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Spinal Cord Injury in Australia

The case for investing in new treatments

December 2020

Executive summary

Approximately 20,800 Australians are living with a spinal cord injury (SCI). These injuries are mostly the result of traumatic causes and are incurred by people under the age of 65.

The impact of an SCI on a person is devastating - one third of Australians with an SCI have a severe injury, resulting in no movement in the affected parts of their body. This limits mobility, affecting independence, and impairs bodily functions such as breathing, digestion and sexual function. As a result, people living with an SCI require substantial support and assistance in daily activities, are less likely to return to work and suffer from poorer health and wellbeing.

These factors all contribute to high lifetime costs to the government, individuals and their families, and losses in broader economic productivity. The total lifetime cost of spinal cord injuries in 2020 is estimated at $75.4bn. This is approximately $3.7bn per year.

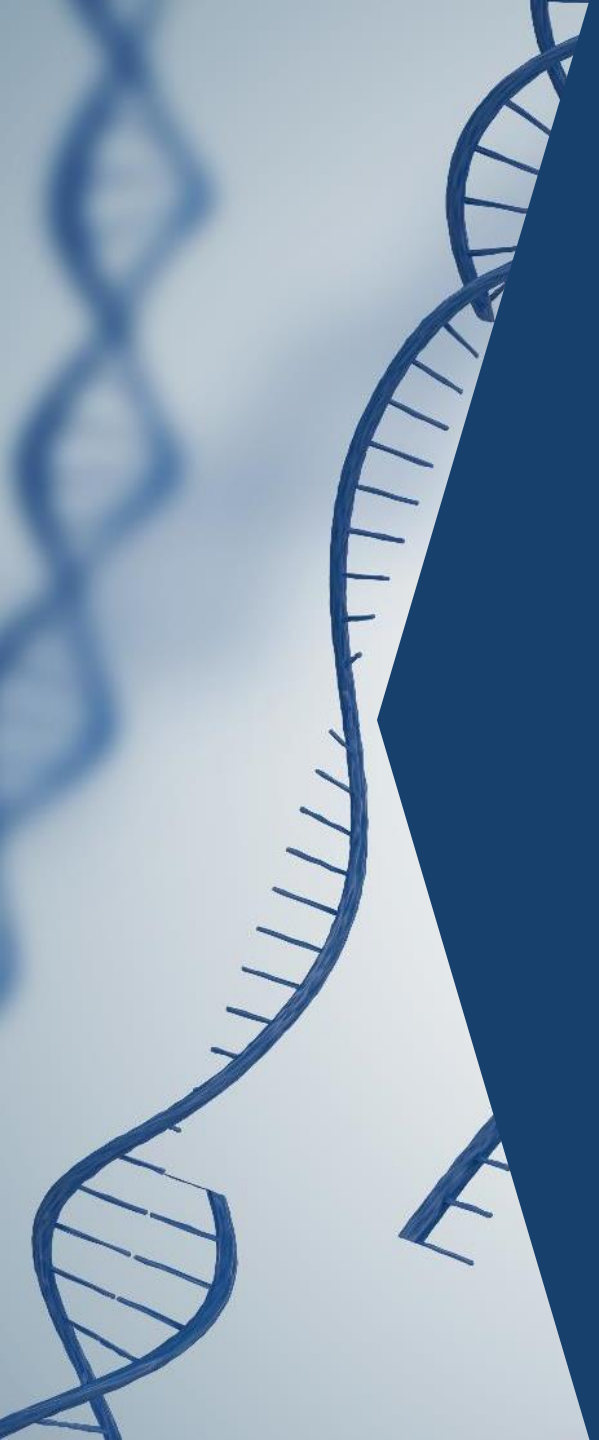
Current treatment options for SCIs are heavily reliant on rehabilitation and the use of external supports, limiting the extent of recovery. However, dedicated researchers have made exciting breakthroughs in treatment options in the last decade that could make restoration of the spinal cord and recovery from SCIs possible. Although this research takes a committed investment of time and money, the economic benefits are substantial.

For example, neurostimulation and stem cell therapy are being trialled as potential ways to restore nerve signals after SCI. This work could potentially lead to dramatic improvements in mobility, including learning to stand or walk again.

If a treatment could improve muscle function in just 10% of people with a spinal cord injury, it can offer $3.5bn in cost savings. These savings could be as high as $10.3bn if results from highly successful clinical trials can be replicated.

Alternatively, some treatments are exploring recovery of specific functional abilities such as hand function, bladder and bowel control, or chronic pain relief. These functions are crucial for individuals to actively engage socially, in the community and in the workforce. The benefits of these treatment outcomes can conservatively offer $2.7bn - 2.9bn in cost savings.

Commitment from both the public and private sector is crucial to getting treatments from bench to bedside. For example, researchers estimate that they need $10m to $20m in research investment to bring spinal cord stimulation from the clinical trial phase to all Australians with an SCI. Once in the market, the cost of delivery is estimated to be $630m but the return on this investment is significant. It is estimated that the lifetime cost saving from such a treatment is approximately $1.3bn – and this is just one of the highly promising new treatments currently being explored.



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This report has been commissioned by Spinal Cure Australia and Insurance and Care NSW (icare), and prepared by AlphaBeta Australia. AlphaBeta Australia is a research firm with offices in Sydney, Canberra and Melbourne. It specialises in combining advanced analytical techniques and innovative data to generate new insights and fresh perspectives on the challenges facing business and government.

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Spinal Cord Injuries in Australia

1

Approximately 20,800 Australians are living with a spinal cord injury

Approximately 20,800 Australians are living with a spinal cord injury, typically due to a traumatic injury in young or middle age groups

Spinal cord injury (SCI) occurs when there has been damage to the spinal cord, often leading to a loss of function and feeling throughout the body. This impacts mobility, **limiting the movement and independence of a person**, and affects bodily functions such as **breathing, digestion and sexual function**.

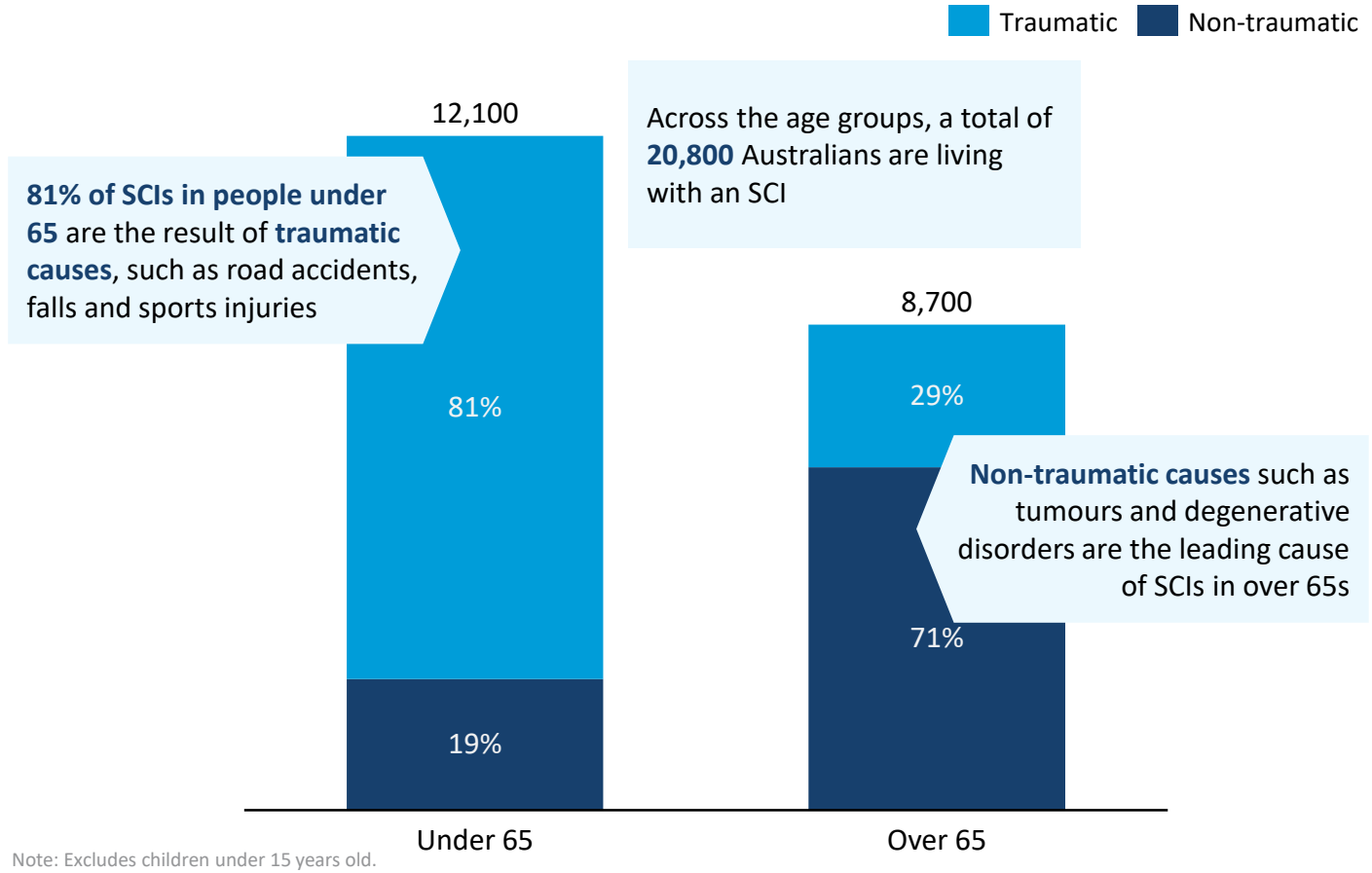
Approximately **20,800 people are estimated to be living with an SCI in Australia today,** including 380 new incidences expected to occur this year. Almost **one quarter (23%) of people with an SCI are under 35 years old**, and the **majority are under 65**. Overall, SCIs are overwhelming incurred by men - with approx. 70% of new incidences reported in male patients.[2]

Most SCIs in Australia are caused by **sudden, traumatic blows to the spine** such as **falls** or **road accidents**.[1] **More than 80% of SCIs in the under 65 age group** are from **traumatic causes**, mostly men in road accidents.

The remaining 41% are the result of non-traumatic causes which cause damage to the spine over a longer period of time. Leading causes of non-traumatic SCIs in Australia include tumours and degenerative disorders.[3]

SCI cases by age group and cause

Australia, % of total cases in under or over 65 age group, 2020 estimate



Note: Excludes children under 15 years old.
1 Road accidents include motor vehicle occupants and unprotected road users (land transport users who are not protected in their vehicles e.g. pedestrians, cyclists and powered two-wheelers): AIHW Spinal cord injury reports 2014-15 to 2016-17.
2 3 year average of traumatic and non-traumatic SCI as recorded in AIHW Spinal cord injury reports 2014-15 to 2016-17.
3 New et al (2014), Global maps of non-traumatic spinal cord injury epidemiology: towards a living data repository - Global non-traumatic SCIs epidemiology for Australia.
SOURCE: AIHW Spinal cord injury reports 2014-15 to 2016-17; New et al (2011), Estimating the Incidence and Prevalence of Traumatic Spinal Cord Injury in Australia as of June 2011; New et al (2010), Prevalence of non-traumatic spinal cord injury in Victoria, Australia as of June 2010; Global non-traumatic SCIs epidemiology – Australia (2014); AlphaBeta analysis

One in three Australian SCI cases are severe, resulting in complete paralysis of the body

SCIs have a **lasting and significant impact** on the lives of the injured person, their family and their friends. People with an SCI require **substantial support and assistance** in daily activities, are **unlikely to return to work** and suffer from **poorer health and wellbeing**.

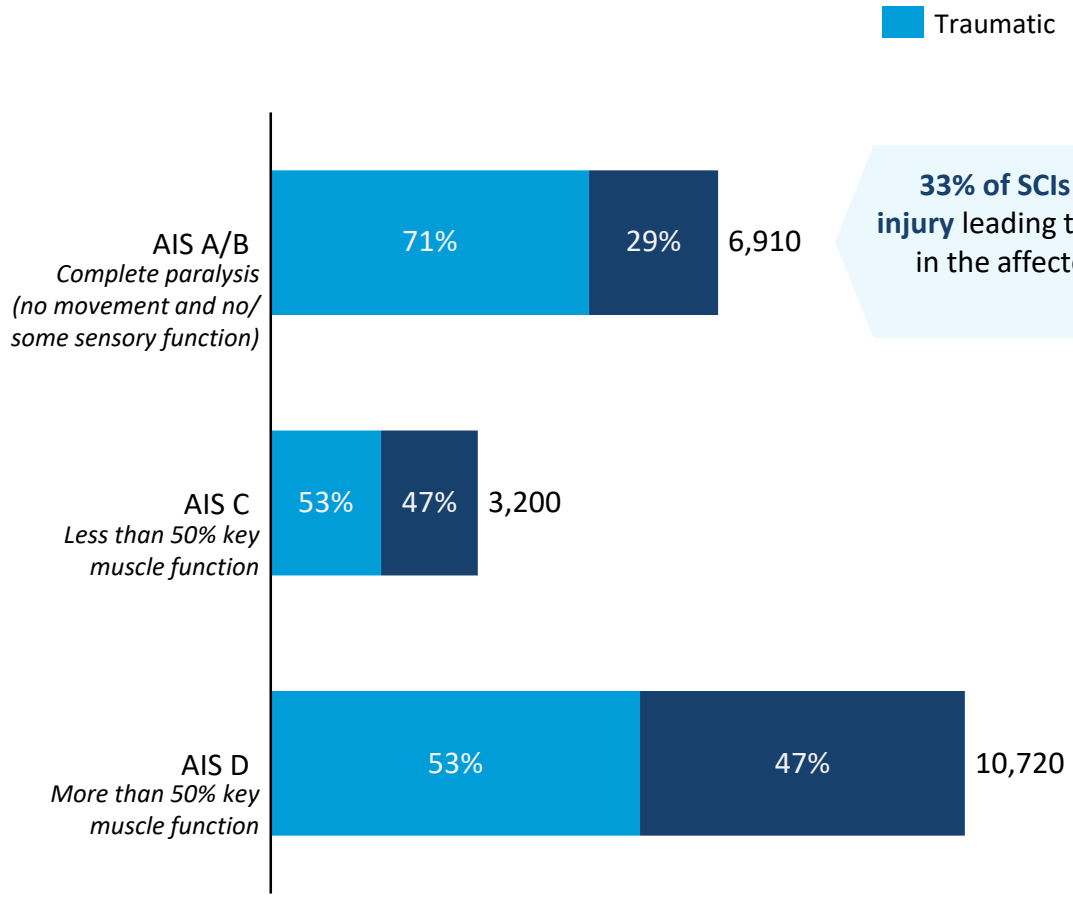
42% of people living with an SCI in Australia suffer from tetraplegia, meaning that movement and feeling in all four limbs and the main body is affected. 58% of people suffer from paraplegia, where movement and feeling is affected in the lower limbs.

The most severe SCIs leave a person with **no movement and no or some feeling** in the affected parts of their body. One third (~7,000) of Australians with an SCI have a severe injury, which is equivalent to an ASIA Impairment Scale (AIS) grade A or B. **Trauma is most likely to result in a severe SCI**, with 71% of severe SCIs (AIS A/B) from traumatic causes.

Some people retain some muscle function after an SCI, defined as an AIS grade C (if a person has less than 50% of key muscle function) or D (more than 50% of key muscle function). Key muscle function includes major muscle groups that allow movement including in the elbows, wrists, hips and knees. Although these are considered 'less severe', the **burden on a person's life is still high**.

Severity of spinal cord injury by cause

% of injury by cause, ASIA Impairment Scale (AIS) grade,[1] 2020



33% of SCIs result in severe injury leading to no movement in the affected parts of their body

1 AIS scores defined as: A No sensory or motor function; B Sensory function but no motor function; C Some motor function but less than half of the key muscle functions below the injury have active movement; D Some motor function, with at least half of the key muscle functions below the injury having active movement.
SOURCE: AIHW Spinal cord injury report 2016-17; AIHW National Injury Surveillance Unit; New et al (2011), Estimating the Incidence and Prevalence of Traumatic Spinal Cord Injury in Australia as of June 2011; New et al (2010), Prevalence of non-traumatic spinal cord injury in Victoria, Australia as of June 2010; iCare costs data; AlphaBeta analysis

SCIs also cause debilitating health consequences such as chronic pain, and bladder and bowel dysfunction

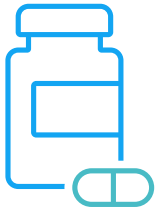
Loss of movement and sensation is not the only challenge facing people with an SCI. A lack of mobility has several other health consequences such as pressure sores, osteoperosis and poor circulation.

People with an SCI are also likely to suffer from additional functional deficits. For example, **80% of people with an SCI are affected by a lack of bladder or bowel control.**[3] Not only does this have a substantial impact on **quality of life,** but it is the **leading cause of re-hospitalisation** as a result of infection, prevents a person from participating in the workforce or community and increases their reliance on external support or care.[4]

A survey of Australians living with an SCI found that people rated **bladder or bowel control, chronic pain and lack of hand function** (for tetraplegic injuries) as the **most significant factors impacting their quality of life**, and would **prefer to regain these three functions** over the improvement of all other functions.[5]

Additional functional deficits caused by SCIs

% of SCIs who suffer from each impairment

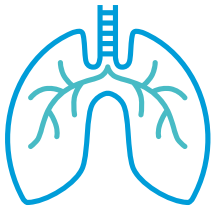


70%

suffer from **chronic pain** for more than 6 months

80%

are affected by a lack of **bladder/bowel control**



40%

of hospitalised people with SCIs have **respiratory failure**

1 AIHW Spinal cord injury reports; Middleton et al (2012), Life expectancy after spinal cord injury: a 50-year study. 2 Quality of life measured as a reduction in value of statistical life year by disability weight. 3 Taweel & Seyam (2015), Neurogenic bladder in spinal cord injury patients. 4 NSCISC (2020), Spinal cord injury facts and figures at a glance. 5 Lo et al (2016), Functional Priorities in Persons with Spinal Cord Injury: Using Discrete Choice Experiments To Determine Preferences
SOURCE: Spinal Cure Australia; Australian Government Best Practice Regulation Guidance Note: Value of statistical life 2019; Lo et al (2016), Functional Priorities in Persons with Spinal Cord Injury: Using Discrete Choice Experiments To Determine Preferences; Teasell et al (2011), A Systematic Review of Pharmacological Treatments of Pain Following Spinal Cord Injury; Taweel & Seyam (2015), Neurogenic bladder in spinal cord injury patients; 4 Anderson (2014), Targeting Recovery: Priorities of the Spinal Cord-Injured Population; Kennedy et al (2006), Quality of life, social participation, appraisals and coping post spinal cord injury: a review of four community samples; NSCISC (2020), Spinal cord injury facts and figures at a glance; ACI Pain Management Network (2020); AlphaBeta analysis

SCIs have significant and lasting impacts on the physical and mental health of people with an SCI and their families

Overall, people with severe SCIs (AIS A/B) have an annual mortality risk up to 7 times higher than the general population and are up to 10 times more likely to be unemployed.[1] Their quality of life is also up to 30% lower than a healthy person.[2]

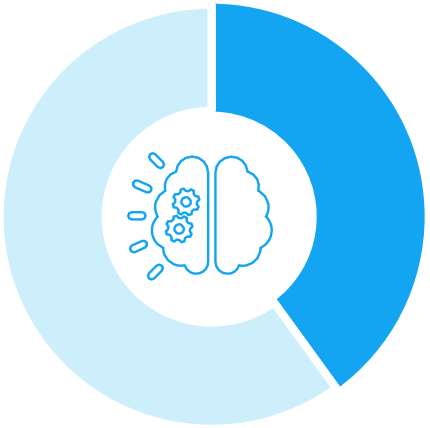
Sudden injuries, such as traumatic SCIs, are likely to impact a person's **mental health and wellbeing**. Beyond Blue estimates that up to **40% of people who suffer a traumatic SCI are likely to develop post-traumatic stress disorder** (PTSD), while up to 30% are at risk of experiencing depression. This is more than double the average rate of PTSD after a sudden injury, where 10-20% of people with a serious injury will develop PTSD within a year of the trauma occurring.[3]

Chronic pain is a key contributor to mental illnesses such as depression in people with SCIs.

These impacts are also felt by their families, who experience increased stress from the emotional consequences of seeing a loved one seriously injured, increased financial impact, and additional caring responsibilities.

Risk of mental health impact after traumatic SCI

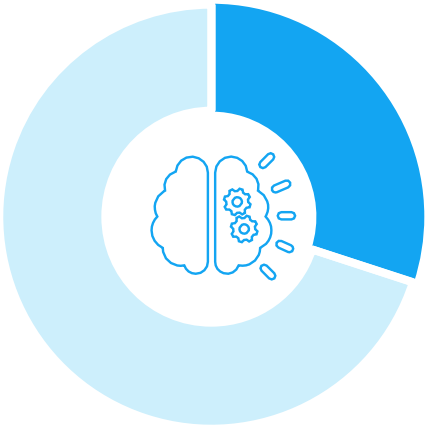
% of traumatic SCIs at risk of mental health impacts



40%

are likely to suffer

PTSD



30%

are at risk of

depression

1 AIHW Spinal cord injury reports; Middleton et al (2012), Life expectancy after spinal cord injury: a 50-year study. 2 Quality of life measured as a reduction in value of statistical life year by disability weight. Average disability weight for tetraplegia A/B used 0.707. 3 Beyond Blue, Serious injury and anxiety, depression and post-traumatic stress disorder.

SOURCE: Australian Government Best Practice Regulation Guidance Note: Value of statistical life 2019; Lancet Neurol (2019), Global, regional, and national burden of traumatic brain injury and spinal cord injury, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016; Beyond Blue, Serious injury and anxiety, depression and post-traumatic stress disorder; AlphaBeta analysis

CASE STUDY

A traumatic spinal cord injury caused by a bike accident left Dr. Steve Peterson with quadriplegia, significantly impacting his personal and professional life

In 2018, Dr. Steve Peterson, 32, was cycling to work when he was involved in a collision that resulted in a severe (AIS A) C4 spinal cord injury. Steve spent 269 days recovering in hospital, but his injuries were severe and left him with quadriplegia, unable to move his arms or legs.

Prior to his injury, Steve was a practicing doctor and extremely active in his personal life. He would run 10km or ride his bike almost everyday.

“After my injury, physical exercise is limited and not enjoyable. Also, my interaction with my kids has changed,” said Steve.

“I used to be able to bike with my kids, with the younger one in the backpack, or jump on the trampoline with them. I can’t do those things anymore.”

Steve’s injuries have had a significant impact on his personal and professional life. His family home is not equipped for accessibility. He and his family are currently living with his parents-in-law, with a plan to buy a new house with modifications suitable for his wheelchair. Additionally, in order to be independent and mobile, Steve needs a new car with modifications as well.

With great optimism and determination, Steve has been able to return to work but his capacity has changed significantly, affecting his income. “It has taken me close to two years, but I have now returned to my normal work hours. I can’t do any hands-on GP or emergency work so I have shifted to telehealth and educational work, as well as working at a Drug & Alcohol clinic where patient examinations are not required”

Steve feels he is one of the fortunate few; he is a specialist in his profession and has extremely supportive parents-in-law. They take care of his children while Steve and his partner are at work. Additionally, Steve has two formal carers providing seven hours of care every day, assisting with routine activities such as getting up, showering and cleaning. The majority of people with SCIs find it difficult to return to work due to limited opportunities or limited support at home and work.

Almost one quarter (23%) of people with an SCI are under 35 years old, and the majority are under 65. **More than 80% of SCIs in the under 65 age group are from traumatic causes**.

2

Economic Costs of Spinal Cord Injuries

Spinal cord injury costs the Australian economy $75bn

Spinal cord injuries cost the Australian economy a total of $74.5bn

Spinal cord injuries cost the economy a total of $74.5bn in personal and health care, lost productivity and reduced wellbeing of the 20,800 Australians living with SCI.[1] This is approx. **$3.7bn per year**.[2] **Almost half of these costs ($31.4bn) are from personal care,** either formal (paid) care or unpaid care from family and friends.

$21.7bn (29%) of the lifetime costs are incurred as a **loss to the economy**, from **reduced economic productivity**. This includes the opportunity cost of increased unemployment and, for those that return to work, increased underemployment and absenteeism, as well as welfare payments and income support.

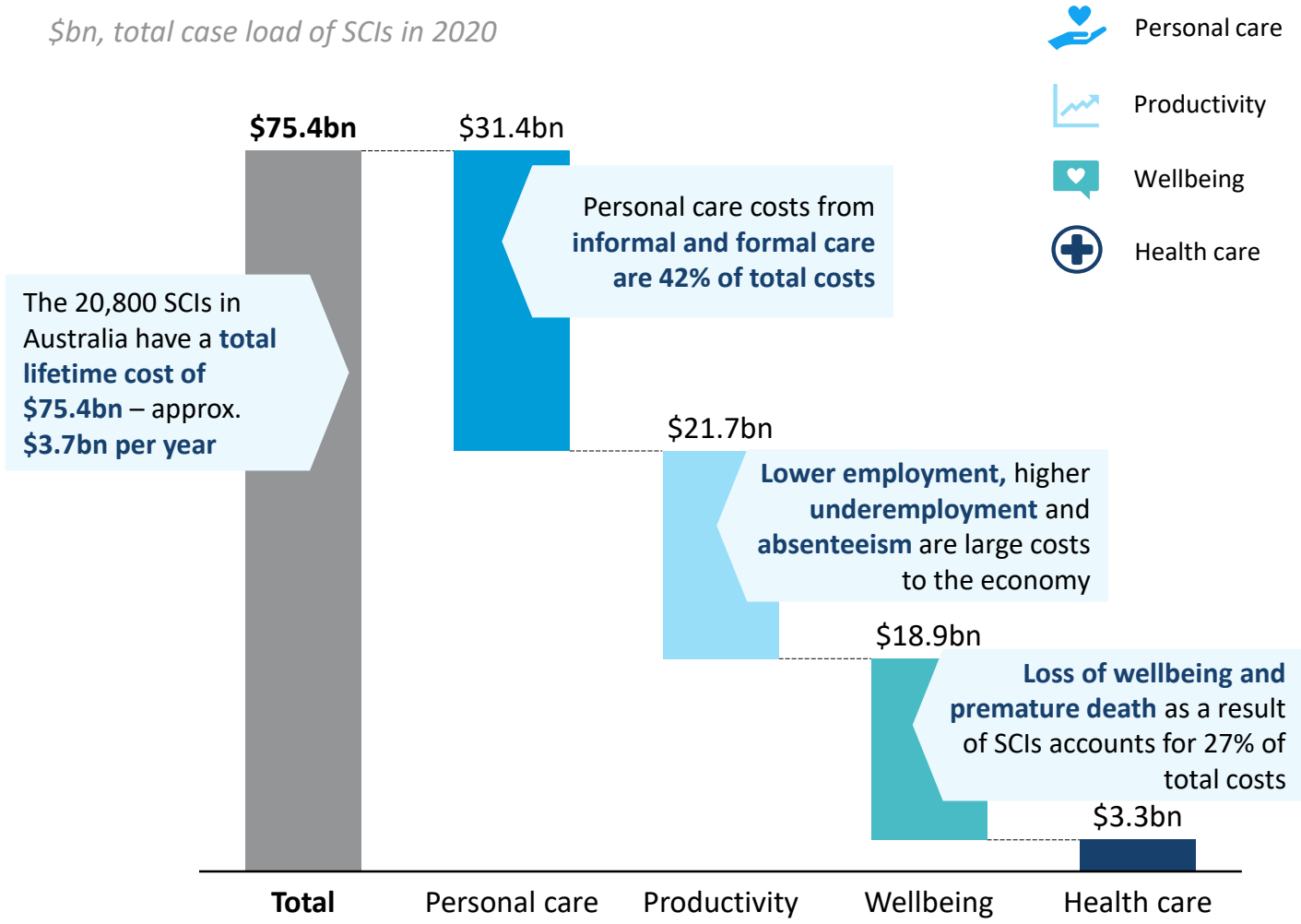
Individuals with SCIs incur $18.9bn of the total lifetime cost, from **reduced wellbeing**, increased likelihood of premature death and funeral costs brought forward.

Health care costs are estimated at $3.3bn.[2] These costs are high in the first years post injury (e.g. $52,000-$82,000 per SCI in the year of injury) but decrease substantially over time (e.g. $5,000-$10,000 each year from year 7 onwards).

75% of total costs are attributable to traumatic SCIs, as these occur more in younger people and are often more severe.

Total lifetime costs of SCIs in Australia ($bn)

$bn, total case load of SCIs in 2020



1 Total lifetime cost includes the cost to government, individuals and the economy incurred for the remaining lifetime of every person with an SCI in Australia in 2020. 2 Weighted average years of life remaining for total SCI cohort is 19.9 years. Years of life remaining varies by age and severity of injury (4-51 years). Costs discounted using a real discount rate of 3%: Australian Burden of Disease Study - Impact and causes of illness and death in Australia 2015.
2 Health care costs include hospital, ambulance, medical care and rehabilitation costs as well as equipment and modifications required for daily living.
Note: Numbers may not sum due to rounding.
SOURCE: AlphaBeta analysis. See appendix for detailed methodology.

Almost half of Australia's SCI costs ($35.9bn) are incurred by government through programs such as the NDIS and state insurance schemes

Direct expenditure is required to provide services such as health care, formal care, income support and welfare payments to people with SCI. This places a heavy burden on government resources as well as the Australian taxpayer. Direct costs are estimated at **$35.9 billion**, accounting for **48% of total lifetime costs.**

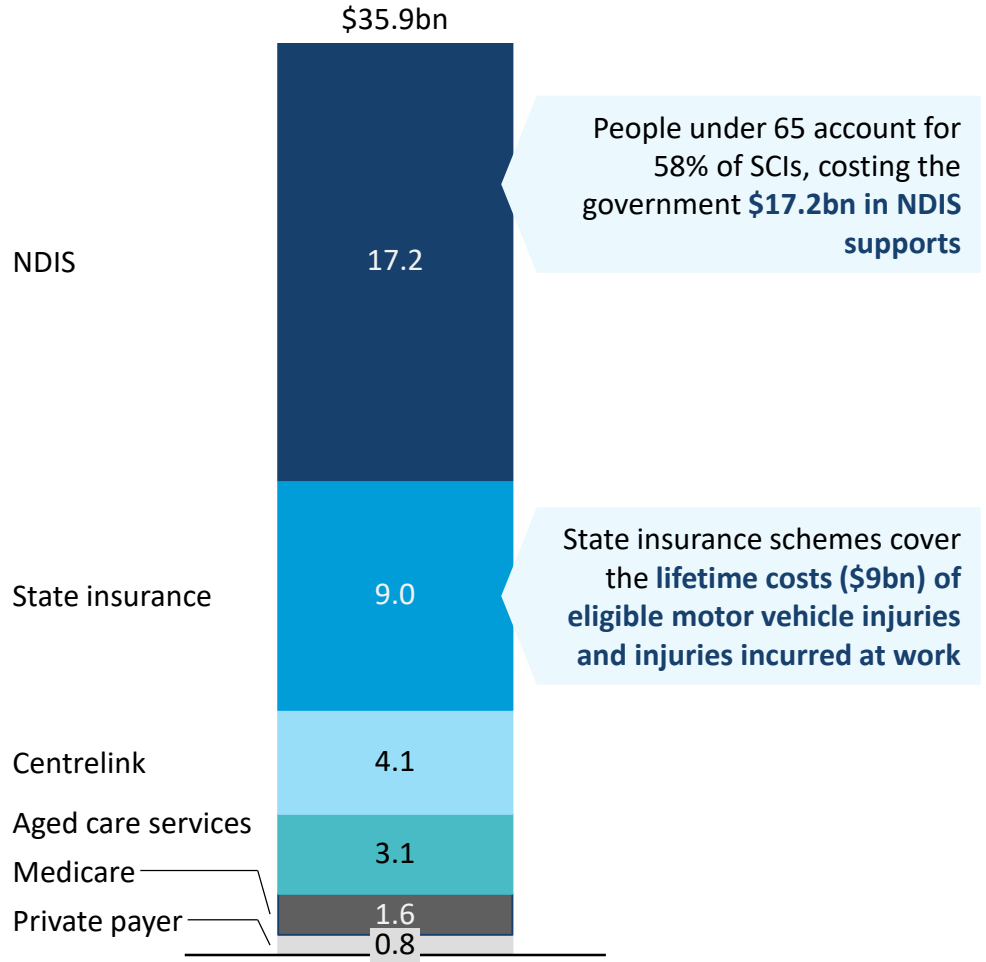
Federal government bears 48.7% of the direct costs ($17.5bn), through schemes such as Centrelink, Medicare, the NDIS and aged care services e.g. Commonwealth Home Support Program. State insurance schemes cover the lifetime costs of eligible motor vehicle injuries and injuries incurred at work. It is estimated that **49.1% ($17.6bn) of direct costs are funded by state governments**, through these insurance schemes and joint funding of the NDIS.

Individuals must also pay $0.8bn in direct health care costs, paid as out of pocket expenses or by private insurers.

Indirect costs to individuals and the broader economy (together bearing 96% of indirect costs) include opportunity costs incurred as a result of SCI, for example the opportunity cost of a family member providing informal care or a person's loss of wellbeing. **Indirect costs are estimated to be $39.5bn.**

Direct costs of SCIs by scheme

Estimated lifetime cost to each scheme, 2020



Note: Numbers may not sum due to rounding. NDIS costs assumed as long term care and equipment and modifications costs for people aged under 65 years old and excludes costs paid by state insurance schemes.
SOURCE: AIHW (2020) Australia's health data insights; AlphaBeta analysis based on inputs from iCare, NDIS, AIHW. See appendix for detailed methodology.

CASE STUDY

Spinal cord injuries impact individuals and their families, both emotionally and financially

Sara was a 24-yr old architecture student when she suffered a C6/7 spinal cord injury after a diving accident, leaving her paralysed from neck down. After 10 months in hospital and intensive rehab, Sara gained some function in her arms but not fingers. Over time, Sara developed severe chronic pain, a common occurrence after spinal cord injury. She returned to university to complete her degree but found that architecture was no longer manageable. Sara graduated with a degree in Fine Arts six years later.

“I was fortunate to have my family’s support,” Sara said. At times when both Sara and her partner have been unable to work due to Sara’s health and support needs her family helped by providing around $30,000 per year for household expenses, food, care and medical costs.

“A year after my injury, my parents purchased and renovated the house that I live in. Over time, my health has deteriorated such that I have needed to change from a manual to a motor wheelchair. This meant that the house needed to be renovated again, costing my family around half a million dollars.”

Chronic pain, pressure sores and deteriorating digestive function have been a major barrier for returning to work, affecting not only Sara’s livelihood, but also her partner’s. Sara requires around 70 hours of formal care each week to help with transfers, showering, managing her blood pressure, ensuring she doesn't develop pressure sores and performing daily tasks such as shopping, cooking and cleaning. Before the NDIS scheme, more than half of her care was provided by her partner.

“My partner had to take a break from his job, significantly impacting our household income. Now, with NDIS support, he has been able to return to work but the hiatus has significantly impacted his career development.”

The injury has not only impacted the family financially but also limited their social interactions. In 2009, Sara and her partner had their son, Jacob. Sara mentions “most buildings and houses of other parents are not wheelchair accessible – which limits our social interactions with other families. Financial limitations and difficulties in transport can sometimes impact Jacob’s participation in extracurricular activities such as sport and music.”

Up to **70% of people with an SCI are estimated to have an informal carer**, often a family member or friend. The total opportunity cost of **providing informal care** to a person with an SCI is estimated at **$5.6bn.**

Severe SCIs cost up to 1.5 times more than less severe cases where a person retains key muscle function

The **lifetime cost burden of SCIs increases with the severity of injury**, as reliance on care, health conditions, unemployment rates and the impact on quality of life increase.

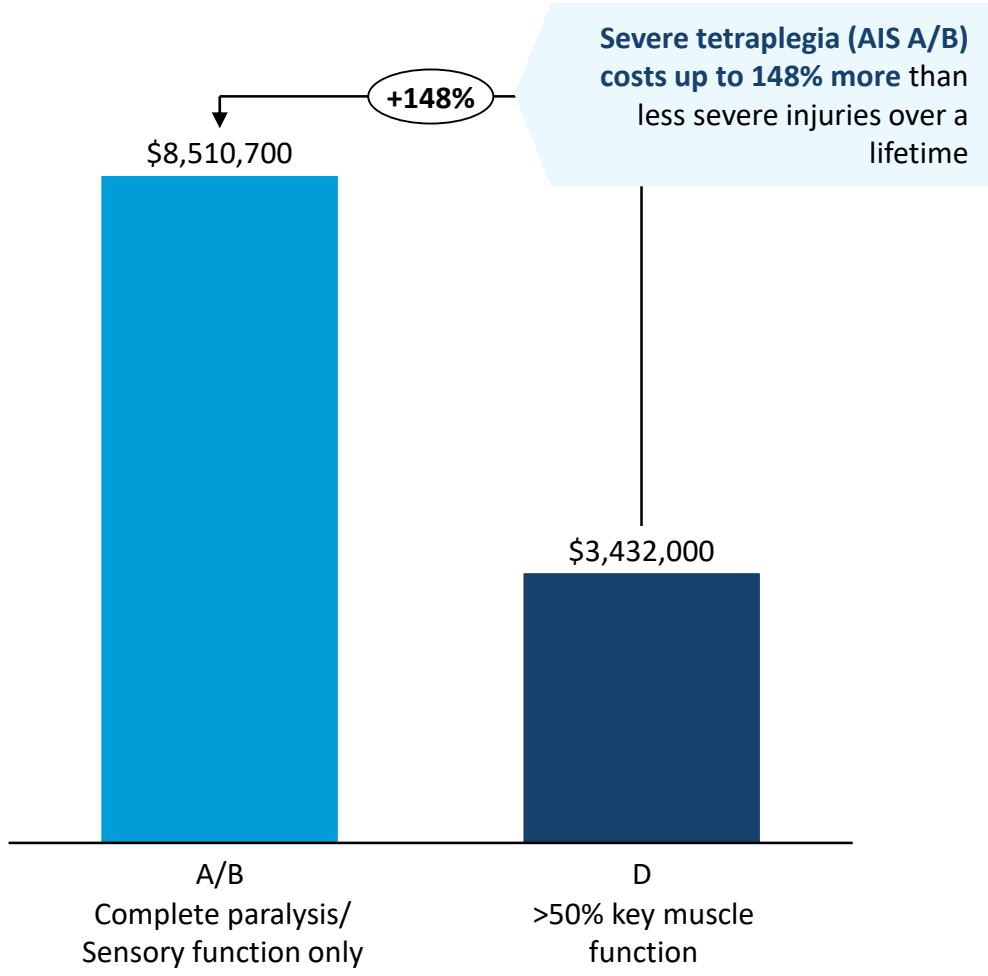
The most severe level of tetraplegia (AIS A/B) has an **average lifetime cost of $8.5m** per person. A person with severe tetraplegia has no movement in their lower limbs and little to no movement of their upper limbs and, as a result, is more likely to develop pressure sores and infections leading to increased re-hospitalisation. A lack of mobility also significantly impacts independence and the likelihood of returning to work.

The **lifetime cost for severe tetraplegia is up to 148% higher** than someone who has retained the majority of key muscle function (AIS D, $3.4m). For people with tetraplegia who have retained some muscle function (AIS C), the average lifetime cost is approximately $7.3m.

The lifetime costs of paraplegic injuries are lower, but not insignificant. The **average lifetime cost of a severe paraplegic injury (AIS A/B) is $4.1m,** 81% higher than a less severe paraplegia (AIS D, $2.3m).

Average lifetime cost of tetraplegic SCIs by severity category

Average lifetime cost per person with SCI, ASIA Impairment Scale (AIS) grade,[1] 2020



1 AIS scores defined as: A No sensory or motor function; B Sensory function but no motor function; C Some motor function but less than half of the key muscle functions below the injury have active movement; D Some motor function, with at least half of the key muscle functions below the injury having active movement.
SOURCE: AlphaBeta analysis. See appendix for detailed methodology.

Benefit of Investing in New Treatment Outcomes

3

No cure exists for spinal cord injuries today. Scientists have made significant progress testing new treatments that could boost recovery from spinal cord injuries. If successful, the cost savings from recovery are conservatively estimated to be $3.5bn, with the potential to be as high as $10.3bn if results from highly successful clinical trials can be replicated.

With the cure for SCIs still unknown, scientists are testing new treatments, in combination with intensive rehabilitation, to minimise or reverse the impact of a spinal injury

No cure for spinal cord injuries exists today.

- Current treatment for spinal cord injury focuses on stabilising the spine at the time of injury. Surgery to minimise damage may be needed when the injury has caused the bones to be unstable or when there is pressure on the spinal cord.
- Once the spine stabilises, treatment focuses on supportive care, management of further complications, and rehabilitation. Rehabilitation often includes physical therapy, occupational therapy and counselling.

However, a cure is possible.

- Scientists have made significant progress in exploring new approaches that can reverse or minimise the impact of a spinal injury. An integrated approach of combining rehabilitation therapy with new experimental treatments is showing positive outcomes such as regaining mobility and/or control over specific functions (e.g. bladder / bowel) within clinical trials.

Key areas of research and new treatments currently in clinical trial

NEUROPROTECTION	Early intervention therapies that prevent cell death and limit damage to the spine. Ongoing trials include use of Minocycline, IVIG, Riluzole, Hyperdynamic therapy, and other
NEUROMODULATION	Epidural or transcutaneous electrical stimulation of the spinal cord. Ongoing clinical trials are delivering positive results using biphasic stimulators
NEUROREGENERATION	Therapies focused on regrowth of damaged neurons, especially in long-term chronic injuries. Clinical trials using a variety of cell types are currently underway
BIOMATERIALS	Biomaterials such as neuro-spinal scaffolds, QL6, and others provide structural support or delivery channels for therapies that promote axonal growth

SOURCE: AIHW (2019) Spinal cord injury Australia 2016-2017; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7313002/ ; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5664995/; AlphaBeta analysis

New treatments are helping individuals regain key muscle function required for movement or recover specific functions such as bladder and bowel control

1 Paralysis recovery

A person recovers key muscle function, and the impact of their SCI becomes minimal. Key muscle functions include elbow, wrist, fingers, hip, knee, ankle, toes as well as other autonomous functions such as cardiovascular and digestion.

It is measured as an improvement in AIS grade from most severe (AIS ABC) to least severe (AIS D)

Example: Majority of research on neuroprotective agents such as IVIG and neuroregenerative treatments such as stem cell therapy are currently focused on protection or regeneration of spinal nerves that have resulted in prevention and reversal of paralysis and regaining movement.

2 Functional recovery

Although a person does not recover key muscle function and mobility, they no longer suffer from a particular functional deficit. This study will focus on the top 3 deficits affecting quality of life of individuals with SCI :

A. Gaining hand function in tetraplegia cases

B. Relieving chronic pain

C. Gaining bladder/bowel control

Example: Some researchers are exploring treatments such as functional electrical stimulation or drug treatments which target specific functions such as bladder control or neuropathic pain.

Paralysis and functional recovery in SCIs can significantly reduce costs due to improved health and wellbeing, reduced need for personal care and increased ability to return to work

	Health care	Personal care	Productivity	Wellbeing
	Reduced cost of rehospitalisation, pharmaceuticals and advanced assistive technology such as ventilators, wheelchairs, vehicle & home modification equipment	Improved ability to care for yourself without any support in domestic tasks and reduce the cost of formal or informal care	Improved ability for individuals and informal carers to go back to work, improving workforce participation and efficiency gains such as taxation revenue	Improved quality of life and reduced mortality risk resulting in an increase in disability adjusted value of life
TREATMENT OUTCOMES				
Paralysis Recovery	Overall reduction in healthcare in all sub-categories	Reduction in hours of care spent on grooming, transfers and mobility	Improved ability to return to work for both individual & informal carer	Major improvement in disability-adjusted life year (DALY)
Functional Recovery	Reduction in pain medicines and specialist visits, fewer rehospitalisations due to infections	Reduction in hours of care spent on domestic & grooming tasks, catherisation, bladder & bowel care	Improved ability to return to work for both individual & informal carer as well as reduction in absenteeism	Improvement in disability-adjusted life year (DALY)

Reversing paralysis in just ~10% of SCI cases can deliver $3.5bn in cost savings to the Australian economy

Clinical trials using neuroprotective agents, stem cells or neurostimulation have been successful in significantly preventing or reversing paralysis, giving back muscle function required for movement and daily living. Recovery rates in recent clinical trials range from 3% - 70% of participants.[1]

Cost savings from reversing paralysis in just ~10% of people with SCIs are estimated at $3.5bn, with the potential to be as high as $10.3bn, if higher recovery rates from some clinical research could be replicated.

Regaining key muscle function required for movement means that an individual can carry out personal care activities (e.g. bathing) or transfers (e.g. bed to wheelchair) with limited assistance, resulting in savings of $1.8bn in costs for formal and informal care.

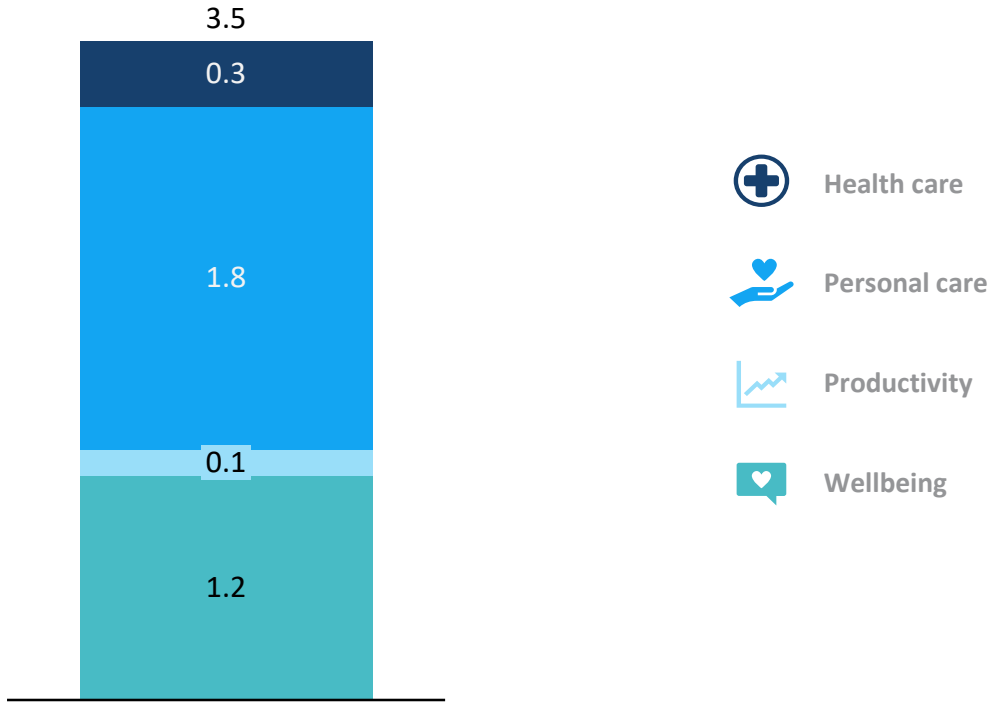
Improvement in mobility also means that individuals are more likely to return to work and have an improved quality of life, resulting in a productivity gain of $0.1bn and wellbeing gain of $1.2bn

Improvement in mobility will also reduce the risk of rehospitalisation and cost of support equipment, leading to an estimated saving of $0.3bn

Conservative Scenario: The potential benefit of investing in new treatments that can reverse paralysis in individuals is estimated based on the lowest recovery rate identified within clinical trials

Total lifetime cost savings for paralysis recovery [2]

$bn, lifetime savings based on total 2020 case load and assumed penetration rates[1]



Note: Recovery rates in recent clinical trials that achieved paralysis recovery in patients ranged from 3% -15% for recovery from AIS A/B to AIS D, 19% - 70% for AIS A/B to AIS C, 23% - 45% for AIS C to AIS D. To estimate benefits, lowest recovery rates were applied to the relevant cohort of AIS A/B (33% of total case load), AIS C (15% of total case load) [1]

SOURCE:

1.Journal of Neurosurgery (2019) Efficacy of riluzole in the treatment of spinal cord injury: a systematic review of the literature; Internal Journal of Molecular Science (2020) Clinical Trials of Stem Cell Treatment for Spinal Cord Injury; (2017) Ulndreaj et al, Promising neuroprotective strategies for traumatic spinal cord injury with a focus on the differential effects among anatomical levels of injury

2. AlphaBeta analysis. See appendix for detailed methodology.

Treatments targeting specific functional recovery such as chronic pain relief, bladder & bowel control or hand function can conservatively achieve up to $2.8bn in savings

In addition to muscle paralysis, a spinal injury can lead to issues such as chronic pain and disruption in bladder, bowel, respiration and sexual function. Hand function, bladder & bowel control and chronic pain relief are ranked as the top three priority functions Australians living with an SCI would like to recover.[1]

Recovery of arm/hand function is ranked to have the greatest potential for improving an individual's independence. Most individuals with tetraplegia preferred restoration of hand function to restoration of bowel, bladder, or sexual function.[1] **Restoring hand function in tetraplegic cases can achieve $1.1bn in cost savings,** with the potential to be as high as $2.5bn, if higher recovery rates could be achieved.

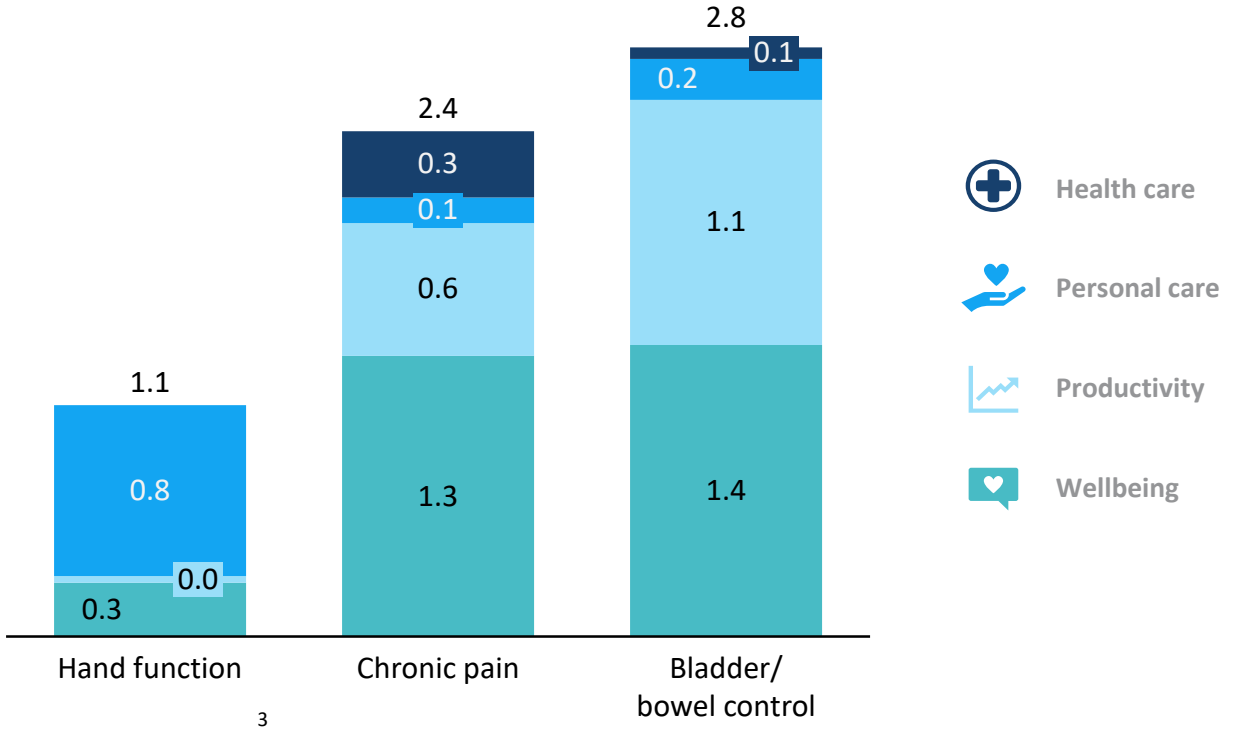
Chronic pain affects 70% of all SCIs, with one third reporting severe pain. It is the most common cause of absenteeism from work. **Alleviating chronic pain can achieve $2.4bn in cost savings, with the potential to be as high as $5.5bn, if higher recovery rates could be achieved.**

Regaining bladder / bowel control is also an important factor of low wellbeing and low return to work rates post injury. 80% of all SCIs suffer from loss of bladder / bowel control. **The benefits of regaining bladder / bowel control is estimated to be $2.8bn, with the potential to be as high as $6.3bn**

Conservative Scenario: The potential benefit of investing in new treatments that can improve functional ability in individuals is estimated based on the lowest recovery rate identified within clinical trials, applied to the relevant cohort of SCIs

Total lifetime cost savings for functional recovery[2]

$bn, lifetime savings based on total 2020 case load and assumed penetration rates[1]



3

* Recovery rates in recent clinical trials that achieved functional recovery in patients ranged from 30% - 70%. To estimate benefits, lowest recovery rates were applied to the relevant cohort of SCIs (70% of SCIs who suffer from chronic pain, 80% who suffer from loss of bowel/bladder control, and 18% tetraplegia AIS ABC cases who do not have hand function)

SOURCE:

1. Lo et al (2016), Functional Priorities in Persons with Spinal Cord Injury; Hanson RW, Franklin WR.(1976) Sexual loss in relation to other functional losses for spinal cord injured males. Arch Phys Med Rehabilitation
2. AlphaBeta analysis. See appendix for detailed methodology
3. Cost savings for gaining hand function are based on difference in costs between C6-8 injuries and T1-6 injuries (where the difference in functional ability is hand function only).

CASE STUDY

New spinal cord stimulation treatment, requiring $20m in investment, can potentially achieve a cost saving of $1.3bn, resulting in a benefit cost ratio of 1.96

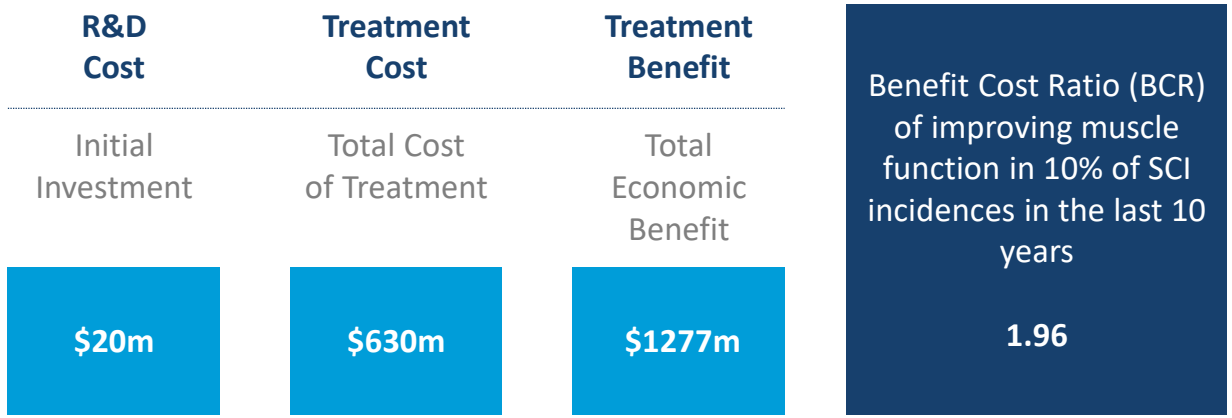
A spinal cord injury can interrupt communication between the nerves in the spinal cord and the brain, causing loss of key muscle function required for movement.

Epidural stimulation involves surgically implanting a small device over your spine that can supply electrical currents that connect nerve signals from the brain to spinal cord tissue below the injury. Outcomes from recent clinical trials suggests that epidural stimulation can have profound benefits in recovering key muscle function in individuals with SCI.

An estimated **$10 to $20 million investment in research funding is required to bring epidural stimulation to all Australians with SCI.**[1] **Cost of delivery for a stimulation device is estimated at ~$41,000 for implantation and ~$6000 for annual ongoing maintenance.**[2] Some researchers are testing non-surgical methods of providing effective spinal cord stimulation. If successful, the cost of delivery would decrease significantly**.**

If SCS could cure just ~10% of SCIs in the last 10 years, the benefit achieved would be $1.3bn (BCR of 1.96). This is a conservative estimate as academic literature suggests recovery rates could be much higher and benefits could be broader (e.g. chronic pain relief) than regaining muscle function

Conservative Scenario: If epidural stimulation can successfully improve key muscle function in ~10% of SCIs incidences in the last 10 years, the total economic cost savings is estimated to be $1.28 billion.



Note: Benefit cost ratio is estimated as total economic benefit divided by total investment in research and total cost of treatment.
Recovery rates in recent clinical trials that achieved paralysis recovery in patients ranged from 3% -15% for recovery from AIS A/B to AIS D, 19% - 70% for AIS A/B to AIS C, 23% - 45% for AIS C to AIS D. To estimate benefits, lowest recovery rates were applied to the relevant cohort in last 10 years , estimated at 7% of 2020 total case load for AIS A/B, 3% of 2020 total case load for AIS C
SOURCE: AlphaBeta analysis. See appendix for detailed methodology.
1. https://www.9news.com.au/national/60-minutes-epidural-stimulation-bryce-vissel-gregoire-courtine-david-mzee-spinal-injury-cure-treatment/5723f171-8bfb-4c95-ad6d-2014d979fc4e,
2. Cost effectiveness of pain devices, Deloitte (2019)

CASE STUDY

Epidural stimulation has helped return cardiovascular function, and the ability to sit up and stand

In 2016, three days before his 29th birthday, Matt Wetherbee suffered a C3 spinal cord injury while playing basketball, leaving him paralysed from the shoulder down.

“I was working for a sports marketing company prior to my injury. I was very active – worked out a lot, played basketball recreationally,” said Matt.

“My fiancé and I had been dating for almost 5 years. I was planning to propose to her a week later, when the injury happened. It changed our lives completely.”

Matt spent 2 months in the hospital and 3 months in rehab after. He relied on caregivers for 82 hours each week for everyday tasks such as getting up, eating and showering.

“Even with formal care, I required support from my fiancé. She took a few months off right after I got hurt. She now works part-time.”

“I am luckier than most people with spinal cord injuries. My medical insurance covered most of my health care and care costs. For some, this is not the case.” After the injury, Matt quit his job at the sports management firm and now runs a not-for-profit to raise money for individuals with spinal cord injuries who require financial assistance for support and treatment.

In 2018, Matt was accepted to participate in a clinical trial for an epidural stimulator at the University of Louisville, Kentucky. The stimulator, consisting of multiple electrodes that trigger different parts of the spine, was surgically implanted. The results have been life-changing for Matt. With a specific setting, Matt is successfully able to sit vertically on his own and stand with support. He has gained movement in his lower body and can flex his foot towards his knee and move his knee towards his chest. He can now stand for two hours a day, with his blood pressure staying in a healthy range.

This study has successfully implanted epidural stimulators in ~20 participants. In addition to an improvement in mobility, many participants have reported fewer health issues such as a decrease in urinary tract infections and more regulated blood pressure, leading to overall health improvements.

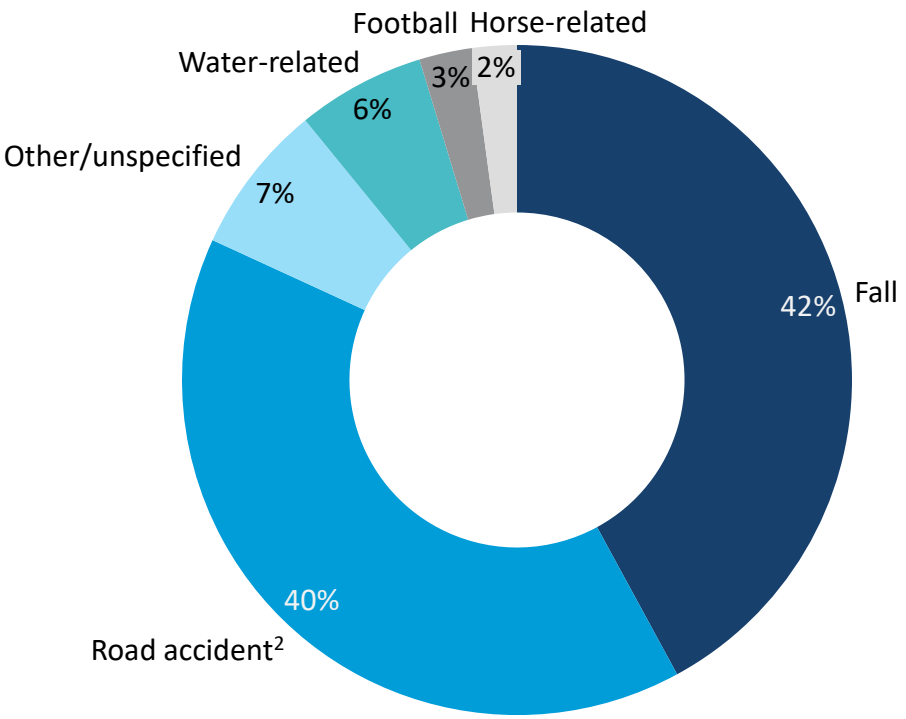
Appendix A: Further estimates

4

Almost half (42%) of traumatic SCIs are caused by falls, closely followed by road accidents (40%)

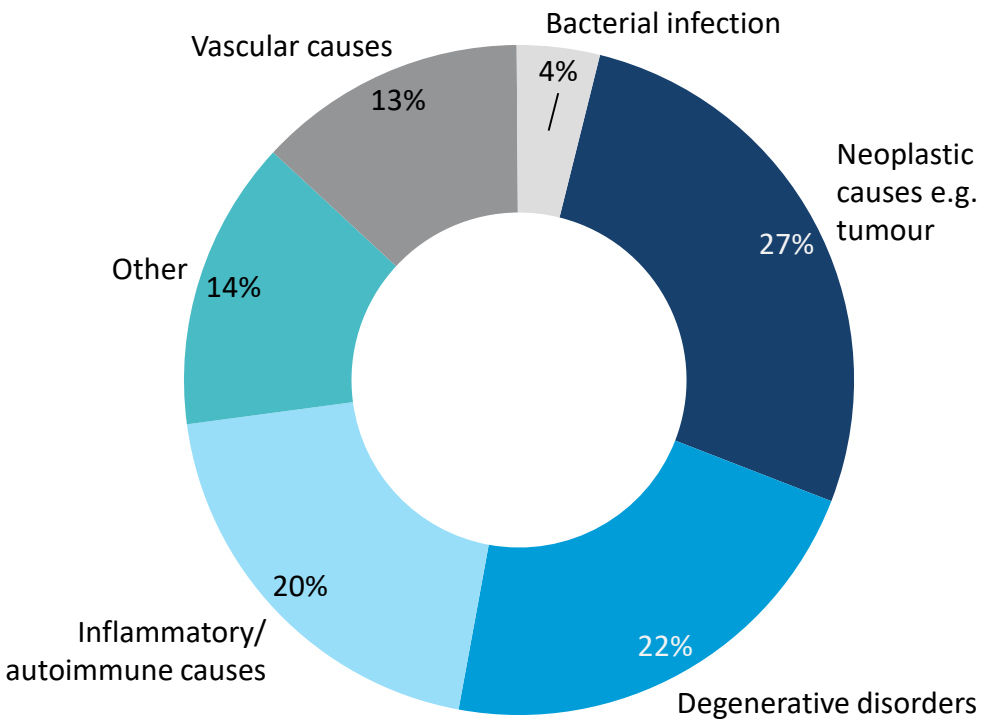
Cause of traumatic SCI

% of SCI by cause, traumatic SCI[1]



Cause of non-traumatic SCI

% of SCI by cause, non-traumatic SCI[3]

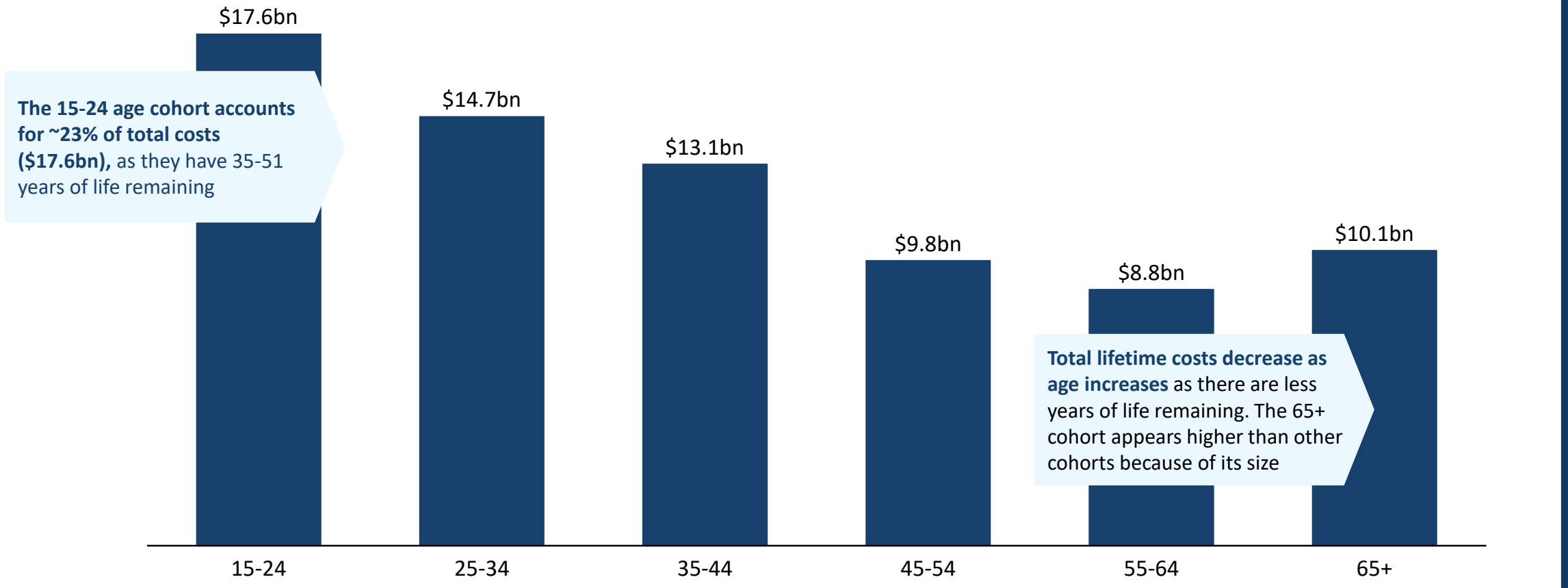


1 Road accidents include motor vehicle occupants and unprotected road users: AIHW Spinal cord injury reports 2014-15 to 2016-17. 2 AIHW Spinal cord injury register reports 2014-15 to 2016-17; New et al (2011), Estimating the Incidence and Prevalence of Traumatic Spinal Cord Injury in Australia as of June 2011. 3 New et al (2010), Prevalence of non-traumatic spinal cord injury in Victoria, Australia as of June 2010; Global non-traumatic SCI epidemiology – Australia (2014); AlphaBeta analysis

The 15-24 age cohort accounts for ~23% of total lifetime costs ($17.6bn), as they have up to 51 years of life remaining

Total lifetime cost by age group ($bn)

Total lifetime costs of SCIs in 10 year age groups, 2020 dollars



Note: Numbers may not sum due to rounding. All analysis excludes children under 15 years old.
SOURCE: AlphaBeta analysis. See appendix for detailed methodology.

Total lifetime cost for NSW ($22.5bn) and VIC ($17.4bn) account for 53% of the total lifetime cost of SCIs in Australia

The **lifetime cost of SCIs for each state and territory is closely related to its population**, particularly for non-traumatic SCI. However, **some jurisdictions have higher traumatic SCI per capita than others**. This includes WA, SA and NT, which have an average of 5-6 traumatic SCI per million population each year compared to the other states and territories' average of 2-4 traumatic SCI per million population each year.[1]

Australia's largest states, **New South Wales and Victoria, account for 53% of the total lifetime cost** of SCIs in Australia ($22.5bn and $17.4bn respectively). It is estimated that there are approximately **6,100 people living with SCIs in NSW, and 4,700 in Victoria**.

There are approximately 4,300 people living with an SCI in Queensland, with a total lifetime cost of $16bn.

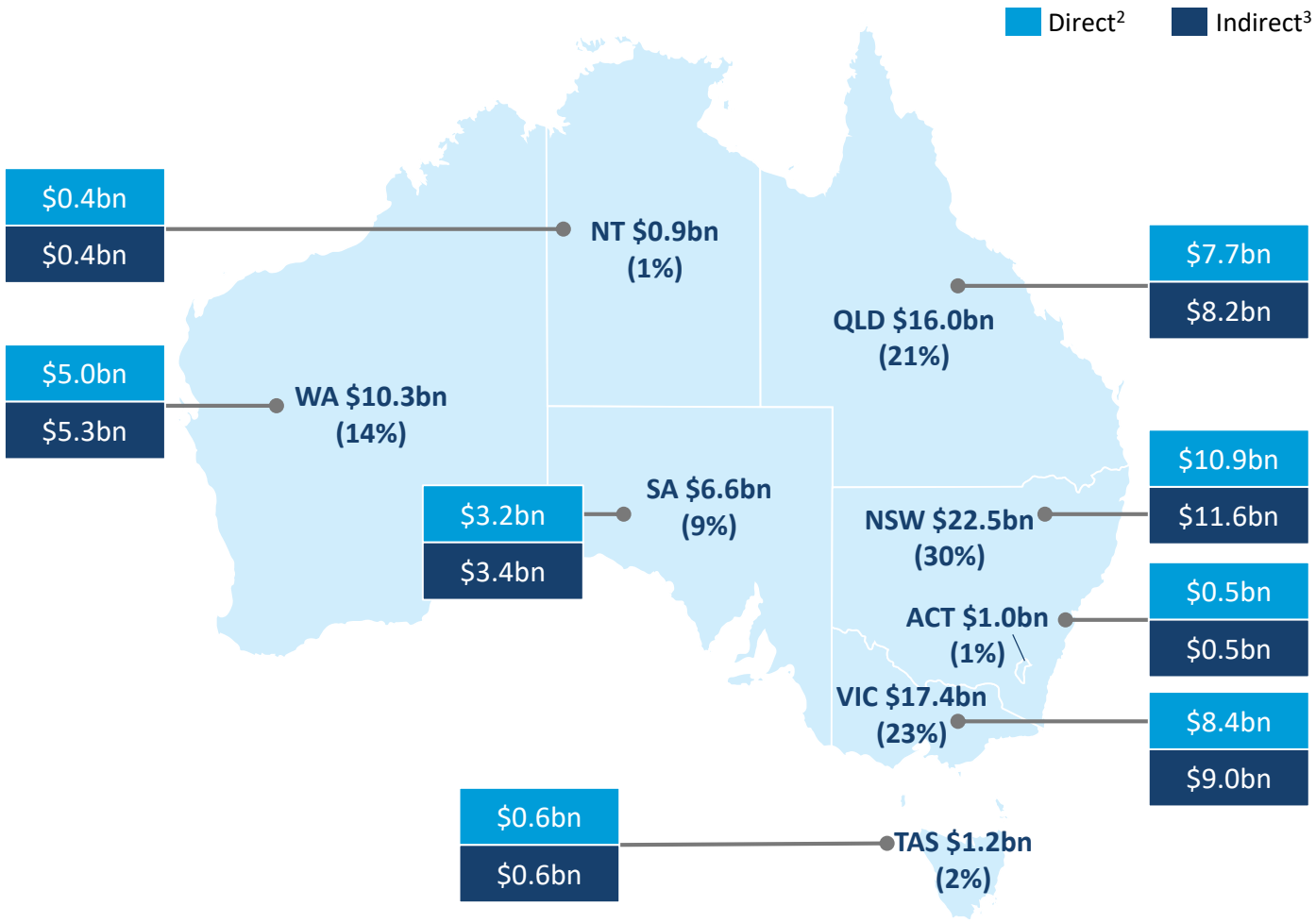
Western Australia accounts for 14% of total lifetime cost ($10.3bn), for approximately 2,800 SCI.

South Australia is home to 1,800 people living with an SCI, at a total lifetime cost of $6.6bn.

Tasmania, the Australian Capital Territory and the Northern Territory have the least SCIs, with 200-300 people with an SCI in each state/territory, at a total lifetime cost of $0.9-1.2bn.

Total lifetime cost by state and territory ($m)

Total lifetime costs of SCIs in 2020, 2020 dollars



1 AIHW (2019), Spinal cord injury register report 2016-17: 3 year rate per million population. Note: Numbers may not sum due to rounding.
2 Direct costs are costs incurred to provide services such as health care, formal care, income support and welfare payments to people with SCI.
3 indirect costs are opportunity costs borne by individuals, families, and broader economy as a result of SCI, for example the opportunity cost of a family member providing informal care or a person's loss of wellbeing.
SOURCE: Number of SCIs by state and territory based on 3 year average published in AIHW Spinal cord injury report 2016-17; AlphaBeta analysis

Total lifetime cost savings from treatments that result in paralysis recovery could be up to $1bn in NSW

Lifetime cost savings for each state and territory are closely related to the size of each state and the number of people with SCIs that could benefit from a possible treatment outcome.

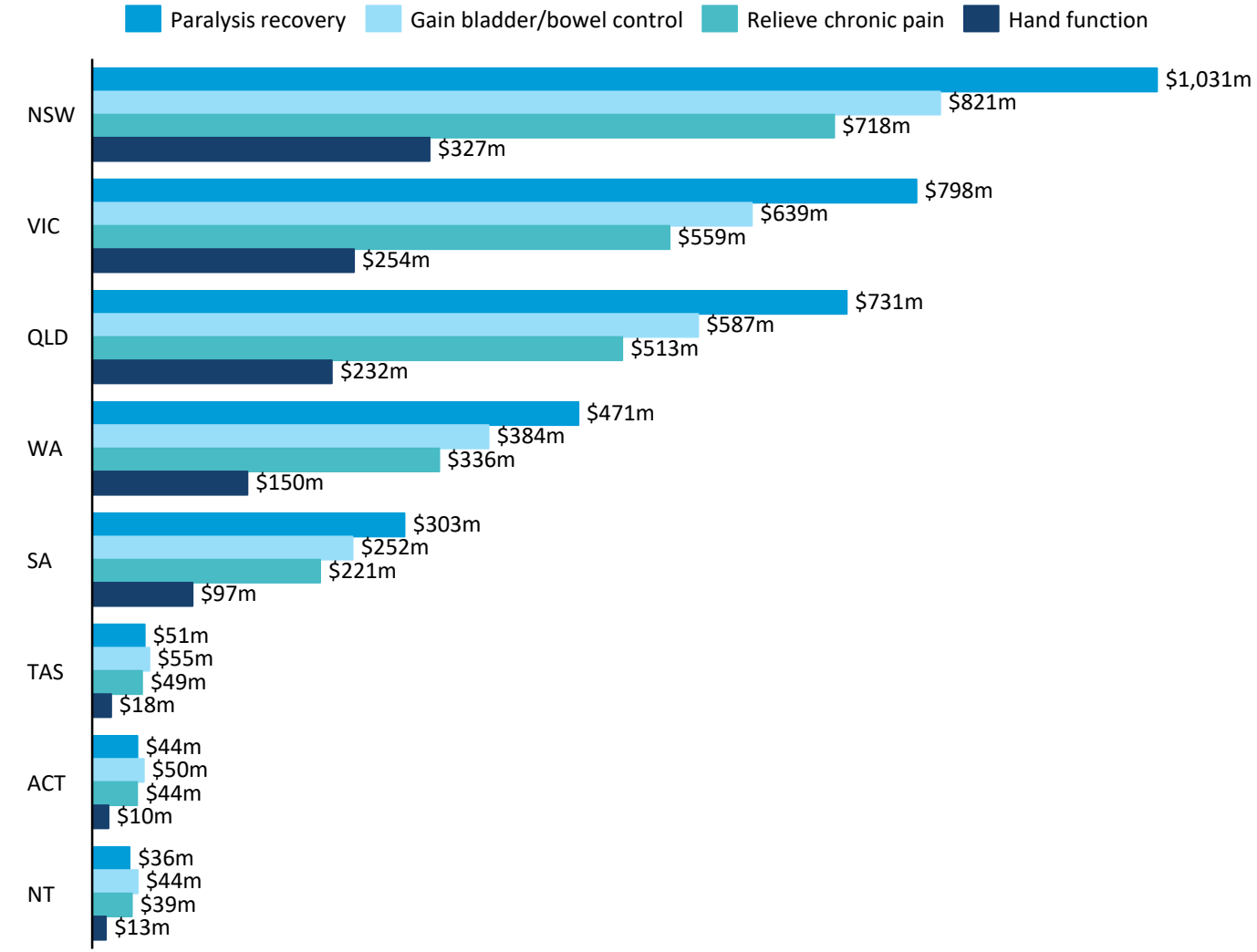
Potential cost savings are the largest for New South Wales, at $**1,031m if** ~10% of people with severe SCIs **recover motor function** (moving from an AIS A, B or C grade to an AIS D).

Restoration of the **three key functional deficits also offers significant cost savings for each state and territory**. For NSW, a treatment that enabled people with an SCI to regain bladder/bowel control could offer up to $821m in savings. Likewise, relief of chronic pain and restoring hand function in people with severe tetraplegia offers $718m and $327m in cost savings respectively.

NSW is closely followed by Victoria and Queensland which have the second and third highest potential cost savings across the different treatment outcomes.

State and territory lifetime cost savings from paralysis recovery ($m)

Total lifetime cost savings for paralysis recovery, 2020 case load



Note: Cost saving based on lowest clinical trial success rate for gaining major/minor muscle function and the relevant cohort of SCIs in each state or territory.
SOURCE: Number of SCIs by state and territory based on 3 year average published in AIHW Spinal cord injury report 2016-17; AlphaBeta analysis

Some treatments can only be applied to acute SCI, meaning that cost savings can only be recovered on new incidences of SCIs in the future

Some treatments are only effective if applied during the **acute or sub-acute stages of SCIs** – often within 48 hours of injury.[1] These treatments are designed to **reduce inflammation and stop further deterioration** of the spinal cord to prevent permanent damage.[2]

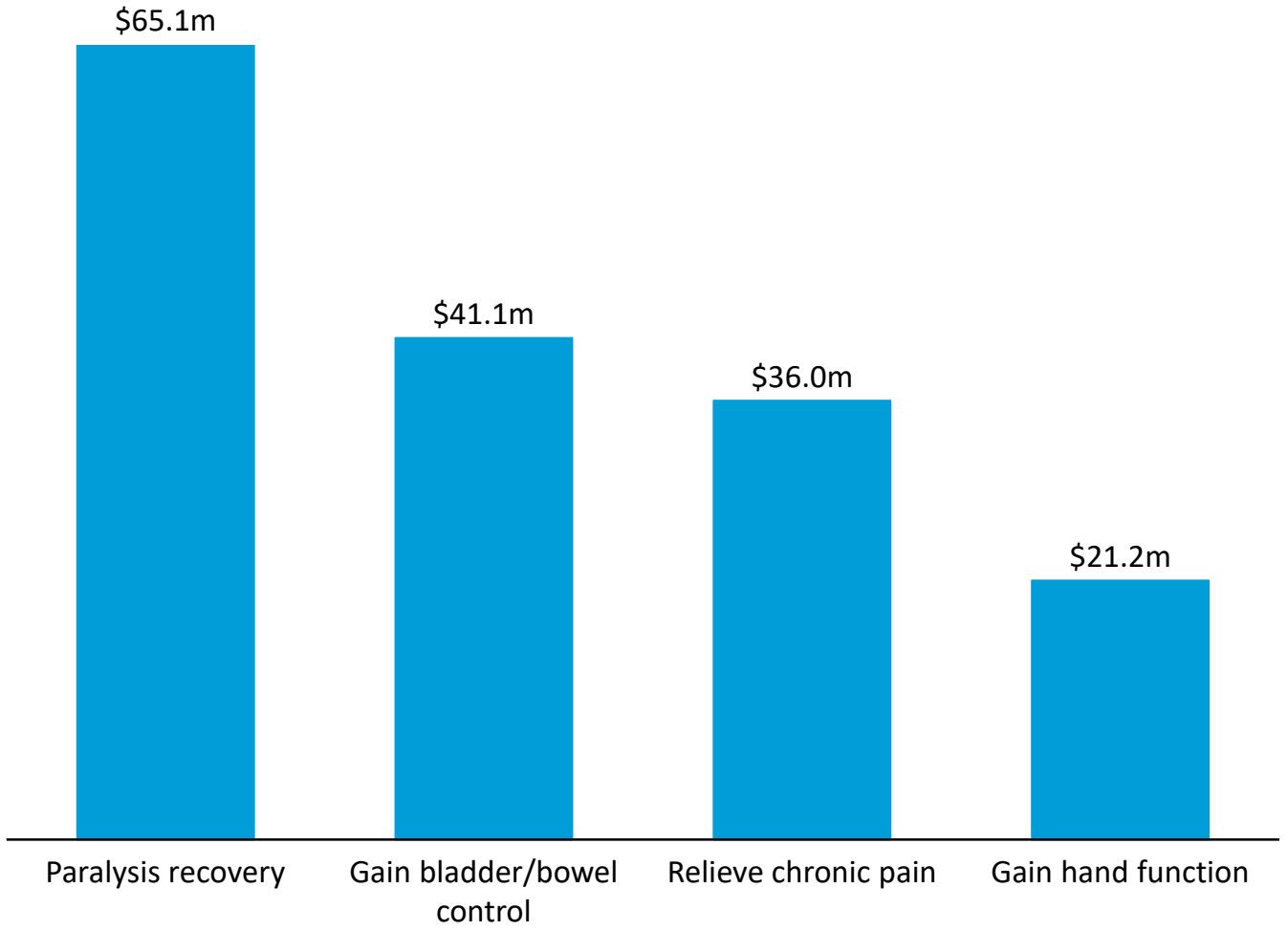
As a result, potential cost savings from these treatments are only available from **treating new incidences** (e.g. 380 SCIs in 2020) instead of the entire case load (e.g. 20,800 in 2020), but are **recurring every year into the future**.

The lifetime cost savings from preventing paralysis in just ~10% of new incidences in 2020 **is estimated at $65.1m**, assuming that these patients would have been discharged at an AIS A, B or C level without the new treatment. If this saving is achieved on new incidences each year for the next 20 years, cost savings are estimated at $969.1m.

Successful treatments ensuring specific functional recovery in new incidences can achieve **between $21.2m** (hand function) **and $41.1m** (bladder/bowel control) **each year**. If this saving is achieved on new incidences each year for the next 20 years, cost savings are estimated between $316m (hand function) and $611.6m (bladder/bowel control).

Total lifetime cost savings for new incidences per treatment outcome ($m)

Total lifetime cost savings for treatment outcomes, new incidences 2020



1 Ahuja et al (2018), Primer - Traumatic spinal cord injury
2 For example: Intravenous Immunoglobulin G (IVIg), Immediate Cooling and Emergency Decompression or Trifluoperazine
SOURCE: Tzekou et al (2014), Treatment of Spinal Cord Injury with Intravenous Immunoglobulin G: Preliminary Evidence and Future Perspectives; Dietrich et al (2011), Hypothermic Treatment for Acute Spinal Cord Injury; AlphaBeta analysis

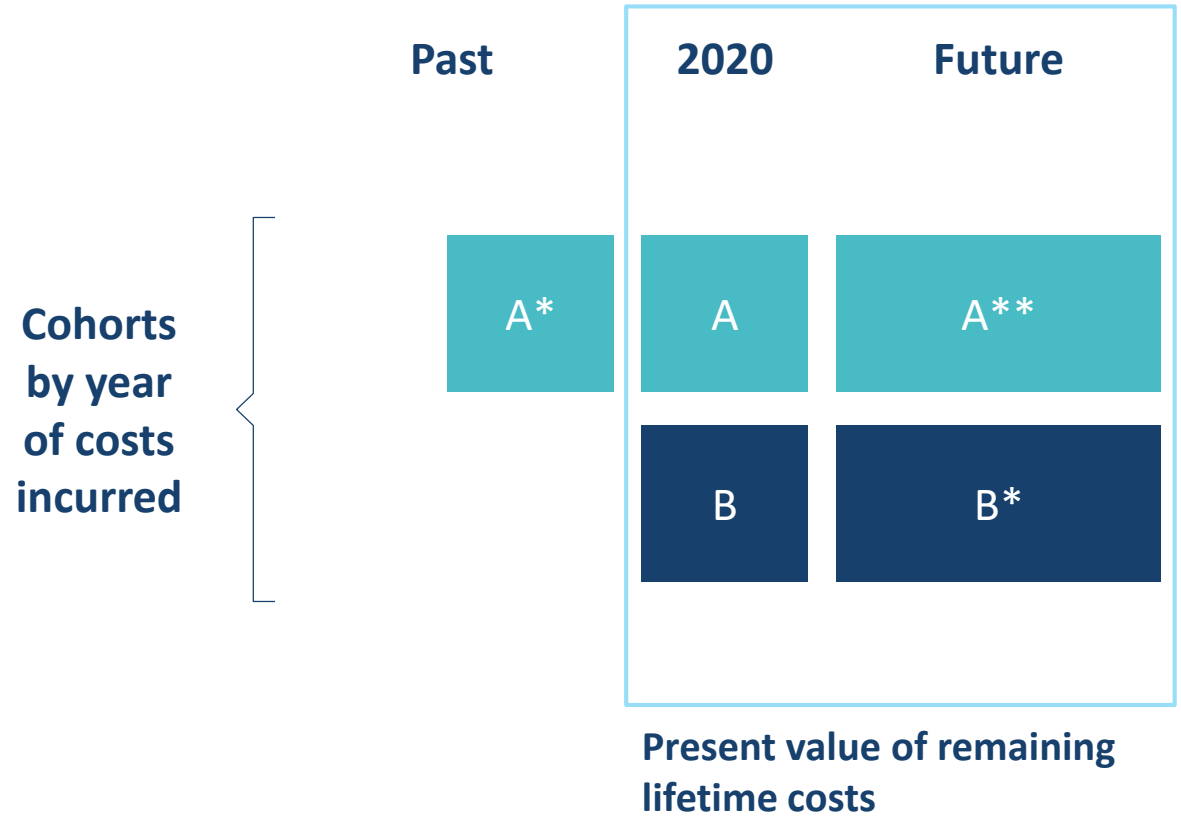
5 Appendix B: Detailed method

The lifetime costs of people living with a spinal cord injury in Australia in 2020 is estimated using both prevalence and incidence based approaches

The remaining lifetime costs of people living with an SCI is estimated using costs incurred in the base year (2020): **A + B**, plus the present value of future costs incurred for the remaining lifetime of each person: **A** + B*.**

- **A:** Represents costs incurred in 2020 by people who have had an SCI in the past, and continue to incur costs into the future (these costs are the **present value of A****).
- **B:** Represents costs incurred in 2020 by people who incurred costs for the first time in 2020, and continue to incur costs into the future (these costs are the **present value of B***).

Measurement of lifetime costs from 2020 onwards



The following methodology was used to estimate financial costs and the burden of disease of SCI

Category	Cost components				
Total cases of SCI in 2020	Age	Injury type	Severity		
Cost to Government	Health care cost (including hospitalisation, medications, rehab, ambulance)	Equipment and modifications to assist with daily living	Long term care	Lost taxation and increased welfare payments from reduced workforce participation	
Costs to individuals	Loss of wellbeing (impact of disability on life remaining measured using disability weight)	Life lost due to premature death	Funeral costs brought forward		
Costs to the economy	Unemployment	Under employment	Absenteeism	Opportunity cost of informal care	Deadweight loss on welfare payments and lost taxation revenue

Methodology to model the economic cost of spinal cord injuries in Australia (1/4)

	Parameters	Description	Reference
Number of SCI cases in Australia	▪ Incidence	▪ New cases of spinal cord injury in Australia in 2020, from traumatic and non-traumatic causes. Using annual incidences reported in AIHW Spinal cord injury register and estimating average % of population (aged 15+) likely to suffer from SCIs each year.	▪ AIHW, Spinal cord injury reports 2005-06 to 2016-17 ▪ ABS 6291.0.55.001 RM1, June 2020
	▪ Prevalence	▪ Existing cases of spinal cord injury in Australia in 2020, from traumatic and non-traumatic causes. Using estimate for Australia in 2010/2011, adding incidence each year (as reported by AIHW) and subtracting estimated deaths in prevalence cohort.	▪ New et al (2015), Estimating the Incidence and Prevalence of Traumatic Spinal Cord Injury in Australia ▪ New et al (2013), Prevalence of non-traumatic spinal cord injury in Victoria ▪ ABS 6291.0.55.001 RM1, June 2020 ▪ AIHW, Spinal cord injury reports 2005-06 to 2016-17
	▪ Accounting for deaths in prevalence cohort	▪ Estimating deaths per 1,000 people with SCIs based on standard mortality ratio for tetraplegia and paraplegia compared to standardised population death rate. ▪ **Assumption:** – Standardised death rate: 5.1 – Tetraplegia mortality rate: 2.2 – Paraplegia mortality rate: 1.7	▪ ABS (2018) 3302.0 - Deaths, Australia, 2018 ▪ Middleton et al (2012), Life expectancy after spinal cord injury: a 50-year study ▪ AIHW Spinal cord injury report 2016-17
	▪ Severity (AIS grade)	▪ Complete injuries (AIS grade A) as reported in AIHW Spinal cord injury reports, incomplete injury breakdown on discharge (AIS B, C, D) as provided by AIHW National Injury Surveillance Unit. ▪ **Assumption:** – AIS B: 13% of incomplete injuries – AIS C: 20% of incomplete injuries – AIS D: 67% incomplete injuries	▪ AIHW (2019), Spinal cord injury report 2016-17 ▪ AIHW National Injury Surveillance Unit
	▪ Age / years of life remaining	▪ Children under 15 years old excluded from the analysis. Age distribution as given in the literature by 10 year age bracket.	▪ AIHW, Spinal cord injury reports 2012-13 to 2016-17 ▪ New et al (2008), Incidence of non-traumatic spinal cord injury in Victoria, Australia: a population based study and literature review ▪ New et al (2015), Estimating the Incidence & Prevalence of Traumatic Spinal Cord Injury in Aust.
	▪ State and territory distribution	▪ Distribution for traumatic SCIs as reported in AIHW Spinal cord injury report (3 year average) and distribution of non-traumatic SCIs assumed to reflect proportion of state population.	▪ AIHW (2019), Spinal cord injury report 2016-17 ▪ ABS 6291.0.55.001 RM1, June 2020
Lifetime calculation	▪ Discount rate	▪ All values given as net present value (NPV) in 2020 Australian dollars, discounted at a real discount rate of 3% per year (adjusted for inflation). This is the standard rate used for health economic analysis, in both costs and outcomes, by organisations such as the Australian Institute of Health and Welfare and the World Health Organisation. ▪ **Assumption:** 3% real discount rate	▪ Australian Burden of Disease Study - Impact and causes of illness and death in Australia 2015 ▪ World Bank Disease Control Priorities Study ▪ Global Burden of Disease Project ▪ World Health Organisation

Methodology to model the economic cost of spinal cord injuries in Australia (2/4)

	Parameters	Description	Reference
Lifetime calculation *(contd.)*	▪ Years of life remaining	▪ Years of life remaining based on average life expectancy per age group, and adjusted by decrease in life expectancy as a result of severity of SCI.	▪ Australian Burden of Disease Study - Impact and causes of illness and death in Australia 2015 ▪ National Spinal Cord Injury Statistical Centre SCI Life Expectancy calculator ▪ Retirement age for working life remaining assumed at 65 (Department of Social Services, Age Pension)
Determining who pays	▪ Insurance schemes	▪ State governments are liable for costs covered by state insurance schemes, which include traumatic injuries incurred at work or in a road accident. Costs paid for by private insurance providers and the individual are also included. ▪ **Assumption:** 22.7% of SCIs covered by state insurance schemes	▪ iCare costs data for Lifetime Care and Workers Compensation schemes 2016-2020, n = 415 ▪ AIHW (2020) Australia's health data insights ▪ Access Economics (2009), The economic cost of spinal cord injury and traumatic brain injury in Australia
	▪ Age of a person	▪ Different government schemes apply to different age cohorts – particularly the NDIS for the under 65 cohort (jointly funded by the federal and state governments) and aged care services (funded by the federal government).	▪ Commonwealth Government websites
Costs to individuals	▪ Years of life lost (YLL)	▪ Cost of years of life lost based on years lost due to premature death from an SCI compared to the average life expectancy for each age group. An increased number of deaths are expected in the first year of injury compared to subsequent years. ▪ **Assumption:** Value of statistical life year: $213,000	▪ Middleton et al (2012), Life expectancy after spinal cord injury: a 50-year study ▪ Australian Burden of Disease Study - Impact and causes of illness and death in Australia 2015 ▪ Office of Best Practice Regulation (2019), Best Practice Regulation Guidance Note Value of statistical life
	▪ Years of life impacted by disability (YLD)	▪ Cost of years of life affected by SCIs calculated using Global Burden of Disease Study 2016 disability weights for SCIs (untreated - frequent pressure sores and infections) by AIS grade, years of life remaining and the value of a statistical life year in Australia. ▪ **Assumption:** Disability weights – Tetraplegia A: 0.732 – Tetraplegia B: 0.682 – Tetraplegia C: 0.682 – Tetraplegia D: 0.061 – Paraplegia A: 0.623 – Paraplegia B: 0.460 – Paraplegia C: 0.460 – Paraplegia D: 0.061 ▪ **Assumption:** Value of statistical life year: $213,000	▪ Lancet Neurol (2019), Global, regional, and national burden of traumatic brain injury and spinal cord injury, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016 ▪ Office of Best Practice Regulation (2019), Best Practice Regulation Guidance Note Value of statistical life
	▪ Funeral costs brought forward	▪ Funeral costs are expected to be incurred by everyone in a lifetime, however funeral costs are brought where SCI leads to premature death. Funeral costs brought forward is the discounted cost of a funeral at time of death with SCI compared to no SCI. ▪ **Assumption:** Inflation rate assumed at 1% (based on % change in inflation from 2018-19) ▪ **Assumption:** Average cost of a funeral is $9,500	▪ Moneysmart.gov.au https://moneysmart.gov.au/paying-for-your-funeral ▪ ABS 6401 CPI Index

Methodology to model the economic cost of spinal cord injuries in Australia (3/4)

	Parameters	Description	Reference
Costs to government	▪ Health care	▪ Health care costs including ambulance, hospital, medical and rehab costs as reported in icare data for SCI, based on severity of injury (AIS grade) and years post injury. Unique annual costs included for years 0 – 6 post injury, with recurring costs for year 7 onwards calculated at 50% of year 5 costs (sample size limited from year 7 onwards but showing downward trend in costs).	▪ iCare costs data for Lifetime Care and Workers Compensation schemes 2016-2020, n = 415
	▪ Equipment and modifications	▪ Equipment and modifications costs as reported in icare data for SCI, based on severity of injury (AIS grade) and years post injury. Unique annual costs included for years 0 – 6 post injury, with recurring costs for year 7 onwards calculated at 50% of year 5 costs (sample size limited from year 7 onwards but showing downward trend in costs).	▪ iCare costs data for Lifetime Care and Workers Compensation schemes 2016-2020, n = 415
	▪ Long term care costs	▪ Long term care costs based on average annualised committed supports (core and capacity building care supports only) for spinal cord injury as reported by NDIA and varied by severity using average weekly hours of formal care required. Average annual cost of the taxi user subsidy scheme also included. ▪ **Assumption:** Average NDIS annualized committed supports (core and capacity building activity supports only) $142,600	▪ NDIS Quarterly Report to disability ministers - Q4 2019/20, June 2020 ▪ icare (Insurance and Care NSW) (2017), Guidance on the support needs for adults with spinal cord injury ▪ Deloitte (2020), Value of informal care ▪ Productivity Commission (2011), Disability Care and Support ▪ Department of Transport (WA) 2017, Reform to the Taxi Users' Subsidy Scheme: Future State Report
	▪ Other expenses	▪ Other expenses including administrative costs and case management as reported in icare data for SCI, based on severity of injury (AIS grade) and years post injury. Unique annual costs included for years 0 – 6 post injury, with recurring costs for year 7 onwards calculated at 100% of year 5 costs (sample size limited from year 7 onwards).	▪ icare (Insurance and Care NSW) (2017), Guidance on the support needs for adults with spinal cord injury
	▪ Taxation income loss	▪ Loss of taxation income assumed at average personal tax income received by the federal government for proportion on people with an SCI no longer employed based on severity of injury (AIS grade). ▪ **Assumption:** Average annual income tax paid per person $13,551	▪ ABS 5506 Personal income tax revenue ▪ National Spinal Cord Injury Statistical Centre unemployment rates analysis
	▪ Welfare payments	▪ Disability Support Pension (DSP) and Carers Payments to people with SCIs eligible for welfare payments: must not be receiving income support (through state insurance schemes) or employed, and otherwise eligible for payment. Assumed 80% of unemployed individuals receive DSP. ▪ **Assumption:** Maximum payment available included in analysis - $944.30/fortnight.	▪ Services Australia (2020), Maximum amount for single person, including pension and energy supplement ▪ DHS Disability support database as referenced in Access Economics (2009), The economic cost of spinal cord injury and traumatic brain injury in Australia
	▪ Income support	▪ Income support payments through state insurance schemes for traumatic SCIs incurred at work or in a motor vehicle accidence. Average annual income support costs as reported in icare data for SCI.	▪ iCare costs data for Lifetime Care and Workers Compensation schemes 2016-2020, n = 415 ▪ AIHW, Spinal cord injury reports 2005-06 to 2016-17

Methodology to model the economic cost of spinal cord injuries in Australia (4/4)

	Parameters	Description	Reference
Costs to the economy	▪ Unemployment	▪ Loss of productivity and wages as a result of increased unemployment from SCI. Likelihood of returning to work compared to the general population estimated using National Spinal Cord Injury Statistical Centre unemployment rates by severity (AIS grade) and verified against icare data on SCIs who return to work in NSW. ▪ **Assumption:** Constant national average earnings applied for working life - $1,257/week	▪ National Spinal Cord Injury Statistical Centre unemployment rates analysis ▪ ABS 6302 Average Weekly Earnings Australia, Nov 2019 (seasonally adjusted) ▪ ABS 6291 Employment Rate Australia, Dec 2019 ▪ iCare costs data for Lifetime Care and Workers Compensation schemes 2016 2020, n = 415
	▪ Under-employment	▪ Reduced productivity and wages for those who do return to work. Measured as a difference in mean income for people with an SCI who return to work (tetraplegia and paraplegia) compared to the general population. ▪ **Assumption:** Mean income for person with tetraplegia $13,661 ▪ **Assumption:** Mean income for person with paraplegia (requires assistance with core activities) $23,881	▪ ABS 6302 Average Weekly Earnings Australia, Nov 2019 (seasonally adjusted) ▪ Rowell (2008) Personal assistance, income and employment: The spinal injuries survey instrument (SISI) and its application in a sample of people with quadriplegia ▪ Census (2016), Average income for persons with disability (assistance required for core activities)
	▪ Absenteeism	▪ Cost of days off (e.g. sick leave) paid by an employer or out-of-pocket for an individual as a result of an SCI. ▪ **Assumption:** For those who do not return to work, 5 days of sick leave is assumed to be taken before state compensation or other payments are accrued. ▪ **Assumption:** For those who return to work, it is assumed the first year is taken off work for recovery, and the equivalent of 10 weeks per year is required in sick days.	▪ Safe Work Australia: Australian workers compensation statistics 2016-17 ▪ Garcia (2007) Spinal Cord Injury and Traumatic Brain Injury: A Cost-of-Illness Study ▪ Access Economics (2009), The economic cost of spinal cord injury and traumatic brain injury in Australia ▪ ABS 6302 Average Weekly Earnings Australia, Nov 2019
	▪ Deadweight loss from taxation revenue lost and welfare payments	▪ Deadweight loss accounts for the loss of additional value that could have been created in the economy as a result of alternative government spending. ▪ **Assumption:** Deadweight loss calculated at 28.75% per $1	▪ Productivity Commission (2003), Evaluation of the Pharmaceutical Industry Investment Program, Australian Government, Canberra ▪ Access Economics (2009), The economic cost of spinal cord injury and traumatic brain injury in Australia
	▪ Informal care	▪ The opportunity cost of the time spent giving informal (unpaid) care is estimated using the average hours of care required by a person with SCI, depending on severity of injury (AIS grade), the average hours of informal care given to a person with moderate to profound disability by primary and non-primary carers, average earnings for Australia and average employment rate. ▪ **Assumption:** 70% people with tetraplegia and 66% people with paraplegia have a primary informal carer ▪ **Assumption:** 20% people with SCIs have a non-primary informal carer ▪ **Assumption:** Constant national average earnings applied for working life - $1,257/week ▪ **Assumption:** National average employment rate 63.2%	▪ Deloitte (2020), Value of informal care ▪ Rowell (2008), Personal assistance, income and employment: The spinal injuries survey instrument (SISI) and its application in a sample of people with quadriplegia ▪ icare (Insurance and Care NSW) (2017), Guidance on the support needs for adults with spinal cord injury ▪ Productivity Commission (2011), Disability Care and Support ▪ ABS 6302 Average Weekly Earnings Australia, Nov 2019 ▪ ABS 6291 Employment Rate Australia, Dec 2019

Methodology to model the benefit of new treatments

	Parameters	Description	Reference
Cost savings from treatment outcomes	▪ Paralysis recovery	▪ Lifetime cost savings as a result of a person with a severe injury (AIS A/B) regaining motor function to an AIS C or D level. This is calculated using the lower range of relevant clinical trial success rates (3% for moving A/B to D, 19% for moving A/B to C, and 23% for moving C to D) and applied to the relevant SCIs cohort.	▪ Yamazaki et al (2020), Clinical trials of stem cell treatment for spinal cord injury ▪ Corallo et al (2020), Assessment of spinal cord stimulation and radiofrequency ▪ Grossman et al (2014), A Prospective, Multicenter, Phase I Matched-Comparison Group Trial of Safety, Pharmacokinetics, and Preliminary Efficacy of Riluzole in Patients with Traumatic Spinal Cord Injury ▪ Ulndreaj et al (2017), Promising neuroprotective strategies for traumatic spinal cord injury with a focus on the differential effects among anatomical levels of injury ▪ Taweel & Seyam (2015), Neurogenic bladder in spinal cord injury patients ▪ Expert interviews with neuroscience researchers
	▪ Relieving chronic pain	▪ Lifetime cost savings as a result of a person no longer experiencing chronic pain. This is measured across savings in health care (mostly medications and specialist fees), personal care, increased employment and a higher quality of life. This is calculated using the lower range of relevant clinical trial success rates (30%) and applied to the relevant SCI cohort who experience chronic pain – 70% of people with an SCI experience pain for more than 6 months: Agency for Clinical Innovation Pain Management Network (2020).	▪ Clinical trial success rates as above ▪ Agency for Clinical Innovation Pain Management Network (2020) ▪ Deloitte Access Economics (2019), The cost of pain in Australia ▪ Rice et al (2016), Pain and the global burden of disease ▪ Institute for Health Metrics and Evaluation (2018), Global Burden of Disease
	▪ Gaining bladder/bowel control	▪ Lifetime cost savings as a result of a person regaining bladder or bowel control. This is measured across savings in health care (mostly reduction in infections and rehospitalisation), personal care, increased employment and a higher quality of life. This is calculated using the lower range of relevant clinical trial success rates (30%) and applied to the relevant SCI cohort who experience bladder/bowel control issues – 80% of people with an SCI: Taweel & Seyam (2015).	▪ Clinical trial success rates as above ▪ iCare health care costs data for Lifetime Care and Workers Compensation schemes 2016 2020, n = 415 ▪ Deloitte Access Economics (2011), The economic impact of incontinence in Australia ▪ Department of Information, Evidence and Research WHO (2018), WHO methods and data sources for global burden of disease estimates 2000-2016 ▪ Taweel & Seyam (2015), Neurogenic bladder in spinal cord injury patients
	▪ Gaining hand function (tetraplegia only)	▪ Lifetime cost savings as a result of a person with tetraplegia (AIS A, B or C) regaining hand function. This is measured across savings in personal care, increased employment and a higher quality of life, using the cost difference between a person with a C6-8 level of tetraplegia and a person with T1-6 level paraplegia. The major difference between these two injuries is hand/arm function. Improved quality of life is measured using disability weight of hand amputation. This is calculated using the lower range of relevant clinical trial success rates (30%) and applied to the relevant SCI cohort.	▪ Clinical trial success rates as above ▪ iCare health care costs data for Lifetime Care and Workers Compensation schemes 2016 2020, n = 415 ▪ Salomon et al (2015), Disability weights for the Global Burden of Disease 2013 study

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