

Appendices

Appendix 1: TBI and mTBI definition.

Drawing from International Classification of Diseases Version 10 codes (ICD 10 codes) used to identify administrative TBI data in the literature²⁴⁻²⁹ and research team expertise, a list of ICD 10 codes and Readcodes were used to define mTBI and moderate to severe TBI in this study and are listed in the appended Excel sheet (converted for these purposes into a Word table: https://uploads-ssl.webflow.com/5e332a62c703f6340a2faf44/633cb73f8edd88cf64ec34f3_5821%20-%20Appendix%201%20Table.pdf.)

Appendix 2: Definitions used in the study.

Service item	The service provided to the patient at the most detailed level, the entity that represents a row in the payments data set.	
Service types (service items grouped into categories)	Treatments	Health-related service items i.e., service items that involved an assessment or treatment of the patient by health-related professionals. Health-related professionals that were identifiable in service items included: acupuncturists; allied health practitioner; audiologists; chiropractors; general practitioners; neurologists; neuropsychologists nurses; occupational therapists; optometrists; osteopaths; physiotherapists; psychiatrists; urgent care practitioners; and vocational rehabilitation practitioners.
	Administration for treatment	Service items that a treatment provider undertakes related to a treatment e.g., report writing.
	Patient travel	Service items related to patient travel.
	Provider travel	Service items related to treatment provider travel to provide a treatment.
	Income maintenance	Service items for payments to the patient or to the employer to cover the patient's income until full return to work is established.
	Lump sum	Service items for compensation for permanent impairments.
	Other	Service items that do not meet other category definitions e.g., non-attendance fees, equipment, vehicle repairs, public holiday supplement and medication.
Services	Any of the service types	
Treatment providers	Categories of health professionals based on the ACC service contract they delivered the treatment under e.g., a medical doctor delivering treatment at a concussion clinic would be categorised as concussion clinic.	
Treatment day	Ranked dates of the healthcare pathway that contain treatments for a claim.	
First treatment day	The first date where treatments are delivered for a claim.	
Known pathway exit claims	Claims that have at least 90 days between last service date and the end of study time period (1 September 2020).	
Pathway exit	Date of last service.	
Services	Any of the service types	
ACC mTBI healthcare pathway	The experiences and journey of the mTBI patient related to the ACC claim and provision of ACC funded services from date of injury to date of pathway exit.	
Urban-rural residency profile	ACC records the residential area unit of the patient based on the 2006 New Zealand area unit definition. The urban-rural profile for the 2006 New Zealand area unit was obtained from Statistics New Zealand and used to label residential area units of patients in this study as urban or rural. Where residential address information was unavailable, the variable was labelled as "Unknown".	

Appendix 3: Data exclusion criterion.

All available data from the three data sets (claims, purchase orders and payments) for all TBI and possible TBI diagnostic codes where the injury occurred in the period of 1 September 2016 to 1 September 2020, including any other claims that were lodged by the TBI patient 14 months prior to and after the TBI claim were requested from ACC. Claims were included if they had at least one mTBI diagnostic code (readcode or ICD 10 code) in any of the readcode or ICD 10 code positions on the ACC 45 form. Claims that also contained moderate or severe TBI codes were excluded. mTBI claims for injuries occurring between 1 September 2016 and 1 September 2018 were included, along with their corresponding payment and purchase order data until 1 September 2020. The cohort of pre- and post-mTBI claims was removed for this study. ACC covers injuries sustained in New Zealand regardless of residency status. Therefore, claims for patients that had a residential and occupational address outside of New Zealand (where applicable) were excluded to mitigate the chance of pathway exits being due to non-New Zealand residents leaving New Zealand. Declined claims were counted then excluded from the analysis.

Appendix 4: Description of the process model for the ACC mTBI healthcare pathway.

Figure 1 outlines the process model for the ACC mTBI healthcare pathway. When a patient sustains an injury (injury date) and reports to a treatment provider for care (treatment date), e.g., general practitioner, the treatment provider assesses and treats the injury and fills out an ACC 45 injury claim form. This form contains the information about the patient, the injury, the injury diagnosis and the provider. The patient then leaves the first treatment. The treatment provider lodges a claim by submitting the ACC 45 form to ACC (claim lodge date). A delay between the treatment date and the lodge date exists if the ACC 45 form is submitted after the day of the treatment. If the claim is submitted in electronic format, the claim is automatically registered in the ACC system. In this case, the date the claim is registered (claim registration date) is the same as the claim lodge date. If the claim is submitted in paper form via email, the ACC 45 form needs to be manually registered into the ACC system by a member of the ACC registration team. This can cause a delay between claim lodge date and claim registration date. The injury diagnostic codes on the form are input into the system at the same time the claim is registered. Therefore, if a TBI has been diagnosed by the provider who delivered the first treatment, the TBI code date will be equal to the claim registration date. A missed TBI diagnosis can be identified when a TBI code is added after the claim is registered, meaning that it was later diagnosed by the same or different provider. Once the claim is registered, ACC decides whether to accept or decline the claim (claim decision date). The decision is made based on the information on the ACC 45 form, additional requested information from the patient or provider, and a medical opinion from ACC medical staff. If the claim is declined, the patient can initiate a review process that can result in the claim decision remaining or the claim being accepted. Due to this decision process, a delay between claim registration date and claim decision date can exist. If the claim is declined or further care is not required, the patient leaves the ACC mTBI healthcare pathway. If the claim is accepted and requires further services, the patient can continue to seek care from the same or a different treatment provider. The treatment provider may make a referral to another treatment provider or request more treatments for the patient. Certain treatments are covered by ACC for mTBIs without needing ACC approval. If required treatments need to be approved by ACC (e.g., referral to concussion clinic), the treatment provider submits a referral request to ACC. When the request is received by ACC, purchase order (PO) lines are created (referral registration date) and ACC decides whether to approve or decline the referral (referral decision date). The time it takes ACC to make the decision can cause a delay between referral registration date and referral decision date. If the referral is declined, the patient is not covered to receive the corresponding treatments and if other available treatments are not suitable, the patient may leave the ACC mTBI healthcare pathway. If the referral is approved, the patient can continue to receive treatment. In some instances, a provider will deliver a treatment that requires ACC approval prior to the decision being reached. In this case, the treatment date for a referral will be prior to its decision date. If the referral is declined, the treatment provider usually funds the treatment that was provided. Treatment providers invoice ACC for services delivered after the treatments. ACC pays the treatment providers, and treatment details and costs on the invoice are stored in the ACC database. ACC may also pay patients for income maintenance, lump sums, treatment costs paid by the patient and other expenses that are also recorded. The patient remains in the ACC mTBI healthcare pathway until no further services are required or approved by ACC.