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It's a Marathon, not a Sprint: Actuarial Models of Lifetime Care and Support for Severely Injured Participants

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Abstract

The introduction of a National Injury Insurance Scheme in Australia would lead to many actuaries being asked to perform valuations of future lifetime care and support costs associated with severely injured participants. The care and support needs of participants within these schemes are generally lifelong and varied. The financial cost can vary depending on a participant's age, injury type, injury severity, time since injury, gender and the level of unpaid participant care and support. A range of psychosocial factors also undoubtedly impact on an individual's use of formal support.

This paper discusses a framework for performing an actuarial valuation of lifelong future care and support need costs for severely injured scheme participants. We consider:

a) types of injury that would be covered by a National Injury Insurance Scheme and a method of injury severity categorisation
b) key principles underpinning the actuarial valuation of severely injured participants
c) characteristics of the types of participant care and support needs, specifically considering the dimensions of injury type, injury severity, age, gender and duration since accident
d) determination of a suitable mortality basis and level of future mortality improvement
e) measurement of injury severity improvement over time, particularly for traumatic brain injuries
f) use of appropriate economic assumptions.

We draw on our knowledge and experience in the development of the NSW Lifetime Care and Support scheme valuation models. In particular, we focus on spinal cord injuries and traumatic brain injuries which account for the majority of the participants within the Lifetime Care and Support scheme.

The valuation framework discussed in this paper can be used to provide a holistic monitoring capability for these schemes to allow the early identification of emerging trends within the portfolio and to establish a basis for discussion with the schemes. This monitoring capability can also include indicators of participant outcomes across a range of domains related to health, economic and social participation, and independence. These factors are beyond the scope of the current paper.

The framework is transferrable to assist in the modelling of care and support needs for other common injuries and disabilities. We understand that similar approaches are being used to value, monitor and manage the care and support costs and outcomes for participants within the National Disability Insurance Scheme.

Keywords: lifetime care and support, National Injury Insurance Scheme, actuarial valuation method, catastrophic injuries

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1. Background

The introduction of a National Injury Insurance Scheme (NIIS[1]) in Australia would lead to many actuaries being asked to perform valuations of future lifetime care and support costs associated with severely injured participants. The care and support needs of participants within these schemes are generally lifelong and varied. The financial cost can vary depending on a participant's age, injury type, injury severity, time since injury, gender and the level of unpaid participant care and support, amongst other factors.

This paper discusses a framework for performing an actuarial valuation of lifelong future care and support need costs for severely injured scheme participants. In this paper we refer to people suffering severe injuries and covered by a NIIS scheme as "participants" within the scheme. We also refer to "severely" injured participants and note that other literature often describes these as participants with "catastrophic" injuries.

We focus on Traumatic Brain Injury (TBI) and Spinal Cord Injury (SCI) as this is where we have been able to conduct the majority of our research, and also where the majority of the severely injured participants are expected to be. Similar methods could be used to calibrate similar models for other injury or disability types and we understand that these methods are currently being used to assist the National Disability Insurance Scheme (NDIS) in their management of NDIS participants.

The valuation framework has been the result of over ten years of research and development by a varied number of actuaries and other individuals. The framework for the base actuarial model was initially established for the NSW Lifetime Care and Support (LTCS) Authority[2] after extensive discussions with clinicians, participants, epidemiologists and carers to best understand the frequency and quantum of care and needs supports for severely injured spinal cord and brain injury participants. Discussions were also held with existing accident compensation schemes providing long-term care and support for severely injured people; however the NSW scheme was the first to focus exclusively on this cohort, and therefore faced challenges of eligibility and assessment not necessarily relevant to other schemes, which were therefore not directly comparable.

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[1] In 2011 the Productivity Commission inquiry into Disability Care and Support recommended that states and territories provide no-fault support for all major injuries through a state based NIIS. It was intended that the scheme would supplement the proposed National Disability Insurance Scheme. These recommendations of the Productivity Commission were accepted by the Council of Australian Governments, and senior officers of the Commonwealth and states and territories are now working towards implementation of the NIIS. National minimum benchmarks for motor and work injury have already been published, with medical injury benchmarks currently under consideration.

[2] The Lifetime Care and Support Authority is a statutory authority established by the "Motor Accidents (Lifetime Care and Support) Act 2006". The LTCS scheme was established to provide assistance and services to people severely injured in a motor vehicle accident in New South Wales, regardless of who was at fault. The scheme became operational in respect of children aged less than 16 years at date of injury as at 1 October 2006, and in respect of adults as at 1 October 2007.

Since the inception of the LTCS scheme the valuation methods have evolved and been adjusted to allow for the emerging experience of the care and support needs within the LTCS scheme. Indeed, these valuation methods are continually evolving. The detail of the framework and approach described in this paper is very much ingrained in the culture of the LTCS and detailed monitoring of the scheme at this level of detail has been useful for the management of the scheme to allow the early identification of emerging trends within the portfolios and to establish a basis for discussion around these emerging trends.

Actuarial valuations are important beyond just providing a balance sheet liability figure. A valuation may also be undertaken for other reasons, for example to estimate short or long term cash flows for the scheme, to monitor changes in scheme trends by injury year or payment year or to assess service provider performance. It is important to tailor the assumptions and methodology to suit the purpose of the valuation.

Appropriate valuation models, analysis and reporting can assist the scheme (and their actuaries) in monitoring trends and assessing participant outcomes. This will be especially important with the introduction of further NIIS, because in the early years of a scheme when data is scarce, prudential fiscal management will be important. As a result, the framework provided in this paper can serve as a benchmark for similar valuations of severely injured claimants.

We would caution actuarial practitioners against relying too heavily on the results shown within this paper as benchmarks. While we provide some details around expected participant characteristics, future care and support payments and benchmark averages, the assumptions in the paper shouldn't be blindly applied to other situations as circumstances may be different. Subject to national minimum benchmarks, each scheme will be unique in terms of their eligibility requirements, benefit coverages, supplier costs, economic assumptions as well as interpretation of definitions of what may be termed "reasonable and necessary"[3] care and support benefits.

[3] An important lever to control costs within a NIIS scheme is the provision of an appropriate level of entitlements for care and support costs. This is generally described as the provision of "reasonable and necessary" care and support costs, where the payment of benefits will be contingent on the meeting of certain criteria. These criteria may include providing value for money, the use of effective and evidence based goods or services, provision of supports that reflect community expectations and also support the participant's towards achievement of their goals. While there are national minimum benchmarks, individual schemes may choose to provide wider benefit coverages. The concept of what is reasonable and necessary is covered further in the beginning of Section 4.

2. A Valuation Framework for Modelling Future Care and Support Costs

Within the context of a NIIS, there are many and varied circumstances where valuations and projections of future cash flows are required. The valuation methodology should ideally begin with an understanding of the nature of the injury itself and the costing model should also reflect the scope of the provision of support services to participants. Both the utilisation and intensity of the support services to be provided since injury should be considered. The nature of the types and range of support services provided may vary depending on the scheme.

A valuation methodology that links closely to a robust monitoring system can help to mitigate against emerging financial risks within the scheme so that they can be identified early and corrective action can be taken to respond to these trends.

The model described in this paper is especially useful for new schemes and for the valuation of recently injured participants. In the latter case the future care and support needs may take a long time to stabilise. Initial calibration of valuation results will likely be based on benchmarking exercises, with greater reliance being placed on emerging costs once credible experience is available within the scheme.

We acknowledge that the valuation method adopted may be limited by the data available for analysis from the scheme. For example, the use of traumatic brain injury severity may be limited by the categorisation methodology used by the scheme[4]. Another example is that the payment detail provided by the scheme may limit the level of analysis into different support services offered by the scheme.

2.1. Existing Valuation Methodologies

2.1.1. Aggregate versus Individual Valuation Methodologies

Aggregate valuation methodologies do not work well when there is limited granular data or a limited number of participants. While the scheme covers 'severely injured participants', there are likely to be large differences in the injury severity profiles of participants entering the scheme[5]. This will lead to large differences in expected future care and support costs for participants and mean that there would remain a need to find some way of risk adjusting aggregate exposures in order to develop reliable valuation estimates.

[4] There are many different ways that injury severity of traumatic brain injuries can be categorised. Most of these methods require either an assessment of a participant's physical and cognitive functionality, a participant's care and needs requirements or the period of post traumatic amnesia. This is discussed further in Section 3.2.2.

[5] NIIS schemes may cover participants with a wide range of injury severity. For example, spinal cord injury severity can be characterised by the neurological level of injury and the completeness of the injury. These two factors greatly influence the level of function and movement of the participant, thus influencing the level of care and support services required. We discuss this further in Section 3.

Aggregate valuation methodologies are also limited in being able to understand the key drivers of change within a scheme from period to period and are unable to provide the same levels of insights as more detailed analysis and modelling.

Apart from technical actuarial considerations, there are good definitional and conceptual reasons for using individual valuation methodologies. These lie in the underlying principles of lifetime care and support schemes, which aim to focus on individual outcomes and to develop person centred support provision. It is impossible to measure effectiveness in achieving these objectives within an aggregate valuation framework.

We therefore form the conclusion that individual annuity based methods are a more robust format of valuation method for the valuation of individual participants. The use of aggregate valuation methods is generally not appropriate, although it might be necessary to blend individual annuity methods with aggregate methods. For example, in projecting future cashflows while allowing for new entrants or for the estimation of incurred but not reported participants.

2.1.2. Annuity Methodologies

Many existing valuations of severely injured participants are centred on individual annuity methodologies. The degree of complexity varies, but most models have structures that consider participant age, gender, existing payment levels, future mortality rates and future economic assumptions. In some cases there may be an overlay for the severity of injury if this is not adequately captured within the existing payment levels.

Some annuity models may have a specific split between one-off payments (such as home modifications and equipment) and periodic payments (such as attendant care and ongoing rehabilitation payments). Other models may just allow for higher initial costs and lower longer term costs.

Allowance may or may not be made for superimposed inflation on care and support costs and there may be specific caps applied to the level of payments over a participant's lifetime. Discounting may be completely based on risk free rates or on longer term expectations, depending on the accounting basis and/or the actuaries' individual views.

The mortality basis used will typically be based on loading up a standard mortality table or through the use of specific mortality rates.

Many of these annuity methods have limitations. For example, many of these methods only allow for a participant's current personal circumstances and may not adequately allow for changing personal circumstances, which become important when considering a participant's lifetime care and support requirements. In addition, for recent injuries the profile of payments may be very different to the longer term profiles of payments. For example, initial payments may be dominated by initial capital outlays that may be one-off in nature (such as hospitalisation, home modifications, initial aids and equipment) and allowance may be required for potential injury severity improvement, especially for traumatic brain injuries.

In addition, the limited detail within many annuity methods may not be useful to the scheme in providing insights into the day to day operations of the scheme. If there was deterioration in costs then an analysis breaking down costs into greater detail and providing an understanding of the pathological pathways of a participant's injury treatment and support can be useful.

2.1.3. The Use of Benchmarks and Dealing with Scarcity of Data

When there is scarcity of data then the use of benchmarks may be required to perform valuations. A ground-up approach can be useful, although it may be prohibitively expensive and time consuming to undertake, and is also likely to be subject to considerable uncertainty and volatility.

As a minimum, we believe that ground up valuations of new small schemes should at least use benchmarks as comparators in early years. For these smaller valuations, a control feedback mechanism is important. Analysis of actual versus expected experience over time allows valuation methods and assumptions to evolve over time, although when there is limited experience it can be difficult to overlay longer term trends and expectations.

2.2. Overview of the Proposed Framework

With the above discussion in mind, the framework which we describe in this paper has been based on a "ground-up" analysis using many aspects of both qualitative and quantitative research. In particular the input of clinicians, participants, epidemiologists and carers have been synthesized to best understand the frequency and quantum of care and needs supports for severely injured spinal cord and brain injury participants. This has been supplemented with the early experience emerging from the LTCS scheme. Notwithstanding the research, any framework has to be sufficiently flexible to remain abreast of and adapt to the latest thinking and developments in care and support delivery.

The premise of the model is to build up an individual case estimate using a summation of annuity methods for each participant and payment type grouping based on each participant's individual risk characteristics.

In Section 3 of this paper we consider the participant characteristics which are important in the estimation of a lifetime valuation. These characteristics include the participant's injury type, injury severity, age, time since injury, status[6] and gender.

Section 4 considers the different patterns of care and support across a number of different payment types. Each payment type has unique patterns of care. These patterns of care are further differentiated by the participant's characteristics noted above.

[6] In this case we refer to a participant's "status" within the scheme, specifically whether they have been accepted as an "interim" participant into the scheme, have been assessed for "lifetime" eligibility, have lapsed from scheme participation etc. The concept of participant "status" is described in further detail in Section 3.4.

Attendant care represents the major payment type and accounts for the majority of the future liability valuation. The minor payment types include hospital, medical, rehabilitation, home modifications, aids & equipment and case management. Each of these payment types have different expected future payment profiles by injury type, injury severity, age and duration since injury.

In Section 5 we discuss an approach to allow for potential improvements in injury severity for traumatic brain injury participants using a transition model. This approach models participant status and injury severity from period to period, including transitions into the "not lifetime" status, where a participant may become ineligible for scheme benefits.

The selection of an appropriate mortality basis is discussed in Section 6, focussing on both a current mortality basis that allows for a participant's age, injury type, injury severity and gender as well as considerations in determining mortality improvement factors over time.

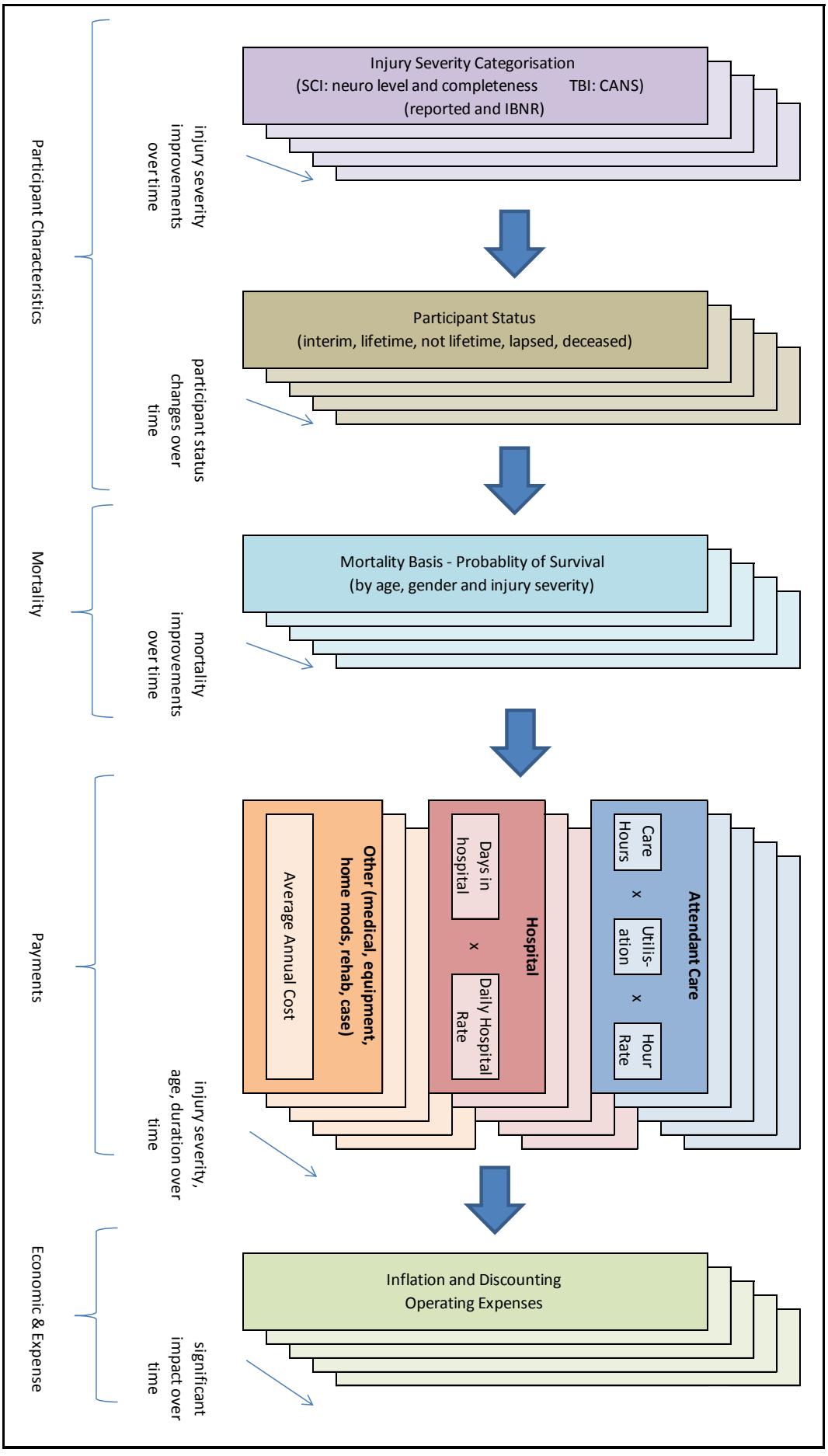
The long term nature of the lifetime liabilities mean that additional thought needs to be given to the economic assumptions and future expense assumptions of the scheme and this is described in Section 7.

The granularity of the proposed valuation framework allows the scheme to monitor and manage the scheme at a relatively operational level of detail. To the extent that these aspects of the scheme risk characteristics are both modelled and managed, the scheme is able to respond effectively and efficiently to emerging themes and to better understand the trends within the scheme.

The framework discussed in this paper could be used to value care and support needs of other common disabilities. We understand that similar approaches are being considered and used to monitor, value and manage the emerging care and support costs for participants within the NDIS.

Figure 1gives a diagrammatic representation of this valuation framework methodology.

Figure 1 Diagrammatic Representation of Valuation Framework Methodology



3. Characteristics of Severely Injured Participants

In this section we cover the types of injuries, categorisation of injury severity, participant age and gender demographics, eligibility and participant status.

3.1. Initial Eligibility

The identification of eligible participants for NIIS can generally occur relatively quickly, given that the scheme is for participants who are severely injured. In many jurisdictions there may be specialist hospitals that treat NIIS-type injuries, such as specialist spinal wards or children's wards, and hence the identification for eligibility becomes easier.

Processes around existing insurance schemes, such as the NSW CTP scheme, can also help with the early identification of eligible participants. For these reasons, most eligible participants are identified relatively close to the date of injury.

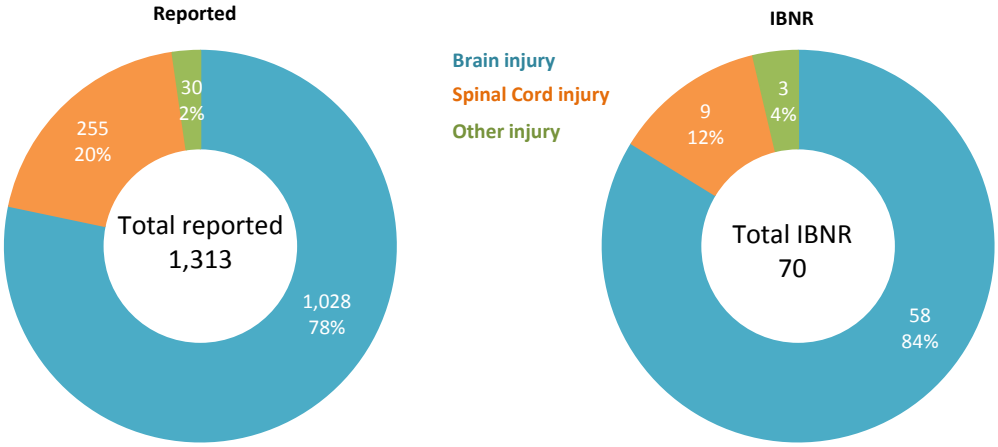
However, in some cases it may be more difficult to determine scheme eligibility. Newly established schemes may take time for the awareness of the scheme coverage to be known by various stakeholders. In the case of traumatic brain injuries, which have less clear pathological predictors, it may also be less clear whether a participant meets the eligibility criteria, especially for old or very young participants, meaning that later emergence of reporting is possible. The assessment of injuries other than spinal cord injury or traumatic brain injuries may also mean that identification of participants will take a longer time. In order that some potentially severe injuries would not miss out on important early support through entry into the scheme, initial "interim" eligibility was consciously designed to provide such early entry for a wide range of people, particularly those with traumatic brain injury.

3.2. Type of Injuries

Spinal cord injuries and traumatic brain injuries make up over 97% of the participants entering the LTCS scheme and would be expected to make up the majority of injuries in other motor transport NIIS-type schemes.

Figure 2 shows the number of reported participants in the LTCS Scheme at 30 June 2015 (left) and the projected Incurred But Not Reported (IBNR) participants (right). The blue shading shows the share of traumatic brain injury participants, the orange shading shows spinal cord injuries and the green shading shows other types of injuries. This represents participant reports over approximately 7.75 years of exposure.

Figure 2 Distribution of Types of Injuries in LTCS Scheme at 30 June 2015



Nearly 80% of total scheme participants have traumatic brain injuries, while nearly 20% of participants have spinal cord injuries. Only about 2% of participants have other types of injuries. Other injuries would include severe burns, blindness and multiple amputations. Depending on the scheme coverage and mechanisms of injury, these other injuries may make up a different proportion of total injuries for other NIIS schemes.

Comparison of the IBNR (right hand chart) with the reported participants (left hand chart) also shows that spinal cord injuries are reported to the scheme, on average, earlier than brain injuries. In NSW this is partly due to a number of specialised spinal cord injury hospitals. Most vehicle accidents leading to spinal cord injuries would result in participants being treated at one of these hospitals. There are reasonably well established procedures in place for identifying participants eligible to the LTCS scheme if they enter these hospitals. Additionally, it may not be immediately clear whether a traumatic brain injury was severe enough to result in eligibility to the scheme as a result of a vehicle accident, especially for either less severely injured or older people.

Each scheme covering severely injured participants may have different distributions of injury types. For example, a scheme covering severely injured workers may have a higher proportion of "other" injuries, for example severe burns or multiple amputations. In addition, subject to national minimum benchmarks, schemes may have different eligibility criteria and ways of assessing entry into the scheme which may skew distributions in other directions.

We now provide some high level details around the classification of injury severity for spinal cord injuries and traumatic brain injuries.

3.2.1. Spinal Cord Injury Severity

Spinal cord injury severity can be characterised by the neurological level of injury and the completeness of the injury.

The neurological level of injury measures the upper most vertebrae where the spinal cord injury has occurred, with the higher the injured vertebrae the higher the dysfunction that can result. For example, high cervical nerve damage is the most severe injury and can result in quadriplegia including paralysis of hands, arms, legs and trunk. In addition there may be problems in the ability to breathe properly, control

bowel or bladder functions and impaired speech. Participants with this type of injury may require 24-hour-a-day personal care and assistance with basic activities of daily living such as eating, dressing, bathing and getting into or out of bed. The further down the spine the injury, the more function and movement the participant is likely to have.

The completeness of the spinal cord injury is a term used to describe the extent and severity of the participant's spinal cord injury. The more "complete" the spinal injury then the higher the level of dysfunction that can occur. The American Spinal Injury Association (ASIA) impairment score is a form of injury categorisation. The patient's grade of completeness is determined by the amount of sensation that the participant can feel at multiple points of the body, as well as a test of motor function. An injury is given an ASIA impairment scale rating from A to E, where A is the most complete injury and E has all neurological function. This scale is described more fully in Table 1 below.

Table 1: ASIA Impairment Score Categorisation

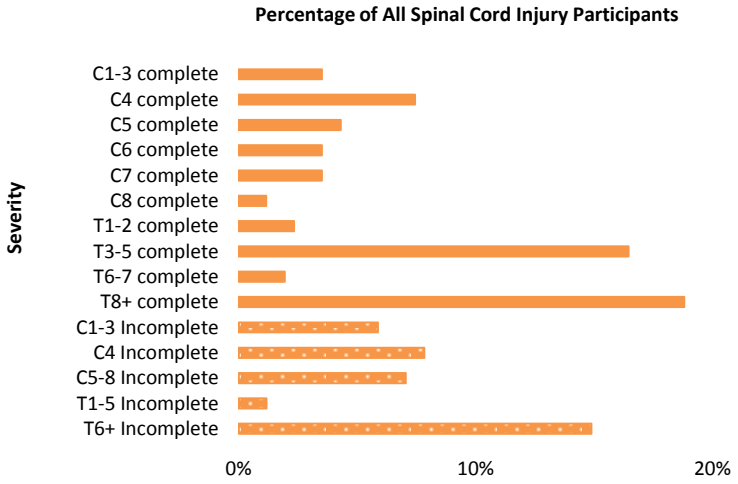
ASIA Score	Description
Grade A	Complete lack of motor and sensory function below the level of injury (including the anal area).
Grade B	Some sensation below the level of the injury (including anal sensation).
Grade C	Some muscle movement is spared below the level of injury, but 50 percent of the muscles below the level of injury cannot move against gravity.
Grade D	Most (more than 50 percent) of the muscles that are spared below the level of injury are strong enough to move against gravity.
Grade E	All neurologic function has returned.

The combination of the neurological level and completeness of the injury is a good predictor of injury severity and the level of future care and support likely to be required by participants.

In our valuation work we describe a spinal cord injury as "complete" (or "C") if the participant has an ASIA score of A,B or C. We describe a spinal cord injury as "incomplete" (or "I") in circumstances where a participant has an ASIA score of D or E. This categorisation has been based on an analysis of emerging participant costs within the LTCS scheme.

Figure 3 shows the distribution of spinal cord injury participants by injury severity for the LTCS scheme as at 30 June 2015. Overall, complete lesions comprise 63% of participants, and incomplete lesions comprise 37%, with paraplegics more likely to sustain complete lesions than quadriplegics.

Figure 3 Distribution of Injury Severity for Spinal Cord Injuries for LTCS Scheme



3.2.2. Traumatic Brain Injury Severity

A key measurement that is used to determine the severity of traumatic brain injuries within the LTCS scheme is the Care and Needs Scale (CANS). CANS is an assessment that determines the level of support that a participant requires and has 8 levels, ranging from 7 (the most severe, where the participant requires continuous attendant care support) to 0 (the least severe, where the participant can live totally independently in the community). This assessment acts as a proxy for the severity of the injury because we assume more severe brain injuries require more support, especially for attendant care.

There are other potential measures of brain injury severity. For example, the Functional Independence Measure (FIM) can also be used to measure the severity of a traumatic brain injury. The FIM 7-point scale assesses physical and cognitive disability over 18 dimensions, with 18 being the most severe and 126 being the least severe. This scale focuses on the burden of care.

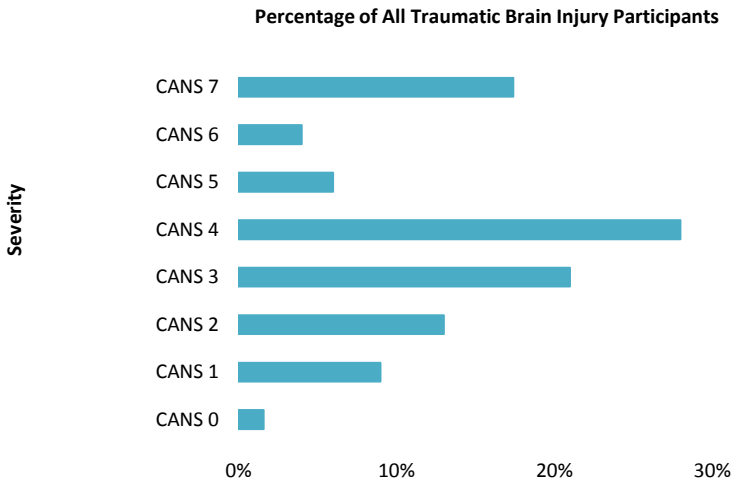
The use of CANS as a benchmark for resource allocation could be argued to be "circular" in the sense that by measuring support need there must necessarily be a high correlation with equitable package size. The same comment can be made of all measures of functional Independence (eg FIM) to a greater or lesser extent, since all of them change through the course of disability development. As discussed later in this paper, our use of CANS has provided quite a suitable methodology for tracking brain injury severity and projected improvement over time.

The severity of injury can also be broadly determined at a very early stage after injury by the length of loss of consciousness, often referred to as the period of Post Traumatic Amnesia (PTA), as well as memory loss. While this has been found to be one of the better predictors of long-term disability, it is far from perfect, and is subject to considerable variability - some people with long periods of PTA recover well, and vice versa. This unpredictability lies at the heart of the difficulty in assigning an early severity score to people with brain injury.

People suffering a brain injury often show quite significant recovery in their injuries over time. This should be considered as part of the valuation process and is discussed in more detail in Section 5. For an injury severity scale to be useful within the valuation framework, there needs to be consistency in the injury assessments over time and also the points at which assessments most commonly occur. For example an assessment with the LTCS scheme is generally made as close to the date of injury as practically possible and at lifetime status assessment points. Being able to source accurate and consistent injury severity data for traumatic brain injury participants can be challenging.

Figure 4 shows the estimated long-term distribution of brain injury participants by injury severity for a cohort of entrants to the LTCS scheme, after removing those with only interim eligibility. We note that this distribution will be far more heavily skewed to the more severe end in periods immediately post injury (see also Section 5).

Figure 4 Ultimate Distribution of Injury Severity for Traumatic Brain Injuries for LTCS Scheme



3.2.3. Other Types of Injury Severity

Given the relatively low numbers of participants in the LTCS scheme with other types of injuries and the more individual characteristics of these other injuries; LTCS tends to take a fairly pragmatic approach in assigning injury severity categories. Participants are assigned either a CANS score or neurological impairment score based on the severity and nature of their injury in order to use our valuation approach. This is a reasonably subjective approach and has some limitations. For example, the equipment support needs for participants with multiple amputations can be quite significant and these costs may not be fully captured using this approach. Hence, an additional overlay for these types of injuries may need to be considered within the proposed valuation framework.

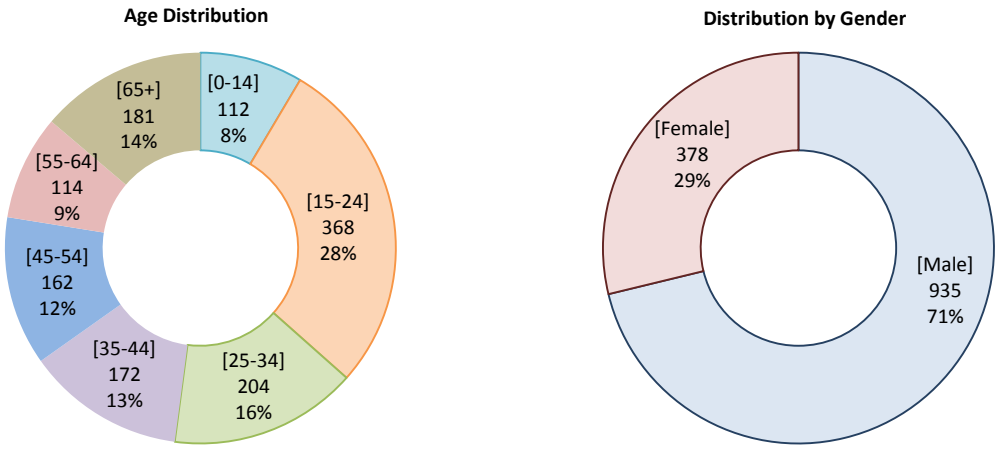
3.3. Participant Age and Gender Characteristics

The long term average number of lifetime participants emerging in the LTCS scheme has been relatively close to those expected since inception of the scheme, although year to year the number of participants and the severity of injuries can vary quite widely. In the same way, the participant age and gender characteristics can also vary

from year to year. One of the more recent emerging trends has been higher numbers of older participants being reported to the scheme.

Figure 5 shows the split by age (left) and gender (right) in the LTCS scheme as at 30 June 2015.

Figure 5 Age and Gender Distribution of Participants in LTCS Scheme as at 30 June 2015



While not shown in Figure 5, there are different age and gender distributions by injury type. Compared to the scheme gender distributions above, there are a higher proportion of male spinal cord injury participants (76%) and a slightly higher proportion of female traumatic brain injury participants (30%). There are also lower proportions of child spinal cord injuries (4%) and a higher proportion of spinal cord injuries for ages [25-34].

3.4. Participant "Status"

For the purpose of the valuation of future care and support costs for severely injured participants, we allow for the "status" of participants both now and projected into the future.

3.4.1. Interim, Lifetime and Not Lifetime Status

A participant is initially accepted into a scheme if they satisfy specific eligibility criteria. For example, a spinal cord injury participant is eligible for entry into the LTCS scheme if the motor vehicle accident resulted in permanent neurological deficit. Initial eligibility for traumatic brain injury participants generally requires the duration of Post Traumatic Amnesia (PTA) to be greater than 1 week, with additional requirements if the PTA assessment is not available. There are also specific thresholds for other injuries such as multiple amputations, burns and permanent blindness.

Once a participant is initially accepted into the scheme they would have "interim" eligibility. This reflects the fact that the above eligibility criteria in respect of severity, while acknowledged as the "best" predictors of the need for lifetime care and support, are not necessarily determinative. They are therefore chosen to allow early determination, and hence early treatment and support, which is argued to be a strong force in achieving positive participant outcomes.

In this context, participants who meet the above criteria would be accepted as interim participants for up to two years, the length of time depending on their support needs, with longer interim times available for children. This is because of the possibility of recovery and ongoing improvement in the injured participant's condition, such that the injured person may not be assessed to need lifetime care and support after the two year period. The period of interim participation in the scheme commences from the date of the Authority's determination.

The decision about whether an interim participant is a lifetime participant in the scheme is made before the end of the interim participation period, generally two years. At this time a participant would be either accepted as a "lifetime" participant or as a "not lifetime" participant, in the latter case being ineligible for further payments from the scheme.

3.4.2. Lapsed and Deceased Status

The 'lapsed' status is allocated to participants who have, most commonly, not engaged in an assessment for lifetime scheme eligibility. In such a case the LTCS Authority is not able to make a determination on final eligibility and may close the case if necessary. Participants classified with a lapsed status do not usually incur any costs to the scheme.

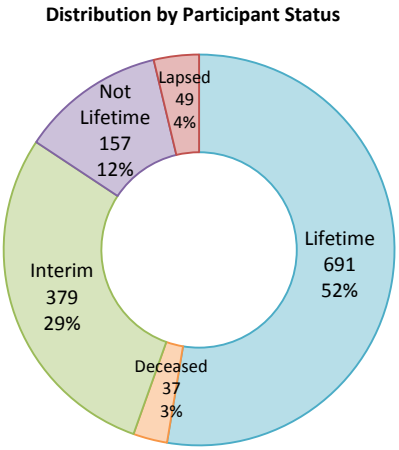
These lapsed participants could re-present themselves to the scheme where they could be assessed for lifetime eligibility. As a result, if lifetime status were successfully granted then there is a possibility that some of these participants may return to the scheme and incur costs. However, most lapsed participants are of a relatively low injury severity compared to other participants within the scheme and the potential increase in incurred costs due to these participants returning is not material. Furthermore, these participants would most likely not be eligible for lifetime status.

A participant will have a deceased status if they have died.

3.4.3. LTCS Participants Split by Status.

Figure 6 shows the split of LTCS scheme participants by status as at 30 June 2015.

Figure 6 Participants Split by Status as at 30 June 2015



The chart splits the currently reported LTCS scheme participants between the different valuation status groupings as previously described. A significant number of participants have been deemed "not lifetime" from their two year interim assessment. In addition, a non-trivial proportion of participants have been deemed to be lapsed or have deceased. There remain a large number of interim participants who have not had their two year eligibility assessment for lifetime status.

Nearly 20% of reported participants into the LTCS scheme are ineligible for payments as at 30 June 2015. Our valuation approach adopts no liability for participants identified as "not lifetime" and "deceased". A nominal amount is included in respect of lapsed participants on the basis that some of these participants could (and have) re-presented themselves to the scheme.

4. Modelling Participant Care and Support Payments

The LTCS scheme is guided by legislation that allows it to pay for a range of treatment, rehabilitation and care services, as long as they are "reasonable and necessary" and "injury-related". Guidance from the LTCS[7] scheme is available on what is deemed "reasonable and necessary". This covers criteria such as how the service will benefit the participant, the appropriateness of the service, the appropriateness of the service provider and the cost effectiveness of the service.

There are some costs not covered by the scheme including, but not limited to, loss of wages, amounts for pain and suffering, accommodation and medical costs not related to the injury sustained from the from motor vehicle accident. Some of these costs may still be available to the participant from other injury support or welfare schemes.

In this section we describe a framework for modelling the care and support costs provided by LTCS. Injury severity underpins this framework as it remains a strong predictor of these future costs. The model is supported by emerging experience within the LTCS scheme. We exclude y-axis keys from the payment charts, as payment levels will depend on a scheme's definition of "reasonable and necessary" care and support. The purpose of the charts is to contrast and compare the levels of expected payments by the different payment categories, across injury severity and from time since injury.

While injury severity can be a good indicator of future paid care and supports, the actual level is often influenced by a number of other factors such as:

- Family functionality, and other unpaid care and needs supports
- Other overlaid health issues such as psychological injuries and the impact of secondary injuries
- The level of community engagement, support and employment opportunities
- The geographic location of the participant in relation to the access of services
- The personal need of individuals to access other supports
- Resilience and personality of the individual

These factors can be important in performing shorter term cash flow modelling where it may be prudent to incorporate these elements into the modelling so that it best reflects a participant's current individual circumstance. In addition, where there are a low number of scheme participants it may make sense to better mimic these individual characteristics more closely.

The discretion allowed with the "reasonable and necessary" definition can help to ensure that the costs incurred by the scheme are kept in control. It is therefore important to monitor the trends in the costs being incurred by the scheme at a reasonably granular level.

[7] http://www.lifetimecare.nsw.gov.au/__data/assets/pdf_file/0003/9309/P03_What_is__Reasonable_and_Necessary__Treatment_Rehabilitation_and_Care___04.12.pdf

4.1. Proposed Valuation Payment Groupings

The payment groupings selected for the valuation should ideally reflect the changing patterns of care since an injury has been sustained. The participant journey and resulting patterns of care are well explained in Walsh, Dayton et al (2011). This explains the typical participant journey from accident to injury retrieval and initial intensive care. Subsequent to this is the specialist acute care treatment and rehabilitation care that is received in hospital prior to a participant's return to the community. On release from hospital is the medium term community reintegration and support which includes ongoing rehabilitation and provision of equipment and home and vehicle modifications. Finally, the participants will require longer term attendant care, case management or other support to meet the challenges for activities of daily living in conjunction with participant options for potential return to work, community involvement and family support.

Given this participant journey, we have found the following categorisations of care and support will each have different characteristics over time since injury due to different pathways and patterns of care.

Table 2: Major Payment Type Categories

Payment Type	Description
Attendant care	The largest payment type accounting for 70% of expected total cost, but with lower requirements earlier on. The intensity and type of attendant care needs will vary significantly by the type of injury and injury severity.
Hospital	Patterns of care post injury are important to understand and less important at later periods.
Rehabilitation	Ongoing rehabilitation is often important for participants and travel costs can also contribute a large part of this cost.
Equipment	Aids and appliances may be required initially and the ongoing maintenance and replacement will be required at intermittent periods.
Home modifications	These requirements will be specific to the participant circumstances and will often be large amounts required up-front and then sporadically thereafter.
Medical	High upfront costs related to the injury and then lower ongoing costs.
Case management	Ongoing case management required to assist participants accessing appropriate services.

There are many different payment splits possible and the level of subdivision will depend on the ability of the scheme to accurately record detailed information. The collection of data for the LTCS Scheme is rich and enables a very granular level of data analytics to model future care and support costs. The richness of the data is not found in many other comparable schemes with severely injured participants, where often lump sum settlements are provided and where functional assessments of claimants are either not performed or not consistently available on data systems.

4.2. Attendant Care

Attendant care payments made by a scheme may include a combination of regular attendant care & support, inactive sleepover support, registered nursing care, respite care, community support or care programs and potentially other forms of domestic assistance (such as gardening & home maintenance).

Attendant care is modelled using a long term number of hours of care based on injury type and injury severity. The utilisation of attendant care in relation to this long term number of hours is overlaid for shorter durations since injury. An hourly rate is applied to these care hours, with this hourly rate likely to vary according to jurisdiction. Finally we consider age-specific factors which may influence the intensity of attendant care.

4.2.1. Age life cycle adjustor

Participant costs are likely to depend on a participant's particular circumstances. Costs will generally be higher during periods of personal crisis or major life change and lower during periods of relative stability. Table 3 identifies periods in life when the care required may be relatively more or less intensive than others, however these times will vary according to individual circumstances.

Table 3: Periods in Participants Lives Requiring More (and Less) Intensive Attendant Care Support

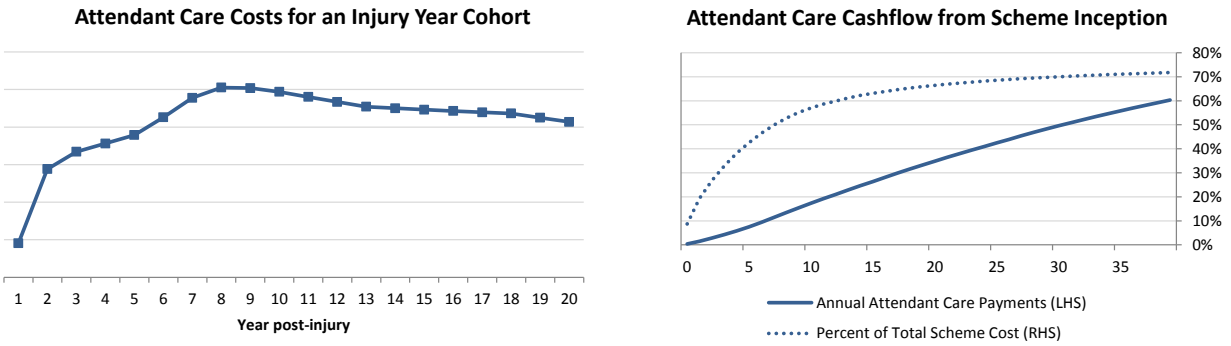
More intensive attendant care	Less intensive attendant care
➢ In the period immediately following discharge from hospital, when the reality of the long term future is being absorbed, and family stability may become threatened ➢ In periods following hospitalisation or surgery ➢ In periods after a young participant leaves home ➢ During early adulthood, where life may be more active or more changes may be occurring in lifestyle ➢ In periods of major life crises, such as breakdown of family or relationships, home movements, job loss (or gain), illness or injury complication ➢ During periods of carer illness or change ➢ Through the ageing process	➢ In early childhood, when parents prefer to bear much of the burden of care, whether or not help is available ➢ In the period of transition immediately following injury, before the enormity of the problem emerges ➢ Following corrective surgery (e.g. limb reconstruction) after an initial intense period ➢ Where home modification or aids result in greater independence (e.g. hoists, environ-control, bathroom modifications) ➢ During periods of stability of relationships or employment ➢ During hospitalisation ➢ Where adequate respite and/or emergency care is available (e.g. at school / work)

To incorporate these cycles, we establish a parameter into our projection model that allows loadings or discounts to be applied at varying ages. Loadings are higher at older ages. We have seen other actuarial models use a superimposed inflation allowance in the place of these adjustment factors as, all other things being equal, attendant care requirements will generally increase with age. However, we believe that age specific loadings allow greater control over the emerging costs. Using superimposed inflation allowances can be a blunter instrument to allow for these increasing age costs.

4.2.2. Attendant care payment profile

Figure 7 shows estimates of emerging attendant care costs from the date of injury (left) and for a new scheme (right).

Figure 7 Attendant Care Payment Patterns: for an Injury Year Cohort and for a New Scheme



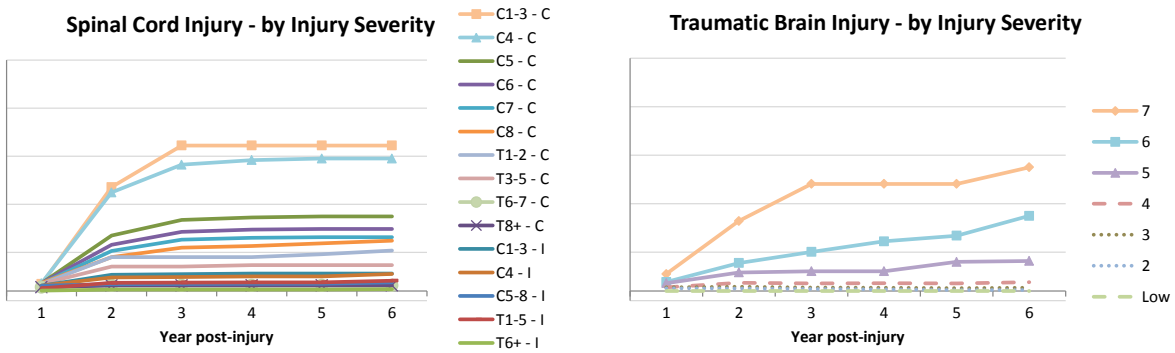
Participants tend to spend a significant amount of time in hospital in their first few years after injury, and during this period there is often a ready supply of family and community support (which does not necessarily continue long-term). Hence attendant care (as a proportion of total cost) is lower in the first few years post-injury. After this, attendant care costs increase rapidly. The gradual decline in the injury year cohort after year 10 is due to the impact of mortality over time.

In the initial years of scheme operation, attendant care may only comprise about 10% of total scheme costs. Over time, attendant care payments dominate expected total future scheme costs, with over 70% of costs expected to relate to attendant care services in the longer term. The dollar value associated with attendant care payments increases relatively linearly over time for the scheme as a whole as more participants require attendant care services.

4.2.3. Attendant Care Payments by Injury Severity

Figure 8 shows how our assumptions around hourly care per day vary by delay since injury and injury severity.

Figure 8 Patterns of Participant Attendant Care: Hours per Day



Note:

- The chart maximum value for the number of hours of care is the same in both charts.
- Injury severity for SCI is measured using both the neurological level of lesion and level of completeness (i.e. C: Complete and I: Incomplete).
- Injury severity for TBI is measured using the CANS.

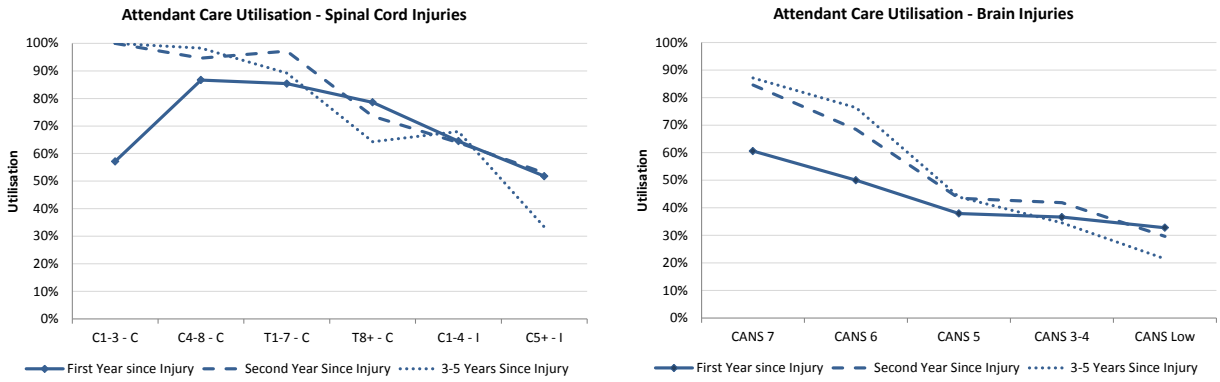
Attendant care costs are reasonably low in the first year after injury, as participants spend a significant amount of time in hospital, and then attendant care usage gradually increases over time to longer term levels. The gradual increase to the longer term levels are reflective of the utilisation of attendant care.

Attendant care costs are generally high for both spinal cord injuries and traumatic brain injuries and are higher for higher severity injuries. Scheme costs are dominated by higher severity participants, for example complete quadriplegia spinal cord injuries and CANS 5-7 traumatic brain injury participants

4.2.4. Attendant care utilisation

Figure 9 shows the proportion of participants who use the attendant care payment type for spinal cord injuries (left) and brain injuries (right), split by both injury severity and by duration since injury.

Figure 9 Attendant Care Utilisation: by Injury Severity and Duration since Injury



Higher severity injuries generally utilise attendant care more often than lower severity injuries. A higher proportion of spinal cord injury participants utilise attendant care than for brain injuries. First year utilisation rates are generally lower than for second and subsequent years since injury for more severe injuries, primarily because participants may remain in hospital receiving acute care and rehabilitation, rather than receiving direct attendant care.

4.3. Hospital

Hospital payments made by a scheme generally represents a combination of a daily hospital bed rate and hospital length of stay. The emergence of hospital claims cost within a scheme can be lumpy, reflecting sporadic hospital billing practices. As a result, the timing of payments may not directly reflect the period when a participant was in hospital. The aim of our modelling has been to capture the total early hospital cost per participant (over a period of two to three years) rather than matching the precise timing of cash flows.

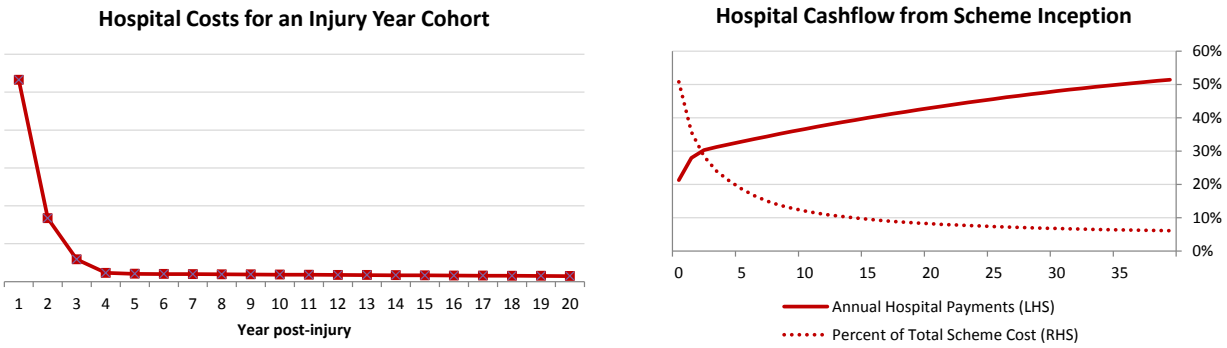
Consideration also needs to be given to a jurisdiction's bulk billing practices whereby bulk-billed acute treatments in public hospitals may not be included in participant scheme costs. Additionally, bulk billed costs may not be directly attributable to specific participants but should nonetheless be included in any costs associated with the scheme. It is important to understand the structure of a jurisdictions' bulk billing practices to ensure that all hospital costs are correctly treated in the valuation.

4.3.1. Hospital Payment Profile

It can be difficult to obtain data that reflects the hospital stay of participants. This type of information, including diagnoses and procedural codes, and dates of transfer from acute hospital bed to rehabilitation hospital bed and date of discharge from hospital, would be useful to assist in the estimation of hospital scheme costs.

The following charts show estimates of emerging hospital costs from the date of injury (left) and for a new scheme (right).

Figure 10 Hospital Payment Patterns: for an Injury Year Cohort and for a New Scheme



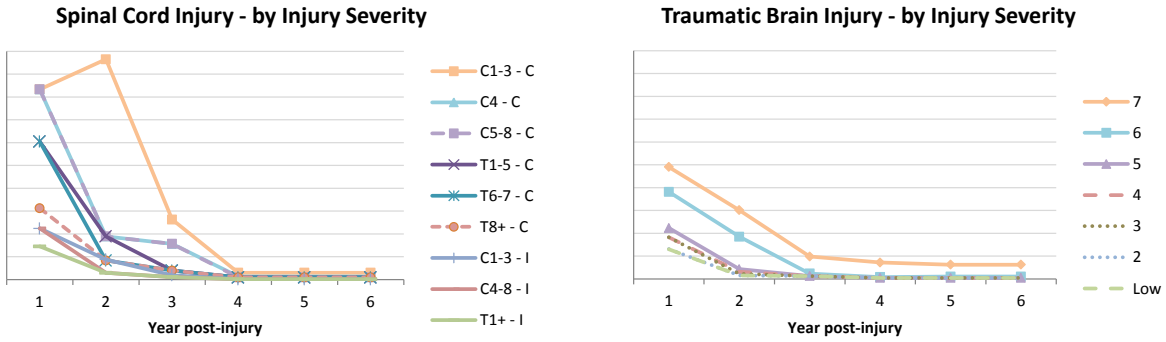
Participants tend to spend a significant amount of their time in hospital in their early periods after injury, with hospital costs tapering off rapidly after the initial couple of years since injury.

A scheme's initial costs will primarily be comprised of hospital payments, as participants support costs will generally begin with hospitalisation. Our model estimates that about 50% of total scheme costs in year 1 may relate to hospital payments. Over time, hospital payments become a lower proportion of total scheme costs, with the dollar value associated with hospital payments increasing only slightly above inflation for the scheme as a whole.

4.3.2. Hospital Days by Injury Severity

Figure 11 gives some detail behind our hospital payment assumptions by delay since injury and illustrates how hospital costs vary by injury severity. The chart maximum value for the number of hospital days is the same in both charts.

Figure 11 Participant Hospital Patterns: Hospital Days

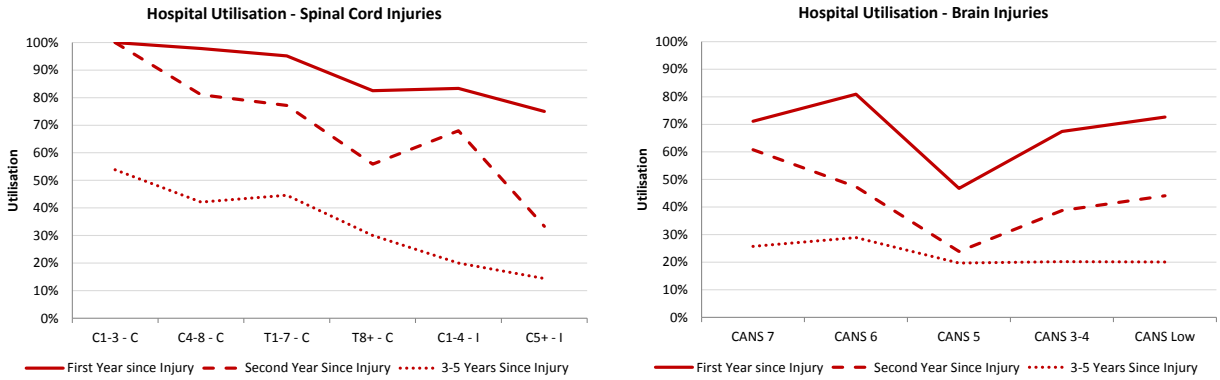


Hospital costs are significant in the first couple of years after the injury is sustained, and the participants may spend a significant amount of time in hospital, especially for those with more severe injuries. Hospital costs are generally higher for spinal cord injuries compared to traumatic brain injuries and also generally higher for higher severity injuries.

4.3.3. Hospital utilisation

Figure 12 shows the proportion of participants who use the hospital payment type for spinal cord injuries (left) and brain injuries (right), split by both injury severity and by duration since injury.

Figure 12 Hospital Utilisation: by Injury Severity and Duration since Injury



Higher severity spinal cord injuries utilise hospital payments more often than lower severity injuries. A higher proportion of spinal cord injury participants utilise hospital payments than for brain injuries. First year utilisation rates are higher than for second and subsequent years since the injury is sustained. The kick up in brain injury utilisation at lower levels may be due to different transfer from rehabilitation patterns.

4.4. Medical

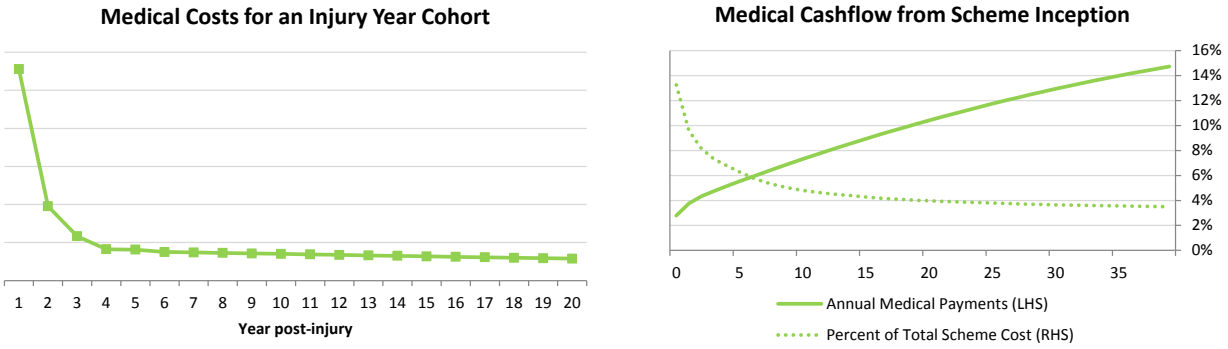
Medical payments made by a scheme represent a combination of different medical operations, interventions and expenses. For LTCS, this may include neurosurgery, pharmaceutical, orthopaedic, intensivist, general practitioner, dental surgery, anaesthetist, registered nursing assessment, medical rehabilitation, pathology, radiology, psychiatrist, burns, plastics, ophthalmology and urologist payments.

4.4.1. Medical Payment Profile

The emergence of medical claims cost within a scheme can reflect sporadic medical billing practices and means that the timing of payments may not necessarily reflect the period when a participant received the medical care.

Figure 13 shows estimates of emerging medical costs from the date of injury (left) and for a new scheme (right).

Figure 13 Medical Payment Patterns: for an Injury Year Cohort and for a New Scheme



Participants tend to have higher medical costs in the first couple of years after injury, tapering off rapidly thereafter. The medical costs for the later years after injury may also include costs not directly related to the brain or spinal cord injury, but also as a result of other injuries sustained from the accident.

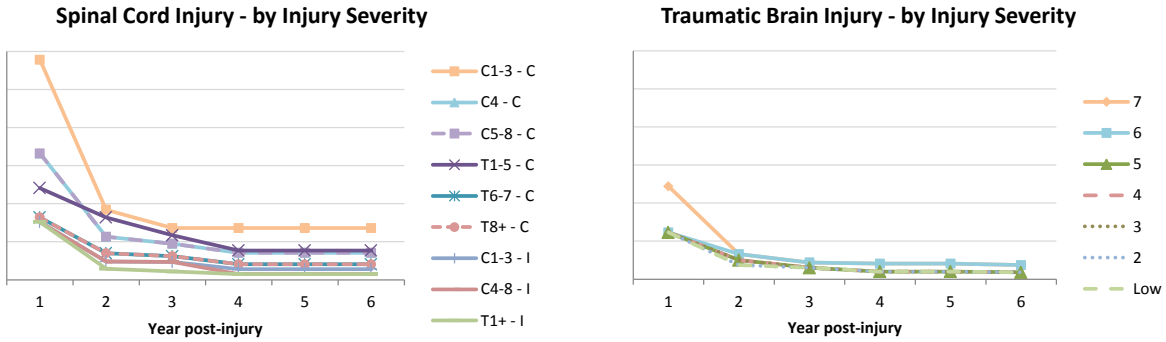
A scheme's initial costs will contain a significant proportion of medical payments, as participants initial support costs will generally require a higher level of medical intervention. Our model estimates that about 13% of total scheme costs in year 1 may relate to medical payments.

Over time, medical payments become a much lower proportion of the total scheme costs, although the dollar value associated with medical payments increases at above inflation for the scheme as a whole.

4.4.2. Medical Payments by Injury Severity

Figure 14 gives some detail behind our medical payment assumptions by delay since injury and also illustrates how medical costs vary by injury severity. The chart maximum value for the annual medical spend is the same in both charts.

Figure 14 Participant Medical Patterns: Payment

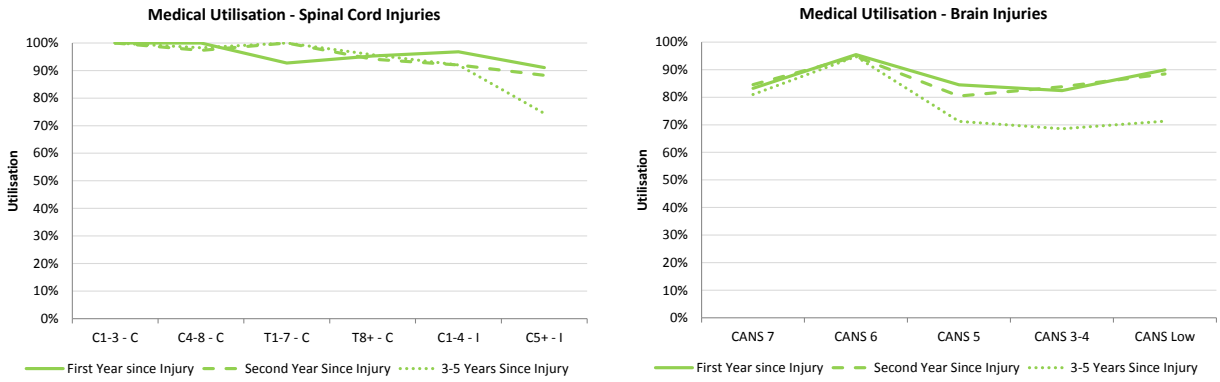


Medical costs are significant in the first year after the injury and are generally higher for spinal cord injuries compared to traumatic brain injuries. Medical costs are generally higher for the higher severity injuries.

4.4.3. Medical utilisation

Figure 15 shows the proportion of participants who use the medical payment type for spinal cord injuries (left) and brain injuries (right), split by both injury severity and by duration since injury.

Figure 15 Medical Utilisation: by Injury Severity and Duration since Injury



Utilisation of medical payments is close to 100% for all participants, regardless of injury type and the delay since injury. There is a slight reduction in utilisation of medical payments for years since injury.

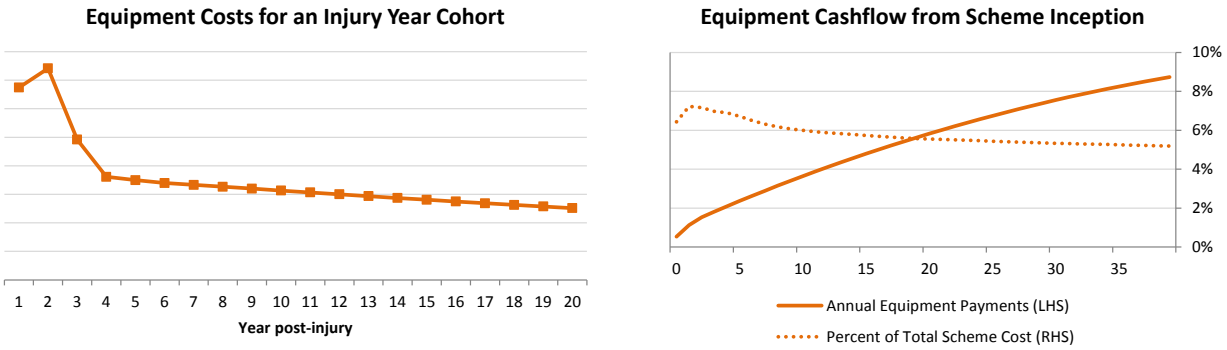
4.5. Aids and Equipment

Aids and equipment payments represent a combination of items that may include disposables, equipment (such as wheelchairs), pressure garments, prostheses, orthoses, vehicle modifications and equipment repair & maintenance.

4.5.1. Equipment Payment Profile

Figure 16 shows estimates of emerging equipment costs from the date of injury (left) and for a new scheme (right).

Figure 16 Equipment Payment Patterns: for an Injury Year Cohort and for a New Scheme



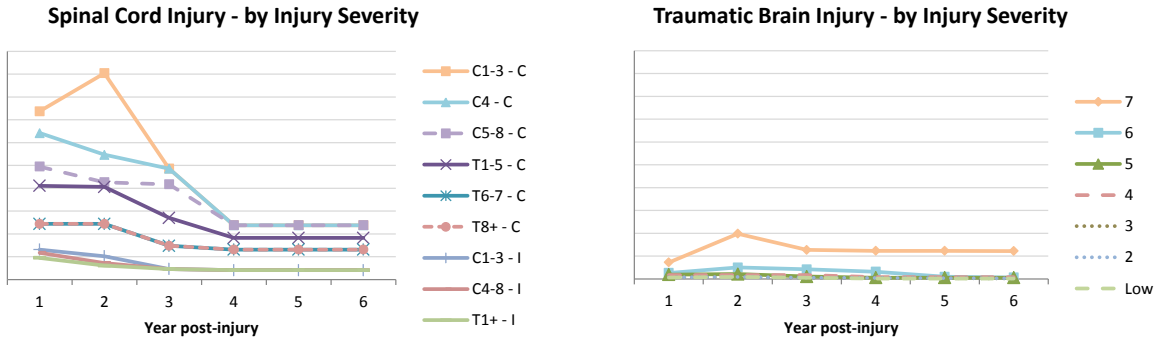
Participants tend to have higher aids and equipment costs in the first couple of years after injury. Equipment costs remain a reasonably significant cost after these first couple of years, primarily as a result of either maintenance or replacement of existing equipment.

A scheme's initial costs will contain a significant proportion of aids and equipment payments, as the majority of participants will require some form of aids and/or equipment. Our model estimates that about 6% of total scheme costs in year 1 may relate to equipment payments. Over time, equipment payments remain a similar, although slightly reducing, proportion of the total scheme costs. The dollar value associated with equipment payments increases fairly linearly over time for the scheme as a whole.

4.5.2. Equipment Payments by Injury Severity

Figure 17 gives some detail behind our aids and equipment payment assumptions by delay since injury and also illustrates how equipment costs vary by injury severity. The chart maximum value for the annual equipment spending is the same in both charts.

Figure 17 Participant Equipment Patterns: Payment

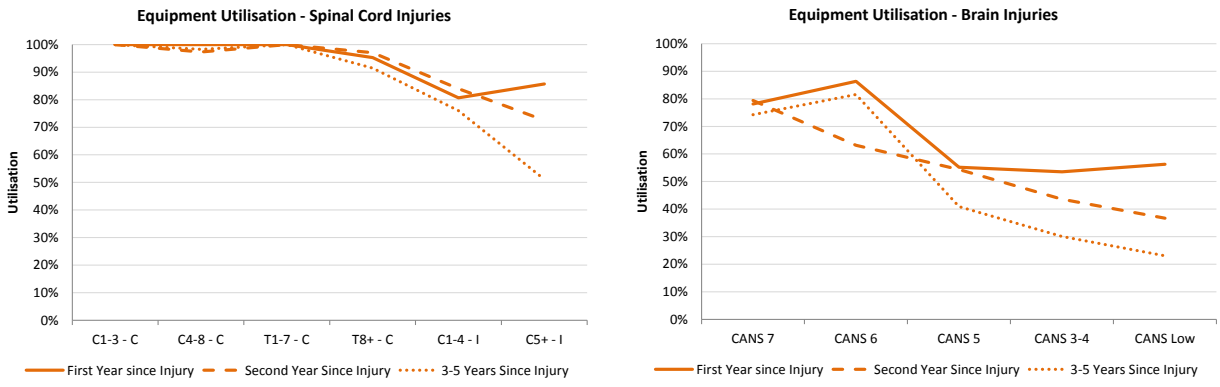


Equipment costs are significant in the first few years since injury for spinal cord injuries, with relatively low equipment requirements for traumatic brain injuries apart from the most severely injured. Equipment costs are higher for the higher severity injuries.

4.5.3. Equipment utilisation

Figure 18 shows the proportion of participants who use the equipment payment type for spinal cord injuries (left) and brain injuries (right), split by both injury severity and by duration since injury.

Figure 18 Equipment Utilisation: by Injury Severity and Duration since Injury



Most complete spinal cord injuries require aids and equipment, as expected. Higher severity brain injuries utilise equipment more often than lower severity injuries. First year utilisation rates are generally higher than for second and subsequent years since injury.

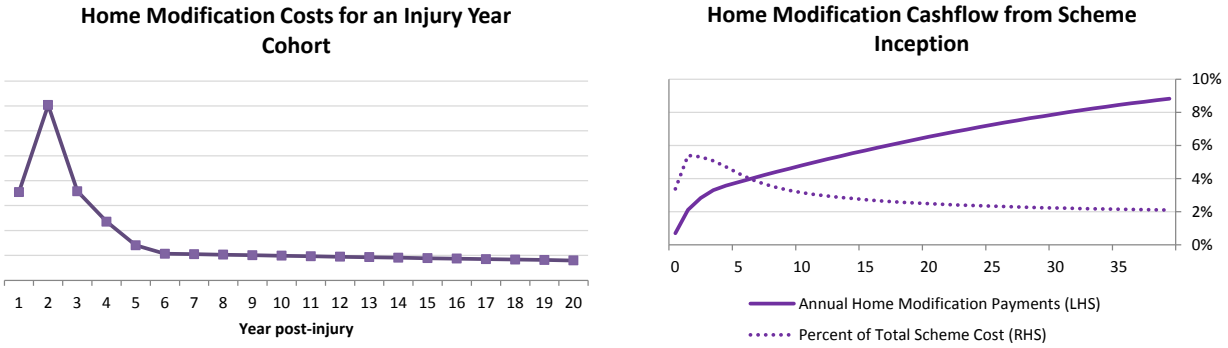
4.6. Home Modifications

Home modification payments may involve a small number of relatively large payments. Modifications may be required in respect to a participant's home, workplace, school or occupational therapist.

4.6.1. Home Modification Payment Profile

Figure 19 shows estimates of emerging equipment costs from the date of injury (left) and for a new scheme (right).

Figure 19 Home Modification Payment Patterns: for an Injury Year Cohort and for a New Scheme



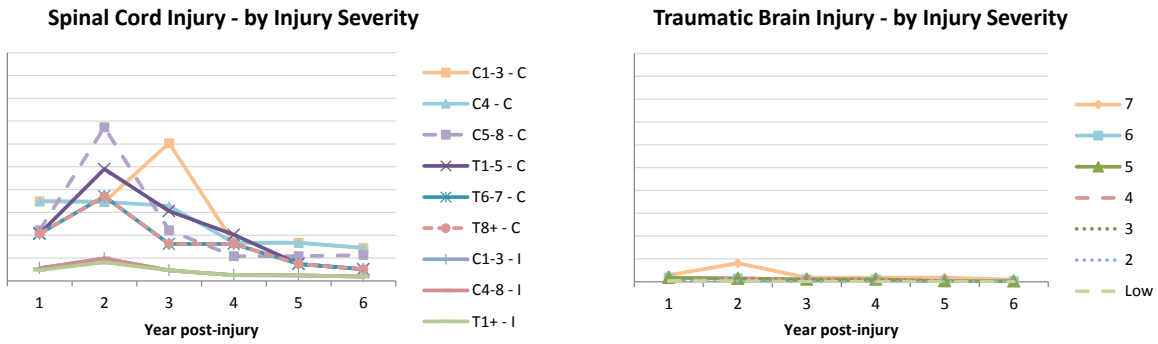
Participants tend to have higher home modification costs in the first four years after injury. Participants spend a lower, although still significant, amount after this period, often reflecting ongoing maintenance, or replacement, of existing home modifications.

A scheme's initial costs will contain a moderate proportion of home modification payments, as some participants may require some form of home modification. Our model estimates that about 4% of total scheme costs in year 1 may relate to home modification payments. Over time, home modification payments become a smaller proportion of the total scheme costs.

4.6.2. Home Modification Payments by Injury Severity

Figure 20 gives some detail behind our home modification payment assumptions by delay since injury and illustrates how home modification costs vary by injury severity. The chart maximum value for the annual home modifications spend is the same in both charts.

Figure 20 Participant Home Modification Patterns: Payment

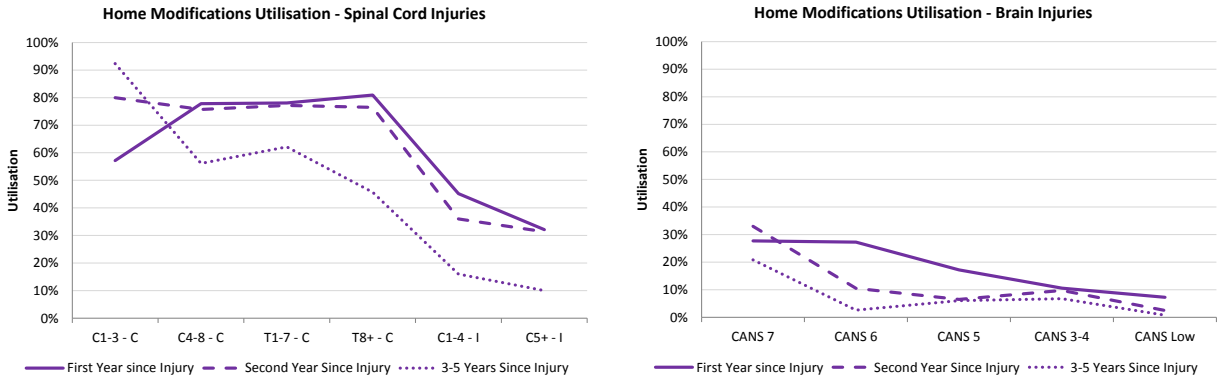


Home modification costs are significant in the first few years after injury for spinal cord injuries, with relatively low home modification requirements for traumatic brain injuries. Home modification costs are generally higher for the higher severity injuries and the timing of payments can be later for higher severity injuries to align with the timing of a participants release from hospital care.

4.6.3. Home Modification utilisation

Figure 21 shows the proportion of participants who use the home modification payment type for spinal cord injuries (left) and brain injuries (right), split by both injury severity and by duration since injury.

Figure 21 Home Modification Utilisation: by Injury Severity and Duration since Injury



A majority of the complete spinal cord injuries require some form of home modification payments, as expected. Utilisation of the home modification payment generally decreases after the first couple of years. However, for the most severely injured spinal cord injuries it may take a couple of years to best understand the types of home modifications required and hence utilisation can remain high.

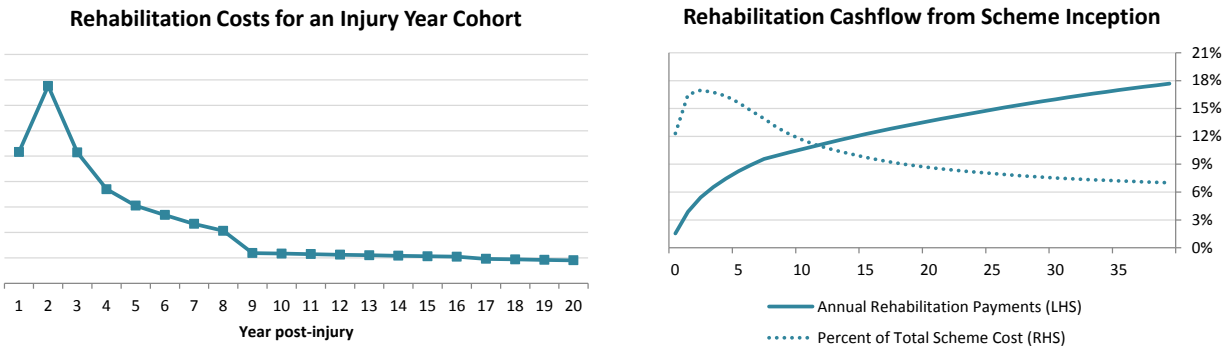
4.7. Rehabilitation

Rehabilitation payments may include initial needs assessments and then the actual provision of the appropriate rehabilitation services. The services provided may include occupational therapy, clinical psychology, social work, physiotherapy, speech pathology, neuropsychology, return or transition to work education, vocational services, dietician, podiatry, cognitive training, counselling, behavioural management, driving, education support, pain management programs and may also include participant or provider travel and accommodation to the rehabilitation sites.

4.7.1. Rehabilitation Payment Profile

Figure 22 shows estimates of emerging rehabilitation costs from the date of injury (left) and for a new scheme (right).

Figure 22 Rehabilitation Payment Patterns: for an Injury Year Cohort and for a New Scheme



Participants tend to have higher rehabilitation costs in the first few years after injury, with our model assuming that participants spend a lower, although still significant, amount after this period.

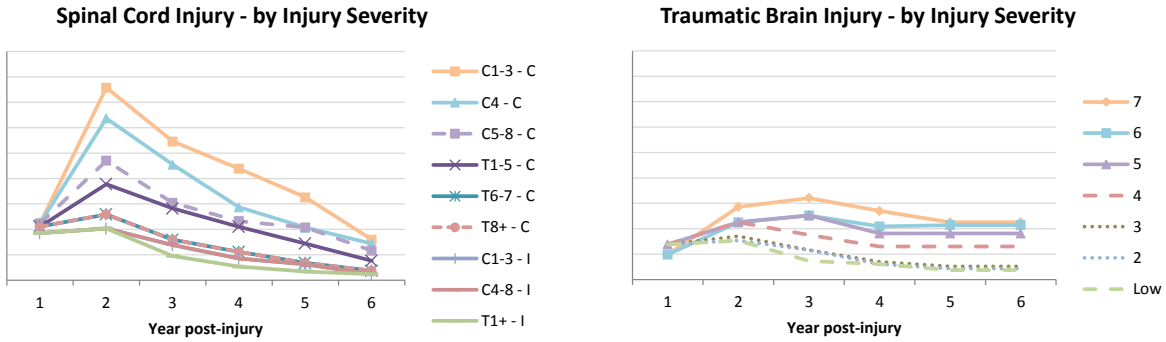
A scheme's initial costs will contain a moderate proportion of rehabilitation payments, including those initial assessments in relation to a participant's rehabilitation program. Our model estimates that about 12% to 17% of total scheme costs in the first few years may relate to rehabilitation payments.

Over time, rehabilitation payments become a smaller proportion of the total scheme costs, although still remaining a significant scheme cost, reducing to about 7% over a number of years.

4.7.2. Rehabilitation Payments by Injury Severity

Figure 23 gives some detail behind our rehabilitation payment assumptions by delay since injury and illustrates how rehabilitation costs vary by injury severity. The chart maximum value for the annual rehabilitation spending is the same in both charts.

Figure 23 Participant Rehabilitation Patterns: Payment

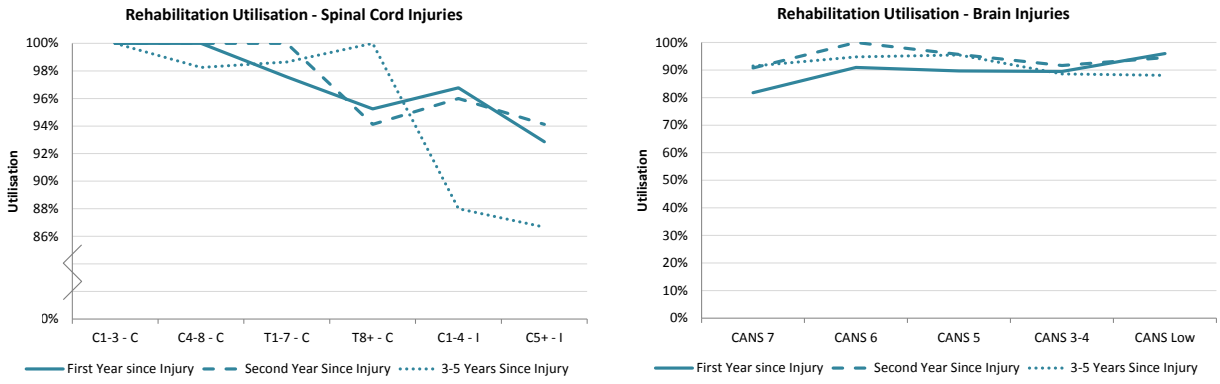


Rehabilitation costs in the first year are relatively independent of injury severity. Rehabilitation costs are low in the first year after the injury and increase in year 2 before reducing to longer term levels. Rehabilitation costs are generally higher for spinal cord injuries compared to traumatic brain injuries and higher for higher severity injuries.

4.7.3. Rehabilitation utilisation

Figure 24 shows the proportion of participants who use the rehabilitation payment type for spinal cord injuries (left) and brain injuries (right), split by both injury severity and by duration since injury.

Figure 24 Rehabilitation Utilisation: by Injury Severity and Duration since Injury



A majority of brain injury participants requires ongoing rehabilitation. Most spinal cord injury participants also require ongoing rehabilitation, with the utilisation reducing for less severely injured participants. Rehabilitation is an ongoing payment type and while the intensity of rehabilitation may reduce over time, the utilisation generally remains high.

4.8. Case Management

The LTCS scheme allocates a care co-ordinator to each participant who becomes the primary point of contact with the participant. The types of support that the case co-ordinator provides includes the assessments of the individual needs of participants, the development of case management plans, interpretation and translation services, respite and other support services.

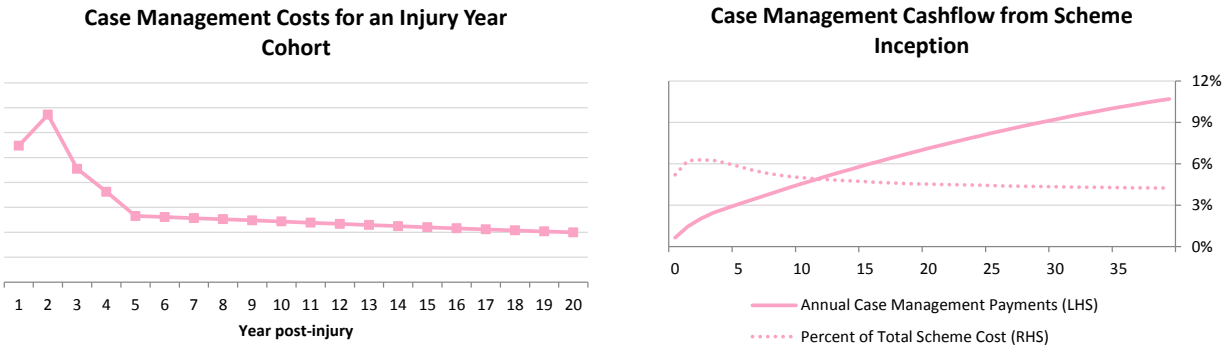
The provision of these services can be very complicated and hence the LTCS scheme also purchases case management services to manage the details of service provision. Case management services, and in particular early injury management, can impact on long term health outcomes to help reduce future care needs and also act as a key governance tool. In some cases, particularly for lower-level brain injury, the provision of case management services mitigates (or replaces) the need to provide attendant care services.

A scheme which invests in good case management is likely to be more cost effective than one which doesn't. The benefits of the case management are likely to outweigh the costs of potentially overinvesting.

4.8.1. Case management Payment Profile

Figure 25 shows estimates of emerging case management costs from the date of injury (left) and for a new scheme (right).

Figure 25 Case management Payment Patterns: for an Injury Year Cohort and for a New Scheme



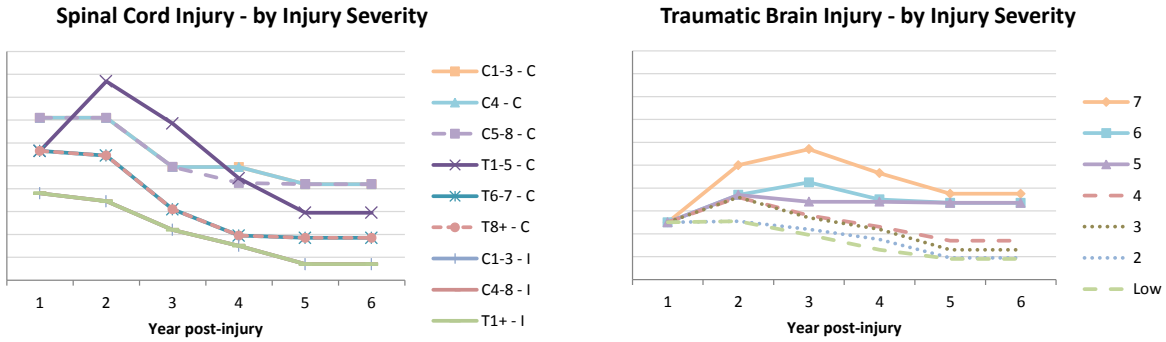
Participants tend to have higher case management costs in the first few years after injury, with our model assuming that case management spend is a lower, although still significant, amount after this period.

Case management costs are relatively low in comparison to total scheme costs, with our models estimating that about 4% to 6% of total scheme costs in the first few years may relate to case management payments. Over time, case management payments become a smaller proportion of the total scheme costs, reducing to about 4% over a number of years.

4.8.2. Case Management Payments by Injury Severity

Figure 26 gives some detail behind our case management assumptions by delay since injury and illustrates how case management costs vary by injury severity. The chart maximum value for the annual case management spending is the same in both charts.

Figure 26 Participant Case management Patterns: Payment

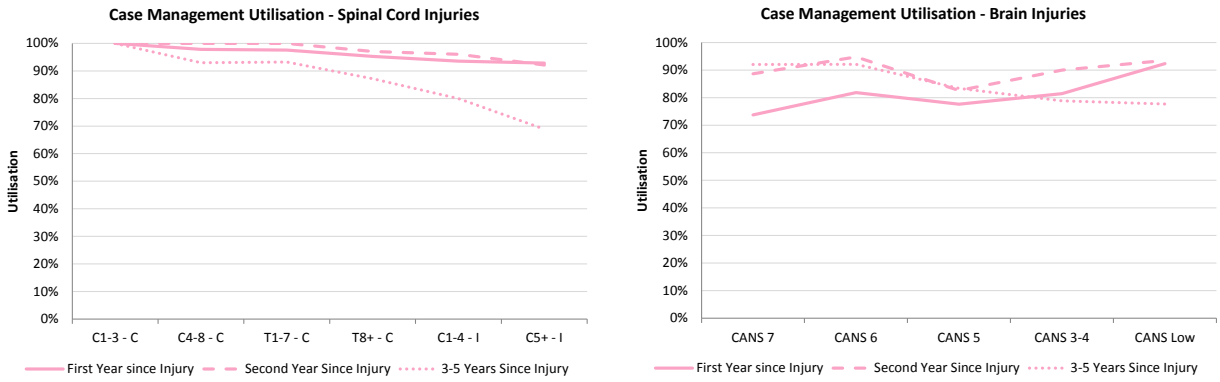


Case management costs are generally higher in the first few years since injury and then reduce to lower, although still significant, costs at later durations. Case management costs are generally higher for spinal cord injuries compared to traumatic brain injuries.

4.8.3. Case Management Utilisation

Figure 27 shows the proportion of participants who use the case management payment type for spinal cord injuries (left) and brain injuries (right), split by both injury severity and by duration since injury.

Figure 27 Case management Utilisation: by Injury Severity and Duration since Injury



The majority of participants receive some form of ongoing case management and this is appropriate as an important part of the governance structure of the scheme.

4.9. Combining the Payment Groupings

The previous sections described individual payment type characteristics. This section combines this information to give a scheme-wide perspective on payments.

4.9.1. Expected Average Participant Payments over Time since Injury

The payment profile of participants will vary considerably depending on the type of injury sustained, the severity of the injury and also by the age of the participant. Figure 28 shows the expected payments arising from an "average" participant over the first 10 years since injury, split by payment type. The amounts in this chart are weighted to incorporate the probability of exit.

Figure 28 Average Expected Participant Payments over Time – First 10 Years since Injury

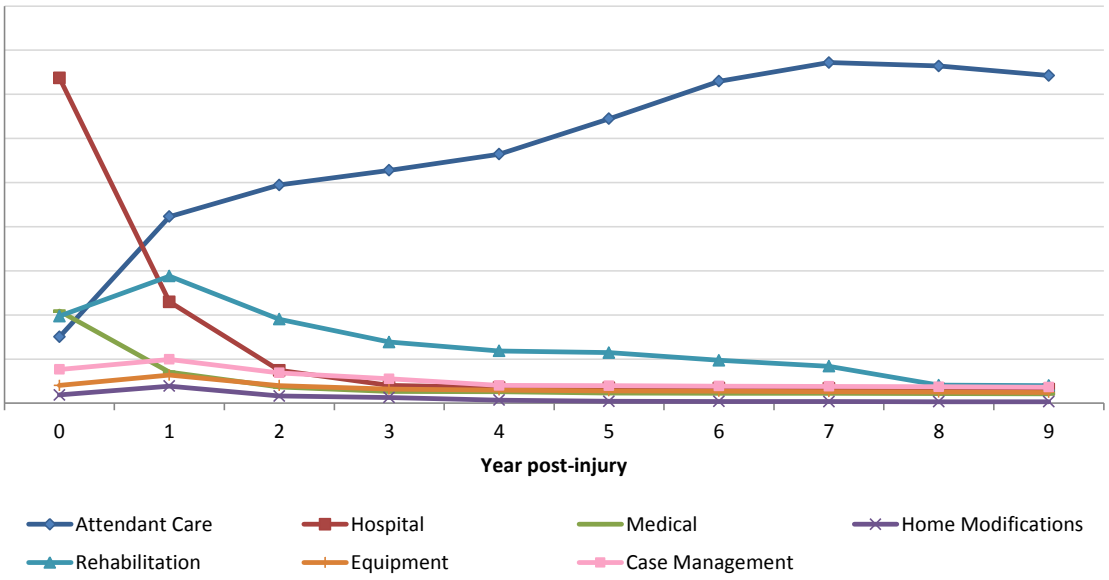
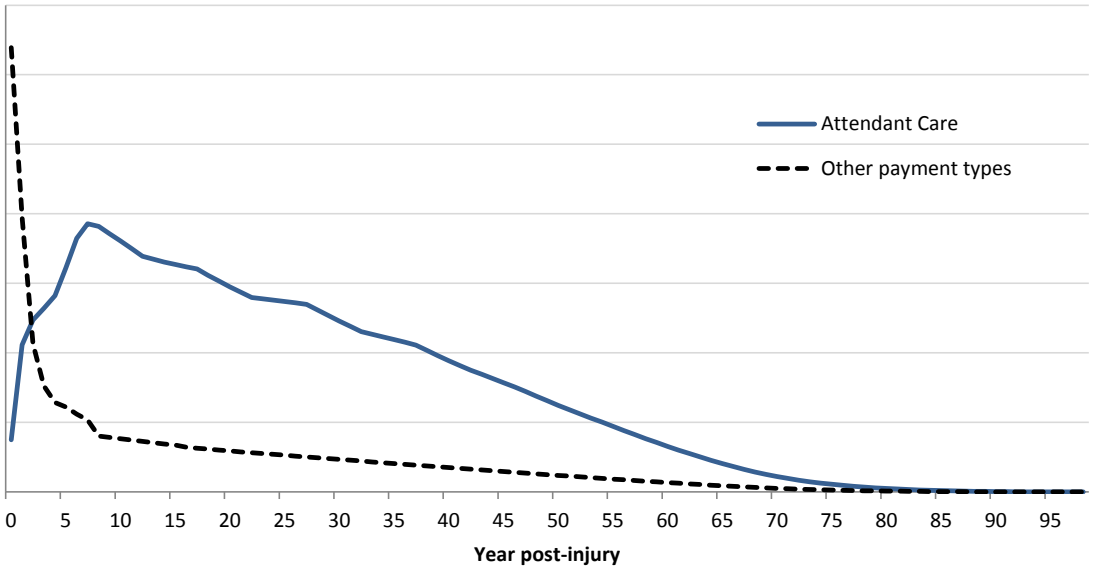


Figure 29 shows the same information over the lifetime of an average participant. Given the dominance of attendant care costs at later durations, we have combined all other payment types together. The amounts shown reduce over time because they have been weighted by the probability of remaining alive in the scheme at each future duration.

Figure 29 Average Expected Participant Payments over Time – All Years since Injury

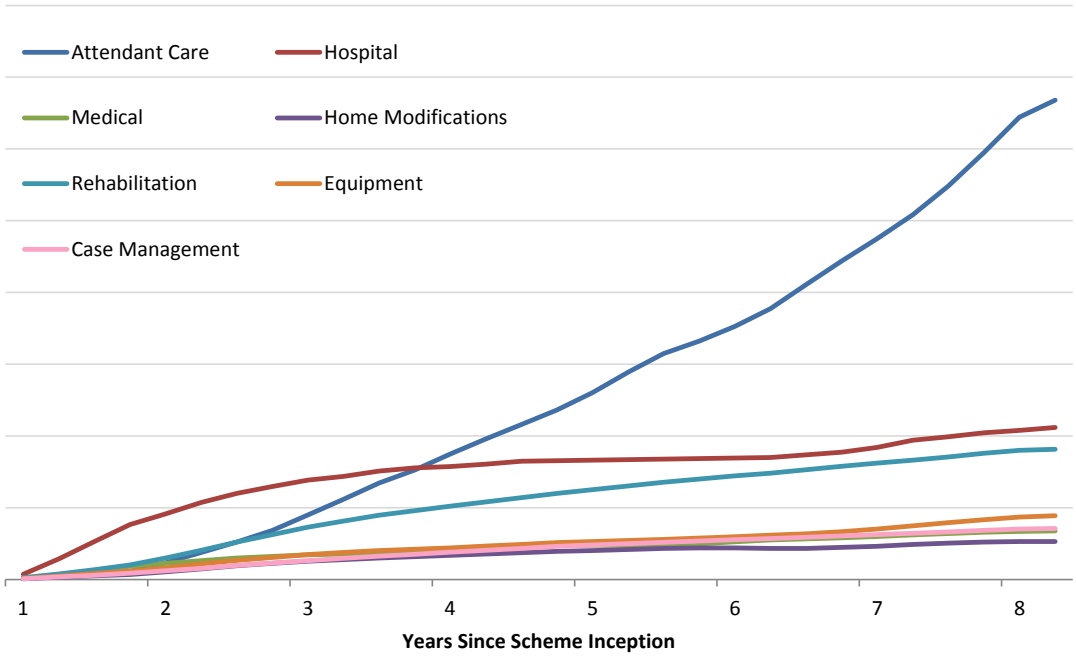


Initially the scheme would cover payments related to up-front hospital payments. Attendant care payments would begin slowly, as attendant care services may not be utilised during initial post-injury hospital stays, and then increase and stabilise after about 10 years. Rehabilitation payments would begin high in the earlier periods and then drift slightly downwards, although remaining a significant cost. Most other payment categories (medical, equipment, home modifications and case management) would begin higher in the first couple of years since injury and then taper down to a lower annual cost level. Some payment types such as home modifications and equipment may be lumpy, but generally higher in the first few years as initial purchases are made and then tapering off as maintenance or replacement occurs. For the later periods of the projection the reductions in payments relate to the impact of mortality.

4.9.2. Expected Average Scheme Payments over Time since Scheme Inception

If you were to combine Section 4.9.1 individual participant information together year after year, then the expected cash flows for a new NIIS scheme starting from inception may look something like Figure 30.

Figure 30 Expected Scheme payments over time since NIIS scheme inception



Initially the scheme would cover payments related to up-front hospital payments, but over time these hospital payments would stabilise. Attendant care payments would start slowly, as attendant care would not be utilised as a result of many participants staying in hospital. However, over the longer term the attendant care payments would be expected to increase significantly and dominate the total payment profile of the scheme. Rehabilitation would be another payment type that may start relatively slowly, but continue to build up over time. Home modifications would be required very early on after injury and then taper off.

In the longer term, payments in this type of scheme would not be expected to reach a stable state until many years into the future, perhaps 50 years from scheme inception.

5. Measurement of Brain Injury Severity Improvements over Time

People who have suffered a traumatic brain injury are likely to show material improvement after the initial impact and shock of the accident. The more improvement that is shown, the lower the long-term care and support needs of the participants and thus a lower scheme liability. As a result, it is important to consider improvements (and sometimes, deterioration) in the brain injury severity of participants over time and allow for these improvements in the modelling. Spinal cord injuries do not tend to show significant changes in severity.

A key measurement that is used to determine the severity of traumatic brain injuries is the Care and Needs Scale (CANS). CANS is an assessment that determines the level of support that a participant requires and has 8 levels, ranging from 7 (the most severe) to 0 (the least severe). This assessment acts as a proxy for the severity of the injury because we assume more severe brain injuries require more support, especially for attendant care.

In the LTCS scheme, typically assessments are made early in a participant's entry to the scheme, then at the lifetime assessment at the 2 year point when it is determined whether the participant will be in the scheme for the rest of their lives. If the participant has improved so much that they no longer need to be a part of the scheme, their interim eligibility ends. The assessments become less regular thereafter.

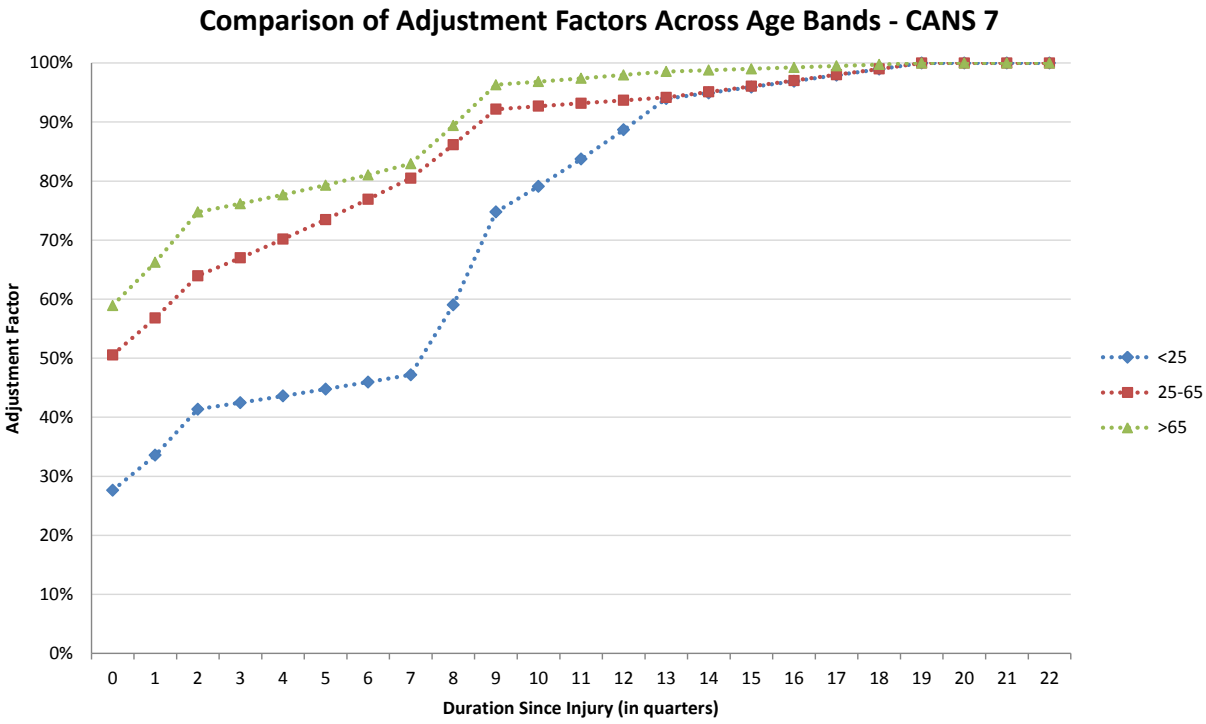
For LTCS, we have built a transition model that projects the movement between CANS levels of participants in the 5 years after injury and then quantifies the impact of these transitions on participant costs – which we refer to as an adjustment factor. Experience has shown that improvements generally occur soon after the injury and for more severe injuries (i.e. higher CANS scores at the initial assessment). The first 4 years after injury show the most significant changes, with severity of injury largely stabilising thereafter.

We use a transition model approach that analyses experience by development quarter since injury. A credibility method is used to determine the transition from one CANS level to another based on the amount of scheme experience in the transition analysis. This allows us to select transitions over the key points in a participant's time since injury to better model when these assessments are occurring. The results are sensitive to both the consistency of assessments over time and the frequency of assessments over time.

An adjustment factor can be above 100%. This occurs in circumstances at the lower injury severity levels where there may be some deterioration in CANS assessment since injury, generally for lower CANS levels.

The following chart shows how the improvement of the most severe brain injuries (a CANS 7 at the first assessment soon after injury) can vary by age at injury.

Figure 31 Adjustment factors for most severe injuries across development delays (by age at injury)



This shows quite a clear trend in adjustment factors, with large improvements possible within the first two to three years since injury. In addition, older ages tend to have higher adjustment factors and lower ages have lower adjustment factors. In particular:

- The level of injury severity improvement for traumatic brain injury reduces as the time since injury increases, thus supporting evidence that early intervention in these types of injuries may be able to have a large impact in improving longer term outcomes.

- The greater than 65 age group (green line) has consistently higher age adjustment factors than lower ages across all durations, therefore showing lower levels of injury severity improvement within the scheme.

- The less than 25 age group (blue line) generally have lower age adjustment factors than higher age bands, especially for the first three years since the injury occurred, showing higher levels of injury severity improvement.

Age thus is an important factor that needs to be considered. Given CANS is a measure of the level of support needed by a person, older people tend to have higher CANS assigned when assessed. A measure such as the Functional Independence Measure (FIM) is a useful complement to CANS in this transition model, predominantly at the higher severity levels.

6. Considerations in Choosing a Suitable Mortality Basis

Longevity remains a significant risk for not only the life insurance industry and pension funds, but also for various other injury support schemes, including those schemes providing lifetime care and support coverage for severely injured participants.

There is a relatively limited amount of benchmark information available on how to best to account for the mortality of severely injured participants. Individual scheme experience is likely to be limited, except for the largest and most mature schemes, meaning that a heavy reliance needs to be made on the use of benchmark studies.

We separately consider the choice of a suitable mortality basis for severely injured participants and then consider a suitable basis for mortality improvements.

6.1. Mortality Basis for Severely Injured Participants

We have seen three main types of mortality basis approaches for severely injured participants:

1. An addition to the normal population mortality rate – sometimes referred to as the "excess death rate".

2. A multiplier to the normal population mortality rate – sometimes called the "standard mortality ratio" or "SMR".

3. An addition to the assumed age of the impaired person – sometimes called "rating up".

The relative strength and weaknesses of each of these methods is often described in the benchmark studies[8], with the conclusions being that no single method is necessarily suitable over all ages and types of injuries.

To form a view on the most appropriate mortality basis method it is useful to consider the nature of the causes of additional mortality relative to the normal population.

6.1.1. Spinal Cord Injuries

There are a number of studies that analyse the mortality of spinal cord injuries against standard life tables. There are many limitations in directly adopting the findings of these studies to participants within injury schemes. For example, many of the larger studies are based on overseas lives, such as in the US, while in other cases the studies may be based on participants where different care and support provisions are either available, or unavailable. The studies are useful in benchmarking high level approaches and trends, but this must be carefully overlaid with both scheme circumstances and scheme experience, where this is available.

[8] For example, Strauss, Vachon et al *Estimation of Future Mortality Rates and Life Expectancy in Chronic Medical Conditions* (2005)

A previous study[9] found the major causes of excess mortality for people with spinal cord injury were septicaemia, pneumonia & influenza, diseases of the urinary system and suicide. That study also found that the SMRs due to neoplasms and ischaemic heart disease (the major causes of death in the normal population, especially at older ages) were near to normal. In high level quadriplegia there is also the potential for excess mortality arising from respiratory complications.

This suggests that spinal cord injury introduces an additional force of mortality due to these other causes, rather than exacerbating all causes of mortality, including the major ones impacting the normal population. It is also plausible that these additional forces of mortality vary across age.

The level of detail provided by the studies varies, with some studies giving separate results for complete versus incomplete spinal cord injuries as well as for varying neurological levels of lesions. We use this information to help inform our assumptions.

We adopt a middle ground approach that assumes decreasing standard mortality ratios across the age cycle. This approach is similar to that proposed in Yeo et al (1998) and Middleton et al (2012). It also aligns well with both observed LTCS scheme experience and our discussions above on the additional sources of mortality in spinal cord injury participants.

6.1.2. Traumatic Brain Injuries

Similar to spinal cord injuries, there is evidence that the causes of death in people with traumatic brain injuries are different to the causes of death for the general population. A previous study[10] found the major causes of excess mortality were epilepsy, aspiration, pneumonia and external causes of mortality.

We adopt a similar approach as for spinal cord injury. That is, we assume decreasing standard mortality ratios across the age cycle.

6.1.3. Observations and Thoughts

Many of the studies express a mortality basis in terms of life expectancy as a result of impairment, relative to normal population life expectancy. In calibrating our assumptions we adopt mortality ratios leaning heavily on these life expectancies, relative to normal population life expectancy.

We also test this by comparison of an actual versus expected scheme experience analysis. While experience is often sparse, we try to understand the reasons why variations from expectations exist. However, such a comparison is only realistic for larger schemes that have enough historic experience.

The literature describes a pronounced first year mortality effect for severely injured participants. While this impact is real, we have not seen this effect being translated into scheme participant experience. The main reason for this is that those potential participants who have deceased close to the injury date do not enter the scheme to

[9] Soden et al *Causes of death after spinal cord injury*. Spinal Cord (2000) 38:604-610
[10] Baguley, Nott, howle, *Long-term mortality trends following traumatic brain injury* (2008)

begin with, and noting that this process was a conscious decision from the LTCS scheme. It is therefore important to understand which participants enter the scheme and also to understand those participants who may be eligible to enter the scheme but do not, to ensure that first year mortality is not overstated.

6.2. Mortality Improvements

In recent years we have seen an increased focus on mortality improvements and the associated longevity risk, the measurement of which is subject to significant debate.

In order to better understand the impact of mortality improvements, a literature review was conducted into both general population mortality as well as the mortality of persons with SCI and TBI.

In respect to general population mortality, authors noted reduced mortality rates at virtually all ages in recent years, with the exception being for the very old lives. For these older ages, this is likely due to the fact that with an increasing proportion of the population surviving to these ages, the average health status of this group may have declined. The level of improvement declines with age over the age range from approximately 20 to 50 before increasing again in middle age.

Mortality improvement factors for the general population are provided in the 2010-12 Australian Life Tables. These are based on 25-year and 100-year mortality improvement factors and are applied as percentage improvements in mortality. These trends ultimately translate into increases in life expectancies and hence the expected period for which lifetime care and support services will be provided.

The existing research on implementing mortality improvements for severely injured individuals into actuarial models is limited. For the mortality patterns of persons suffering from SCI and TBI, authors came to similar conclusions about mortality trends for such individuals. Most studies suggested that there have not been significant improvements in mortality rates for severely injured participants over time, apart from for those durations close to the date of injury.

Firstly, we must consider whether the factors that have resulted in these mortality improvements are applicable to persons with spinal cord and brain injuries. Research by the AIHW (2006) highlights rapid improvements in the detection and treatment of cardiovascular diseases as the major contributing factor to normal population mortality improvements in the last 25 years. In contrast, De Vivo and Stover (1995) point to respiratory system complications and septicaemia as the leading cause of death for persons with SCI, whilst Baguley et al (2008) highlight pneumonia, stroke and haemorrhage as the leading causes of death for persons with TBI.

Noting that improvements in the detection and treatment of cardiovascular diseases do not play a significant role in the mortality of persons suffering from TBI and SCI it was deemed prudent that our implementation of mortality improvement factors reflect this. Therefore, the absolute improvements on raw mortality rates were calculated and subsequently deducted from severity-adjusted mortality rates. Under this approach the increase in cost attributable to mortality improvements is shown in Table 4, split by age and injury severity.

Table 4: Increase in Future Attendant Care Cost from Mortality Improvement Factors

	Age at Injury			
Severity	<15	15-44	45-64	65+
C1-3 - Complete	2%	3%	4%	3%
C4 - Complete	3%	4%	4%	3%
C5-6 - Complete	3%	4%	4%	3%
C7-8 - Complete	4%	4%	4%	3%
Paraplegics - Complete	5%	6%	6%	4%
All Incomplete	7%	8%	8%	6%
CANS 7	3%	4%	5%	4%
CANS 6	3%	4%	5%	4%
CANS 5	5%	5%	6%	4%
CANS 3-4	6%	7%	7%	5%
CANS 0-2	8%	9%	9%	6%

This analysis is not to conclude that actuaries should be limited to a certain assumption selection for mortality improvements. It is, however, an area of significant uncertainty and not a straight forward analysis. It is an area where the use of sensitivity analysis can help to ascertain and document the level of uncertainty in the valuation models.

7. Economic and Operating Expense Assumptions

Schemes which cover liabilities for severely injured participants are unique in their cash flow profile compared to most other Australian accident compensation schemes. In particular the average mean term of future cash flows on outstanding claims will typically exceed 25 years, with cash flows from current participants projected to be paid up to 100 years from the current date. The majority of these payments relate to the attendant care and support needs for these participants.

The considerable mean term of the LTCS scheme liabilities introduces a number of challenges for actuaries to consider in their valuations. Here we consider economic assumptions and operating expense assumptions.

7.1. Inflation and discounting assumptions

The projected net cash flow for a new fully funded NIIS scheme covering liabilities in respect to severely injured participants would be expected to be cash flow positive in the medium term period of at least 20 years, barring significant catastrophe or mispricing of risks. It will likely take these schemes in excess of 50 years to reach a stable state.

Given these scheme characteristics, a long term view should be taken in regards to the economic assumptions used in the valuation of liabilities, in a consistent manner with long term economic fundamentals.

7.1.1. Investment Mix Considerations

NIIS scheme liabilities are subject to general inflationary pressures, particularly in the inflation of attendant care and other medical-specific costs. Growth assets such as shares and property have generally provided better inflationary protection than in the case of risk free assets such as cash and Commonwealth government bonds.

Hence, NIIS schemes are likely to have investment policies that are relatively high in growth assets which are expected to be better suited in the longer term to match the inflationary expectations of future benefit payments. This type of asset mix is also likely to lead to a higher expected rate of return, compared to a risk-free rate, over the longer term, commensurate with the greater risk. However, one of the key risks specific to these schemes is that assets and liabilities are mismatched over the shorter to medium term.

7.1.2. Accounting Standards and Professional Standards Considerations

Liability calculations generally fall under the actuarial requirements of Professional Standard 300 (PS 300) issued by the Actuaries Institute. In addition, the liability calculations for these types of schemes typically fall under 2 possible accounting standards:

1. Accounting standard AASB 137 "*Provisions, Contingent Liabilities and Contingent Assets*".

2. Accounting standard AASB 1023 "*General Insurance Contracts*".

AASB 137

Sections 45-47 of AASB 137 relates to the use of a "Present Value" approach in the determination of liability estimates, where the effect of the time value of money is material. Given the lengthy mean term of LTCS liabilities the impact of allowing for discounting is clearly material.

The first sentence of Section 47 of AASB 137 states:

> "*The discount rate (or rates) shall be a pre-tax rate (or rates) that reflect(s) current market assessments of the time value of money and the risks specific to the liability.*"

In our view the wording does not necessarily advocate the use of a risk-free discount rate approach. In particular, the phrase "risks specific to the liability" probably means that the use of risk free rates is not appropriate in the context of the LTCS scheme due to the extended mean term of its outstanding claims liabilities. However, we do note that the default view of the Commonwealth Auditor is generally that risk-free discount rates be used.

AASB 1023

Section 6.1 of AASB 1023 provides commentary on the use of discount rates in the determination of outstanding claims liabilities and states:

> "*The outstanding claims liability shall be discounted for the time value of money using risk-free discount rates that are based on current observable, objective rates that relate to the nature, structure and term of the future obligations.*"

This stipulates the use of risk free discount rates. The use of risk free discount rates generally references the market yield on Commonwealth government bonds as published by the Reserve Bank of Australia. The determination of these discount rates is a relatively straight forward process for shorter durations; however there are a number of limitations when determining rates at longer durations, such as would apply for a NIIS scheme valuation.

Actuarial Professional Standards

Most actuarial valuations of outstanding claims in respect to NIIS type benefits would fall under the requirements of Professional Standard 300 Valuations of General Insurance Claims. Section 10.2 of PS 300 requires that:

> "*Discount rates used must be based on the redemption yields of a Replicating Portfolio as at the valuation date, where reasonably practicable.*"
>
> '*Replicating Portfolio' means a notional portfolio of current, observable, market-based, fixed-interest investments of highest credit rating, which has the same payment profile (including currency and term) as the relevant claim liability being valued.*"

7.1.3. Discussion and Suggested Approach

The professional standards and accounting standards appear to advocate the use of discount rates that are specific to the claim liability being valued, with consideration given to the term of the liabilities, the structure of the liabilities and investments of highest credit rating specific to these liability characteristics.

For NIIS schemes this would seem to support the use of discount rate assumptions based on comparable assets of a hypothetical portfolio that would match the mean term of the liabilities. In this case, the use of a longer term expected rate appears to be appropriate in the context of matching the liabilities of the scheme with suitable longer term growth assets.

The highly positive expected future cash flow expectations for a new fully funded scheme would also support this approach. Moreover, it seems reasonable to maintain a "gap" approach between future inflation and future discount rate assumptions, recognising the longer term expected economic relationship between the two.

We therefore propose an approach which balances the above discussion points by assuming a fixed gap between inflation and discount rate over the entire term of the liabilities, currently of 2% p.a. This gap is lower than the longer term differential expected between growth assets and inflation, is reflective of a longer term "risk-free" type gap that may be appropriate for periods over 25 years and the fixed gap approach helps to stabilise a source of volatility from the liability calculation that would otherwise prove to be a distraction. Any surplus arising from the use of this approach could therefore be invested in establishing an appropriate risk margin for the scheme.

As noted above, accounting standards may require the use of risk free rates of return, although there is a reasonable level of debate around what that means at longer term durations.

Ultimately, the approach taken in regard to future economic assumptions will depend on the accounting standards applicable to the scheme and the nature of the scheme. We also note that there may be other reasons to perform a liability valuation, other than for accounting purposes, and that the selected discount rates should be suitable for the particular purpose of the valuation.

The Use of Risk Free Discount Rates

The longest dated current Commonwealth government bond has a term of about 22 years, while the majority of Commonwealth government bonds have a term of less than 10 years. Projections of returns in excess of about thirteen years or more is subject to some element of subjectivity. There is limited information at longer terms because of the scarcity of government bonds at these longer durations. Additionally, other factors (such as liquidity risk or demand-related factors) may influence the yields implicit in the longer term bonds. Hence, the yields on longer term government bonds may not be representative of true risk free rates.

A NIIS scheme typically has the majority of future cash flows expected in respect to periods of payment where there are no observable government bonds. There is also no generally accepted approach to what risk free rates should be adopted for periods after the last observable Commonwealth government bond. For example, we have

seen some approaches that extrapolate the latest observable government bond forward rate into the future, while in other cases a longer term rate is blended with the latest observable rate over a fixed period of time.

One of the most common approaches is to adopt a "fixed gap" assumption between discount rates and inflation rates for periods after the last observable Commonwealth government bond. However, we are aware that there are different approaches of actuarial practice in this regard.

In our view, a move towards a risk free basis would introduce an element of volatility into the scheme liability calculations which would not be helpful and often would not be consistent with many scheme's objective to aim for a fully funded scheme. Further, the move to a risk free basis would introduce a level of distraction that is not helpful for the prudential management of such a scheme and could potentially mask other emerging issues within the scheme.

The potential volatility of individual liability calculations from month to month using risk free rates of return is shown in Table 5 below under the two bases described above. The percentages in the table represent the change in liability from the base month of August 2015. The first column of percentages shows the changes if the risk free forward rate after 15 years is assumed to continue for all future years. The second column of percentages uses a "fixed gap" approach and assumes that the risk free rate of return is blended progressively towards a "fixed gap" approach for the period 15 to 20 years, thus moving to a "fixed gap" approach in the longer term.

Table 5: Impact on Liability of Risk Free Rates

Date of Yield Curve	Fixed Forward Rate After 15 Years	"Fixed Gap" of 2% After 20 Years
31/08/2015	0%	0%
31/07/2015	-3%	-1%
30/06/2015	-12%	-6%
31/05/2015	2%	0%
30/04/2015	10%	3%
31/03/2015	26%	9%
28/02/2015	17%	6%

This shows very volatile liability results from movements in risk free discount rates, with month by month variations of up to 16% and absolute variations over a six month period of 38% using the "fixed forward rates after 15 years" approach. Month by month variations of up to 6% and absolute variations of 15% using risk free rates with a "fixed gap" approach are also possible. In our view these levels of volatility would not be consistent with a typical jurisdictions scheme objective, probably centred on providing a fully funded scheme.

7.1.4. Sensitivity of Valuation Results to Economic Assumptions

The high mean term of the liabilities means that the valuation results are highly sensitive to the economic assumptions adopted. Table 6 below highlights the sensitivity of liability valuation results to a change in the "gap" between inflation and discount rates. A 0.5% change in the "gap" assumptions leads to about a 10% change in liability.

Table 6: Sensitivity of Results from a Change in the Long Term Gap

Gap	Impact on Liability from 2.0% Gap
3.00%	-16%
2.50%	-8%
2.00%	0%
1.50%	10%
1.00%	21%
0.50%	35%

7.2. Operating Expenses

A long term view is required in determining appropriate operating expense assumptions. The annual spend on operating expenses is projected to follow the same pattern as service cost - that is increase steadily for approximately 45 years (in actual future dollars) before declining for the rest of the cohort's lifetime

When a new NIIS scheme is established there will likely be significant establishment costs associated with setting up the scheme. Here we are assuming a government underwritten scheme and these establishment costs may include the implementation of an IT system, development of initial governance, policies and procedures and upfront consulting costs. At this time, the cost structure of the scheme will likely bear little resemblance to the cost structures of the scheme when it reaches a stable state many years into the future.

Operating expenses, referring to those costs necessary to run the scheme, may include:

- **Personnel services**: This would include any salary costs, both direct and indirect, relating to staff. This would include the salary costs of staff, IT requirements of staff (software, hardware and support), rent and so forth. This would need to cover costs for participant co-ordinator staff, management staff and support or review functions.

- **Corporate overhead services:** This would include the normal corporate services such as payroll, recruitment, finance and IT not already covered above.

- **Other operating expense:** This would include expenses such as audit fees, legal fees, research, advertising, computer services, consulting fees, contractor fees, grants and sponsorships

Any expense analysis should therefore consider the longer term view. For example, allowance should be made for economies of scale for future corporate services when a scheme is relatively immature, noting that this may be the case for the first 20 years or so. In addition, thought should be given as to what allowance should be given for scheme establishment costs to be amortised over a number of years.

Personnel services would require a caseload determination, which may need to allow for the expected complexity of cases and allow for more recently injured being likely to have higher needs as are the more severely injured

8. Outcomes based analysis

8.1. Other Factors Influencing Participant Costs

The methods covered in this paper provide a useful starting point in estimating the lifetime support cost of each participant. However, in practice each participant's injury and situation is unique and the impact that their injury has on the rest of their lives is different. Some other factors, beyond the age and disability profile of the participant, that can influence this include:

- **resilience**, which encompasses the ability – and willingness – of a participant to bounce back after such a severe injury
- **co-morbidity factors**, i.e. having other health conditions which can have a compounding effect on care and support costs
- **family relationships**, including the level of emotional support and level of unpaid care
- **independence**, or gaining independence through aids, equipment and home modifications
- **socio-economic background**

Applying an adjustment based on the above factors (and more) to the lifetime cost estimate of a participant means an individual's situation and needs are allowed for directly. This is useful for shorter term cash flow management, especially for smaller schemes.

8.2. Outcomes Based Analysis

It is important to keep in mind, when talking about the provision of different forms of care and support, that the primary consideration should be on improving participant outcomes. What types of supports are leading to better health and social outcomes for the participant? What outcomes should we be measuring to determine how well the supports are meeting the participant's needs, and helping them reach their goals?

Tracking outcomes such as the level of social participation, relationships, employment, living arrangements and degree of disability over time would help to judge the effectiveness of supports. It would also allow identification of areas where schemes may have the ability to influence outcomes. For example, investing in the upfront cost of a home modification to the bathroom of a participant may be effective in allowing a participant to be more independent and to reduce the attendant carer support required for the participant. The reduced need for attendant care hours and the participant's greater level of independence would likely lead to better social and financial outcomes in the long term. For recording these outcomes, there is the need to consider how the data is captured and stored. The selection of outcomes from a pre-set number of options may be preferred as free text fields may make analysis difficult.

It is also possible that care and support models can have an impact on brain injury improvements. However, this is hard to test given there could be many other factors

leading to brain injury improvements and it would be difficult to isolate the impact of the care and support models alone. Severity assessments done by different assessors and at different points in time may also be inconsistent.

Benchmarking of outcomes across different schemes would be very valuable in understanding the potential benefits of different care and support models. However it involves obtaining access to data that requires the co-operation of all schemes as well as an understanding of the differences in the profiles of participants in each scheme.

We are aware that the NDIS has developed an outcomes framework based on a number of domains, both for participant and carers, which vary across the age range of the participant. This framework has also been through considerable consultation and discussion, and we understand has been through a pilot phase for further refinement. In any future NIIS scheme it would seem sensible for outcome frameworks to investigate the NDIS findings, and potentially work towards some consistency across schemes, subject to privacy issues associated with this.

8.3. The Importance of Scheme Monitoring

A robust scheme monitoring system is an important governance tool. To the extent that the monitoring can be linked into the actuarial valuation process and to monitor scheme outcomes, then discussions can be undertaken to help identify, understand and respond to emerging scheme trends.

For example, some of the types of monitoring that the LTCS scheme undertakes includes:

- Monitoring of levy income relative to expectations and compared with that required to fund a particular injury year cohort.
- Trends in participant reporting patterns across time and compared to expectations, split by characteristics such as age, gender, injury type and injury severity.
- The time to reporting of entry into the scheme compared to the date of injury.
- Movements in participant status over time, including the number of lapsed, deceased, interim and lifetime participants.
- Improvements in brain injury severity across time and compared with expectations.
- Current payment levels including payment trends across time and compared to expectations, split by payment type, age, injury type and injury severity.

This granular level of detail allows discussions to emerge around emerging trends. For example, the LTCS scheme has recently seen an increase in the reporting of older participants and the potential reasons and implications of this is under current consideration.

9. Some Benchmark Results

The following tables give a summary of the expected present value of future benefits using the framework and methodologies that we have described in this paper. These results are specific to the LTCS scheme and are very sensitive to the underlying economic and other assumptions used. It reflects current scheme experience and our methods and assumptions continue to evolve as scheme experience begins to mature.

The expected future cost of traumatic brain injury participants are shown in Table 7 below. The average cost is about $1.8M and ranges from about $0.1M to $11.6M.

Table 7: Average Size of Traumatic Brain Injury by CANS Level and Age

CANS	Average cost by CANS level and age ($'m)								
Severity	< 5	5 - 14	15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65 +	Total
7	11.6	11.1	10.7	10.1	9.3	8.1	6.4	3.2	8.7
6	6.7	6.4	6.2	5.8	5.3	4.6	3.6	1.7	5.0
5	3.1	3.0	2.9	2.7	2.5	2.1	1.7	0.9	2.3
4	1.5	1.4	1.4	1.3	1.2	1.1	0.9	0.5	1.2
3	0.9	0.8	0.8	0.8	0.7	0.6	0.5	0.3	0.7
2	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.3	0.5
1	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.4
0	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.3
Interim only	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total	2.4	2.3	2.2	2.1	1.9	1.7	1.4	0.8	1.8

If we combine the average claim size information from Table 7 with the expected distribution of brain injury participants within the LTCS scheme, then the proportion of traumatic brain injury cost for a typical injury year cohort would be split as shown in Table 8 below.

Table 8: Expected Brain Injury Cost Distribution for LTCS Scheme by CANS Severity and Age

CANS	Proportion of Expected LTCS Brain Injury Scheme Cost by CANS Level and Age								
Severity	< 5	5 - 14	15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65 +	Total
7	2.6%	4.7%	21.4%	10.7%	8.2%	7.3%	3.7%	3.4%	61.9%
6	0.3%	0.6%	2.9%	1.4%	1.1%	1.0%	0.5%	0.4%	8.2%
5	0.2%	0.4%	2.0%	1.0%	0.7%	0.6%	0.3%	0.3%	5.7%
4	0.5%	1.0%	4.4%	2.2%	1.7%	1.5%	0.8%	0.8%	12.9%
3	0.2%	0.4%	2.0%	1.0%	0.7%	0.7%	0.3%	0.4%	5.7%
2	0.1%	0.2%	0.9%	0.4%	0.3%	0.3%	0.2%	0.2%	2.6%
1	0.1%	0.1%	0.4%	0.2%	0.2%	0.1%	0.1%	0.1%	1.3%
0	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Interim only	0.0%	0.1%	0.4%	0.2%	0.2%	0.2%	0.1%	0.2%	1.4%
Total	4.2%	7.4%	34.4%	17.2%	13.2%	11.7%	6.0%	5.8%	100.0%

Traumatic brain injury participants are expected to contribute about 68% of each injury year's total cost to the LTCS scheme. The majority of this cost arises from participants with CANS 7 injury severity. Further, the majority of this cost arises from participants aged between 15 and 44.

The expected future cost of spinal cord injury participants are, on average, larger than traumatic brain injuries, as shown in Table 9 below.

Table 9: Average Size of Spinal Cord Injury by Neurological Level, Severity and Age

Neurolevel &	Average cost by neurolevel and age ($'m)								
Completeness	< 5	5 - 14	15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65 +	Total
C1-3 - C	16.2	15.4	14.5	13.6	12.3	10.6	8.4	4.4	11.7
C4 - C	12.1	11.6	11.1	10.5	9.6	8.4	6.7	3.7	9.1
C5 - C	8.5	8.1	7.8	7.3	6.5	5.5	4.3	2.4	6.2
C6 - C	7.5	7.2	6.9	6.4	5.7	4.9	3.8	2.2	5.5
C7 - C	7.0	6.8	6.5	6.0	5.4	4.5	3.5	2.0	5.1
C8 - C	6.4	6.1	5.9	5.5	4.9	4.1	3.2	1.9	4.7
T1-2 - C	5.3	5.1	5.0	4.7	4.2	3.7	3.0	1.8	4.0
T3-5 - C	4.3	4.1	3.9	3.7	3.4	2.9	2.4	1.5	3.2
T6-7 - C	2.0	1.9	1.8	1.7	1.5	1.4	1.1	0.8	1.5
T8+ - C	2.0	1.9	1.8	1.6	1.5	1.3	1.1	0.7	1.4
C1-3 - I	2.9	2.9	2.9	2.7	2.5	2.2	1.7	0.9	2.3
C4 - I	2.5	2.5	2.4	2.3	2.1	1.9	1.5	0.8	2.0
C5-8 - I	1.6	1.5	1.5	1.4	1.3	1.2	0.9	0.6	1.2
T1-5 - I	1.7	1.7	1.7	1.6	1.4	1.3	1.0	0.6	1.3
T6+ - I	0.8	0.8	0.7	0.7	0.6	0.5	0.5	0.3	0.6
Total	4.4	4.2	4.0	3.8	3.4	3.0	2.4	1.4	3.3

The average expected cost of spinal cord injuries are about $3.3m for the LTCS scheme, although the expected cost varies significantly depending on the participant's age, neurological level of injury and completeness of injury. The size of spinal cord injury claims may vary from $0.3M to over $16M, in the case of younger complete tetraplegia participants.

Combining the average claim size information from Table 9 with the assumed distribution of spinal cord participants within the LTCS scheme, then the proportion of spinal cord injury cost for a typical injury year cohort would be split as shown Table 10 below.

Table 10: Expected Spinal Cord Injury Cost Distribution for LTCS Scheme by Neurological Level, Severity and Age

Neurolevel &	Proportion of Expected LTCS Spinal Cord Injury Scheme Cost by CANS Level and Age								
Completeness	< 5	5 - 14	15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65 +	Total
C1-3 - C	0.4%	0.3%	4.3%	2.6%	2.0%	1.4%	1.0%	0.6%	12.5%
C4 - C	0.7%	0.4%	6.7%	4.0%	3.1%	2.2%	1.5%	1.0%	19.5%
C5 - C	0.3%	0.2%	3.0%	1.8%	1.3%	0.9%	0.6%	0.4%	8.6%
C6 - C	0.3%	0.2%	3.0%	1.7%	1.3%	0.9%	0.6%	0.4%	8.4%
C7 - C	0.2%	0.1%	2.2%	1.3%	1.0%	0.7%	0.5%	0.3%	6.3%
C8 - C	0.0%	0.0%	0.5%	0.3%	0.2%	0.2%	0.1%	0.1%	1.4%
T1-2 - C	0.1%	0.1%	0.8%	0.5%	0.4%	0.3%	0.2%	0.1%	2.5%
T3-5 - C	0.5%	0.3%	5.4%	3.2%	2.5%	1.7%	1.2%	0.9%	15.9%
T6-7 - C	0.0%	0.0%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.5%
T8+ - C	0.3%	0.2%	3.0%	1.8%	1.4%	0.9%	0.7%	0.6%	8.9%
C1-3 - I	0.1%	0.1%	1.6%	1.0%	0.7%	0.5%	0.4%	0.2%	4.7%
C4 - I	0.2%	0.1%	1.9%	1.1%	0.9%	0.6%	0.4%	0.3%	5.5%
C5-8 - I	0.1%	0.1%	0.9%	0.5%	0.4%	0.3%	0.2%	0.2%	2.7%
T1-5 - I	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
T6+ - I	0.1%	0.1%	0.8%	0.5%	0.4%	0.3%	0.2%	0.2%	2.4%
Total	3.4%	2.2%	34.4%	20.4%	15.6%	10.9%	7.7%	5.5%	100.0%

Spinal cord injury participants are expected to contribute about 30% of each injury year's total cost to the LTCS scheme. The spread of cost, while still biased towards more severely injured participants and ages 15 to 44, is more spread than for brain injury participants.

Participants with injuries other than spinal cord injury and traumatic brain injury are only expected to contribute about 2% of each year's total cost to the LTCS scheme.

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