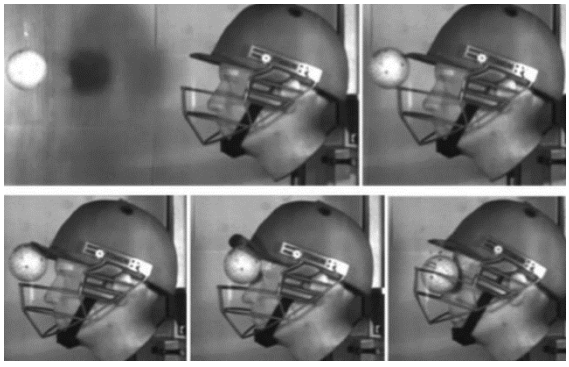
Institution: Cardiff Metropolitan University		
Unit of Assessment: UOA24: Sport and Exercise Sciences, Leisure and Tourism		
Title of case study: Prevention and management of head injuries in cricket and rugby union		
Period when the underpinning research was undertaken: 2013-2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Dr Isabel Moore	Reader in Human Movement and Sports Medicine	2013-present
Dr Craig Ranson	Senior Lecturer in Sport and Exercise Medicine	2011-2017
Period when the claimed impact occurred: August 2013 – December 2020		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact (indicative maximum 100 words)

Moore and Ranson's research has informed policy and practice in identifying and preventing head injuries in cricket and rugby union, nationally and internationally. The impact includes a new **British Standard for Head Protectors in Cricket** (BS7928:2013), a standard the International Cricket Council (ICC) has required all nations to adopt (n=104); a revised **ICC Injury Surveillance Consensus Statement**; the introduction of an **Injury Surveillance System** by the Welsh Rugby Union (WRU) that was adopted by the British and Irish Lions and Guinness PRO14 Rugby Union league; and, a mandatory **WRU Concussion Education Programme** for players, coaches, managers, and referees (n>550).

2. Underpinning research (indicative maximum 500 words)

The injury surveillance research that underpins this impact case study was specifically designed to inform improvements in protective equipment and injury risk management in cricket and rugby union. As a body of research, it dates back to 2013, is aligned with, and in response to the increasing incidence of injuries, as well as the growing concerns for the health and well-being of players within those sports.



In response to the growing prevalence of head injuries among batters in cricket, an examination of the types and mechanisms of head injuries sustained by batters wearing a helmet highlighted clear deficits in current cricket helmet design, particularly to protect against fractures and concussions. The deficits included the ball's ability to penetrate the gap between the helmet peak and faceguard, and lack of protection covering the posterior aspect of the head [R1]. The findings of the research resulted in a new British Standard for Head Protectors in Cricket (BS7928:2013), which came into effect on 1 July 2014 and required helmets to withstand a ball penetrating the helmet peak to faceguard gap. Subsequent research by Moore and Ranson also showed medical attention injuries to occur more frequently than time-loss injuries in cricket [R2] and reported the development of a new mathematical workload metric that identified cricket players at risk of bowling injuries. Collectively, this research also

contributed to the redefining of injury and the calculations used in the revised international consensus statement for conducting injury surveillance in cricket [R3].

Building on the surveillance research in cricket, in collaboration with and supported by a series of grants (Grants 3-8) from the Welsh Rugby Union, Moore and Ranson employed their epidemiology methodology in rugby union to identify priority injury problems and risk factors in club and international rugby. Through their longitudinal, prospective research, Moore and Ranson showed a three-fold increase in the incidence of concussion coincided with a reduction in thigh haematomas at club level [R4], indicating the risk of injury is indicative of tackle-technique and tactical decisions. Additionally, Moore and Ranson found a 38% greater risk of injury following concussion than a non-concussive injury and that players are more likely than not to sustain a concussion after 25 matches [R5]. The novel analytic technique they applied suggested that increasing season length appeared to be detrimental to player welfare.

Building on their earlier research Moore and Ranson surveyed all adult levels of rugby union and key stakeholders (e.g., clinicians, players, coaches and referees) in Wales to identify deficiencies in concussion knowledge and preferred education dissemination routes [R6]. Players, coaches and referees showed poor knowledge of the signs/symptoms of concussion, as well as the misconception that current protective equipment offered protection against concussion. Face-to-face training courses and online resources provided by the Welsh Rugby Union were the preferred education tools. The findings directly informed changes to the content and delivery of a bespoke Concussion Education Programme.

The work has been supported by 8 competitively secured grants with a total value of £340k.
Grant 1: ECB injury surveillance (2013: £21k)
Grant 2: ICC injury surveillance (2013: £31k)
Grant 3: WRU injury surveillance (2012-15; £30k)
Grant 4: WRU injury surveillance (2015-18: £45k)
Grant 5: Preventing Head and Shoulder Injuries through Coach Education (2015-18: £45k)
Grant 6: Impact of concussion on subsequent injury risk (2015: £38k)
Grant 7: WRU injury surveillance (2018-21: £78k)
Grant 8: Player-specific injury risk and the impact of replacement players (2018: £52k).

3. References to the research (indicative maximum of six references)

Outputs comprise epidemiology studies, four of which were published in the top ranked journal (British Journal of Sports Medicine) for Orthopedics and Sports Medicine as per Scimago Journal and Country Rank. [R5] is being returned as part of Cardiff Metropolitan University's submission to UOA24.

[R1] **Ranson, C.,** Peirce, N., & Young, M. (2013). Batting head injury in professional cricket: A systematic video analysis of helmet safety characteristics. *British Journal of Sports Medicine*, 47, 644-648. DOI: 10.1136/bjsports-2012-091898.

[R2] **Moore, I. S.,** Mount, S., Mathema, P., & **Ranson, C.** (2017). Application of the Subsequent Injury Categorisation (SIC) model for longitudinal injury surveillance in elite rugby and cricket: Inter-sport comparisons and inter-rater reliability of coding. *British Journal of Sports Medicine,* 52, 1137-1142. DOI: 10.1136/bjsports-2016-097040.

[R3] Orchard, J. W., **Ranson, C.,** Olivier, B., Dhillon, M., Gray, J., Langley, B., Mansingh, A., & **Moore, I. S.,** et al. (2016). International consensus statement on injury surveillance in cricket: A 2016 update. *British Journal of Sports Medicine,* 50, 1245-1251. DOI: 10.1136/bjsports-2016-096125.

[R4] Bitchell, C. L., Mathema, P., & **Moore, I. S.** (2019). Four-year match injury surveillance in male Welsh professional Rugby Union teams. *Physical Therapy in Sport*, 42, 26-32. DOI: 10.1016/j.ptsp.2019.12.001.

[R5] Rafferty, J., **Ranson, C.,** Oatley, G., Mostafa, M., Mathema, P., Crick, T., & **Moore, I. S.** (2018). On average, a professional rugby union player is more likely than not to sustain a concussion after 25 matches. *British Journal of Sports Medicine,* 49, 506-510. DOI: 10.1136/bjsports-2017-098417.

[R6] Mathema, P., Evans, D., **Moore, I. S., Ranson, C.,** & Martin, R. (2016). Concussed or not? An assessment of concussion experience and knowledge within elite and semi-professional Rugby Union. *Clinical Journal of Sports Medicine,* 26, 320-325. DOI: 10.1097/JSM.0000000000000256

4. Details of the impact (indicative maximum 750 words)

Injury surveillance research conducted by Moore and Ranson for the International Cricket Council (ICC), World Rugby (WR), England and Wales Cricket Board (ECB) and Welsh Rugby Union (WRU) has had significant impact on the identification and prevention of head injuries in cricket and rugby union, nationally and internationally. In relation to cricket, injury surveillance research by Ranson that revealed deficiencies in helmet design resulted in the ICC commissioning a helmet safety project. Led by Ranson, the project involved the ECB, player associations, helmet manufacturers, standards testing houses and academic institutions [E1]. Based on Ranson's research and the project findings, a British Standards Institute panel published a new **British Standard for Head Protectors in Cricket (BS7928:2013)** [E2]. The deficits identified in the underpinning research were used to create the new testing protocol for cricket helmets, which includes a facial contact projectile test to ensure helmets must be able to withstand a cricket ball being directed at specific areas. The new British Standard came into effect on July 1st 2014. The ECB and Professional Cricketers Association began producing helmets that met the new British Standard in 2014 [E3]. On February 1st 2017 the ICC's Helmets/Head Protectors Rules and Regulations were revised, stipulating that **all helmets worn during any format of international cricket matches played by all member and associate nations (n=104) must comply with the new British Standards** [E3]. All major helmet manufactures now make helmets that meet the new standard (with a full list of compliant models available on the ICC's website [E3]) and all international cricketers who wear helmets are now required to wear the new standard helmet. **Cricket Australia** have updated their equipment regulations to state that the **new British Standard must be worn by all individuals playing cricket in Australia (n=~1.65 million),** from junior and community levels through to professional and international levels [E4]. To date, no fatal head injuries associated with wearing new standard helmets have been recorded, with the last death recorded in 2014 before the British Standard was adopted by the ICC [E5].

The head injury research also resulted in funding from the ICC and ECB to revise their respective **injury surveillance programmes**, and **the Injury Surveillance consensus methods** to include a *medical attention* definition and updated calculations. This revised definition is currently being used to identify injury problems that were previously unreported, such as throwing arm pain. Further funding was provided by the ECB, in addition to a fully funded PhD project (2015) to evaluate reported injury rates, usage of the Injury Surveillance system and implementation of the revised methods. The associated research also contributed to the **first International Olympic Committee consensus statement** on conducting injury epidemiology in sports [E6].

As a direct result of Ranson's surveillance research in cricket, the **first injury surveillance programme in Welsh rugby union** was fully implemented in late 2013 at National (men's senior, men's sevens, men's U20s, women's senior and women's sevens) and Club (all 4

professional teams in Wales) level (n=~350 players)[E7]. The system was also adopted by the British and Irish Lions at the end of 2013. The findings of subsequent research led to the development of the **WRU Concussion Education Programme**, which aims to safeguard the on-field identification and subsequent management of head injuries in rugby [E8]. Since the inception of the programme, which has been mandatory for players, coaches, referees and medical practitioners since 2014, **reported concussion rates have risen by 65%** from 12.9 to 21.3 injuries per 1000 match hours [R5] and the management of all reported concussions has adhered to the WRU's graduated concussion return to play protocol. To date, over **550 players, coaches, team managers and referees** have attended one of the courses that have been delivered by medical practitioners within Wales over the last 6 years. Over 150 European club and International level games, including the Rugby World Cup Final in 2015 and Semi-final in 2019, were officiated by referees educated through the concussion education programme.

In 2015, Ranson and Moore received £90K from the WRU to evaluate the impact of the Concussion Education Programme and concussion risk factors (e.g., cervical and shoulder strength, and playing surface) on reported concussions in professional Welsh rugby. As a result of this evaluation and continued investment (£130K; 2018), the courses and programme have been regularly updated to reflect emerging research evidence. National press coverage of Moore's work has also increased the awareness of concussion across key stakeholders (players, coaches, medical staff) [E9]. In 2015, £38K from World Rugby and a Data Science Award from Microsoft Azure ($20K US), enabled Moore and Ranson to provide normative injury rates for international rugby and assess subsequent injury risk following concussion, which led to the development of a **free, online bespoke software tool** that can be accessed by any sport to predict concussion and quantify subsequent injury risk following concussion (released 2020). Finally, as a result of the injury surveillance research and work with Welsh rugby, Moore has been commissioned by the **Guinness PRO14 Rugby Union** league to develop the **first multi-continent injury surveillance system** in rugby union (2019; £45k funding received) [E7]. In sum, collectively the research in rugby has had a direct impact on player welfare by improving coach, medical staff, referee and player concussion management knowledge.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[E1] British Standard Institute cricket head protector **commendation** for Dr Craig Ranson

[E2] British Standard report for BS7928:2013 ('*Specification for head protectors for cricketers'*)

[E3] Helmet regulations from the ICC and list of approved helmets: (https://www.icc-cricket.com/about/cricket/rules-and-regulations/helmets),
ECB **citing** the new standard: (https://www.ecb.co.uk/concussion-in-cricket/helmets#:~:text=The%20ECB's%20current%20guidance%20is,against%20the%20junior%20sized%20ball), and
Cricket Australia **citing** the new standard (document provided)

[E4] Cricket playing numbers in Australia based on total participation estimated from Cricket Australia.

[E5] List of fatal cricket injuries in two publications show **no** head related incidents **since 2014**: Brukner, P., Gara, T. J., & Fortington, L. V. (2018). Traumatic cricket-related fatalities in Australia: a historical review. *The Medical Journal of Australia*, 208, 261-264. DOI: 10.5694/mja17.00908; Meo, A. S. (2019). Cricket ball fatal head injuries. *Journal of the Pakistan Medical Association,* 69. *https*://jpma.org.pk/article-details/9343

[E6] Bahr, R., et al. (2020). International Olympic Committee consensus statement: Methods for recording and reporting of epidemiology data on injury and illness in sport 2020 (including

STROBE Extension for Sport Injury and Illness Surveillance (STROBE-SIIS)). *British Journal of Sports Medicine*, 54, 372-389. DOI: 10.1136/bjsports-2019-101969

[E7] Rugby injury reports: Welsh Rugby Union 2013/14 Regional injury surveillance report and Guinness PRO14 Rugby Union league 2019/20 injury surveillance report.

[E8] Welsh Rugby Union press release relating to launch of **concussion education** programme. Highlights the collaboration with the Sports injury Research Group (SiRG).

[E9] BBC News stories:
Article with Dr Moore discussing the need to reduce injury risk within Rugby Union, particularly to reduce the risk of concussion.
BBC Wales Live interview with Dr Moore discussing the risk of concussion in Rugby Union and the impact concussion has on players.