MATCHING THE DENSITY OF THE RUGBY PLAYING POPULATION TO THE MEDICAL SERVICES AVAILABLE IN THE EASTERN CAPE, SOUTH AFRICA

By

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Declaration

I, Simon Moore, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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(Date)

Acknowledgements

To Prof Mike Lambert for his wisdom, guidance, patience on my journey towards completion of the MSc.

To my wife Charlotte, for everything, always.

"*Rugby injuries are an important source of morbidity in young men. They need to be better understood if their frequency and consequences are to be reduced*."

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List of Abbreviations/Terms

Ball-carrier	The attacking player who has possession of the ball during a tackle
Catastrophic injury	Any life threatening injury to the neck, head, spine or brain that has potential to cause permanent disability and results in the emergency admission of a rugby player to a medical care centre or hospital
Injury Risk	The likelihood that harm will occur when exposed to an activity
Line out	The way the game re-starts after the ball crosses the side boundaries of the field. The forwards of each team form a single file formation and compete to catch the ball which is thrown in between the two lines
Maul	Loose scrum, formed by a player who has possession of the ball and is still on his feet
Passing	Technique used to get the ball to a teammate. The ball has to travel backwards for a legal pass to take place
Ruck/Breakdown	After the tackle, players contest for the ball over the grounded player(s)
Rugby Union	A full contact team sport, played with 15 players on each team, on a grass field, with an oval ball. Points are scored with a try (5 points), penalty (3 points) , drop goal, (3 points) and conversion (2 points)
Safety	Lowering the risk of injury
SA RUGBY	South African Rugby Union
Scrum	Contact phase of play where the eight forwards go into a set formation by interlocking arms and pushing against the opposition.
Tackle	A tackle is characterised by a ball carrier, contacting an opposing player, known as the tackler. During a tackle, the tackler physically impedes the attacking ball carrier to prevent progress towards the try line, and tries to regain ball possession.

World Rugby	The international body that governs rugby in throughout the world. This was formerly known as the International Rugby Board.

Abstract

Background: Rugby Union is a popular contact sport played worldwide. The physical demands of the game are characterized by short duration, high intensity bouts of activity, with collisions between players, often while running fast. The head, neck, upper limb and lower limb are common sites for injury. Although catastrophic injuries are rare in rugby, they do occur. Immediate action (4-hour window) must occur after the injury to minimise the damage incurred from a catastrophic injury. This infers that a well-functioning medical infrastructure should be available to anticipate injuries of this nature and provide treatment for the best possible outcome. Currently there is no system information/map in South Africa describing the medical infrastructure in relation to places where clubs and schools practice and play matches. Such a system may assist providing early and immediate transfer of injured players to the appropriate treatment facility. This would minimise the damaging effects caused by delays in medical treatment. Therefore the aim of this study was to; (i) investigate and report on the location, distance and travel time from rugby playing/training venues in the Eastern Cape to the nearest specialist hospital where a player may be able to receive adequate treatment for a catastrophic injury, and
ii) report on safety equipment available at these playing venues to facilitate this transport in a safe manner.

Methods: All the clubs (n=403) and schools (n =264) that played rugby in the Eastern Cape were accounted for in the study. However, only 15 clubs and 35 schools were included in the analysis as they had their own facilities for training and playing matches. Distances between clubs/schools and the nearest public, private and specialized hospital (able to treat catastrophic injuries) were measured. In addition driving time was also estimated between the clubs/schools and nearest specialized hospital to determine if an injured player could be transported within four hours to receive medical treatment for a catastrophic injury. In addition medical safety equipment was audited (according to information provided by SA RUGBY)) for each club and school to identify if they were meeting the minimum safety standards as set by SA RUGBY.

Results: Twenty schools were identified as being less than one hour away from the nearest hospital equipped to deal with catastrophic rugby injuries; nine schools were between 1-2 hours away and six schools were between 2-3 hours away.
All schools were within 100 km driving distance of the nearest public hospital; 28 schools were within 100km driving distance to the nearest private hospital. For seven schools, the nearest private hospital was between 100 and 150 km away. Fourteen schools had spinal boards, eleven had neck braces, ten had harnesses, nine had change rooms, five had floodlights, and twenty-two had trained first aiders. Six schools were located 2-3 hours away and were at higher risk due to a lack of first aid equipment. Ten clubs were less than an hour away from the nearest hospital equipped to treat catastrophic injuries; two clubs were between 1-2 hours away, two were between 2-3 hours away and one was between 3-4 hours away. All clubs were within 100 km driving distance of the nearest public hospital. Nine clubs were within 100km driving distance to the nearest private hospital, three clubs were based between 100 and 150 km from the nearest private hospital and three were based over 150km away from the nearest private hospital. Twelve clubs had a spinal board, eleven clubs had neck braces, ten clubs had harnesses, ten clubs had change rooms, seven clubs had floodlights and twelve clubs had first aid trainers. One club was classified as high risk as it was located 2-3 hours away from the nearest hospital equipped to manage a catastrophic injury and had no first aid equipment.

Discussion/Conclusion:

No clubs or schools included in the study were more than four hours away from a hospital that was equipped to deal with a catastrophic rugby injury. Therefore, any player who suffers a catastrophic injury should be able to get to treatment within the 4-hour window period. Another finding was that not all clubs or schools possessed the minimum equipment required to host training or a rugby match. SA RUGBY can take appropriate action towards these clubs and schools to ensure that they maintain the safest possible practice to not put their own players at increased risk.

Chapter 1

Introduction and Scope of Thesis

Rugby Union (henceforth "rugby") is a popular contact sport played worldwide with over three million males and females players. There are 118 international unions[10]. Each team has 15 players and eight substitutes. Rugby is popular in South Africa with approximately 287 034 junior players and 147 203 senior players[43].

Rugby is a contact sport that involves collisions between players, often occurring at high speeds. There is an increase in magnitude of forces acting on various parts of the body and thus the players involved are at risk of bodily harm and injury[43, 9.] . The head, neck, upper limb and lower limb are all common injury sites. The most common injuries are ligaments and muscle strains[43, 9]. Common sites of injury appear to be pelvis, hip and knee caused mainly at the tackle phase of gameplay[21]. Any head, neck, spine or brain injury that is life-threatening, or has the potential to be permanently debilitating and results in the emergency admission of a rugby player to a hospital or medical care centre, is defined as a catastrophic injury[10]. Catastrophic injuries are rare in rugby but can still occur[1, 11, 5, 20]. A brain or spinal cord injury that results in permanent (>12 months) severe functional disability is referred to as a 'non−fatal catastrophic injury[21]. Severe functional disability is defined as a loss of >50% of the capability of the structure[42].

The outcome of head, brain and spinal cord injuries may depend upon the accuracy, adequacy, speed of first aid management, diagnosis, and treatment within the first few hours after injury[16]. Regional pre-hospital triage protocols should be in place to direct acutely injured patients with potential head, brain and spinal injury to accredited trauma centres. Trauma-trained surgeons need to be promptly available at these centres for initial evaluation and management[16]. The first 24 hours after trauma is the most crucial period for medical intervention[16]. Primary and secondary injuries to the central nervous system are the leading cause of death, underscoring the importance of prompt evaluation by appropriate providers in an appropriate health-care setting[1].

Concern about the high number of spinal cord injuries (SCIs), sustained by rugby players in South Africa were noted for the first time in 1977[24]. The number appeared to increase in the 1980's and again in 2000 and 2006[39]. Players' aged 17 had the highest number of SCIs[24]. Medical personal were present at the time of injury in only about 50% of the cases. Just below 50% of injured players waited longer than 6 hours for acute management[24].

In 2008, The South African Rugby Union (SA RUGBY) in conjunction with the Chris Burger/Petro Jackson Players' Fund developed the BokSmart National Rugby Safety programme, which educated rugby participants about physical conditioning, injury management, and safe techniques in the contact phases of rugby[12]. The aim of BokSmart was to reduce the increasing number of catastrophic injuries associated with rugby in South Africa. The programme has four key components[28]. The first component is educational workshops, which all coaches and referees within the country are required to attend. The second component is online educational material, which is free and easily accessible via the Internet. The material covers a wide range of topics such as sports medicine, management and prevention of injuries, training, physical conditioning and player. The third component is an online entry-level medic programme. This programme focuses on basic first aid in rugby with a focus on head, neck and spinal injuries. The fourth component is a toll free telephone line (Spineline), which provides advice on potentially serious and catastrophic injuries. In addition the toll free service facilitates ambulance transport to the nearest appropriate medical facility[28].

BokSmart specifically targets those closest to the player at the time of injury, namely, coaches and referees. The programme's goal is to ensure a basic standard of prevention, knowledge, and care[6]. There is a fulltime manager employed by SA RUGBY who coordinates management committees, programme content, development, and rollout of the programme on a national scale. The manager organises input and data from scientific experts on various aspects of sports, exercise, and rugby medicine[6]. The most relevant and prioritized content is incorporated into educational videos and is facilitated by the BokSmart trainers to all coaches and referees attending the Rugby Safety Workshops countrywide[6].

BokSmart has highlighted risk factors, implements strategies to address issues that acknowledge regional demographic challenges and employs independent monitoring to assess effectiveness[6].

Since the inception of BokSmart an analysis of serious and catastrophic head, neck, and spine injuries in South Africa over five years revealed a 14% decrease in the number of these injuries at an amateur club level and a 23% decrease at school level[6]. This may be a consequence of a number of factors such as increased awareness of catastrophic injuries, advancing medical care and law changes within the rules of the game. An example of this is that World Rugby recommended certain

law changes to be tried globally for a year during the 2013/2014 season[23]. This was in response to a study that detailed scrum-related catastrophic injury data. These data were able to provide evidence to justify a change in the amateur scrum laws of rugby. The goal of the law changes was to make scrumming a safer aspect of the game[23].

The recommendations for care after injury, as advocated by BokSmart, suggest that a player with a suspected catastrophic cervical spine injury needs to be stabilised and transported to hospital immediately[14]. An appropriate specialist should then assess the player. A diagnosis should be made based on clinical assessment and special investigations[14]. These special investigations may include X-Ray and MRI scans. Once a diagnosis is confirmed, management for the diagnosis may begin. Depending on the diagnosis and severity of the injury, a player may require reduction, inline traction or surgical stabilisation for the cervical spine[14].

In South Africa there are many obstacles that any intervention strategy has to deal with to be effective. Examples include lack of resources, education, limited skills and decreased support from government structures. Currently there are many geographically remote, underprivileged, and under-resourced communities, where catastrophic injuries are highest[6]. This can be explained by the poor infrastructure that cannot support the timely delivery of an injured player to an appropriate medical facility. In addition many of these medical facilities may not have the appropriate specialist services to manage catastrophic injuries.

Therefore in the South African context it is important to have knowledge of available medical services in the respective provinces and the specific impact they may have on injuries caused by playing Rugby Union.

SA RUGBY has a database all the rugby playing clubs and schools in South Africa. This thesis has focused on rugby clubs and schools located in the Eastern Cape Province. Using these data the aims of the study were to:
a) investigate and report on the location, distance and travel time from rugby playing/training venues to the nearest specialist hospital where a player may be able to receive adequate treatment for a catastrophic injury, and
b) report on safety equipment available at these playing venues to facilitate this transport in a safe manner.

The objective of the thesis is to use the results to create a system where SA RUGBY can easily identify areas in the Eastern Cape Province, where playing rugby and hosting matches/tournaments is safe, from the perspective of access to appropriate medical services. Timeous and speedy transport to a medical facility and the availability of the correct safety equipment are considered safe in this instance. Unsafe areas can by identified and appropriate action can be implemented with regard to hosting matches or tournaments in these areas.

The next phase of the thesis is a narrative review of the literature on rugby injuries to put the aim of the thesis into context. The aim of the review was twofold; (i) describe the nature of rugby injuries, and (ii) describe the medical services in the Eastern Cape. This section will be followed by the report of the location of clubs/schools and medical infrastructure to identify the high-risk areas (Chapter 3). The final section (Chapter 4) will discuss the research findings and make recommendations based on the results of the study.

Chapter 2

Literature review

2.1 Introduction

Rugby is a contact sport involving collisions between players often running at high speeds. Players use physical force to tackle opposing players carrying the ball in an attempt to bring them to the ground. There are strict rules governing this phase of play. A tackle is completed when the ball carrier is held and brought to the ground by the tackler. A player simply knocked over, is not considered to be tackled. In this case the player may get back up and continue playing. This phase of play, particularly the tackle, has a high risk of injury[22].

The definition of an injury associated with rugby, defined at a consensus meeting, is "*any physical complaint, which is caused by a transfer of energy that exceeds the body's ability to maintain its structural and/or functional integrity"*[4]. The injury can be sustained during a match or during training. An injury that results in a player receiving medical attention is referred to as a ''*medical-attention*'' injury. An injury that results in a player being unable to take a full part in future rugby training or match play as a ''*time-loss*'' injury[21].

A catastrophic injury is defined as any life threatening injury to the neck, head, spine or brain that has potential to cause permanent disability and results in the emergency admission of a rugby player to a medical care centre or hospital[10]. Catastrophic injuries can be categorised into one of three groups: Acute Spinal Cord Injury (ASCI), Traumatic Brain Injury and Cardiac Event.

In the event of a catastrophic injury, a player requires treatment in a hospital, or medical facility where appropriate assessment and diagnosis can take place. On admission to hospital the patient needs to be examined by a doctor who has access to special investigations such as X-Ray, Magnetic Resonance Imaging (MRI) and possible referral to specialist services such as orthopaedic or neurosurgery[14]. Facilities vary widely and access may depend on geographical location and financial status of the patient[14].

The SA RUGBY Medical Safety and Minimum Standards stipulate that all injured players must have access to public and private health care facilities that are fully functional, fully capacitated, and fully equipped to provide medical care to all rugby

related injuries that may occur[27]. It is the responsibility of the tournament doctor to specify how far away these facilities are at least two months before the tournament is set to start[27].

The Eastern Cape Province has the largest number of public hospitals, per province, in South Africa. There are 72 public health facilities that are run by the government[35]. These include: 47 district hospitals, (level 1), nine regional hospitals (level 2), zero provincial hospitals (level 3), zero national health centres and 16 specialized hospitals. There are nine hospitals offering treatment for spinal/catastrophic injuries[35].

In addition to the public hospitals, there are 15 private hospitals that serve various regions and districts of the Eastern cape. These hospitals are located as follows: one is in Uitenhague, five in East London, five in Port Elizabeth, one in Umtata, one in Queenstown, one in Port Alfred and one in Grahamstown. Within these private hospitals are 53 Intensive Care Unit (ICU) beds, seven specialized ICU beds and 42 high care beds[13].

The main purpose of this review is to provide background for the aim of the thesis.

2.2 Rugby Union in South Africa

The rugby playing population in South Africa is vast, with the players' ages ranging from children as young as six years to adults playing the game. The game is played at the amateur and professional level. The Springboks are the national representative team and constitute the best 22 players in the country. The next level down is the Super 15 Rugby Competition[30]. In the competition in 2018 South Africa will have four teams representing various franchises. They will compete against five teams from New Zealand, four teams from Australia, one team from Japan, and one team from Argentina[30].

From a junior perspective, there are three annual competitions specifically for the under 13, 16 and 18-age groups respectively. The u13 and u18 tournaments are named the Coca-Cola Craven Weeks. The u16 tournament is named the Grant Khomo Tournament. Like the other two tournaments, the competition runs for one week and is held annually at different venues around South Africa, between the top u16 provincial teams [15,40].

The age group tournaments are made up of the top schoolboys per province who compete in a provincial competition. The u18 competition started in the mid 1960's with 15 teams competing in the tournament. The size of this tournament had more than doubled by the year 2000. This resulted in increased exposure for rugby at a schoolboy level. Consequently, more schoolboy rugby matches have regular coverage on national television. With an increased exposure at school and university level, players at a young age are becoming more competitive because the path into senior ranks starts at school[37, 38]. In addition, the pressure placed on international rugby players is filtering into the junior amateur ranks of schools sport. This has resulted in young players, some as young as 13 years old, engaging in strength and conditioning programs to gain a competitive advantage[37].

2.3 Rugby and Injury

Before 1965 there were few papers on rugby and associated injury[31]. The papers that were available reported that the number of spinal injuries associated with rugby were one in every four years[31]. During the 1970s and early 1980s, medical researchers identified a significant increase in the frequency of spinal injuries among rugby union players in many countries[24]. Early sentiment regarding these injuries saw the cause of injury as an "*act of god*" or "*luck of the game*" without any thought of pattern or research[24]. A spike in neck injuries occurred in South Africa in the 1980's with nine players being admitted to hospital with fractured necks directly as a result of playing rugby. In 1984, the mechanism of injury of 67 rugby players were detailed and studied. Many factors were identified as responsible for causing these injuries. A major factor identified was the head being driven into the ground[31]. As a consequence, measures to reduce spinal injuries were proposed and implemented during the 1980s. There was a subsequent reduction in the frequency of spinal injuries recorded during the late 1980s and early 1990s in the United Kingdom and Australia, but not in New Zealand or South Africa[24].

Acute musculoskeletal injuries are common in rugby with the lower limb being the most common region to be injured[36]. Skeletal muscle strain injuries and ligament sprain injuries are the most common types of injuries in rugby players. These are termed soft tissue injuries. They occur at a rate of between 69 and 218 injuries per 1000 playing hours[36].

The concern expressed about rugby related catastrophic injury has been acted upon in South Africa in various ways. Chris Burger, a Western Province fullback, sustained a fatal neck injury during a match in 1980[12]. This led to the establishment of the Chris Burger Fund to raise money to assist injured players. In 1987 Petro Jackson, a Stellenbosch club player, also sustained a fatal neck injury during a rugby match. The fund became known as the Chris Burger/Petro Jackson Players' Fund (CBPJPF) and still exists to support injured players. The fund is also actively involved in research with the goal of making rugby safer[19, 3].

2.4 Epidemiology and Risk of Injury in Rugby

In general, the risk of injury in rugby is high relative to other team sports such as Australian Rules, football and soccer[28]. Reported rates of incidence of injuries requiring medical attention in adolescents playing rugby ranged from 28 to 130 injuries per 1000 match playing hours, with the head, neck, upper limb and lower limb all common injury sites[4, 28]. The incidence of time-loss injury of more than seven days ranged from 1.0 to 1.6 injuries per 1000 playing hours[4]. The overall incidence of injuries in senior men's professional Rugby Union matches was reported as 81 injuries per 1000 player hours, and 3 injuries per 1000 player hours during training[41]. The mean severity for match injuries was estimated at 20 days, and the mean severity for training injuries was 22 days. On an international level it was reported that 55 injuries occur per 1000 hours of playing time in a tournament, where the most common injuries were ligaments and muscle strains[41]. The same study reported that the most common sites of injury were pelvis, hip and knee caused mainly during the tackle phase of gameplay.

A study on the injury risk associated with the scrum in English professional Rugby showed that one third of scrums in competitive matches resulted in collapse[34]. Injury incidence associated with collapsed scrum-events was 8 injuries per 1000 scrums. This was more than double the incidence that occurred in scrums that did not collapse[34]. In South Africa, scrum-related spinal chord injuries were strongly correlated with the scrum engagement phase and the collapse of the scrum[23]. The study suggested that the scrum laws should be scrutinised to see whether any changes could be implemented to make them safer. Consequently a working panel of experts was established to explore interventions. The interventions were focused on the level of impact on engagement, pre-binding of the front rows to improve stability and advancements of the scrum contest after

the engagement. In this regard, certain modifications to the scrum engagement sequence were addressed.

The changes in the scrum laws were implemented and have been in practice since the beginning of 2013 in South Africa. Consequently the International Rugby Board (now known as World Rugby) recommended the implementation of similar law changes to be tried globally for one year during the 2013/2014 season. In this study, scrum-related catastrophic injury data were able to provide evidence to justify a change in the amateur scrum laws of rugby. The goal of the law changes was to make scrumming a safer aspect of the game[23].

SA RUGBY has stipulated a minimum medical requirement for each tournament at all levels to address any injuries that may take place as a result of the contact nature of the sport[27].

2.5 Rugby Related Catastrophic Injuries in South Africa

Although catastrophic injuries are rare in rugby, they can still occur. There have been 198 catastrophic injuries in South Africa between 2001 and 2015, with 38 of these resulting in death[6].

One study aimed to establish an accurate and comprehensive injury incidence registry of all rugby union-related catastrophic events in South Africa between 2008 and 2011[10]. The study found that two out of 100 000 South African professional and amateur rugby players sustained acute spinal cord and traumatic brain injuries[10]. Player's aged 17 years had the highest number of spinal cord injuries. In about half of the cases medical personnel were present at the time of injury. Just below half of the injured players waited longer than 6 hours for acute management. An analysis of serious and catastrophic head, neck, and spine injuries in South Africa over 5 years revealed a 14% decrease in the number of these injuries at an amateur club level and a 23% decrease at school level[6].

The definitions of terms of data collected before 2008 were not standardised and therefore these data should be interpreted with caution. After 2008 the data were collected in a more standardised way. This coincided with the launch of the BokSmart National Rugby Safety Programme, which implements evidence-based sports medicine and exercise research to prevent injury and enhance performance at

all levels of rugby union in South Africa[39].The BokSmart programme has established an injury database, which records the number of catastrophic injuries sustained in rugby. The database also records information about the circumstances before and after the injury.

In the BokSmart database, rugby-related catastrophic injuries are divided into four major categories; Acute Spinal Chord Injury, Traumatic Brain Injury, Cardiovascular Events and Unknown[39]. These categories are further divided and reveal several rugby related injuries causing various levels of disability such as neurological deficit, quadriplegia, full recovery, recovery with neurological deficit and fatalities.

A study published in July 2017 described significant differences in the catastrophic injury incidence rates amongst the Provincial Unions in South Africa[3]. The prevalence of Acute Spinal Cord Injuries and Traumatic Brain Injuries differed across the provinces. Catastrophic injury incidence rates had a wide range between the provincial Unions in South Africa. The lowest was 1.8 catastrophic injuries per 100 000 players and the highest was to 7.9 catastrophic injuries per 100 000 players per year[3]. The study concluded that between 2008 and 2014 there were significant differences in the catastrophic injury rates between the provincial rugby unions South Africa; possibly related to a difference in general socioeconomic status of the players. The study concluded that future studies should investigate whether socioeconomic status is the underlying reason contributing to these differences between provinces.

At schoolboy level, the period of 2005 and 2006 had the highest number of rugby related catastrophic injuries. Twelve catastrophic injuries were sustained each year[39]. Fifteen of the 24 injuries were Acute Spinal Chord Injury “near misses”. A “near miss” is defined as an acute spinal chord injury or neck fracture where full ambulation and recovery are expected. There have been 17 deaths caused by catastrophic rugby injuries in schoolboys since 2001 and 6 of those occurred after BokSmart started collecting data in 2008[6].

At club level, there have been 129 catastrophic injuries since 2001[6]. Most injuries in the club players occurred in 2007 when 14 catastrophic injuries were sustained. There have been 25 deaths resulting from catastrophic rugby injury since 2001 at club and level[6]. Fifteen of those fatalities occurred after 2008.

A cohort study of catastrophic injuries from rugby in South Africa revealed that the average annual incidence of ASCIs and Traumatic Brain Injuries combined was 2 injuries/100 000 players from 2008 to 2011[10]. In addition, the incidence of ASCIs with permanent outcomes was significantly higher at the senior level than the junior level during this period. The hooker position was associated with 46 % of all permanent ASCI outcomes, the majority of which occurred during the scrum phase of play[10].

The higher incidence rate of permanent ASCIs at the senior level may have been related to the different law variations compared with the junior level[10]. The authors of this paper concluded that the BokSmart injury prevention programme should focus intervention efforts on these high-risk areas (i.e. senior level, hooker and scrum).

2.6 Management of Catastrophic Injuries

The timing of intervention and access to care for a catastrophic injury is an important factor to consider when attempting to achieve a desirable outcome[14]. The concept of the "4-hour window" exists in the South African rugby context[7]. This implies that early intervention within this period will have a superior outcome, compared to medical care occurring after this period. The timing of the 4-hour window begins from the moment of injury, i.e. on the field[7].

Spinal cord injuries are classified as complete or incomplete[14]. This is based on whether there is any residual neurological function below the level of the injury. The spinal cord is responsible for relaying sensation, power (muscle control) and pain modalities. If ASCI causes total disruption and no sensation or voluntary muscle activity is present below the lesion, it is termed complete. This assessment is complex as the only remaining sensation may be semi-anal sensation[7]. This sensation is the last to go, and may be present even if the limbs are totally involved. Being able to differentiate between a complete and incomplete spinal chord injury is extremely important, as the ultimate outcome of the two injuries is vastly different[14].

The timing of the assessment is important. In the initial phase, spinal shock occurs. This simply means that the spinal cord is 'stunned' and that all reflexes are suppressed. During this period (24-72 hours) subtle areas of neurological preservation may be masked. Thus, final assessment can only be made once spinal shock resolves and the patient's reflexes have returned[14].

The first 24 hours after trauma are the most critical and injuries to the central nervous system are the leading cause of death. This emphasizes the importance of prompt evaluation by appropriate providers in an appropriate health-care setting[1]. To preserve neurologic function injured players need to be transferred as early as possible to a specialist centre so they can have access to a trauma team that includes specialists in spine and brain injury[16]. Taking the injured patient to a local hospital without a spine surgeon for an X-ray assessment, risks further delays of repeated transfer[14]. On admission, the patient needs to be examined by a doctor who has access to special investigations such as X-Ray, Magnetic Resonance Imaging (MRI) and possible referral to specialist services such as orthopaedic or neurosurgery[14]. It has been recommended that a rugby player sustaining a cervical dislocation should undergo reduction as soon as possible, irrespective of immediate neurological status[14]. Patients that display persistent compression from a fracture and deteriorating neurological status should undergo expedited surgical decompression[14].

Respiratory complications were more common among patients who were treated in non-specialized units or who experienced delays in transfer to a specialized unit[16]. In addition patients admitted to a Spinal Chord Injury Centre within 1 week of injury suffered a lower rate of complications compared with those admitted later[16]. It was also demonstrated that there is a longer duration in the rehabilitation centre for patients who were not originally managed in a specialized treatment centre.

2.7. Standard Protocols for Low Velocity Cervical Spine Injuries

Cervical facet dislocation appears to be the most prevalent injury in rugby resulting in spinal cord injury (SCI)[26]. It has been suggested that there is a window of opportunity for the prevention of permanence of an SCI following a low-velocity trauma rugby related injury[26]. This is based on the premise that permanent damage of the spinal chord results from secondary ischemic injury, rather than primary mechanical spinal cord damage[26]. It was thought that if ischemia determines the outcome, then the time from injury to reperfusion is a critical factor. In accordance with this mechanism a protocol was developed at Conradie Hospital, Cape Town, South Africa, with the goal of reducing rugby related cervical facet dislocations within four hours of injury to prevent permanent neurological damage from occurring[26]. The protocol included the following:

All patients were immediately admitted directly to the intensive care unit. Initial assessment took place in the intensive care unit and included a neurological examination, Frankel grading, radiographs of the cervical spine and monitoring of heart rate, oxygen saturation and blood pressure[26]. Once the dislocation was confirmed via radiology, fluoroscopy was performed and callipers were inserted. The patient was strapped to a weighted pack bed with a low head pack, which enabled cervical traction to be applied in sufficient cervical flexion to allow the facets to be unlocked and to facilitate subsequent neck extension. Morphine and diazepam were administered for analgesic and muscle relaxing purposes. The consciousness of the patient was maintained so that there could be communication about any neurological changes. Rapid closed reduction was performed using 4.6 kg (10 lb) increments of traction, under fluoroscopic control, until reduction was achieved[26].

Clinical reassessment was performed before each weight increment to ensure no deterioration in clinical or neurological status. The most common weight utilised to achieve reduction was 37 kg (81 lb). An audible or palpable click was often heard when the facet joints successfully reduced. Once reduction was achieved, the neck was put into moderate extension and the traction weight was reduced to a maximum of 4.6 kg (10 lb)[26].

This protocol was applied to 57 patients with acute SCI and facet dislocation sustained when playing rugby. The protocol enabled reduction within about ten minutes in all but two patients. No complications occurred[26]. The study concluded that patients in this series had a significantly improved neurological out-come if reduction was achieved within four hours of injury, using the abovementioned protocol[26].

Imaging Protocols

It has been recommended that patients should be assessed for risk of cervical spine injuries according to evidence based decision rules[2]. A commonly utilised protocol is the National Emergency X-radiography Utilisation (NEXUS) protocol[2]. The NEXUS criteria were shown to have a sensitivity and specificity of 99.6%, and 12.9% respectively. The NEXUS protocol stipulates that cervical spine injury cannot be excluded if any of the following criteria are present on assessment: midline cervical tenderness, altered mental status, focal neurologic deficit, evidence of drug or

alcohol intoxication and presence of other injury considered painful enough to distract from neck pain[2]. If none of these criteria are present, the patient is considered to be at low risk of cervical spine injury and does not require cervical spine imaging. Conversely, if any of the criteria are present, cervical spine imaging is recommended to exclude injury[2].

Another protocol used is the Canadian C-Spine Rule[2]. This protocol hinges on three high risk factors in alert patients that mandate cervical spine imaging. If the patient is more than 65 years old, if there has been a dangerous mechanism of injury or if there is any sensory neurologic deficit, then cervical spine imaging is recommended. Additionally, this rule suggests that if the patient is unable to rotate the neck to 45 degrees to the right and left, then imaging is required[2].

At present there does not seem to be a preferred method or protocol in an emergency medicine context, within South Africa.

2.8 Medical Infrastructure in South Africa: Levels and Definitions

The South African Government has formatted the definitions of medical infrastructure into a hierarchical list[13]. This is to enable more efficient management of scarce resources. As members of the public engage with the public health system, they are guided by a specific referral system, which may enable access to higher levels of care. To access higher levels of care, a patient needs to be assessed and referred by health workers at lower level institutions with exception of medical emergencies[13].

Primary Health Care services are made up mainly of clinics. A clinic is defined as a facility where a wide spectrum of primary health care services is administered. Nurses manage these clinics, although doctors visit many clinics regularly. Clinics are typically available to the public for 8 hours a day[13]. If a more specialized level of care is needed, patients have to be referred to secondary level (hospitals) by clinic staff[13].

Community Health Centres are equipped to provide accident and emergency services in addition to 24-hour maternity services. Patients may be observed in the Community Health Centres for a maximum of 48 hours. These centres have about 30

beds[13]. They usually do not have operating theatres. Patients can undergo treatments in a procedure room when is it appropriate. No general anaesthetics are administered in Community Health Centres, and they do not admit anyone as inpatients.

Primary level services offer a wide range of health services that involve preventive, promotional, curative and rehabilitation services. Examples of these are mother and childcare, immunisation, family planning, treatment for sexually transmitted infections, minor trauma and care for those with chronic illnesses (e.g. diabetes, hypertension)[13].

Hospitals are designated for people who need to be admitted as inpatients. All hospitals offer outpatient services as well as casualty/emergency care[13].

Categories of hospitals

Three categories of hospitals exist in South Africa; level 1, level 2 and level 3. Each category is characterised by the provision of different levels of particular services[13].

A district hospital is defined as a level 1 facility. These hospitals generally serve as the first level of referral. They are open 24 hours a day, offer outpatient and inpatient services. A 24-hour emergency service and an operating theatre are usually available in these facilities[13]. They have diagnostic and therapeutic services, such as X-Rays, and basic laboratory tests. General practitioners are usually available to assess and treat patients and they usually have a functional operating theatre. Although general anaesthesia can be administered in these hospitals, there are no intensive care units available for critically ill patients[13]. District hospitals provide diagnostic, treatment, care, counselling and rehabilitation services. They usually offer services including, surgery, psychiatry, rehabilitation, primary health care, obstetrics, paediatrics and geriatrics. These hospitals offer treatment for common injuries and a 24-hour resuscitation service[13].

Regional hospitals are facilities that provide services of specialists and general practitioners. They are defined as level 2 facilities and have at least five permanently employed specialists from the following specialties: surgery, medicine, orthopaedics, paediatrics, obstetrics and gynaecology, psychiatry, diagnostic radiology and anaesthetics[13].

Tertiary hospitals are described as level 3 hospitals and are offer specialist and subspecialist care. These hospitals are further categorised into Tertiary 1, 2 and 3 hospitals, according to what services they are able to provide.

A Tertiary 1 hospital has services that are rated as level 3 care. These are services, which requires expertise of professionals working in rare specialities. An example of such a speciality would be cardiothoracic surgery. Tertiary 2 hospitals have a defined package of services, in addition to the specialist services. A Tertiary 3 hospital has an even bigger package of subspecialties; these are also known as Central Referral Hospitals[13].

Central Referral Hospitals offer referral systems for multi-specialty clinical services, innovation and research. They have advanced technological infrastructure and multi -disciplinary teams of people with scarce skills to provide sustained care of high quality[13].

Another category of hospitals are the Specialized Hospitals. These hospitals provide specialized services, which are the primary focus of service of the hospital. For example, there are Psychiatric hospitals, which provide focused care for patients with chronic psychiatric conditions, and Tuberculosis hospitals, which provide focused care for patients with chronic tuberculosis[13].

Private Medical Infrastructure

There are 216 private hospitals in South Africa in total[25]. They are governed by eight hospital groups in South Africa. The three biggest hospital groups, in terms of number of private hospital facilities owned in South Africa, are Netcare, Medi-Clinic and Life Healthcare[25]. These groups make up 65% of all private sector hospitals in South Africa. They collectively own 142 private hospitals. The remaining five groups are Community Health Care, Clinix Health Group, Joint Medical Holdings, Melomed and Mining. These five groups collectively own 20 private hospitals. The remaining 54 are independently owned private hospitals.

Unlike in the public sector, private hospitals are not standardised into categories or levels. However it may be assumed that the private hospitals offer services which

include; surgical theatres, joint replacement, cardiothoracic surgery, vascular surgery, neurosurgery, MRI scans, catheterisation laboratories, twenty-four hour emergency and trauma units[25]. The selection and provision of services in the private sector are guided by the shareholders of the company[25].

Medical Infrastructure in the Eastern Cape Province, South Africa

The Eastern Cape has a population of 6 562 053 people and a geographical land area of 168 966 km[18, 8]. A summary of the all the public and private hospitals in the Eastern Cape, shows that there is one hospital per 1942 km^2 of land with each hospital serving 75 425 people. These data were collected in a census in 2011[18]. Eastern Cape's population increased from 6.6 million people in 2011 to 7.0 million in 2016, making it the third most populace province in the country. The number of households in the province has also increased to 1.8 million in 2016, from 1.7 million in 2011[32].

In the public sector, assessment and treatment of spinal injuries, by definition, can be performed at level 2 Tertiary hospitals[13]. Tertiary Hospitals in the Eastern Cape are located in East London through Frere Hospital and Cecilia Makiwane Hospital[35]. Nelson Mandela Academic Hospital is situated in Umtata and Livingstone Hospital is Port Elizabeth.

In the private sector in the Eastern Cape, the following hospitals and regions offer the following services, which may be able to treat rugby injuries:
In the Buffalo Metropolitan Municipality there are four private hospitals offering an array of services.

- Life Hospital, Beacon Bay, has twenty-four hour emergency services, physiotherapy and two Neurosurgeons available.
- Life East London only offers Internal Medicine and Physiotherapy.
- St Dominic's East London offers Cardiac Surgery, General Surgery and Orthopaedic Surgery.
- Life St James only offers Minor General Surgery and Life St Marks only psychiatric services[25].

There are four Life Private Hospitals in the Nelson Mandela Bay Metropolitan Municipality. Between the four hospitals, there are two that offer general surgery, two that offer radiology (one MRI), two that offer orthopaedic surgery, two that offer cardiothoracic surgery, two that provide physiotherapy, two that have a pharmacy, one that offers Cardiac surgery, and one that offers neurosurgery[25]. In addition Netcare Greenacres Hospital provides twenty-four hour emergency, cardiothoracic surgery, general surgery, maxillo-facial and oral surgery, neurology, neurosurgery orthopaedic surgery, plastic and reconstructive surgery, vascular surgery, radiology and physiotherapy. These services should cover the needs for managing the full spectrum of rugby injuries[25].

Rugby and Safety Standards

The SA RUGBY health and safety guidelines state that the Tournament Doctor is responsible for notifying the identified and approved local Government and Private Medical facilities and hospitals of the upcoming tournament, and the dates, to place these facilities on standby[27]. It is the responsibility of the Tournament Doctor to ensure that the on-call roster for all the specialists at these approved facilities is made available, for the duration of the tournament. It is essential the following services are on standby; trauma unit at an easily accessible hospital, emergency services, pharmacist and a pharmacy. As not every player will be covered by health insurance or medical aid, both private and public hospitals will need to be identified[27].

According to the standards set by SA RUGBY the following services should be available: a fully equipped, functional radiology unit, radiologist, orthopaedic surgeons, physician, sports physician, neurosurgeon, neurologist, cardiologist general surgeon, ophthalmologist, dentist maxillofacial surgeon, plastic/reconstructive surgeon and an ENT surgeon[27].

This demonstrates how important it is to have an understanding of the medical infrastructure in the Eastern Cape. Knowing which services are offered in the different rugby playing areas can expedite decision-making following a serious injury. Although general information can be obtained about the services provided in the private and government sector, there is limited information of the specialist services that each public sector hospital can provide. It should not be assumed that all tertiary and regional hospital could provide specialist care for spinal cord injuries.

Summary of the Literature

The aim of the review was twofold; (i) describe the nature of rugby injuries, and (ii) describe the medical services in the Eastern Cape. It is clear that rugby is popular in the Eastern Cape as there are over 7000 senior male players. At the junior level there are nearly 600 school teams. An important question is whether the medical infrastructure in the province is able to cater for the number and severity of injuries resulting from participation in rugby? Although SA RUGBY has strict guidelines about medical service provision for tournament and matches, the question remains whether these guidelines can be met. Studies show that injuries sustained from rugby are common and are an expected part of the game. Most injuries require some form of medical intervention whether it be a basic assessment or complex surgery. Catastrophic injuries, although rare, do occur in rugby. The first twenty-four hours after the injury are critical in managing catastrophic injuries for the best outcome. Although the private sector has as abundance of specialists and technological services, not every rugby player in the Eastern Cape can afford to go to a private hospital if they sustain a life threatening injury. Therefore, based on the regulations described, it is essential that SA RUGBY is able to quantify the safety measures associated with the sport. Once high-risk clubs/schools are identified SA RUGBY can respond by ensuring they have all the appropriate safety equipment and efficient transport to hospitals. This will reduce the risk to the players, particularly the risk of serious consequences following inappropriate management after injury.

Chapter 3

Matching the density of the rugby playing population to the medical services available in the Eastern Cape Province, South Africa

3.1 Introduction

The South African Rugby Union (SA RUGBY) needs to have an effective mapping system of the location of hospitals, clubs and schools that host rugby matches in the Eastern Cape. The rationale for the mapping system is to guide injured rugby players to the most appropriate medical facility that is equipped to manage the injury. In particular the nearest medical facility, private or public, equipped to handle catastrophic injuries needs to be identified. These data will ensure injured players, particularly emergency cases, are transported to the appropriate medical facilities without delay.

According to principles of best practice, the following medical infrastructure needs to be in place at the match venues for the duration of all SA RUGBY tournaments: *A medical treatment room or medical station should be available at each ground and this room should not be used for any other purpose concurrently (i.e. it may not also be a storeroom or change-room at any time*[27]*. The Medical room should be easily accessible from the playing field for all participants, medical personnel and equipment, ambulance for transportation and/or helicopter evacuation.* The specific compulsory equipment required as a minimum standard should also include, but not be limited to; a trauma board, cervical collar, head block and harness[27].

There is evidence to suggest the first 24 hours after catastrophic injury is the most high-risk period where medical intervention is most crucial[1]. This emphasizes the importance of prompt evaluation by the appropriate medically trained personnel in an appropriate health-care setting that is equipped to treat and manage the injury[1]. In South Africa, the concept of the "4-hour" window exists, with regard to catastrophic injuries[7]. This implies that early intervention, within 4-hours after a brain or spinal cord injury, will have a superior outcome compared to medical care occurring to the same type of injury after 4-hours. An early transfer to a specialist centre that includes specialists in spine and brain injury provides the best chance of preserving neurologic function in the possible presence of an unstable spine[7].

Taking the injured patient to a local hospital without a spine surgeon or the equipment to stabilize and manage a serious head or spinal cord injury delays treatment. Furthermore, this will require another transfer to an appropriate hospital,

which imposes additional risk on the injured patient[14]. In the event of a potentially catastrophic injury, a player should be transferred to a trauma centre immediately[14]. On admission, the patient needs to be examined by a doctor who has access to special investigations such as X-Ray, Magnetic Resonance Imaging (MRI) and possible referral to specialist services such as orthopaedic or neurosurgery[14].

There have been 197 catastrophic injuries in rugby between 2001 and 2015[6]. Thirty-eight of those injuries resulted in death. It is not known how many of the deaths could have been prevented, or the severity of the injury reduced, if the injured player was taken to the appropriate medical care centre immediately.

This study explores ways to reduce this number of catastrophic injuries by having better knowledge of surrounding medical infrastructure in rugby playing populations in the Eastern Cape.

3.2 Aims and Objectives

The aim of this study is to measure the distances and predict the quickest travelling time between medical facilities and clubs/schools that host rugby matches in the Eastern Cape. The objective is to make it easier for medical personnel to identify the most appropriate medical treatment centre after a player gets a serious head or spinal cord injury. This will contribute to, and refine the decision-making process after a player gets a serious injury while playing rugby. Another objective is to identify any "high risk" club or school that is about 4-hours of travelling time away from a specialist medical centre that can treat and manage head or spinal cord injuries or schools.

3.3 Methods

The sample for this study consisted of rugby playing clubs and schools in the Eastern Cape, South Africa. These clubs and schools were identified by SA RUGBY.

The sample in this study included any club or school in the SA RUGBY database that was; a) within the 8 districts of the Eastern Cape, b) has a specific training/match ground. Any club or school without a specified training ground was excluded from the study, because it was not possible to accurately determine their location. It follows that for these clubs and schools it was not possible to determine

the distance to the nearest medical facility. It was also likely that these clubs and schools would not host any competitions, and therefore the reason for doing the study was not applicable to them.

In the SA RUGBY database, each club and school had a physical address in the province. In addition, each club and school detailed whether they had their own playing fields/facilities or not. For the purposes of the study, clubs and schools were included if they; (i) had a physical address which could be found on a map using x and y co-ordinates, and (ii) had their own playing fields.

The census contained details of 1123 clubs and 448 schools in South Africa. Of these clubs and schools, 720 clubs and 184 schools were not located in the Eastern Cape province. Furthermore, 388 clubs and 229 schools, located in the Eastern Cape, did not have their own training fields/facilities (Appendix A and B). It was therefore not possible to determine where these clubs and schools trained for rugby or played matches.

In total, 15 clubs and 35 schools met the inclusion criteria and were used in the study. These data are summarized in Table 1 (clubs) and 2 (schools).

Table 1*: Rugby clubs included in the study*

Clubs	Town/City
Aliwal Buffels RFC	Aliwal North
All Blacks RFC	Potsdam
Black Lions RFC	Port Elizabeth
Brumbies RFC	Grahamstown
Correctional Services RFC	East London
Crusaders RFC	Alice
Gladiators RFC	Port Elizabeth
Kwaru RFC	Port Elizabeth
Landbou Kollege RFC	Grootfontien
NMMU RFC	Port Elizabeth
Police RFC,	Port Elizabeth
Police RFC	Swartkops
Police RFC	East London
Red Lions RFC	Adelaide
Rhodes University RFC	Grahamstown

Table 2*: Rugby schools included in the study*

School	Town/City
Adelaide Gymnasium	Adelaide
Aeroville High	Somerset East
Alexandria High	Alexandria
Archie Velile Secondary	King William's Town
Attwell Madala High	Mthatha
Bisho High	Bisho
Buru Secondary	Butterworth
Cenyu Public School	Stutterheim
Chapman High	Port Elizabeth
Chatty High School	Port Elizabeth
Coselelani Secondary	Motherwell
Dalibaso Secondary	Mthatha
Dale College	King Williams Town
Dangwana Secondary	Dangwana
David Livingston Secondary	Port Elizabeth
Davies Secondary	Butterworth
DF Malherbe High	Port Elizabeth
Douglas Mbopaha	Port Elizabeth
Emaqwatini Secondary	Queenstown
Empumelelweni Primary	Whittlesea
Emzi Secondary	Queenstown
Enkqubela Secondary	Butterworth
Gelvendale High	Port Elizabeth
Grey High School	Port Elizabeth
Gqebenya Secondary	Queenstown
Gwelane High	Butterworth
Hangklip High School	Queenstown
Hankey High	Hankey
Howard Ben Mazwi	Queenstown
Humansdorp High	Humansdorp
Inkwenkwezi High	East London
Itembelihle High	Port Elizabeth
Selbourne College	East London
St Andrews College	Grahamstown
Queens College	Queenstown

A breakdown of the inclusion of the clubs and schools included in the study is shown in figure 1.

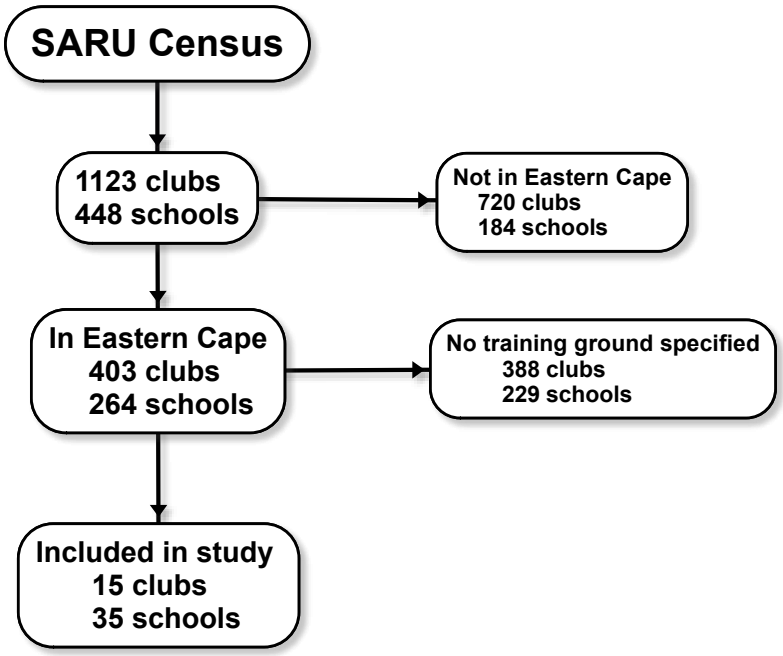

Figure 1: *A breakdown of the clubs and schools in the Eastern Cape that were selected for the study*.

Data Analysis

Three categories of medical facilities were chosen: 1) public/government hospitals, 2) private hospitals, and 3) hospitals that had orthopaedic and neurological surgery facilities. The Eastern Cape Province has the most public/government hospitals, per province, in South Africa. There are 72 public health facilities that are run by the government[17]. These include: 47 district hospitals, (level 1), 9 regional hospitals and 16 specialized hospitals. In addition to the public hospitals, there are 15 private hospitals that serve various regions and districts of the Eastern Cape. The private hospitals are shown in Table 3. These hospitals were found through individual searches and various sources available on the internet.

Table 3*:* *Private hospitals in the Eastern Cape.*

Private Hospital	Town/City
Life East London	East London
Life Beacon Bay	East London
Life St Dominics	East London
Life St James	East London
Life St Marks	East London
Settlers PPP	Grahamstown
Port Alfred PPP	Port Alfred
Netcare Greenacres	Port Elizabeth
Life Hunterscraig	Port Elizabeth
Life Mercentile	Port Elizabeth
Life Isivivana	Port Elizabeth
Life St Georges	Port Elizabeth
Netcare Cuyler	Uitenhage
St Marys	Mthata
Life Queenstown	Queenstown

Within these private hospitals are 53 Intensive Care Unit (ICU) beds, seven specialized ICU beds and 42 high care beds[8].

Nine hospitals with orthopaedic and neurological surgery facilities were identified. One of these hospitals was in Bloemfontein, which is not in the Eastern Cape. It has however been included because it is the closest specialist hospital to Aliwal North rugby club. These hospitals are shown in Table 4.

Table 4*: Number of hospitals with orthopaedic and neurological surgery facilities in the Eastern Cape **.*

Town	Number
Port Elizabeth	2
Uitenhague	1
East London	3
Mthatha	2
Bloemfontein*	1
	9

**Bloemfontein is not in the Eastern Cape but it is the nearest appropriate facility to Aliwal North Rugby Club*

The locations of these hospitals were identified on the Internet and by contacting relevant personnel, where possible. Medical practitioners that the researcher knew personally from working in the Eastern Cape were contacted to confirm various sources of information where possible.

Each club and school address was then entered into Google maps and, using the direction functionality, was mapped to the nearest government, private and surgically suitable hospital. The Google Maps direction function produces two main metrics for this study: a) number of kilometres from club/school to hospital, and b) time taken to drive from club/school to hospital. Google Maps are able to display the fastest route possible with its directions function.

Thus was done for every club and school to calculate the distance (kilometres) to the nearest government, private and surgical hospital respectively. The time taken (hours) by car to get to the nearest surgical hospital (public or private) was also calculated. For the analysis the time taken to drive from the rugby playing facility to the medical facility was split into four categories namely: a) less than one hour, b) between 1-2 hours, c) between 3-4 hours and d) 4 hours and over.

These data were compiled in a spread sheet and descriptive statistics were used to summarize the data. These data were also superimposed onto a map of the Eastern Cape Province, using symbols for clubs, schools and medical facilities to provide a visual assessment of the location of the schools and clubs from the medical facilities.

3.4 Results

A map of the Eastern Cape is shown in Figure 2. The shaded region in the bottom right hand corner shows the location of the Eastern Cape within South Africa. The map of the Eastern Cape is divided into 6 sections; Amatole Region, Drakensberg District, Drakensberg Region. Kei River Region, Stormberg District and Western Region.

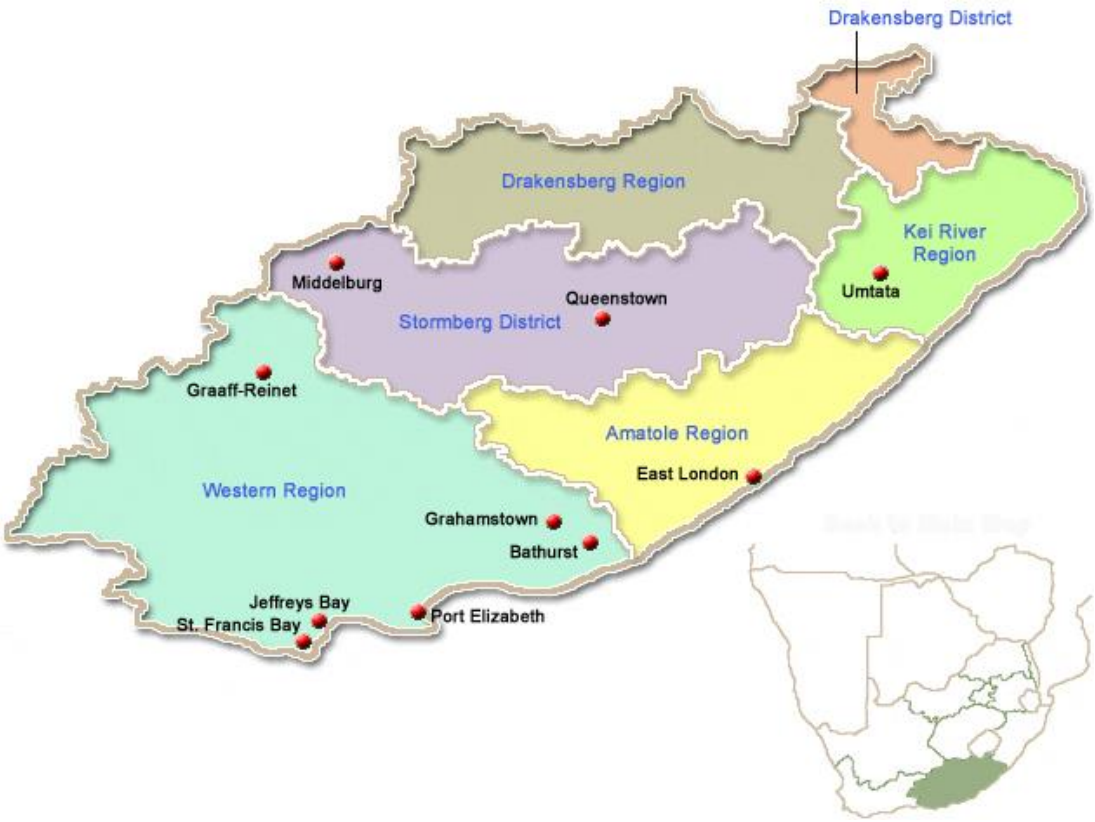

Figure 2: *Map of the Eastern Cape Province, South Africa (Adapted from http://www.sleeping-out.co.za/Eastern-Cape-Map.asp).*

The location of the public hospitals, private hospitals and specialized hospitals are shown in Figure 3. The specialized hospitals are equipped to cater for catastrophic head and spinal injuries.

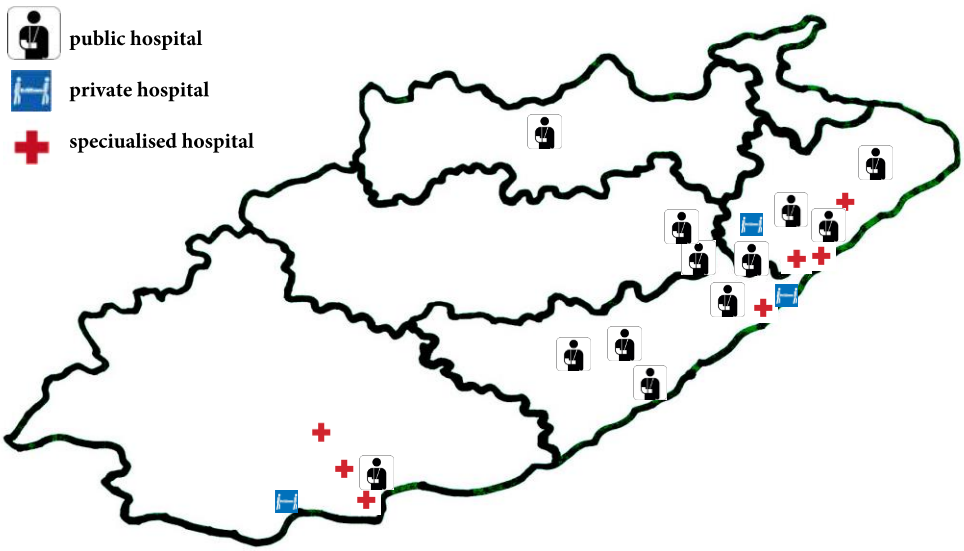

Figure 3: *Distribution of the public hospitals, private hospitals and specialized Hospitals.*

The distribution of the schools which are included in the study are shown in Figure 4

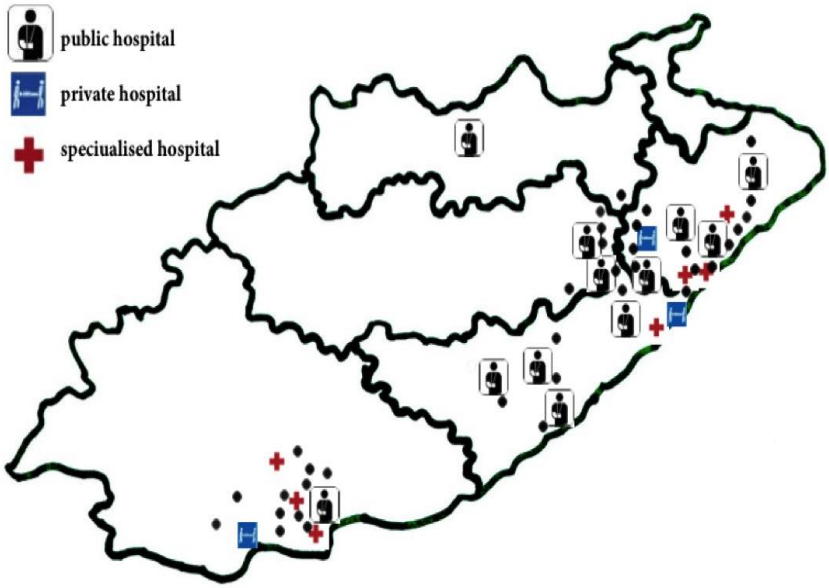

Figure 4: *Distribution of the schools and their proximity to public hospitals, private hospitals and specialized hospitals.*

The distribution of the clubs which are included in the study are shown in Figure 5.

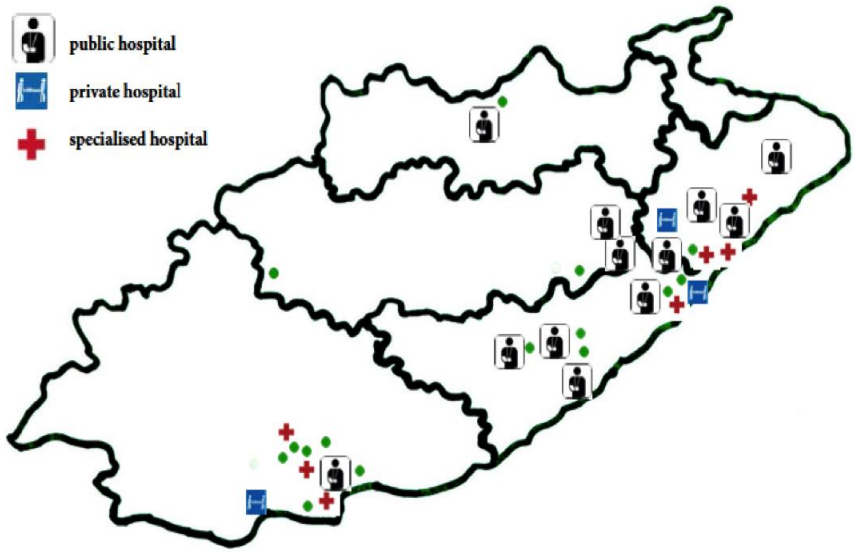

Figure 5 *Distribution of the clubs and their proximity to public hospitals, private hospitals and specialized hospitals.*

The distance the clubs and schools are from the public, private, and specialized hospitals are shown in Figure 6.

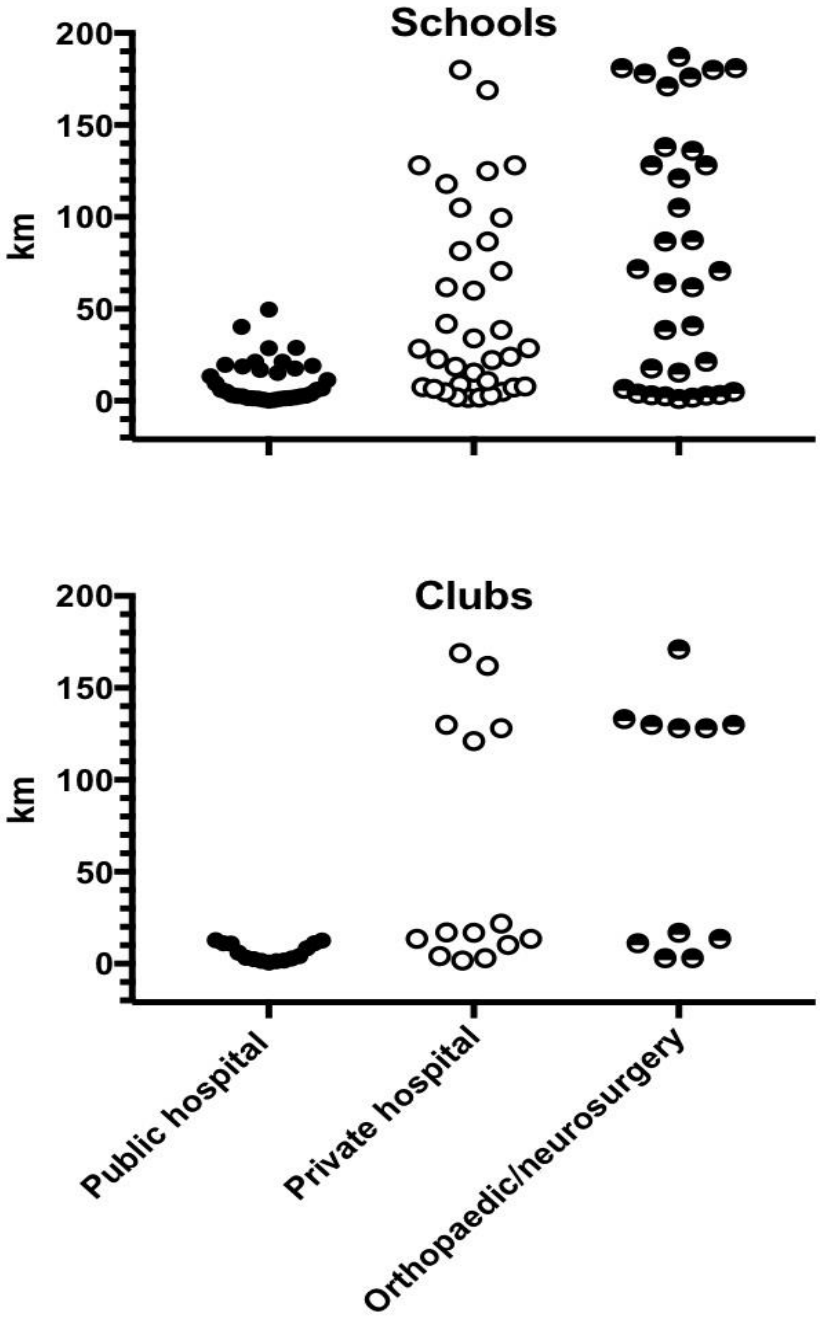

Figure 6: *Distances between playing locations and nearest hospitals for clubs and Schools.*

The number of clubs and schools with respective travel times to nearest facility equipped to deal with a catastrophic injury are shown in Table 5. The number of clubs and school in possession of safety equipment required for stabilising a rugby player who sustains a potential catastrophic injury are shown in Table 6.

Table 5: *Number of clubs and schools and respective travel times to nearest facility equipped to deal with a catastrophic injury.*

	<1 h	1-2 h	2-3 h	3-4 h	>4 h
Clubs	10	2	2	1	0
Schools	20	9	6	0	0

Table 6: *Number of clubs and school in possession of safety equipment required for stabilising a rugby player who sustains a potential catastrophic injury.*

	Spinal Board	Neck Brace	Harness	Change Rooms	Flood Lights	First Aid Trainers
Clubs	12	11	10	10	7	12
Schools	14	11	10	9	5	22

The distances (km) between clubs / schools and the nearest public and private hospital respectively, were split into three categories namely: a) 0-100km, b) 100-150km and c) >150km. The number of clubs and schools in each category are shown in Table 7 and 8

Table 7: *The distance between clubs and schools from the nearest public hospital.*

	Clubs	Schools
0-100 km	15	35
100 – 150 km	0	0
>150 km	0	0
	15	35

Table 8: *The distance between clubs and schools from the nearest hospital equipped to manage catastrophic injuries.*

	Clubs	Schools
0-100 km	9	28
100 – 150 km	3	5
>150 km	3	2
	15	35

When the distance was converted to travelling time, one club was between 3-4 hours and six schools were within 2-3 hours of a hospital that could manage catastrophic injuries. The breakdown is shown in Table 9.

Table 9: *The three club and six schools that were within 2-3 hours and 3-4 hours away, respectively, from a hospital equipped to manage catastrophic injuries.*

2-3 hours	
	Schools
• Aidelaid Gymnasium	
• Emzi Junior Secondary School	
• Gqebenya Junior Secondary School	
• Howard Ben Mazwi Junior	
• Emaqwatini Junior Secondary School	
• Empumelele Senior Primary School	
	Clubs
• Aliwal Buffels Rugby Club	
• Red Lions Rugby Club	
3-4 hours	
• Landbou Kollege Grootfontien	

A detailed breakdown of the safety equipment of clubs and schools and travelling time to the nearest hospital that can deal with catastrophic injuries is shown in Tables 10 and 11.

Table 10: *Safety equipment and travelling time to the nearest hospital that can deal with catastrophic injuries for schools.*

Schools

	< 1h	1-2 h	2-3h	3-4h	4h<	Total
Schools	***20***	***9***	***6***	***0***	***0***	***35***
Spinal Board	9	4	1	0	0	14
Neck Brace	6	4	1	0	0	11
Harness	5	4	1	0	0	10
Change Rooms	5	4	0	0	0	09
Flood Lights	4	1	0	0	0	05
First Aid Trainers	12	6	4	0	0	22

Table 11: *Safety equipment and travelling time to the nearest hospital that can deal with catastrophic injuries for clubs.*

Clubs

	>1h	1-2h	2-3h	3-4h	4h<	Total
Clubs	***10***	***2***	***2***	***1***	***0***	***15***
Spinal Board	8	2	1	1	0	12
Neck Brace	7	2	1	1	0	11
Harness	6	2	1	1	0	10
Change Rooms	6	2	1	1	0	10
Flood Lights	5	1	1	0	0	7
First Aid Trainers	8	2	1	1	0	12

3.5 Discussion

The purpose of the study was to identify clubs and schools that played rugby and determine how long it would take to transport a player with a catastrophic injury to the nearest facility with the necessary services to deal with the catastrophic injury.

The reason for the study was to determine if any facility was beyond the "4-hour rule/window". The "4-hour window" is a general rule that describes how early intervention to a catastrophic injury within this period will have a better chance for a superior outcome, compared to medical care occurring after this period[1].

The distances (km) between clubs/schools and the nearest specialized hospital (equipped to treat catastrophic injuries), were calculated and split into three categories namely: a) 0-100km, b) 100-150km and c) >150km.

Nine clubs and twenty-eight schools were located between 0-100 km, three clubs and five schools between 100-150 km and three clubs and two schools located more than 150 km away from the nearest hospital equipped to manage catastrophic injuries.

When the distance between club/school and hospital was converted to travelling time, two clubs and six schools were within 2-3 hours of a hospital that could manage catastrophic injuries. Only one club (no schools) was between 3-4 hours travelling time to a hospital that could manage catastrophic injuries. No clubs or schools were more than four hours away from a specialized hospital.

The clubs positioned 2-3 hours away included Red Lions Rugby Club (Adelaide) and Aliwal Buffels Rugby Club (Aliwal North). The club positioned 3-4 hours away was Landbou Kollege, Grootfontien (Middleburg). Red Lions Rugby Club did not possess any of the safety equipment required to host rugby training or rugby matches. In addition Landbou Kollege did not possess any floodlights to host rugby training or matches.

The club/school at greatest risk for playing rugby seems to be located at the Red Lions Rugby Club, in Adelaide, as they are located 2-3 hours away from the nearest hospital equipped to manage catastrophic injuries and they possess no safety equipment required to stabilise injured players prior to transport.

The results show that anybody playing rugby for a club or school in the Eastern Cape should not be at risk of falling beyond the "4-hour window" and therefore should not be at risk of exacerbating the seriousness of their injury through delayed treatment.

Therefore, any player sustaining a catastrophic injury should be able to be transferred to a trauma centre immediately which previous literature suggests is best practice[1]. The aim ultimately for the early transfer is to preserve as much neurologic function in the injured person, in the possible presence of an unstable spine. On admission, the patient will be able to be examined by a doctor who has access to special investigations such as X-Ray, Magnetic Resonance Imaging (MRI) and possible referral to specialist services such as orthopaedic or neurosurgery, within the same facility[14]. Early and rapid access to a trauma team that includes specialists in spine and brain injury is critical and the results show that this is likely to occur in the rugby playing regions of the Eastern Cape[1].

The Medical and Safety Minimum Standards Document of 2014 states that a medical room, on or close to the Rugby field, must have the following facilities available: spinal immobilization equipment, trauma board, head block, cervical collar, and spider harness[27]. This study revealed that that not all clubs and schools possessed the minimum equipment required to host training or a rugby match. Out of 15 clubs, three did not have a spinal board; four did not have neck braces, five did not have harnesses, five did not have change rooms, eight did not have floodlights and three did not have qualified first aid support available.

Out of 35 schools, 21 did not have a spinal board, 24 did not have neck braces, 25 did not have harnesses, 26 did not have change rooms, 30 did not have floodlights and 13 did not have qualified first aid support available. Four schools were flagged as being at high risk as they were located between 2-3 hours away from a hospital equipped to

manage catastrophic injuries and had minimal first aid equipment/support. These schools were Howard Ben Mazwi Junior, Emzi Junior Secondary School, Gqebenya Junior Secondary School and Emaqwatini Junior Secondary School.

The abovementioned safety equipment is crucial in stabilising injured rugby players whilst transporting them to hospital to protect from any further injury or damage. If this safety equipment is not available, injured persons may be at risk of further injury during transportation. Cervical spine injuries have potential for permanent loss of neural function (i.e., hemiplegia, quadriplegia) or even a fatal outcome[33]. Therefore, careful management of potentially catastrophic spinal injuries is critical because of the recognized risk of neurologic deterioration[33]. The cervical spine should be immobilised in a neutral position in preparation for transport to an emergency facility, and neck motion should be limited as much as possible[14]. The player's spinal column needs to be secured from any further movement as soon as possible. Should there be an obvious neck deformity, gentle in-line traction may be necessary for comfort and immobilisation. No forced movement should be performed and movement should be limited if there is pain associated[14]. If the player is lying on his side or face down, the medic needs to ensure that the player is safely rolled onto their back as quickly as possible. Manual In-Line Cervical Spine Stabilisation is required to be maintained to prevent rotational torque[14, 6]. The patient should be well immobilised on a firm board before transporting to avoid secondary injury[14].

Based on this description, it may be concluded that if the necessary equipment is not available, or a qualified and skilled first aider is not available, there is increased risk that the patient may experience a negative medical outcome while being transported to hospital.

The SA RUGBY Medical Safety and Minimum Standards stipulates that is the responsibility of the tournament doctor to specify how far away appropriate facilities are at least two months before the start of the tournament[27]. Therefore the results of this study can be practically utilised for medical professionals to be better educated on the surrounding medical infrastructure within the Eastern Cape. These medical professionals can therefore act quicker to ensure that an injured member is going to the correct facility, minimise potential delay and increase the chances of a positive

outcome of medical treatment as much as possible. With the aid of this study, SA RUGBY will be able to identify the level of safety in rugby playing regions in the Eastern Cape and will be able to make appropriate decisions regarding tournament hosting, to ensure the safest environment possible.

This study is not without limitations. Only clubs and schools who had their own facilities, as indicated by the census, were considered. The majority of the clubs and schools included in the census did not list training facilities that could be geographically located. Therefore the majority of the census was not included in the sample. This rendered the sample size small in comparison to the population. In addition, the efficiency of emergency ambulance response, critical in transporting the stabilized patient safely, timeously and effectively, was not assessed. Ineffective and poorly responsive emergency services would certainly hinder the medical outcome of a catastrophically injured rugby player. Furthermore, the skill and experience of the first aiders were not included in the census. Therefore even if the club or school possessed all necessary safety equipment, it could not be assumed that the immobilisation process, a delicate skill within itself, would be correctly and appropriately applied. Therefore first aiders, who were not appropriately trained or experienced in immobilising a spinal injury, could contribute to a negative medical outcome.

There were additional factors associated with transporting an injured patient to a hospital that were not considered. For example, the traffic on the road and the quality of the roads would impact on travelling time. The traffic times (peak hour travel time vs. off-peak) would certainly impact the time taken to transport a patient. Unfortunately, traffic patterns for the various routes were not explored when the distances were calculated. A road of poor quality could reduce the average speed of an ambulance transporting an injured patient to hospital. In addition, jolting and jarring of a patient in an ambulance, due to potholes and poorly maintained roads, may pose increased danger to the patient's health. Adding increased force to an already unstable cervical spine could result in further damage to the spine itself. Further research should include traffic patterns and conditions of the road in the various areas to see if they would delay travel time for the transporting of injured patients.

In summary this study shows the importance for SA RUGBY to quantify the above safety measures associated with the sport. Similar studies should be done around the country to identify high risk playing areas. Once high-risk clubs/schools are identified SA RUGBY can respond by ensuring they have all the appropriate safety equipment and efficient transport to hospital. Hospital protocols should also be identified and selected based on neurological outcome. An example of this is the Conradie Hospital, Cape Town being able to achieve superior neurological outcome when using a specific protocol. Hospitals using similar protocols should be identified and prioritised for management of catastrophic rugby injury. This will reduce the risk to the players, particularly the risk of serious consequences following inappropriate management after injury.

Chapter 4

Summary and Conclusion

The risk of injury associated with playing rugby has been well documented[4, 41]. The lower limb is the most common region in the body to be injured in rugby, and skeletal muscle strain injuries and ligament sprain injuries are the most common types of injuries[41]. On rare occasions injuries may be life threatening. These injuries occur predominantly to the neck, head, spine or brain and have the potential to cause permanent disability[1].

Previous studies have shown that following a potential catastrophic injury early intervention within a 4-hour window, from time of injury to time of treatment, will have a superior outcome, compared to medical care occurring after this period[7]. Furthermore, within these 4-hours various steps need to be completed to treat a player with a catastrophic injury. These steps include, but are not limited to, stabilising the injured person at site/time of injury, ensuring safe transport to a hospital, requiring admission to a hospital, having access to diagnostic services such as X-Ray, Magnetic Resonance Imaging (MRI) and possible referral to specialist services such as orthopaedic or neurosurgery[14].

The study described the nature of rugby injuries as well as the medical services in the Eastern Cape. The study reported on the distance and travel time from a rugby playing/training venue to the nearest specialist hospital where a player may be able to receive adequate treatment for a catastrophic injury. In addition, safety equipment available at these playing venues to facilitate this transport in a safe manner was described.

Clubs and schools within 4-hours travel time to the nearest specialist hospital should be able to get injured players there for treatment within the "window-period" associated with best possible outcome from the serious injury. The data from this study provides information for each club and school. This information can be used to formulate a contingency plan to get the injured player to the nearest appropriate hospital as quickly as possible.

Some clubs and schools failed to meet the minimum required safety standard as they did not possess all the required safety equipment used to manage a catastrophic injury. These deficiencies need to be addressed. SA RUGBY should also use these

data to monitor clubs and schools more closely and implement policies where clubs/schools have to meet the minimum requirements to ensure the safest possible environment to play rugby.

The SA RUGBY Medical Safety and Minimum Standards stipulates that it is the responsibility of the tournament doctor to specify how far away appropriate medical facilities are at least two months before the tournament is set to start. This decision is difficult to make without a systematic assessment of the facilities and their location to the tournament. This study represents the first attempt to create an easy-to-use-platform that medical personnel can quickly refer to for that purpose.

This study had limitations. The primary limiting factor was that the clubs and schools included in the study only represented a small percentage of the total clubs and schools that exist within the Eastern Cape. A total of 403 clubs and 264 schools were identified in the Eastern Cape. The clubs and schools were excluded from the study if they did not have their own training grounds. According to these criteria, 388 clubs and 229 schools were excluded from the study because they did not have their own training grounds or match venues. It was important for this study that the training or match facilities were identified so that the distance and travel time to the nearest appropriate hospital could be identified. Based on these exclusion criteria, this study only represents 4% of the clubs and 13% of schools in the Eastern Cape. As the primary outcome of this study is for SA RUGBY to be able to efficiently map out the safe and unsafe areas for rugby playing in the Eastern Cape, it is important that the remaining 96% of clubs and 87% of schools are accounted for. However, if they do not have their own facilities, it is unlikely they will host a tournament or match. It is more likely that if they were to be a host they will use one of the established fields, which have been included in the audit in this study.

Recommendations for future studies include compiling data about the clubs and schools in the Eastern Cape Province that do not have their own facilities, and, to find out where they train and play matches. These venues need to undergo scrutiny to determine their location and proximity to medical services. An effective way to go about doing this would be to have a representative chosen in each district of the province to physically visit every club and school that plays rugby. They could meet

with the coaches and school staff and confirm the training and match venues. In addition they can enquire as to what the contingency plan is for that club/school in the event of a serious injury occurring. Telephonic follow-ups could be made every 4-6 months to confirm if any changes have been made so that the accuracy of the data is maintained. Funding for this may possibly be provided from SA RUGBY or the Chris Burger/Petro Jackson Players' Fund. This structured approach is shown in Figure 7.

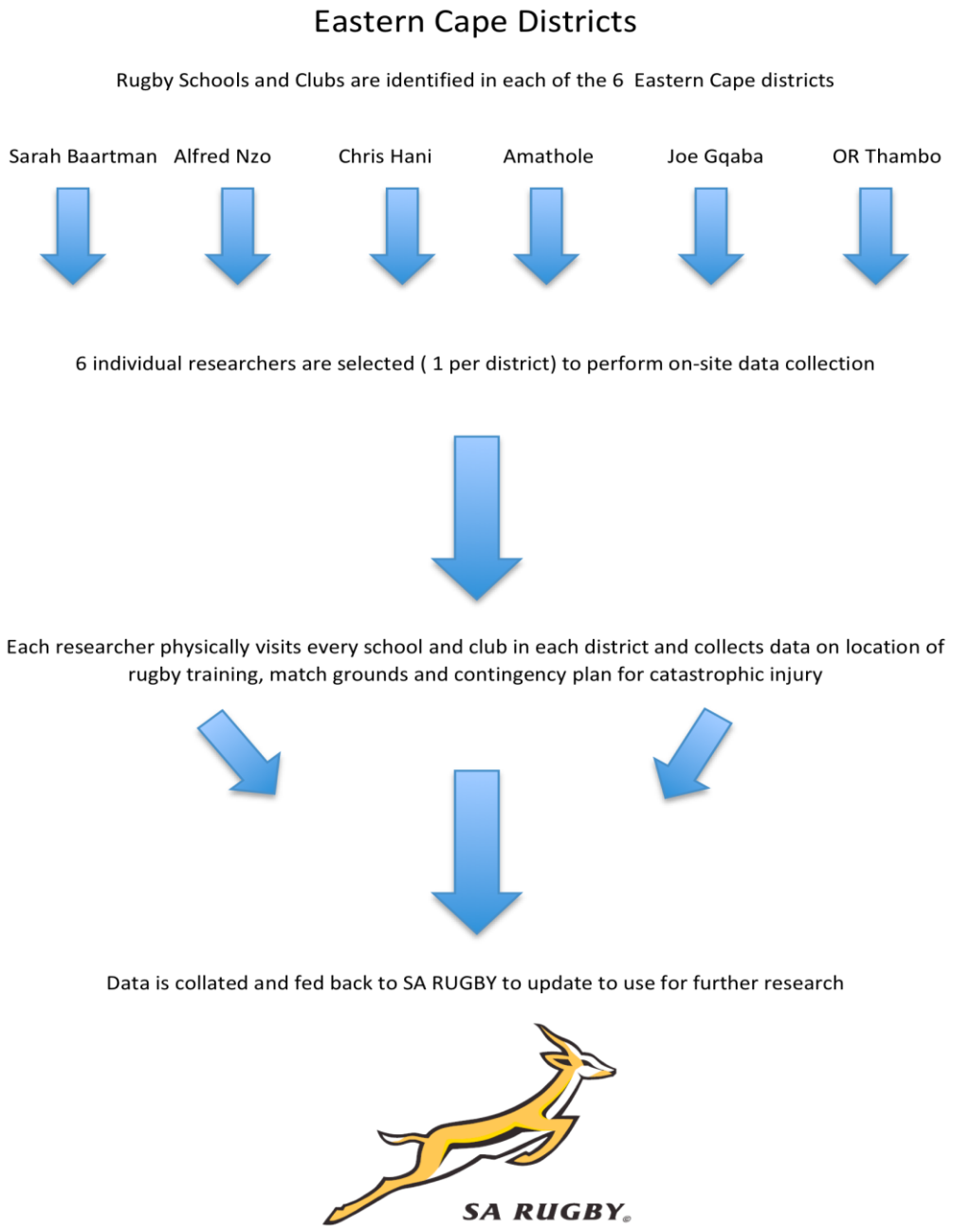

Figure 7 *Flow chart for further data collection process.*

This would ensure that a more accurate representation of the Eastern Cape rugby playing population could be established. This will also contribute to every club or school having a plan to get an injured player to an appropriate hospital or medical services in the event of a catastrophic injury.

Analogies can be made with a Swedish injury prevention programme named 'Vision Zero', which was implemented specifically for road accident fatalities[11]. The aim of the programme was to reduce the number of motor vehicle fatalities to zero. The intervention was successful partially because of its ambitious name and significant buy-in from government organizations as well as the general public[11]. BokSmart was created as South Africa's rugby equivalent to Vision Zero.

To contribute to the longevity of Rugby Union as a popular sport in South Africa, research should be focused on identifying further dangerous aspects of the game that may have a serious impact on the players' physical and mental health. In addition the quality of field side care and emergency services should be taken into account. Lastly, the laws of the game should be continually monitored to assess whether a change can impact on the risk of injury.

Chapter 5

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APPENDICES

Appendix A

Did Clubs have their own playing fields?

Club	**Playing Field Status**
Attackers Rugby Club	No
Abahlobo RFC	No
Aberdeen	No
Acadia rugby football club	No
Adelaide Rangers RFC	No
African Bombers RFC	No
African Eagles Rugby Club	No
African Youth Attackers Rugby Club	No
Africans RFC	No
Alderonians RC	No
Alice Sharks RFC	No
Aliwal Buffels Rugby Club	Yes
All Blacks (Humansdorp)	No
All Blacks (PE)	No
All Blacks Potsdam	Yes
All Blacks RFC	No
All Stars RFC	No
Amatola Stars Rugby Football Club	No
Auckland Tigers	No
Aucklandbucks RFC	No
Balasi Tigers Rugby Football Club	No
Barbarians RFC	No
BC Highlanders	No
BD Blues	No
Bedford Crusaders	No
Bengal Tigers Rugby Football Club	No
Bili Tigers	No
Black Danger Rugby Football Club	No
Black eagles rugby club	Yes
Black Eagles South Rugby Club	No
Black Hawkers Rugby Club	No
Black Hawkers Rugby Club	No
Black Lion RFC (Buffalo)	No
Black Lions (Port Elizabeth)	Yes
Black Lions Rugby Club (Whittlesea)	No
Black Swallows (Alice)	No

Black Swallows Rugby club (KWT)	No
Black Tigers Rugby Club	No
Black Wildcats Rugby Club	No
Blue Birds RFC (Alice)	No
Blue Birds Rugby Club (Stutterheim)	No
Blue Birds Rugby Club (Queenstown)	No
Blue Buffs Rugby Club	No
Boiling Water RFC	No
Boiling water rugby club (Alice)	No
Booysens Pride RFC (Klaville)	No
Born Fighters RFC	No
Breakers Rugby Football Club	No
Buffalo FC	No
Buffaloes RFC (Khayalethu)	No
Buffaloes Rugby Club (KWT)	No
Buffaloes Rugby Club (Berlin)	No
Buffaloes Rugby Club (East London)	No
Buffaloes Rugby Football Club (Buffalo)	No
Buntingville (BV) RFC	No
Busy Bees rugby club	No
Busy Boys rugby football club	No
Cambridge RFC	No
Cape Aloes Rugby Club	No
Central RFC	No
Chicco Rugby Club	No
Cold Stream Crusaders	No
Colesberg Wanderers	No
Colosa RFC	No
Comrades Rugby Club	No
Continental Rugby Football Club	No
Cookhouse United	No
Correctional services rugby club	Yes
Cradock Eagles	No
Cradock Lions	No
Cranes Rugby Club	No
Cruel Vultures Rugby Club	No
Crusaders RFC (Alice)	Yes
Crusaders RFC (Ugie)	No
Cwaru United RFC	No
Dangerous Lion Rugby Club	No
Dangwane Rovers RFC	No
DB Blues	No
Debeneck Home defenders	No
Despatch Oostelikes	Yes
Despatch RC	No
Dimbaza Kings RFC (Dimbaza)	No
Dimbaza Kings RFC (KWT)	No
Dodgers rugby club	No
Dolphins Rugby Club	No

Dovers RFC	No
Dragons	No
Dunting Vale Rugby Club	No
Eagle Stars	No
East Cape Middlands College	No
Eastern Blues RFC	No
Eastern RFC	No
Easterns PE	No
Elliotsdale Black 15	No
Enon	No
Entertainers Rugby Club	No
Evergreens (Tsaba)	No
Evergreens RFC (Middledrift)	No
Evergreens Rugby Club (Cradock)	No
Evergreens Sport Club (Uitenhague)	No
Evergreens United RFC	No
Excelsior (Middelburg)	No
Excelsior (Uitenhage) RC	No
Extension United	No
FABS Football Club	No
Fire Brigade Rugby Club	No
Flamingo RFC	No
Flying Eagles RFC	No
Flying Squad, RFC	No
Flying Stars RFC	No
FNB NMMU Madibaz RC	Yes
Fortune Teller RSC	No
Gardens RC	No
Gasela United Rugby Club	No
Gelvendale Wallabies RFC	No
Gladiators	Yes
Glen Rose RFC	No
Godzi RFC	No
Goodhope RFC	No
Goxe Force	No
Grahamstown Brumbies Rugby Klub	Yes
Green Aloes Rugby Club (Buffalo)	No
Green Aloes Rugby Club (East London)	No
Green Lovers RFC (Stutterheim)	No
Green lovers RFC (Alice)	No
Grey Oldies	Yes
Guerillas Rugby Club	No
Hamilton	No
Hamilton RFC	No
Hamilton RFC (Middledrift)	No
Hampshire	No
Hankey Villagers	No
Harlequins RFC (PE)	No
Harlequins RFC (Buffalo)	No

Helenvale United	No
Highlanders Rugby Club	No
Hilltop Eagles	No
Home boys rugby club (Fort Beaufort)	No
Home boys rugby club (East London	No
Home Defenders RFC (Peddie)	No
Home Defenders RFC (Stutterheim)	No
Home Defenders RFC (Middledrift)	No
Home Defenders RFC (KWT)	No
Home Defenders RFC (PE)	No
Home Defenders RFC (Alice)	No
Home Stars rugby football club	No
Homeboys RFC (Alice)	No
Honeydale RFC	No
Humansdorp RC	Yes
Humansdorp United RC	No
Hungry Lion Rugby Club (Amamthole)	No
Hungry Lions (Buffalo)	No
Hungry Lions Rugby Club (EL)	No
Hungry Lions RFC (KWT)	No
Hungry Lions RFC (PE)	No
Hunters Rugby Club	No
Ikhala FET College	No
Ikhwezi Rugby Football Club	No
Ikwezi Lomso Rugby Club	No
Ikwezi Young Stars rugby club	No
Ilitha United	No
Imidushane Rugby Football Club	No
Indwe RFC	No
Indwe United RFC	No
Isizwe RFC	No
Jansenville RC	No
Jeffreysbay RC	No
Jongi Langa Ladies Rugby Club	No
Joubertina United	No
Jubisa United	No
Kabah United	No
Kareedouw Tigers	No
Karoo Springboks RC	No
Kei Road United Rugby Club	No
Keiskammahoek Sharks	No
Khayelitsha United	No
Killer Bees	No
King Brumbies RFC	No
King Hintsa FET College	Yes
King Sabata Dalindyebo FET College	Yes
Kings (Lovedale FET)	Yes
Kirkwood RFC	No
Klipfontein United	No

Kliplaat	No
Kowie United	No
Kruisfontein United Rugby Klub	No
Kulanathi Rugby Club	No
Kuyga Rugby Club	No
Kwanobuhle RFC	No
Kwaru RFC	Yes
Kwelera Pelicans Rugby Club	No
Landbou Kollege Grootfontein AC	Yes
Langkloof United	Yes
Lily White RFC (Amathole)	Yes
Lily White RFC (Cacadu)	No
Lion Power RFC	No
Loerie Blues	No
Louterwater	No
Lovedale FEF (King)	Yes
Lovedale FET (Alice)	Yes
Lukhanyiso Rugby Club	No
Lusikisiki Falcons	No
MacLear Zebras	No
Makhwalweni Rugby Club	No
Mandela Blues	No
Mbekhwa Tigers RFC	No
Mbizana (Crusaders)	No
Mbokotwana RFC	No
Mbongweni Rugby Club	No
Mid-Eagles	No
Middelburg	Yes
Middelburg Stormers	No
Middledrift Tigers RFC	No
Mighty Blues	No
Mighty Greens rugby club (Peddie)	No
Mighty Greens rugby club (Amathole)	No
Mighty Greens rugby club (Buffalo)	No
Mission United	No
Mkhwezo RFC	No
Molteno Rugby Club	No
Moonlight RFC (Buffalo)	No
Moonlight RFC (Mtlabati)	No
Moonlight RFC (Cacadu)	No
Morning Stars	No
Motherwell RFC	No
Mqanduli Sharks RFC	No
Mthayisa RFC	No
Murraysburg	No
Nailbreakers Ladies Rugby Club	No
Ncera Leopard RFC	No
Ncera Winter Rose	No
Ndabakazi Rugby Football Club	No

New Roses RFC	No
Newtown Blues RFC	No
Ngcele United RFC	No
Ngculu Zebras	No
Ngqamakhwe RFC	No
Ngxabaxha (Mount Frere)	No
Ngxakaxa RFC	No
Nqamakwe Pioneers Women	No
Ntlaza Lions	No
Ntselamanzi United RFC	No
Old Collegians	No
Old Grey Rugby Club	Yes
Orientals RFC	No
Orlando Eagles RFC	No
Osborn RFC	No
Park RC	No
Paterson Lions RC	No
Patriots RFC	No
PE College	No
PE Crusaders RC	Yes
PE Villagers	No
Peddie Ladies Rugby Club	No
Pirates	Yes
Police RFC (PE)	Yes
Police RFC (EL)	Yes
Progress RFC	No
Progress Rugby Klub	No
Protea Rugby club	No
Queenstown Breakers RFC	No
Qumbu Scorpions	No
Rabula United Rugby Club	No
Rangers Sportklub	No
Ready Blues RFC	No
Red fire RFC (Cacadu)	No
Red Lion RFC (KWT)	No
Red Lion Rugby Club (Buffalo)	no
Red Lion RF Adelaide	Yes
Red Lions (Queenstown)	Yes
Red Lions (PE)	No
Red Lions RC Humansdorp	No
Rhinos RFC	No
Rhodes University	Yes
Rising Stars RFC (EL)	No
Rising Stars Rugby Club (KWT)	No
Roaring Lions Rugby Football Club	No
Rock of Ages Rugby club	No
Rock Tigers Rugby Club	No
Rolling Eagles Rugby Club	No
Rosebuds Sports Club	No

Rovers rugby club	No
Rubberhides Rugby Football Club	No
SA Barbarians	No
Sandrift Cheetah	No
SAPS P.E. Rugby Club	Yes
Scorpions RFC (Hewu)	No
Scorpions RFC (PE)	No
Scorpions RFC (Mthata)	No
SE Harlequins	Yes
Sea Birds Rugby Club	No
Sea lion rugby club	No
Sea Water Rugby Club	No
Seymour Green Lovers RFC	No
Shining Stars RFC (Seymore)	No
Shining Stars Rugby Club (Amathole)	No
Shining stars rugby club (EL)	No
Shining Stars Rugby Club (Alice)	No
Siyakhula Youth RC	No
Sky Blues Rugby Club (Uitenhague)	No
Sky Blues Rugby Club (Peddie)	No
Spes Bona Rugby Club	No
Spring Lion	No
Spring Rose RFC (Debenek)	Yes
Spring Rose RFC (Queenstown)	No
Spring Rose Rugby Club (KWT)	No
Springbok rugby club	No
Springrose RFC	No
St Cyprians	No
St Francis Sharks RFC	No
St Marks Rugby Club	No
St Marks Sports Club	No
Star Bombers Rugby Football Club	No
Star of Alice Rugby Club	No
Star of Hope (Alice)	No
Star of Hope RFC (Mthatha)	No
Star of Hope RFC (Mooiplaas)	No
Steynsburg	No
Steytleville Barbarians	No
Steytleville United	No
Storm Breaker RFC	No
Strand Leopards	No
Strong Vultures Rugby Club	No
Suburban RFC	No
Summer Rose RFC	No
Sunday Stars	No
Sunrise RFC	No
Sunrise Rugby Club	No
Swallows Grahamstown	No
Swallows RFC Uitenhage	No

Swallows Rugby Club Mooiplaas	No
Swifts Police	No
Tails Rugby Club	No
Tarkastad Stars	No
Tembu Rugby Club	No
Thekwini RFC	No
Thistles	No
Tigers RFC (Debenek)	No
Tigers RFC (Somerset East)	Yes
Tigers RFC (EL)	No
Try Again RFC	No
Trying Brothers RFC	No
Trying Stars RFC	No
Tsolo RFC	No
Tsomo Rangers RFC	No
Tyutyuza Black Lion RFC	No
Uitenhage Rugby Klub	Yes
Union	No
United Barbarians RFC	No
United Brothers rugby club	No
United Sports Club	No
Universals	No
University of Fort Hare	Yes
Vela RFC	No
Villagers	No
Visitors	No
Vultures RFC (Debenek)	No
Vultures RFC (Berlin)	No
Wailers Sports Klub	No
Wallabies (Middledrift)	Yes
Wallabies RFC (Alice)	No
Wallabies RFC (Mthatha)	No
Wallabies RFC (Bisho)	No
Wallabies RFC (PE)	No
Walmer Wales	No
Walter Sisulu University Unitra Rugby	No
Wanderers RFC	No
Western Eagles rugby club	No
Western leopards rugby club	No
Western Vultures RFC	No
Wild Boys	No
Windvogel United RFC	No
Winter rose RFC (Grahamstown)	No
Winter Rose RFC (Fort Beaufort)	No
Winter Rose RFC	No
Winter Rose Rugby Club (EL)	No
Winter rose UIT	No
Wonderful XV	No
WSU Ibika	No

WSU Womans RFC & Mens IBIKA	Yes
XV Attackers	No
XV Attackers Rugby Football Club	No
Young Brothers rugby club	No
Young Collegioans RC	No
Young Ideas RFC	No
Young Killers rugby club (Peddie)	No
Young Killers rugby club (EL)	No
Young Leopards RFC	No
Young Lions Rugby Club (Stutterheim)	No
Young Lions Rugby Club (Shama)	No
Young Lions Rugby club (EL)	No
Young Sader Rugby Club	No
Young Sharks Rugby Football Club	No
Young Spurs RFC (Alice)	No
Young spurs Rugby football club (EL)	No
Young Stars (Amathole)	No
Young Stars Rugby Club (Peddie)	No
Young Stars Rugby Club (Middledrift)	No
Young Stars Rugby Club (Kidds Beach)	No
Zibokwana RFC	No
Zwelakhe RFC	No
Zwelitsha Sharks RFC	No
Zwide United	No

Appendix B

Did schools have their own playing fields?

School	Playing Field?
Aberdeen Secondary School	No
Adelaide Gym	Yes
Addo	Yes
Aeroville High	Yes
Agulas School of Skills	Yes
Alexandria	Yes
Arcadia	No
Archie Velile SS School	Yes
Asherville	No
Athur Ngunga	No
Attwell Madala High School	Yes
Bavumeleni JSS	Yes
Bethel College High	No
Bisho High	Yes
Bizana SS	No
Booysens Park	No
Botshabelo Youth	No
Buru JS School	Yes
Cacadu SS	No
Cambridge	Yes
Carel du Toit	No
Cenyu Public School	Yes
Chapman	Yes
Charles Morgan Public	No
Chatty	Yes
Chebenca Farm JSS	No
Cingani High	Yes
Coffee Bay JSS	No
Coselelani	Yes
Cowan High	No
Cwebeni JSS	No
Dale College	Yes
Dalibaso SSS	Yes
Dalindyebo SSS	Yes
Daliwe PPS	No
Dangwana SSS	Yes
Daniel Kutiso	No
David Livingstone SSS	Yes
David Mama High	No
Davies JSS	Yes
DF Malherbe	Yes
DF Malherbe	Yes

Dilizintaba SS School	No
Douglas Mbopaha SSS	Yes
Dumalisile SS School	No
Ekuphumeleni High	No
Ekuphumleni	No
Elethu Primary School	No
Emaqwatini JSS	Yes
Empumelelweni SP School	Yes
Emzi JS School	Yes
Enkqubela PS	Yes
Enqabeni JSS	No
Ezingqayi SSS	No
Fameni J.T. School	No
Fanti Gaqa Primary	No
Forbes Grant High	No
Fundani HS	No
Gamble Street High	No
Gasela High School	No
Gcato SS School	No
Gelvendale	Yes
Godzi JS School	No
Gqebenya JS School	Yes
Graeme College	Yes
Grey High School	Yes
Gwaba	No
Gwelane HS	Yes
Hangklip	Yes
Hankey High	Yes
Hillside High	No
Holomisa SSS	No
Howard Ben Mazwi JSS	Yes
Hudson Park	Yes
Humansdorp	Yes
Ikhwezi Technical Centre	No
Inkwenkwezi High School	Yes
Iqonce High School	No
Itembelihle High	Yes
Ithembelihle	No
J F Mati High	No
JA Calata	Yes
Jalamba SSS	No
Jamansile SS	Yes
James Jolobe	Yes
Jamukuluwyisa SSS	No
Jansenville	No
JJ Njeza HS	Yes
John Bisseker High	No
Johnson Nqonqoza	No
Jongabantu SS School	Yes

Jongilanga Public School	No
Jongile Nompondo	No
Jongilizwe	Yes
Joubertina	No
JS Skarjana SSS	Yes
Kasa JSS	No
Kei-Road Combined	Yes
Khotso JSS	No
Khulani Commercial High School	Yes
Khwezi Lomso High	Yes
Kingswood College	Yes
Klipplaat SS	Yes
Komga Public	No
Kulanathi SSS	Yes
Kulani Commercial	No
Kulisile Comprehensive	No
Kunene Junior Secondary School	No
Kuyasa JSS	No
KwaDick JS School	No
Kwamagxaki High	Yes
KwaZakhele	No
Kwelegha Public	No
L.F. May High School	No
Langa SS School	No
Lawson Brown	Yes
Lehana High	No
Lilana Senior Secondary	No
Linkside High	Yes
Lovedale Primary School	No
Lucwaba JSS	No
Lukhozi HS	No
Lungisa High	No
Lungiso High School	No
Lutubeni SSS	Yes
Luzie Drift SSS	Yes
Lwandlekazi	No
Mahamane JS School	No
Makaula JS School	No
Manzi Olwandle Senior SS	No
Mary Waters High	No
Masiphathisane High	Yes
Matthew Goniwe	Yes
Mbanyana JS School	Yes
Mbozisa JSS	Yes
McClaglin	Yes
Mdlankomo JSS	No
Merrifield Prep	Yes
Mfesane High	Yes
Mhlontlo Secondary	No

Michausdal	No
Middelburg	Yes
Middellande	No
Mlungisi Public School	No
Mndwaka JS School	Yes
Mngcangcathelo JS School	Yes
Modderdam High	No
Molly Blackburn	No
Montana High School	Yes
Morningside	No
Mount Packard JSS	Yes
Mpeko SSS	Yes
Mpimbo JS School	Yes
Mqokolweni JS School	Yes
Mt Fletcher Village JSS	No
Mthwaku SSS	Yes
Mtwaku JS School	No
Mtyana Public	No
Mweli's JS School	Yes
Mzingisi JSS	Yes
Mzintshane JSS	Yes
Mzomhle HS	No
Mzontsundu	Yes
Ncipizeni JAA	Yes
Ndabankulu JSS	Yes
Ndamase SSS	Yes
Ndasama JSS	Yes
Ndlantaka JSS	Yes
New Orleans Sekonder	No
Newell	Yes
Ngavungavu JS School	Yes
Ngcele JSS	No
Ngcelwane HS	Yes
Ngqeleni SSS	Yes
Nqxaza JS School	No
Ngwekazi HS	No
Ngwenyathi High	No
Ngxaza JSS	No
Nkosemntu Motman Combined	Yes
Nogemane SSS	No
Nolufefe PS	No
Nombulelo	No
Nompumelelo High School	No
Nonyembezi JS School	Yes
Nosizwe HS	No
Nozuko SSS	Yes
Nqabara SS School	No
Nqwera	No
Ntaba JS School	No

Ntlebi JS School	Yes
Ntsonkotha High	No
Nxaruni Primary	No
Nyameko High	No
Nyaluza High	No
Nzululwazi HS	Yes
Paterson	Yes
Paul Sauer High	Yes
Pearston SSS	No
Pendla Public School	No
Phakamisa High	No
Phillip Mtywaku Senior Secondary School	No
Port Alfred High School	No
Port Rex Technical	Yes
Qaphelani	No
Qebedu JS School	No
Queens College	Yes
Qumbu Village SSS	Yes
Qunu JSS	Yes
Ramafole SSS	Yes
Sakhisizwe high	No
Samkelwe High	Yes
Sanctor High	Yes
Sandi SSS	Yes
Sandisiwe High	No
Selbourne College	Yes
Senzile High School	Yes
Sidinane Secondary	Yes
Sikemjana SSS	Yes
Sikhulule High	No
Silimela High	No
Simzamile SSS	No
Sinethemba High	No
Sirunu JSS	Yes
Sisonke	No
Sixishe JS School	Yes
Siyazakha HS	Yes
Solomon Mahlangu	No
Sophakama	No
St Andrews College	Yes
St Dominics	Yes
St Matthews High School	Yes
Tarkastad	No
Teko Springs JSS	Yes
Templeton High	Yes
Thakabanna High	No
Thanduxolo	No
Thembalabantu High	Yes
Tinarha High	No

Thubalethu	Yes
Thuba Lihle	No
Tshifena Secondary	No
Tshikundu Secondary School	No
Tsolo High School	No
Tsolo Residency JSS	Yes
Tutor Ndamase SS School	Yes
Tyhilulwazi SSS	No
Ukhanyo	No
Upper Mpako JSS	Yes
Vernon Gamanda	Yes
Vulamazibulo High	No
Vulumzi High	Yes
Westbank	Yes
Westville High School	Yes
Westering High	Yes
Willowmore	No
Woodridge College	Yes
Zanokhanyo JSS	Yes
Zibokwana SSS	Yes
Zinzani High	No
	No
Zozo Combined	No
Zwelandile SS	No
Zweledinga JSS	Yes
Zwelibangile SSS	Yes