Concussion sideline management intervention for rugby union leads to reduced concussion claims

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Abstract. The effectiveness of a concussion management education programme (CMEP) in rugby in reducing the number and cost of concussion/brain injury (CBI) moderate to serious claims (MSC) was assessed. A RugbySmart\textsuperscript{TM} educational video and a sideline concussion check (SCC) tool comprised the CMEP. Over 30,000 SCC, providing information on management of suspected concussion among community level rugby players prior to seeking medical treatment, were distributed from July 2003 to June 2005. Each year approximately 10,000 coaches and 2,000 referees participated in RugbySmart\textsuperscript{TM}. From 2003 to 2005 new rugby CBI MSC reduced by 10.7\% (actual) and 58.2\% (forecast). Rugby player numbers, new non-sport CBI MSC and new sport MSC all increased by 13.6\%, 16.9\% and 24.6\% respectively in the same period. The median number of days between CBI injury and the player seeking medical treatment decreased from six days to four days. Cost savings after CMEP were USD690,690 (actual) to USD3,354,780 (forecast). The two-year cost of CMEP was USD54,810 returning USD12.60 (actual) and USD61.21 (forecast) for every USD1 invested (ROI). CMEP provided community coaches and managers with education on minimum best practice for managing suspected concussion, contributed towards ROI and savings for CBI MSC in rugby.

Keywords: Concussion, injury prevention intervention, concussion management, community, rugby, return on investment, education

1. Introduction

The summary and agreement statement of the first International Conference on Concussion in Sport, Vienna 2001 [1], defined concussion as “a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.” Common features defining the nature of a concussive head injury include: Caused by a direct blow to the head, face, neck, or elsewhere on the body with an “impulsive” force transmitted to the head; Typically results in the rapid onset of short lived impairment of neurological function that resolves spontaneously; May result in neuropathological changes but the acute clinical symptoms largely reflect a functional disturbance rather than structural injury; Results in a graded set of clinical syndromes that may or may not involve loss of consciousness; Resolution of the clinical and cognitive symptoms typically follows a sequential course; and typically associated with grossly normal structural neuroimaging studies [1]. There were no changes to this definition at the Second International Symposium on Concussion in Sport, Prague 2004 [19].

There has been a lack of well-performed research on the incidence of concussion in rugby union (rugby). A review of rugby concussion studies highlights a variety in incidence from 0.1 per 100 player season [5] to 11.3
per 100 player season [15] making a comparative analysis difficult. When stringent inclusion criteria (such as medical care) are applied to concussion studies in the literature, the incidence rates appear lower [15]. In addition, lower rates of concussions were recorded in studies where teachers or coaches reported concussion rather than where athletic trainers or the players reported concussions. Only a study with a data set where trained medical doctors or neuropsychologists make the concussion diagnosis will provide any value for concussion analysis.

In professional rugby there are a number of medical experts who have a good understanding of concussion principles and use robust procedures in assessment and treatment [2]. At the community level, covering 99% of the 137,960 rugby players in New Zealand [21], there is little evidence of concussion management systems or processes. Anecdotally, at the community level, long-term memory questions such as “What’s your middle name?” or “Who is the Prime Minister?” have been employed [6]. As one former New Zealand international player reported “They let you stay on the field if you could count to three. Even at the senior level, the physiotherapist came on and asked you if you were okay. You carried on if you said ‘yes’ – simple as that” [2]. Further, “being knocked out” or losing consciousness was used as the definitive way of assessing if someone was concussed. It is now widely recognised that these types of questions and methods being used at the community level are of little diagnostic value in determining whether an athlete has sustained a concussion [1, 16].

In New Zealand there are a number of robust health systems in place to deal with concussion symptoms, with associated costs met by the Accident Compensation Corporation (ACC). ACC is the Crown entity charged with the administration of New Zealand’s 24-hour, no-fault accident compensation and rehabilitation scheme. The scheme provides personal injury coverage for all New Zealand citizens, residents and temporary visitors to New Zealand. In return, people do not have the right to sue for personal injury, other than for exemplary damages. People make acute personal injury claims to ACC resulting in medical information about the injury being collected. In the 2004/05 ACC financial year there were 1.6 million new claims from a population of approximately 4 million people; 296,000 were sport and recreation (sport) claims. As there is no disincentive for making a claim to ACC, the data set is useful for analysing the epidemiology of injuries and the effectiveness of injury prevention initiatives such as the concussion management education programme (CMEP).

2. Development of the sideline concussion check cards

To address the lack of suitable assessment and management of concussion in New Zealand community sport, ACC developed the sideline concussion check (SCC)1 as part of a CMEP. At the community level ACC wanted to provide temporary interim management guidelines for a suspected concussion and to encourage players to seek medical treatment. The aim of introducing a standardised instrument was to remove the uncertainty [16] often encountered in assessing concussion on the sideline. Given the lack of concussion management that was occurring at the community level the Hippocratic aphorism ‘Primum non nocere’ (first do no harm) [18] was applied.

The SCC was based on a similar card used by the University of Pittsburgh [4] that utilised ‘Maddocks questions’ [14], as well as a series of ‘anterograde’ and ‘retrograde’ questions shown as another predictive way of assessing concussion [3]. Changes were made to reflect New Zealand linguistics and situations. Subsequently several aspects of the SSC have been incorporated into the recently produced Sports Concussion Assessment Tool, developed for trained medical personnel [19]. The SCC is designed for community coaches who are unlikely to be medical personnel and only, at best, have minimal first-aid training.

The initial SCC was tested for suitability with two focus groups of community rugby coaches (n = 17) (held in April and May 2003). Focus group feedback supported the introduction of the SCC, as these groups considered that there was nothing else available for them. Focus groups were valuable for making further adjustments to improve the SCC, particularly identifying ways players would try and “beat the system” (i.e., remembering answers to standard questions to enable them to keep playing rather than being removed from play due to showing signs of concussion).

The SCC is $6\frac{1}{2}'' \times 3\frac{1}{2}''$ ($16 \times 9$ cm) in size and folds in three sections down to $2'' \times 3\frac{1}{2}''$ ($5 \times 9$ cm). It was designed to be small so it could be carried in the coaches, referees or match officials’ pocket. The SCC was constructed of waterproof material so it could withstand handling in bags, pockets and in wet environments, as rugby is a winter outdoor sport.

1A ‘Sideline Concussion Checklist-B’ has been previously reported [13]. However, this was a proposed checklist and no data or tests using this instrument have been reported in the literature.
Every SCC has a pouch containing five insert cards to provide the type of straight-forward advice for the first 48 hours including seeking medical treatment as recommended in the literature [9,17]. The insert card ensures advice is consistent and reflects best practice. The insert card was given to the player/parents/player’s support network to provide advice on how to manage any symptoms until the player sought medical advice. This was important, as typically there was a lack of medical staff available at the community level [9,15]. The insert card acted as a safeguard if the symptoms manifested, if the player had yet to seek medical treatment after a suspected concussion. The insert card also provided useful advice ranging from return to play guidelines to the type of pain relief recommended. Extra insert cards could be ordered through the ACC website and/or free phone number and like the SCC, were free. To reflect New Zealand’s multi-cultural society, insert cards were translated into Maori, Samoan and Tongan so they could be given to caregivers of children where English was not their first language.

The aim of this study was to assess the effectiveness of the concussion management education programme (CMEP) and sideline concussion check (SCC) in rugby using concussion/brain injury (CBI) moderate to serious claims (MSC) made to ACC, and a return on investment analysis.

3. Methods

3.1. Sideline concussion check cards and education

The period between July 2003 and June 2005 was used for analysis of the CMEP. During this time 30,000 SCC were distributed to rugby coaches. In the first year (July 2003 to June 2004) 8,000 SCC were mailed directly to coaches with an additional 12,000 distributed (July 2003 to June 2004) 8,000 SCC were mailed directly to coaches. In the second year (July 2004 to June 2005), 10,000 SCC were distributed in RugbySmartTM workshops; none were mailed directly to coaches.

3.2. ACC concussion/brain injury database extraction

There are two types of acute personal injury claims that represent 99.6% of all claims to ACC, minor and MSC. Both are defined under the Injury Prevention, Rehabilitation, and Compensation Act (IPRC) 2001 with ACC meeting most of the costs of the injuries. To qualify for ACC cover a person presents, with a personal acute injury as a result of an accident, to one of approximately 30,000 registered health professionals ACC has recognised throughout New Zealand.

A minor claim is when ACC only pays a registered health professional (e.g., doctor, physiotherapist) for the medical treatment of a patient who presents with an acute personal injury. Minor claims typically involve a few treatments with ACC meeting most of the cost of treatment. An MSC is a moderate to serious injury requiring entitlement beyond mere medical treatment only. A person with an MSC might have a mix of medical, income replacement and rehabilitation costs associated with an injury. Approximately 80% of the cost of a CBI is met by ACC. To give an indication of severity, a person must be absent from employment for more than five working days to qualify for income replacement from ACC [12]. Of the 296,000 sport claims made to ACC in the 2004/05 financial year costing $USD153 million, only 8% were MSC, yet represented 80% ($USD122 million) of the total cost. ACC measures the change in MSC pre and post implementation as an indicator of the effectiveness of injury prevention initiatives by comparing the actual number of claims as well as a forecast number of claims, based on the trends up to 30 years depending on the intervention. The forecast is used to estimate the number of new MSC that would have occurred had a prevention programme not been in place.

When a person presents for treatment, self-reported information about the injury is collected (such as date of injury, how the injury occurred, how the injury was caused, age, gender etc) and entered into the ACC database. Medical information such as injury diagnosis and injury site (head, knee, ankle etc) is completed by the registered health professional. A medical doctor makes the diagnosis for a CBI claim to ACC, which avoids potentially incorrect assessment of concussion as highlighted in the literature.

For further information about ACC and claim data: www.acc.co.nz.

An exchange rate of 69 United States of America cents for every NZ dollar was used.
Data for this paper were extracted using SAS on 4th January 2006 from the ACC customised database allowing for any claims that occurred towards the end of the study period (June 2005) to be included.

To evaluate the effectiveness of the CMEP intervention, new rugby CBI MSC to the Accident Compensation Corporation (ACC) in 2004 and 2005 were compared with CBI MSC to ACC in 2003. Actual and forecast values were compared on the following criteria:

- Where the injury diagnosis and type were specified as CBI;
- Where the activity prior was ‘Recreation or Sport Activity’ and the scene of the injury was ‘Place of Recreation or Sports’; and
- Where the sport involved was rugby.
- From July 1999 to June 2005, presented in 12 month periods to match distribution;

A comparison was also made for two other groups of CBI MSC made to the ACC scheme from July 1999 to June 2005. The first comparison was non-sport CBI MSC and sport CBI MSC to assess whether there were any policies or CBI treatment changes. The second comparison was various sports that were specifically targeted for use of the SCC (Y) and those that were not targeted (N). To detect further environmental factors that could influence MSC, rugby playing numbers, new rugby MSC, and new sport MSC were also compared.

In addition the number of days from accident date to the date medical treatment was calculated to determine if the SCC directions encouraging players to seek medical treatment were being followed resulting in a small number of days. This analysis was possible as accident date and first treatment date are collected when MSC data and information are entered into the ACC database.

3.3. Return on investment and potential savings analysis

ACC is in the unique position of having 30 years of claims and costs data. This allows an estimate of the average lifetime cost of claims reflecting the length of time the claim requires ACC services (e.g. medical care, income replacement and rehabilitation costs). The average lifetime cost of a sport CBI MSC is approximately USD98,670 per new claim. The return on investment was calculated using the CBI MSC costs compared with the actual production and other programme costs of the CMEP (total cost of USD54,810 comprised of USD21,000 production costs and USD33,810 pro-rata RugbySmart and overhead costs). Estimated potential savings/costs were then calculated by multiplying the number of MSC, both actual and forecast, *ceteris paribus*, by the average lifetime cost of a new sport CBI MSC. These savings were then divided by the total programme costs to provide a return on investment for every USD1 invested.

The equations [7] use the following variables in the formulae:

- \( A \) = Actual claims, the difference between the number of MSC before implementation and post-implementation at a particular point in time;
- \( F \) = Forecasted claims. The claims are adjusted to show what would happen if no programme was in place. This is achieved by using a forecast made based on factors that would have impacted on the ACC claims database that need to be taken into account.
- \( TPC \), Total Programme Costs since implementation. This includes only programme costs invested by ACC and excludes associated costs such as overheads and staff salaries; and
- \( ALC \), Average Lifetime Cost. This represents the cost to ACC of a MSC in the area targeted for implementation, over the time length of the claim. This is important as treatment for some injuries can occur across more than one financial reporting year, particularly MSC. ACC has 30 years of injury data and is able to determine the length and cost of a particular injury type, and the last ten years is used as the best indicator. The size of the data set can estimate the number of treatments, visits, time off employment and other factors to provide what services from ACC the person may require. While the mid point is used, a 95% confidence level is generated. The ALC is the amount paid to either the injured person or to treatment providers. It does not include a portion of ACC operating costs. The ALC is presented at current costs and reviewed each year to reflect changes in costing that may occur, from year to year.

\[
\begin{align*}
\text{Actual} &= \frac{A \times ALC}{TPC} \\
\text{Forecast} &= \frac{F \times ALC}{TPC}
\end{align*}
\]

Post-implementation formulae provide cost-savings and are presented over a ratio of $1 reflecting return on investment.
Table 1  
Key rugby and sport moderate to serious claims (MSC) data pre-implementation (2002/03) and post implementation (2003/04 & 2004/05) of the concussion management education programme (CMEP) including the sideline concussion check (SCC)

<table>
<thead>
<tr>
<th></th>
<th>2002/03</th>
<th>2003/04</th>
<th>2004/05</th>
<th>2002/03</th>
<th>2003/04</th>
<th>2004/05</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Number</td>
<td>Annual % change</td>
<td>Number</td>
<td>Number</td>
<td>Annual % change</td>
</tr>
<tr>
<td>Rugby players</td>
<td>120,903</td>
<td>129,253</td>
<td>6.9%</td>
<td>137,960</td>
<td>6.3%</td>
<td>13.6%</td>
</tr>
<tr>
<td>New rugby CBI MSC (actual)</td>
<td>51</td>
<td>39</td>
<td>−23.5%</td>
<td>44</td>
<td>12.8%</td>
<td>−10.7%</td>
</tr>
<tr>
<td>New rugby CBI MSC (forecast)</td>
<td>51</td>
<td>56</td>
<td>9.8%</td>
<td>61</td>
<td>8.9%</td>
<td>18.7%</td>
</tr>
<tr>
<td>New rugby CBI MSC (forecast v actual)</td>
<td></td>
<td></td>
<td>−30.4%</td>
<td></td>
<td>−27.9%</td>
<td>−58.2%</td>
</tr>
<tr>
<td>New rugby MSC (actual)</td>
<td>3,329</td>
<td>3,428</td>
<td>3.0%</td>
<td>3,311</td>
<td>−3.4%</td>
<td>−0.4%</td>
</tr>
<tr>
<td>New rugby MSC (forecast)</td>
<td>3,301</td>
<td>3,480</td>
<td>5.4%</td>
<td>3,580</td>
<td>2.8%</td>
<td>8.3%</td>
</tr>
<tr>
<td>New rugby MSC (forecast v actual)</td>
<td></td>
<td></td>
<td>−1.5%</td>
<td></td>
<td>−7.5%</td>
<td>−9.0%</td>
</tr>
<tr>
<td>New sport MSC</td>
<td>15,552</td>
<td>17,568</td>
<td>13.0%</td>
<td>19,618</td>
<td>11.7%</td>
<td>26.1%</td>
</tr>
<tr>
<td>Sport new CBI MSC (actual)</td>
<td>246</td>
<td>210</td>
<td>−14.6%</td>
<td>232</td>
<td>10.5%</td>
<td>−4.2%</td>
</tr>
<tr>
<td>Sport new CBI MSC (forecast)</td>
<td>246</td>
<td>290</td>
<td>17.9%</td>
<td>345</td>
<td>17.2%</td>
<td>35.1</td>
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<tr>
<td>Sport new CBI MSC (forecast v actual)</td>
<td></td>
<td></td>
<td>−27.6%</td>
<td></td>
<td>−31.8%</td>
<td>−59.4%</td>
</tr>
<tr>
<td>Non sport new CBI MSC</td>
<td>816</td>
<td>1019</td>
<td>24.9%</td>
<td>938</td>
<td>−7.9%</td>
<td>16.9%</td>
</tr>
</tbody>
</table>

4. Results

4.1. ACC concussion/brain injury moderate to serious claims

Over the two-year period of implementation from July 2003 to June 2005, the following changes in MSC were observed (see Table 1):

- registered rugby playing numbers increased by 13.6%
- new rugby CBI MSC decreased by 10.7% actual and decreased by 58.2% against forecast
- new rugby MSC decreased by 0.4% actual and decreased 9.0% against forecast
- new sport CBI MSC decreased by 4.2% actual and decreased by 59.4% against forecast
- new sport MSC (for all injury types) increased by 24.6%
- non-sport CBI MSC increased by 16.9%

Results presented in Fig. 1 show a comparison between non-sport and sport CBI MSC. This highlights the changes the environment had on MSC. Key factors identified included ACC return to workplace insurance market after a one-year absence (2000/01), and the development and funding of specialised concussion clinics (2001/02). There were no new major environmental changes identified after the CMEP was implemented.

Examination of specific sports that were targeted from 2003/04 (T1) and from 2004/05 (T2) with the SCC indicated a decrease in CBI MSC compared with sports that were not targeted (N) (see Fig. 2). For those sports that were not targeted, typically an increase in CBI MSC was observed. New rugby CBI MSC decreased by 24% (12 CBI MSC) in the first year, greater than the average of 15% decrease observed in all new sport CBI MSC. It is to be noted that the sports other than rugby had 100,000 SCC distributed (40,000 in 2003/04 and 60,000 in 2004/05). In the second year new rugby CBI MSC were greater than the first year, but there was still a decrease of 15% (7 MSC) compared with the baseline 2002/03 claims (see Fig. 2). Against the forecast of the number of new rugby CBI MSC there were 17 fewer in year one and another 17 fewer in year two, (forecast of 56 and 61 respectively) providing a total of 34 less MSC after CEP was implemented (see Fig. 2).

An evaluation of the number of days between the injury and the player presenting for treatment were analysed using median days. In addition, to provide a comparison, lower and upper quartiles were used, 25th and 75th percentiles respectively. The data were compared using rugby, sport (excluding rugby) and non-sport new CBI MSC. Analyses showed that the median of days from injury to first treatment had decreased from six days before implementation to four days after implementation. There were also decreases in the lower and upper quartiles. Non-sport and sport (excluding rugby) also showed decreases, but not to the same magnitude (see Table 2).

4.2. ACC return on investment and potential savings

The total cost to ACC of CMEP including 30,000 SCC for rugby was $USD54,810. The seven few-

5Mean days were excluded from analysis, as the SD indicated a lack of reliability using the mean for this purpose e.g., rugby mean (SD) pre-implementation was 9 (10) and post-implementation 8 (14).
Fig. 1. New concussion/brain injury (CBI) moderate to serious claims (MSC) made to Accident Compensation Corporation ACC from July 1999 to June 2005.

1 – ACC re-enters the work-place insurance market  
2 – ACC funds speciality concussion clinics  
3 – ACC implements the SCC

The ACC claim data can be used to provide an assessment of the effectiveness of any injury prevention initiative. Diagnosis of claims is made by a medical doctor and is not subject to different criteria identified in comparing concussion incidence rates experienced in the literature. ACC claims provide an analysis of an injury prevention initiative in terms of number and cost of injury. The limitation of using claim data to evaluate an injury prevention programme is that it is subject to external influences that need to be excluded. To provide a balanced assessment, other factors, such as population, must be identified that may have influenced claim numbers. This provides a forecast that is used to assess the preventive measures. The impact of some of these ‘known’ external influences can be seen in Fig. 1 such as in 1999/2000 ACC did not participate in the work-related insurance market. This clearly affected MSC. ACC returned to the work-related insurance market and MSC numbers initially increased to previous

5. Discussion

5.1. ACC concussion/brain injury MSC
levels, continuing to rise. The impact of ACC’s leaving and subsequent return to the work-related insurance market was observed in all ACC claims. With respect to concussion, in July 2001 onwards, ACC funded speciality concussion clinics over New Zealand which increased the number of recorded MSC as a result of concussion being correctly diagnosed and treated. While the factors identified arguably affected the overall trend of CBI MSC, there was no evidence of any changes made to the ACC CBI policy process for MSC approval from July 2002 onwards. ACC’s investigations found no other factors [7] that would significantly impact on claim numbers, but identified a number of factors that are considered ‘extraneous random noise’ [10,11] such as the increased older workforce.

An analysis of any rugby specific factors that could have influenced the new rugby CBI MSC numbers was also undertaken. These factors were identified as rule changes (there was no evidence of changes to the rules of rugby, or evidence to indicate the rugby referees were interpreting the rules any different than before), rugby exposure numbers (there was a 13.6% increase in playing numbers; see Table 1), other injury prevention initiatives, and other CMEPs (none were identified). Given some sports (Motor Sport, Water related activities, Cycling) had an increased CBI MSC and others who implemented the SCC (Rugby, Snow, Horse riding) did not (see Fig. 1), there is support for the argument that the ACC system did not change its policy or data collection. If a substantial change had occurred then there would be similar gradient curves observed in Fig. 1 and between sports in Fig. 2. Based on this analysis there were no identifiable rugby factors that would explain the decease in new rugby CBI MSC. Arguably the number of new rugby CBI MSC should have increased given the increase in exposure (playing numbers).

The decrease observed from 2002/03 could have been from an unusual year with ‘unknowns’ occurring that were not present in 2003/04 and 2004/05. MSC could have decreased in 2003/04 despite the introduction of the SCC. Only a long-term analysis from future data will be able to conclusively assess the effect of the SCC. A long-term analysis would also indicate if any ‘self-diagnosis’ by players and coaches was occurring in determining their own return to play decisions within the following week. If this were so, there would be an increase in MSC in future years if the ‘self-diagnosis’ were a ‘mis-diagnosis’. However, ACC data shows 50% of injury MSC are made within 5 days of the injury, 95% are made within two weeks of injury, and about 1% occur over 250 days [10]. Further a change in

Fig. 2. A comparison of new sport concussion/brain injury (CBI) moderate to serious claims (MSC) made to the Accident Compensation Corporation (ACC) from July 1999 to June 2005 for sports where the sideline concussion check (SCC) was specifically implemented compared with sports that were not specifically targeted.
the number of days between injury and first treatment (see Table 2) did not indicate that ‘self-diagnosis’ or ‘mis-diagnosis’ was occurring.

Despite the limitations of the ACC data and the absence of a more suitable mechanism to assess the SCC, the results for the first two years are pleasing. This is especially so given non-sport CBI MSC increased in 2003/04, playing numbers (exposure) in rugby increased, new rugby MSC increased in 2003/04 but decreased in 2004/05. New rugby CBI MSC went against this trend in both years.

The intention to have a standardised system of community concussion management has been achieved. As a result concussion awareness has occurred. As one senior member of the rugby community commented “This (SCC) is an extremely useful tool in helping community coaches with their understanding and management of concussion. I am yet to find one coach or person who weren’t anything but positive about it. The design of the SCC, the ease of use and clarity has greatly assisted our coaches. It has heightened awareness and given coaches some tools to confidently management concussion.” [8]. The re-ordered 40,405 insert cards are evidence that the SCC is being used and the change in the number of days between accident date and first treatment suggest advice is being followed.

5.2. ACC return on investment and potential savings

A cost analysis is useful as an indicator of what the injury prevention programme is returning on investment. As ACC is a taxpayer funded system there is an expectation that injury prevention programmes return value for money. Forecast cost analysis is also important as it may identify environmental changes that may affect MSC. Only a long term trends analysis using accumulated MSC and costs will provide convincing evidence of whether the CMEP is returning value for money. Details on cost-benefit analysis are available in Gianotti and Hume [7].

5.3. Practical outcomes as a result of the CMEP analysis

After the initial evaluation of the use of the CMEP in the first year (2003/04) of implementation it was recommended that:

– The SCC should be extended to all sports and supported by other marketing mechanisms such as posters in community changing rooms. The SCC was implemented in horse back riding (Horse) in July 2004/05 with a decrease in new Horse CBI MSC (see Fig. 1), and Soccer in March 2005. Concussion posters, specifically for rugby and soccer have now been available since June 2005.
– A reference to the ACC website that contains suggested return to play guidelines should be included on the SCC and insert card. This was undertaken in February 2005.
– A tear-off return to play strip with clinic/doctor stamp should be included so that there is an indication of medical clearance following a concussion before a player returns to play. This is to avoid players signing themselves.

<table>
<thead>
<tr>
<th>Number of days pre-implementation</th>
<th>Number of days post-implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rugby</td>
</tr>
<tr>
<td></td>
<td>July 1999 to June 2003</td>
</tr>
<tr>
<td>Mean</td>
<td>9</td>
</tr>
<tr>
<td>Median</td>
<td>6</td>
</tr>
<tr>
<td>1st Quartile (25th)</td>
<td>4</td>
</tr>
<tr>
<td>3rd Quartile (75th)</td>
<td>10</td>
</tr>
</tbody>
</table>

| Average | 62.03 | 50.69 |
| Median | 7 | 5 |
| 1st Quartile | 4 | 3 |
| 3rd Quartile | 11 | 8 |
Acknowledgements

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References