5	33.3	38.8	11.1	11.3	11.8	12.3	12.6
Higgins, VIC	22.3	23.2	28.2	33.0	37.6	12.7	12.7	12.8	12.9	13.0
Holt, VIC	20.0	20.9	25.4	29.9	34.2	11.0	11.1	11.6	12.2	12.5
Hotham, VIC	24.8	25.8	30.9	36.0	40.8	13.0	13.0	13.5	13.9	14.1

Electorate	Prevalence ('000s)					Prevalence (%)				
	2018	2020	2030	2040	2050	2018	2020	2030	2040	2050
Indi, VIC	21.5	22.1	24.9	27.7	30.3	14.4	14.5	15.3	16.1	16.7
Isaacs, VIC	21.2	22.1	26.3	30.5	34.4	13.4	13.5	14.1	14.6	15.0
Jagajaga, VIC	20.9	21.7	26.5	31.1	35.4	13.1	13.1	13.3	13.4	13.5
Kooyong, VIC	22.3	22.9	26.7	30.2	33.5	13.1	13.1	13.2	13.3	13.4
La Trobe, VIC	18.9	19.9	24.4	29.1	33.4	11.8	11.9	12.4	12.9	13.1
Lalor, VIC	20.3	21.5	27.2	32.9	38.3	11.0	11.0	11.5	11.8	12.0
Macnamara, VIC	23.8	24.8	30.8	36.5	42.0	12.7	12.6	12.8	12.9	13.0
Mallee, VIC	22.6	23.2	26.0	29.0	31.7	14.4	14.5	15.2	15.9	16.5
Maribyrnong, VIC	22.3	23.3	28.6	33.8	38.6	12.8	12.8	13.1	13.4	13.5
McEwen, VIC	17.9	18.7	22.7	26.7	30.4	12.4	12.6	13.1	13.7	14.1
Melbourne, VIC	23.7	24.7	30.5	36.0	41.3	11.2	11.2	11.3	11.5	11.5
Menzies, VIC	22.6	23.3	27.1	30.9	34.3	14.0	14.1	14.6	15.1	15.5
Monash, VIC	21.1	21.6	24.2	26.9	29.4	14.6	14.8	15.8	16.9	17.8
Nicholls, VIC	21.8	22.4	25.5	28.7	31.5	14.0	14.1	14.9	15.7	16.3
Scullin, VIC	22.0	23.1	28.7	34.2	39.4	12.0	12.2	12.8	13.4	13.8
Wannon, VIC	22.3	22.9	25.9	28.8	31.5	14.3	14.5	15.2	16.0	16.7
Wills, VIC	21.2	22.0	27.1	32.0	36.5	12.3	12.2	12.1	12.1	12.1
Blair, QLD	20.7	21.8	27.3	32.7	38.0	12.2	12.3	12.8	13.2	13.5
Bonner, QLD	20.6	21.5	26.3	31.1	35.6	12.7	12.7	12.9	13.1	13.2
Bowman, QLD	21.6	22.6	27.1	31.6	36.0	13.7	13.8	14.3	14.8	15.2
Brisbane, QLD	21.0	21.8	27.1	32.3	37.3	11.9	11.9	12.0	12.2	12.2
Capricornia, QLD	20.2	21.1	26.0	30.9	35.6	12.5	12.5	12.7	13.0	13.1
Dawson, QLD	20.9	21.9	27.1	32.1	37.0	12.7	12.7	13.1	13.3	13.5
Dickson, QLD	20.7	21.7	27.1	32.4	37.6	12.2	12.2	12.6	12.9	13.1
Fadden, QLD	22.8	23.7	28.3	32.9	37.4	13.1	13.3	13.8	14.3	14.6
Fairfax, QLD	21.8	22.7	27.2	31.7	35.9	14.0	14.2	14.8	15.4	15.9
Fisher, QLD	22.1	23.0	27.3	31.6	35.7	14.2	14.3	14.8	15.2	15.5
Flynn, QLD	20.2	21.1	26.2	31.3	36.2	12.2	12.2	12.5	12.7	12.9
Forde, QLD	21.5	22.6	28.1	33.5	38.7	11.9	12.0	12.5	12.9	13.2
Griffith, QLD	19.7	20.6	25.8	31.1	36.2	11.9	11.8	11.9	12.0	12.0
Groom, QLD	20.5	21.5	26.8	32.0	37.0	13.0	13.1	13.6	14.0	14.3
Herbert, QLD	20.1	21.0	26.1	31.1	35.9	11.9	11.9	12.3	12.7	12.9
Hinkler, QLD	22.5	23.4	27.9	32.4	36.7	15.0	15.1	15.9	16.6	17.1
Kennedy, QLD	22.7	23.7	28.8	33.8	38.8	13.0	13.1	13.6	14.0	14.3
Leichhardt, QLD	22.4	23.4	28.6	33.8	38.8	12.5	12.6	13.1	13.6	13.9
Lilley, QLD	21.0	22.0	27.4	32.6	37.7	12.7	12.7	12.8	13.0	13.0
Longman, QLD	22.2	23.2	28.1	33.2	38.1	13.1	13.3	13.9	14.4	14.8
Maranoa, QLD	21.3	22.2	27.0	31.6	36.1	13.6	13.7	14.2	14.7	15.0
McPherson, QLD	22.1	23.0	28.0	32.9	37.7	13.5	13.6	14.1	14.5	14.8

Electorate	Prevalence ('000s)					Prevalence (%)				
	2018	2020	2030	2040	2050	2018	2020	2030	2040	2050
Moncrieff, QLD	24.8	25.8	31.2	36.5	41.6	13.7	13.8	14.3	14.7	15.0
Moreton, QLD	21.7	22.8	28.7	34.6	40.2	12.1	12.2	12.4	12.7	12.8
Oxley, QLD	21.1	22.2	27.3	32.6	37.6	11.3	11.4	11.7	12.0	12.2
Petrie, QLD	22.5	23.4	28.1	32.9	37.4	13.2	13.3	13.8	14.2	14.5
Rankin, QLD	22.3	23.5	29.6	35.7	41.6	11.4	11.4	11.8	12.0	12.2
Ryan, QLD	20.1	20.9	25.2	29.5	33.6	12.0	12.0	12.1	12.2	12.3
Wide Bay, QLD	22.7	23.5	27.8	32.1	36.3	15.0	15.2	16.2	17.1	17.8
Wright, QLD	21.2	22.1	26.5	31.0	35.2	12.9	13.1	13.7	14.2	14.6
Adelaide, SA	24.8	25.5	29.0	31.8	34.0	13.1	13.1	13.3	13.4	13.4
Barker, SA	24.5	25.0	27.6	29.8	31.6	14.2	14.4	15.1	15.9	16.4
Boothby, SA	24.6	25.1	28.2	30.7	32.5	14.1	14.1	14.4	14.6	14.6
Grey, SA	24.7	25.2	27.4	29.1	30.3	14.1	14.2	14.7	15.2	15.5
Hindmarsh, SA	23.8	24.3	27.3	29.7	31.5	14.1	14.1	14.4	14.7	14.7
Kingston, SA	22.0	22.6	25.8	28.4	30.4	13.3	13.4	13.9	14.3	14.5
Makin, SA	23.1	23.8	27.2	30.3	32.7	13.2	13.3	13.8	14.2	14.4
Mayo, SA	23.7	24.1	26.5	28.6	30.2	14.4	14.5	14.9	15.3	15.5
Spence, SA	21.8	22.7	26.7	30.2	33.1	12.1	12.2	12.7	13.1	13.3
Sturt, SA	25.6	26.1	29.1	31.6	33.5	14.0	14.0	14.4	14.7	14.9
Brand, WA	21.0	22.4	29.7	37.6	45.6	11.7	11.7	12.1	12.5	12.8
Burt, WA	21.8	23.3	31.1	39.4	47.9	11.7	11.7	12.1	12.5	12.8
Canning, WA	21.4	22.7	29.0	36.0	43.2	13.6	13.7	14.2	14.8	15.2
Cowan, WA	20.0	21.3	28.2	35.6	43.2	11.9	12.0	12.2	12.6	12.9
Curtin, WA	20.7	21.9	28.5	35.6	43.0	13.0	12.9	12.9	13.1	13.3
Durack, WA	23.5	24.8	31.2	38.2	45.3	12.0	12.2	12.9	13.6	14.2
Forrest, WA	20.7	21.6	26.6	32.2	37.9	13.3	13.5	14.6	15.7	16.6
Fremantle, WA	20.9	22.2	29.6	37.6	45.6	12.7	12.7	13.0	13.4	13.8
Hasluck, WA	20.2	21.4	28.1	35.2	42.6	13.0	13.1	13.4	13.9	14.2
Moore, WA	20.1	21.2	27.4	34.0	40.7	12.9	12.9	13.1	13.4	13.7
O'Connor, WA	22.0	23.0	28.5	34.6	40.8	13.3	13.5	14.4	15.4	16.1
Pearce, WA	22.5	23.8	30.7	38.3	46.0	11.5	11.6	12.0	12.4	12.8
Perth, WA	21.8	23.2	31.0	39.3	47.7	12.9	12.9	13.1	13.4	13.6
Stirling, WA	21.4	22.9	30.8	39.3	47.9	13.0	12.9	13.1	13.4	13.6
Swan, WA	22.7	24.2	32.7	41.7	50.8	12.4	12.4	12.5	12.7	12.9
Tangney, WA	20.2	21.3	27.4	33.9	40.6	13.5	13.4	13.6	13.9	14.2
Bass, TAS	14.6	14.8	16.0	16.6	16.7	13.9	14.0	14.6	15.0	15.2
Braddon, TAS	15.1	15.4	16.6	17.3	17.4	14.3	14.4	15.0	15.4	15.7
Clark, TAS	14.5	14.8	16.2	17.1	17.4	13.6	13.7	14.2	14.4	14.4
Franklin, TAS	14.4	14.8	16.7	17.9	18.7	14.1	14.2	14.7	15.0	15.1
Lyons, TAS	14.9	15.3	16.6	17.5	17.8	14.3	14.5	15.2	15.8	16.1

Electorate	Prevalence (`000s)					Prevalence (%)				
	2018	2020	2030	2040	2050	2018	2020	2030	2040	2050
Lingiari, NT	14.5	15.1	18.2	21.5	24.6	10.8	10.9	11.2	11.5	11.6
Solomon, NT	13.9	14.4	17.1	20.0	22.8	11.5	11.6	12.0	12.3	12.5
Bean, ACT	18.1	18.8	22.9	26.9	30.9	12.9	12.9	13.4	13.8	14.0
Canberra, ACT	17.1	17.6	20.7	23.7	26.6	12.7	12.6	12.6	12.7	12.7
Fenner, ACT	16.4	17.3	21.8	26.4	30.8	11.4	11.6	12.3	13.0	13.4
Australia	**3,241.8**	**3,365.4**	**4,011.8**	**4,644.4**	**5,233.3**	**13.0**	**13.0**	**13.4**	**13.8**	**14.0**

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

Table B.2 Costs of chronic pain by Federal electorate in 2018

Electorate	Health system ($m)	Productivity ($m)	Other financial ($m)	DALYs ($m)	Total cost ($m)	DALYs (`000s)
Banks, NSW	82.9	319.6	85.2	450.9	938.6	2.3
Barton, NSW	90.8	358.3	94.0	490.4	1,033.5	2.5
Bennelong, NSW	88.3	348.6	91.1	473.8	1,001.8	2.4
Berowra, NSW	77.8	302.8	80.1	421.7	882.5	2.2
Blaxland, NSW	87.1	352.3	90.2	461.2	990.9	2.4
Bradfield, NSW	84.1	325.3	86.6	456.9	952.9	2.4
Calare, NSW	83.0	320.9	85.7	455.0	944.6	2.3
Chifley, NSW	81.5	332.1	84.2	426.9	924.7	2.2
Cook, NSW	76.5	296.2	79.3	421.7	873.7	2.2
Cowper, NSW	88.0	316.9	90.1	500.5	995.4	2.6
Cunningham, NSW	81.4	310.1	83.2	440.9	915.6	2.3
Dobell, NSW	80.6	299.1	82.6	448.5	910.8	2.3
Eden-Monaro, NSW	80.0	317.3	83.2	437.0	917.5	2.3
Farrer, NSW	86.0	322.4	88.3	477.1	973.8	2.5
Fowler, NSW	85.7	341.3	88.2	454.0	969.1	2.3
Gilmore, NSW	84.1	301.4	86.5	485.4	957.5	2.5
Grayndler, NSW	79.9	338.5	84.3	424.0	926.7	2.2
Greenway, NSW	82.2	348.7	86.5	433.1	950.4	2.2
Hughes, NSW	73.3	295.8	76.3	394.4	839.7	2.0
Hume, NSW	77.2	307.7	80.0	416.7	881.6	2.1
Hunter, NSW	80.5	311.3	83.2	442.3	917.4	2.3
Kingsford Smith, NSW	91.1	361.8	93.7	482.0	1,028.6	2.5
Lindsay, NSW	81.1	330.2	84.2	430.3	925.9	2.2
Lyne, NSW	81.9	292.8	84.1	472.0	930.7	2.4

Electorate	Health system ($m)	Productivity ($m)	Other financial ($m)	DALYs ($m)	Total cost ($m)	DALYs ('000s)
Macarthur, NSW	78.8	320.8	81.5	414.1	895.2	2.1
Mackellar, NSW	80.6	313.1	83.5	444.2	921.4	2.3
Macquarie, NSW	76.0	302.1	78.8	411.5	868.4	2.1
McMahon, NSW	83.5	335.2	86.3	443.8	948.8	2.3
Mitchell, NSW	77.6	318.2	80.9	413.9	890.5	2.1
New England, NSW	80.0	300.8	82.0	441.8	904.7	2.3
Newcastle, NSW	79.3	308.6	81.5	426.7	896.1	2.2
North Sydney, NSW	85.6	351.4	90.1	464.7	991.9	2.4
Page, NSW	87.8	330.9	90.4	489.8	998.9	2.5
Parkes, NSW	79.2	305.5	81.7	434.4	900.9	2.2
Parramatta, NSW	92.4	382.1	97.0	494.7	1,066.1	2.5
Paterson, NSW	80.3	309.7	82.9	441.6	914.5	2.3
Reid, NSW	95.1	383.6	98.7	506.8	1,084.3	2.6
Richmond, NSW	87.2	321.6	89.7	493.0	991.5	2.5
Riverina, NSW	80.2	299.7	82.1	443.0	904.9	2.3
Robertson, NSW	78.5	292.8	80.8	439.6	891.7	2.3
Shortland, NSW	77.7	291.2	79.8	432.1	880.7	2.2
Sydney, NSW	103.6	444.4	108.7	533.4	1,190.1	2.7
Warringah, NSW	79.3	328.0	83.5	429.1	920.0	2.2
Watson, NSW	88.2	354.3	91.3	470.1	1,003.8	2.4
Wentworth, NSW	79.3	327.4	83.7	430.6	920.9	2.2
Werriwa, NSW	82.8	339.0	85.3	429.4	936.5	2.2
Whitlam, NSW	79.6	296.6	81.5	440.9	898.6	2.3
Aston, VIC	83.8	332.4	86.8	452.7	955.7	2.3
Ballarat, VIC	77.5	298.5	79.8	423.8	879.6	2.2
Bendigo, VIC	76.5	289.5	78.5	421.0	865.5	2.2
Bruce, VIC	96.2	385.1	99.8	516.8	1,097.9	2.7
Calwell, VIC	78.9	327.1	81.8	410.5	898.3	2.1
Casey, VIC	79.8	321.5	83.0	430.3	914.7	2.2
Chisholm, VIC	91.9	343.5	93.3	496.7	1,025.2	2.6
Cooper, VIC	83.9	337.1	87.2	449.3	957.5	2.3
Corangamite, VIC	71.0	272.0	73.6	395.6	812.2	2.0
Corio, VIC	77.3	297.8	79.4	419.8	874.3	2.2
Deakin, VIC	82.0	321.6	85.1	448.4	937.1	2.3
Dunkley, VIC	81.5	326.3	84.6	439.0	931.3	2.3
Flinders, VIC	79.3	285.0	81.3	453.5	899.1	2.3

Electorate	Health system ($m)	Productivity ($m)	Other financial ($m)	DALYs ($m)	Total cost ($m)	DALYs ('000s)
Fraser, VIC	89.2	355.0	92.1	476.9	1,013.3	2.5
Gellibrand, VIC	87.4	373.0	92.3	462.1	1,014.8	2.4
Gippsland, VIC	78.3	295.7	80.7	436.6	891.3	2.2
Goldstein, VIC	82.4	323.3	85.5	450.9	942.1	2.3
Gorton, VIC	80.0	340.3	83.9	417.8	922.0	2.2
Higgins, VIC	84.8	335.7	87.6	454.6	962.8	2.3
Holt, VIC	78.4	331.5	81.9	407.5	899.4	2.1
Hotham, VIC	93.4	351.8	95.1	505.2	1,045.6	2.6
Indi, VIC	78.6	298.3	81.2	438.2	896.3	2.3
Isaacs, VIC	79.3	315.2	82.6	433.2	910.3	2.2
Jagajaga, VIC	78.7	314.0	81.7	425.6	900.0	2.2
Kooyong, VIC	84.5	323.3	86.2	454.1	948.1	2.3
La Trobe, VIC	72.9	297.3	75.6	385.2	831.0	2.0
Lalor, VIC	79.3	338.3	83.3	413.9	914.7	2.1
Macnamara, VIC	91.4	385.6	96.4	485.4	1,058.7	2.5
Mallee, VIC	82.6	307.0	84.8	461.7	936.2	2.4
Maribyrnong, VIC	84.8	338.9	87.9	454.3	965.9	2.3
McEwen, VIC	68.7	281.9	71.5	364.9	787.0	1.9
Melbourne, VIC	95.5	374.7	96.1	482.3	1,048.6	2.5
Menzies, VIC	84.1	317.5	86.1	460.8	948.5	2.4
Monash, VIC	76.7	286.4	79.0	431.0	873.1	2.2
Nicholls, VIC	80.0	300.3	82.2	444.8	907.3	2.3
Scullin, VIC	84.2	340.9	87.4	447.8	960.2	2.3
Wannon, VIC	81.8	311.8	84.5	455.0	933.0	2.3
Wills, VIC	80.5	322.4	83.6	431.9	918.5	2.2
Blair, QLD	79.3	318.4	82.0	422.7	902.4	2.2
Bonner, QLD	78.8	314.9	81.4	420.6	895.7	2.2
Bowman, QLD	80.5	312.8	83.2	441.0	917.5	2.3
Brisbane, QLD	82.5	345.7	85.9	427.4	941.5	2.2
Capricornia, QLD	77.4	318.2	80.7	412.2	888.5	2.1
Dawson, QLD	80.3	328.9	83.5	426.5	919.2	2.2
Dickson, QLD	79.7	331.1	83.2	421.5	915.6	2.2
Fadden, QLD	85.4	332.1	88.1	464.5	970.0	2.4
Fairfax, QLD	80.6	308.4	83.1	444.7	916.8	2.3
Fisher, QLD	80.7	301.9	83.1	451.0	916.7	2.3
Flynn, QLD	78.0	331.0	82.0	411.7	902.7	2.1
Forde, QLD	82.3	330.1	85.1	438.3	935.8	2.3

Electorate	Health system ($m)	Productivity ($m)	Other financial ($m)	DALYs ($m)	Total cost ($m)	DALYs ('000s)
Griffith, QLD	77.0	322.1	80.2	400.7	880.1	2.1
Groom, QLD	76.7	290.7	78.5	418.8	864.7	2.2
Herbert, QLD	78.3	316.3	80.6	409.3	884.4	2.1
Hinkler, QLD	80.4	287.9	82.2	458.1	908.5	2.4
Kennedy, QLD	85.5	340.3	88.7	463.4	977.9	2.4
Leichhardt, QLD	86.3	359.3	90.2	456.3	992.1	2.3
Lilley, QLD	79.7	319.7	82.9	429.2	911.5	2.2
Longman, QLD	82.6	318.1	85.2	453.7	939.7	2.3
Maranoa, QLD	78.8	305.3	81.6	434.5	900.2	2.2
McPherson, QLD	82.3	316.3	84.7	449.8	933.1	2.3
Moncrieff, QLD	92.7	357.9	95.5	506.1	1,052.2	2.6
Moreton, QLD	83.7	334.5	86.2	442.3	946.6	2.3
Oxley, QLD	82.7	344.8	86.0	431.1	944.6	2.2
Petrie, QLD	83.4	320.7	86.1	458.6	948.8	2.4
Rankin, QLD	87.0	358.4	90.3	455.5	991.3	2.3
Ryan, QLD	78.5	304.7	79.6	410.6	873.5	2.1
Wide Bay, QLD	82.0	308.5	84.8	461.9	937.2	2.4
Wright, QLD	80.6	327.0	83.9	432.3	923.8	2.2
Adelaide, SA	93.8	363.6	96.4	505.8	1,059.6	2.6
Barker, SA	89.7	345.1	93.0	498.8	1,026.6	2.6
Boothby, SA	90.3	336.7	92.6	500.8	1,020.3	2.6
Grey, SA	91.2	354.9	94.7	504.5	1,045.2	2.6
Hindmarsh, SA	87.9	337.7	90.8	484.3	1,000.7	2.5
Kingston, SA	82.5	324.3	85.4	448.9	941.1	2.3
Makin, SA	86.6	340.3	89.6	470.5	986.9	2.4
Mayo, SA	86.6	328.5	89.4	482.9	987.5	2.5
Spence, SA	83.7	330.3	85.9	444.5	944.5	2.3
Sturt, SA	94.0	350.2	96.4	521.6	1,062.1	2.7
Brand, WA	80.9	332.6	84.2	428.2	925.9	2.2
Burt, WA	84.4	350.0	88.1	445.3	967.8	2.3
Canning, WA	79.1	301.9	81.6	436.9	899.5	2.2
Cowan, WA	77.5	322.3	80.9	408.0	888.8	2.1
Curtin, WA	78.2	306.5	80.7	422.8	888.2	2.2
Durack, WA	91.3	411.8	98.2	479.7	1,081.0	2.5
Forrest, WA	77.2	307.7	80.5	422.0	887.4	2.2
Fremantle, WA	79.5	327.8	83.3	425.7	916.3	2.2
Hasluck, WA	76.4	309.3	79.6	410.9	876.2	2.1

Electorate	Health system ($m)	Productivity ($m)	Other financial ($m)	DALYs ($m)	Total cost ($m)	DALYs ('000s)
Moore, WA	77.4	316.7	80.3	409.5	883.9	2.1
O'Connor, WA	82.6	333.0	86.1	447.9	949.7	2.3
Pearce, WA	87.3	364.1	91.1	458.6	1,001.1	2.4
Perth, WA	82.7	341.5	86.9	445.0	956.2	2.3
Stirling, WA	80.3	320.3	83.7	437.3	921.6	2.3
Swan, WA	86.6	348.5	89.9	462.7	987.8	2.4
Tangney, WA	75.8	292.5	77.9	412.0	858.2	2.1
Bass, TAS	54.2	202.8	55.3	297.3	609.6	1.5
Braddon, TAS	55.6	208.7	57.0	307.6	628.9	1.6
Clark, TAS	54.3	206.7	55.7	296.4	613.1	1.5
Franklin, TAS	53.2	204.2	55.0	294.6	607.0	1.5
Lyons, TAS	55.1	213.8	57.1	304.1	630.1	1.6
Lingiari, NT	58.3	257.6	61.3	295.2	672.4	1.5
Solomon, NT	54.6	238.0	57.7	282.6	632.9	1.5
Bean, ACT	68.9	279.2	71.7	368.9	788.7	1.9
Canberra, ACT	65.5	255.7	67.1	348.6	736.9	1.8
Fenner, ACT	63.4	265.7	66.4	333.8	729.3	1.7
Australia	**12,225.3**	**48,342.5**	**12,655.9**	**66,103.2**	**139,327.0**	**340.4**
Average	**81.0**	**320.1**	**83.8**	**437.8**	**922.7**	**2.3**

Source: Deloitte Access Economics analysis. Note: components may not sum to totals due to rounding.

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