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A review of athletes presenting for medical assistance at the 2011 Ironman South Africa triathlon event

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University of the Witwatersrand

Centre for Exercise Science and Sports Medicine

RESEARCH REPORT

A review of athletes presenting for medical assistance at the 2011 Ironman South Africa triathlon event.

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331757

Submitted in partial fulfilment of the requirements for the degree

Masters of Science (Med) in Sports Science

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DECLARATION

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ABSTRACT

With the increasing popularity all over the world of Ironman triathlon events, the need to determine the type, timing and number of injuries sustained by these triathletes on race day is evident. Also to determine the optimum medical staffing requirements and knowledge during these events is of importance.

The Ironman South Africa 2011 (IMSA) took place on the 10 of April of that year. On that day 1742 triathletes started the event and a total of 1477 where able to complete the entire race distance in the time period allowed, (completion rate of 84.8%). Of those athletes competing, a total of 183 (male 155)(87.4%) and 28 (female)(11.3%) presented to the medical facility for treatment. The mean age of the triathletes presenting was 38.73(SD±9.82) years and the mean time of presentation to the facility was 12.35(SD±2.33) hours after the start of the event. Injury prevalence showed exercise associated collapse (EAC) to be the most common presentation at 44.8%.

The medical support and staffing was established to fit the temporal model of injuries sustained by non elite Ironman triathletes. This allowed increasing medical staffing in the latter stages of the race when a greater number of athletes were expected to present for medical assistance.

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To my wife, Catherine and son, Sebastian for their never ending support.

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CHAPTER 1 – INTRODUCTION

The sport of triathlon is a combination of three specific disciplines, namely that of swimming, cycling and running, separated by two transitions which are combined into one singular event.[1-3] Triathlon has seen an exponential growth in popularity since its humble beginnings in the late 1970's.[4,5] So much so that it was held as an exhibition sport at the 1992 Barcelona Olympic games and then as an Olympic event at the Sydney 2000, Athens 2004, Beijing 2008 and London 2012 Olympic Games.[1,5]

At present there are many different distances in which a triathlete may participate including the sprint distance (750m swim, 20km cycle, 5km run), Olympic distance (1,5km swim, 40km Cycle, 10km run), half Ironman distance (1.9km swim, 90km cycle and 21.1km run) and full ironman distance (3.9km swim, 180km cycle, 42.2km run).[1,2,4-8] However, the Full Ironman distance event by its very nature poses some unique ultra endurance challenges to the triathlete.[4] From the first Full Ironman event in Hawaii which was held in 1978 [4,6] where there were 15 starters to the thousands of triathletes who participate around the world in various Full Ironman events currently participating. With this increase and the nature of the event, many require medical attention on race day. There is a need to improve our knowledge of the medical conditions that present and the management of these athletes during these types of ultra endurance events.[9-11] Research therefore to better understand the types and timing of injuries sustained by these ultra distance triathletes is required.[9]

1.1 Background and brief motivation for this study

With the sport of ultra distance triathlons becoming ever more popular in the world, the need for greater understanding of the medical staffing requirements for these athletes during the Ironman race day becomes ever more important. Studies show a much higher rate of severe injuries, up to 38.3% and sudden cardiac deaths rates at 1,5 per 100000 in those triathletes participating in Ironman distance events.[3,8] Current staffing guidelines seem to be inadequate during the peak hours of the presenting Ironman triathletes.

1.2 Objectives and purpose of this study

The main objectives for the study were to:

a. Describe the types, timing and number of injuries that occurred during the 2011 Ironman South Africa triathlon event.

b. Evaluate the composition and type of the medical staffing support team providing care during the 2011 Ironman South Africa event.

1.3 Hypothesis

The current composition of the medical team used during the Ironman South Africa triathlon event has been inadequate for the type, timing and number of injuries sustained by triathletes presenting for medical care during the 2011 Ironman South Africa triathlon event.

CHAPTER 2 – LITERATURE REVIEW

2.1 Introduction

Within the expansive field of sports medicine, the medical care for the sport of endurance triathlon is now becoming ever more popular. With the growing popularity of this discipline a need for an ever increasing knowledge base about the specific aspects of the sport becomes more evident. This review will attempt to outline the current knowledge within this field.[1,3,5,7,12-14]

2.1.1 Background review

The risk of acute injury of the triathlete during a full Ironman triathlon can vary greatly between 37% and 91%.[1,3,5,7,12-14] The types of injuries sustained during these types of events may include but are not limited to the following: Hypothermia, exhaustion, dehydration, muscle cramping, heat stroke, hyponatraemia/water intoxication, postural hypotension, excessive exposure to ultraviolet radiation, musculoskeletal injuries, minor trauma, bacterial infection, gastrointestinal disturbances, sympathetic nervous system exhaustion, haemolysis and cardiac complications.[7-11,13,15-23]

The most common condition presenting during Ironman events is dehydration and exercise-associated collapse, with the prevalence between 50% and 85%.[3,5,25] This presentation increases the risk of electrolyte imbalances and hyponatraemia.[5] Muscle cramping follows a close second(36%).[3] The incidence of gastrointestinal disturbance in these athletes is approximately 30%.[7]

Medical management at Ironman distance triathlon events needs to thus be carefully planned, as 85% of athletes requiring treatment present during the final running stage of the event.[7] It has also been shown that athletes needing treatment at the later stages of these events at the 14hour to 16hour time period required longer stays in the Ironman medical facility for management and presented with a higher incidence of acute hyponatraemia.[3]

Current recommendations state that the composition of the medical staffing at each event of Ironman triathlon medical facility should be at a minimum, a race medical director, and

additional physicians at a ratio of one per 200 athletes participating, and nursing staff at a ratio of one to every 100 athletes.[7] Lastly, there should be sufficient massage staff to serve the entire race population.[7] Critically, this staff need to be effectively timed to allow for the maximum personnel to avail themselves during the latter times in the event when the demand for medical care is at its highest.[3]

Thus, the need for specialised medical personnel is imperative. Especially more so in the case of full Ironman events where the incidence of severe injury was shown to be 38.2% and the presentation of other medical conditions at a rate of 37.7%.[3] This was shown to be a higher rate than that of shorter distance triathlons.[3]

Therefore, the makeup and skill of the medical team which attends to these unique ultra distance triathletes need to be specifically organised and manned with the needs of this specific athlete in mind.[3,5,7]

2.2 Endurance associated sport injures

With all sporting disciplines, as with endurance triathlon, certain injuries are more prevalent on the race day. Endurance associated sporting injuries are more common in Ironman triathlon due to the extended duration of the event the participants have to endure.[3] Described below are the most common injuries presenting for treatment at endurance events.[1,3,5,7]

2.2.1 Exercise associated collapse (EAC)

By far the most common injury presenting for treatment in Ironman triathlon events was exercise associated collapse (EAC) which occurred directly at or soon after crossing the finish line of an endurance race.[12,24-31] The incidence EAC ranges between 17% and 85% of endurance athletes occurring post race depending on the precise definition.[25] That type of condition was caused mostly by postural hypotension and insufficient peripheral vasoconstriction occurring during long endurance exercise, worsened by the abrupt stopping of activity or exercise at the completion of the event.[24-26] The presentation of EAC is characterised by altered mental state, light headedness, dizziness, fainting and syncope.[25] This condition should be distinctly differentiated from the collapse of an endurance athlete

which occurred during, or on the swim, cycle or run course of an Ironman triathlon event.[24-27] The latter may present the possibility of a more serious medical condition and in some cases may even be life threatening.[24-27,32] The attending medical staff should also be wary of such conditions more serious nature such as cardiac, metabolic or neurological disturbances.[8,24-28]

All of these triathletes who present with EAC require a specific triage algorithm which must be performed systematically and methodically by the medical staff manning medical facilities at Ironman events.[26] The evaluation of the patient should include determination of mental status as well as site of the collapse. Secondly, all vital signs should be assessed including, heart rate, blood pressure, body temperature, hydration status, serum glucose level and serum sodium levels.[24-26] Once all this information is gathered about the presenting athlete a more accurate determination of the diagnosis and severity of the EAC can be established. Athletes presenting with this condition were divided into two distinct groups "severe" and "not so severe" EAC.[24-26] Those with severe EAC symptoms are those in whom the mental state was altered, with confusion, disorientation or aggression. Secondly, it was also present if there was a recorded body temperature above or equal to 40°C, or with systolic blood pressure less than or equal to 100mmHg, or a heart rate above or equal to 100 bpm. Lastly, when serum blood glucose was below 4mmol/L or serum sodium below 135mmol/L or above 148mmol/L.[24-28] The less severe group of athletes presenting with this condition were classified with having an alert mental status, body temperature less than 40°C, systolic blood pressure of greater than or equal to 100mmHg, a heart rate of less than 100 bpm, serum blood glucose of between 4 – 8 mmol/L and serum sodium of between 135 – 148 mmol/L.[24-28]

Current treatment consensus guidelines for EAC includes the elevation of the athlete's legs and pelvis by at least 6 inches(±15cm) by lifting the end of the stretcher, the so called Trendelenburg position, as well as oral rehydration and intermittent re-evaluation of the affected athlete every 15-20 minutes.[24-30] Most athletes who presented with EAC recovered within 15-30 minutes and were able to walk unassisted. The current research review also highlighted that the need and use of intravenous (IV) fluids in these athletes was seldom warranted as it has not been shown to reduce the discharge time.[29]

2.2.2 Exercise associated hyponatraemia (EAH)

The prevalence of acute hyponatraemia in Ironman triathlon and endurance athletes has been

reported to be between 10% to 75%.[3,5-8,24,33-42] Hyponatraemia is defined as a serum sodium concentration of less than 135mmol/L.[3,5-8] However, many triathletes who present with serum sodium concentration of between 130 and 135mmol/L present with disorientation or even be asymptomatic.[3 5 8] The current literature review attempting to define the exact cause of the presentation of EAH was somewhat controversial.[42] This controversy revolves essentially around whether the altered hyponatraemic state presenting in athletes was due to electrolyte loss caused by excessive perspiration and dehydration or water intoxication as a result of overhydration. [5,6-8,12,15,26,28 30,33,41-45]

Rust et al.(2012) described three main factors which are primarily responsible for EAH. These include habitual over drinking by the athlete, abnormal secretion of antidiuretic hormone (ADH) and the failure of the down regulation of ADH with increasing body fluid volume. Lastly, a lack of mobilisation of Na^+ from osmotically inactive sodium stores.[33] Other studies also showed that in Ironman triathletes who had a vast increase in body weight due to fluid overload showed a decrease in serum sodium.[33,45]

2.2.3 Gastrointestinal disturbances

The incidence of gastrointestinal (GI) disturbances of athletes participating in endurance events such as Ironman triathlons have been documented between 5% and 59%.[7,8,46-50] These GI disturbances included both the upper and the lower gastro-intestinal tract.[7,8,46-50] The GI complaints included nausea, vomiting, epigastric pain, gastro-oesophageal reflux, generalised abdominal pain, diarrhoea and "caecal slap syndromes".[7,8,46-50] Some studies highlight certain factors which may worsen or precipitate the presentation of these types of GI disturbances.[47] At increased risk were those athletes who ate a meal less than 30 minutes prior to race start, those who ate high fat, high fibre or high protein meals during the event or consumed hypertonic beverages.[47] In one Ironman triathlon event study, which included a 3.8km sea swim, the incidence of motion sickness and accidental sea water ingestion may have increase the likelihood of GI symptoms.[7] Further, the use of non-steroidal anti-inflammatory drugs (NSAIDS) may also worsen the incidence of GI disturbances due to their pharmacological gastric side effects.[7]

2.2.4 Heat distress disorders

Athletes competing in an endurance event may present with two extremes of body temperature. A below normal body temperature know as hypothermia and an above normal body temperature known as hyperthermia.[25-28] Normal core body temperature is described in the range between 36.1^{o}C and 39.4^{o}C.[24] Athletes presenting with symptoms of hypothermia have core body temperatures ranging between 36.1^{o}C and 32°C.[24,27] Those hypothermic athletes should be treated by removing them from the cold environment, removal of all wet clothing and warmed by passive measures such as blankets and ingesting warm oral drinking fluids.[24 27] If the athlete does not respond to that treatment evacuation to a hospital emergency unit was recommended.[24,27]

On the other extreme, hyperthermia presents as a core body temperature above 39.4^{o}C with severe cases presenting with core body temperatures above 41.1^{o}C.[24,27] In extreme cases of hyperthermia the thermoregulatory system of the body will shut down completely leading to a potentially life threatening condition called heatstroke, with temperatures exceeding 42°C. [24,27] In such severe heatstroke rapid intervention is essential with active cooling and ice baths to attempt to cool the core body temperature to below 38°C.[27] If the condition is not recognised and treated appropriately and rapidly and the core body temperature rises above 42°C the mortality rate of the athlete may rise to as much as 80%.[24,27]

Heat related injury is an important medical risk during any endurance triathlon event such as Ironman. Increased core temperature from intense exercise together with environmental conditions such as ambient temperature and humidity combine usually with the run segment of the triathlon event at the hottest time of the day.[7] This is worsened when combined with dehydration following the swim and cycle leg, exhaustion and potential hyponatraemia due to the slow pace, increased ambient temperature and increased fluid intake during the marathon run.[7]

2.2.5 Exercise associated muscle cramping

Exercise associated muscle cramping is a painful, spasmodic, involuntary contraction of any skeletal muscle directly after the completion of an endurance exercise event.[25-27] The cause of such painful involuntary muscle contractions had initially been attributed to electrolyte

imbalances, hydration, heat stress and glycogen depletion. However, this assumption was not evidence based and subsequent studies show no link between serum electrolyte depletion such as sodium or hydration status as a cause of this condition.[25,26,35,36] More likely are the influence of metabolic factors such as acids, pH, ions, proteins and other circulating hormones. Also implicated are prolonged repetitive eccentric muscle activity with connective tissue injury as well as fatigue induced neuromuscular activity.[25,26] Schwellnus et al. (2011) described a more scientific basis of the abnormal neuromuscular control.[35] Showing that as muscles fatigue there is an increase in the afferent activity of muscle spindle and a decrease in the afferent activity of Golgi tendon organs which in turn may increase alpha motor neuron activity.[26,35] Although this condition presents frequently it is relatively easily treated with rest and passive stretching techniques which maintain the affected muscle group in a lengthened position.[25,26]

2.3 Conclusion

The presentation of these endurance associated sporting medical conditions are not unique to Ironman triathlon but the medical team on standby at any endurance event should to be acutely aware of this type of information.[7]

CHAPTER 3 –MATERIALS AND METHODS

3.1 Ironman South Africa 2011

In the year 2011, the Ironman South Africa (IMSA 2011) event was held on the 10th day of April. This event attracted a total of 1742 participants at the start on race day, of which only 1477 would be able to officially complete the entire ultra distance triathlon event.[51] Thus, showing a completion rate of 84.8% of the race field for the IMSA 2011. On race day the minimum forecast temperature was 10^0C with a maximum of 23^oC, a sea temperature of 20^oC, relative humidity of 80% with a predicted 10km/h to 20km/h South Easterly wind.[52] During that particular race day a total of 183 triathletes (10.5%) presented for assessment and treatment at the IMSA 2011 medical facility. Of those 183 triathletes presenting, a total of 155 (87.4%) where male and a total of 28 (15.3%) where female. The age range of presenting athletes was between 20 and 73 years old with a mean age of 38.73 and standard deviation of ±9.83 years.

3.2 Medical planning for Ironman South Africa 2011

The medical planning and risk assessment of such a large sporting event is regulated by an act of parliament, The Safety at Sports and Recreation Events Act number 2 of 2010 of the Republic of South Africa.[53] This act requires the stringent planning and placement of measures as to safeguard persons and property during these types of events. The health and safety at events requirements published by the South African Bureau of Standards must also be considered.[54] To this end the medical planning and risk assessments for the IMSA 2011 began methodically at least six calendar months prior to the event taking place as required by the gazetted legislation. This medical planning and risk assessment is divided into three specific areas namely, aquatic safety, cycle route safety and running route safety. Consideration must also be taken for the medical facility layout and staffing requirements and positioning. Lastly, all incidents must be co-ordinated though the race and medical directors to avoid duplication of orders and poor utilisation of medical resources.

3.2.1 Aquatic safety plan

This leg of the event requires special attention due to the incidence of sudden cardiac deaths

which have been documented in triathlons.[28] Harris et al. (2010) showed a sudden cardiac death rate of 1.5 per 100000 triathlon participants with 93% of the deaths occurring during the swim leg of the triathlon.[32] Most recently in January 2013 during the Ironman South Africa 70.3 half Ironman distance, two sudden cardiac deaths were reported during the swim portion of the event. The planning of the aquatic safety must first consider the required length of the Ironman swim distance. It requires the competitor to complete a 3.8km swim course. During the IMSA event the swim course consists of two 1.9km loops, from the start at Hobie beach, Port Elizabeth, South Africa, which the participating Ironman triathlete must complete within the 2 hour 20 minute, cut off time limit. (Appendix A) A second consideration is the possible safety risks during the swim leg; these include, but are not limited to, shark attack, blue bottle stings, tidal currents and all possible medical conditions as described in chapter 2. Additionally strict compliance to International Triathlon Union (ITU) wetsuit regulations was enforced.[7]

3.2.2 Cycle route safety plan

The cycle route safety plan was also considered around the length of the 180km cycle distance. This entire cycle course was closed to the public and to traffic for the duration of the cycle leg. It consisted of a three loop 60km course which the competing triathlete had to complete before the 17h30(10hours and 30minutes) cut off time on race day. (Appendix B) This cycle route was non-draft legal thus requiring the Ironman triathletes to maintain a 10m gap both behind and in front of each participant. Safety considerations include the risk of traumatic injury due to falls as well as water table requirements and support vehicles.

3.2.3 Run route safety plan

The run route safety plan needs to be planned around the 42.2km marathon course run along the Marine Drive on Port Elizabeth's beach front. Again the run course must be closed to traffic and to the public. Each competitor must complete three loops of the run course to finish by the 24h00(17 hours) race cut off time. (Appendix C) Consideration of traumatic fall injuries, other possible medical conditions and water table availability are paramount. This included the placement of water and aid stations at approximately 2km intervals along the entire length of the run course. In addition, an ambulance would continually sweep the entire run course and be available to transport any athlete needing medical assistance.

3.2.4 Medical facility layout and requirements

The medical facility was set up and laid out according to a specific plan. (Appendix D)
It included the following:

- 3 ICU beds with ICU equipment
- 34 general beds with 1 vital signs monitor per 4 beds
- 1 blood gas machine
- 1 ECG and 1 nebulizer
- 1 O_2 cylinder per 4 beds
- 1 portable defibrillator
- All drug requirements (Appendix E)
- Wound care supplies (Appendix E)
- Emergency equipment (Appendix E)
- General medical supplies (Appendix E)
- Sterile and diagnostic equipment (Appendix E)

This medical facility was established prior to the beginning of the race day start at 07h00 and continued to be available to the end of the race day at 24h00 or until the last triathlete requiring treatment had been discharged by the medical team. In addition, both the Netcare Greenacres, and Life St Georges Hospitals were placed on standby for the duration of the event day to receive critically ill or injured triathletes referred.

3.2.5 Medical facility staffing requirements

The staffing of the medical standby facilities at IMSA 2011 were divided into two main areas. Firstly, the main medical facility and a secondary staging area in the bicycle and run transition tent area. In addition to that, three different time shifts were used to divide the staffing throughout race day. Those times were as follows:

- 05h00-12h00
- 12h00-16h00
- 16h00-24h00

The first time slot from 05h00 to 12h00 was also subdivided into three additional time slots. Those times were as follows:

- 05h00-07h00
- 07h00-09h20
- 09h20-11h30

The reason for that additional coverage allowed the best medical coverage for the sea swim portion during the pre-race warm up and race swim times where there are greater risk of injury for the competing triathlete.[32] The incidence of sudden cardiac death, anaphylaxis due to blue bottle or jelly fish stings, simple exhaustion, hypothermia, corneal abrasions and swim-induced pulmonary oedema and near drowning must be considered.[28] During that important time during the swim leg, on the beach there was at least 1 advanced trauma life support (ATLS) / advanced cardiac life support (ACLS) trained doctor, 1 advanced life support (ALS) paramedic, 8 stretcher bearers and a quad bike available to ferry patients across the beach to the medical facility. In addition, in the transition staging area there are, 1 doctor, 3 nurses and 8 stretcher bearers. Also during that time there would be no less than 3 doctors and 9 nursing staff manning the main medical facility to receive injured triathletes from the beach and transition areas. During the 05h00-07h00, 07h00-09h20 and 09h30-11h30 time slots there were 2 physiotherapists in the transition area and medical facility.

As an extra precaution the entire swim course was covered by life savers, with Jet Ski and inflatable rubber duck to supervise the swimming portion of the event and to assist and ferry triathletes to the beach if required. (Appendix F)

The second time slot from 12h00-16h00 had the same staffing as for the 05h00 12h00 times with the addition of a 1 doctor and 2 physiotherapists in the medical facility.

With the most important time slot from 16h00-24h00 when most of the volume of patients are expected, sees a drastic increase in the amount of staffing recruited.[3 7] During that crucial time slot an additional 14 doctors, 20 nurses, 10 Bio-kinetic interns, 16 stretcher bearers and 4 physiotherapists would join the existing medical team.

In addition to this paramedical staff manning 6 stationary ambulances around the cycle and run courses are also at the disposal of the medical facility to ferry patients from around the race course to be triaged at the medical tent.

It is noted that the medical race director will be on duty from 05h00-24h00 to co-ordinate all functions and decisions on race day.

3.2.6 Patient triage protocols

The IMSA protocol dictates every triathlete that presented for treatment at the medical facility on race day will be triaged consistently and assessed with the same methodology. This will include the determination of mental status in relation to the established Glasgow coma scale (Appendix G) as well as all vital signs including heart rate, blood pressure, temperature and blood glucose and oxygen saturation. In addition all demographic data was collected as well as medical history and primary presenting complaint recorded.[55] Only those patients who were assessed by the medical staff and found to be metabolically unstable had additional blood testing performed. Blood chemistry measures including pH, partial pressure of carbon dioxide (pCo_2), partial pressure of oxygen (pO_2), serum sodium (Na^+), serum potassium (K^+), serum glucose, serum lactate (Lac) and Heamatocrit (Hct).

3.2.7 Patient treatment protocols

The treatment protocols established for the use during the Ironman 2011 triathlon event were based on already sound published guidelines.[24-31] These guideline protocols were documented and approved by the IMSA medical director, Dr Konrad von Hagen, and the Race director Mr Paul Wolf. All documentation was then made available to all medical staff members manning the medical facility at the IMSA 2011 event.

These protocols document algorithms of treatment for the most common injuries which may present for treatment on the race day. These included the following:

- Exercise associated collapse (EAC)
- Guidelines to determine the severity of the collapsed triathlete
- Considerations for the initiating of IV fluid therapy
- Hyperthermia
- Hypothermia
- Hyperglycaemia
- Hypoglycaemia

- Exercise associated muscle cramps

All of these treatment protocols are shown in detail in appendix H.

3.3 Research Design

A retrospective and descriptive study of the medical data collected from competitors presenting for treatment at the Ironman South Africa medical facility in 2011.

This data included demographics, vital signs, presenting injuries or complaints, treatment provided, as well as the timing of the presenting triathlete at the medical tent during the entire 2011 Ironman South Africa Triathlon event.

3.4 Study setting

Ironman South Africa Medical facility, Nelson Mandela Metropolitan Municipality, Port Elizabeth.

3.5 Study Population

3.5.1 Sampling, Selection and recruitment of subjects

The study population was the athlete's participants in the IMSA 2011 event. The study subjects were those participants who presented for medical management on race day.

3.5.2 Inclusion criteria

Only officially registered Ironman South Africa athletes who presented to the medical facility who had a valid race number and timing chip were included.

3.5.3 Exclusion criteria

More seriously injured athletes who were transported directly to the standby hospital facility were excluded from the study.

3.6 Data Collection Procedures

Data were collected by means of a standardised data collection sheet. (Appendix I) Athletes presenting for medical care during the events were triaged by trained medical personnel. Once this was completed, athletes were managed medically and information about their presenting injury/medical condition, vital signs, course of treatment, duration of stay and final discharge was captured on a central database.

3.7 Statistical Analysis

Raw data were captured by support staff attending to the athlete in a Microsoft® Excel® 2007 document for statistical analysis. The collected data were analysed with the Statistical Package for the Social Sciences (SPSS) version 13.0.[56, 57] The use of descriptive statistics was then employed to determine the measures of central tendency i.e.: maximum, minimum, range, means, standard deviations, frequencies and percentages of the cohort of triathletes.

These statistical methods were used to describe the type, timing and frequency of the injury data collected during the 2011 IMSA.

3.8 Ethics

3.8.1 Ethical approval

Ethical approval was applied for and obtained from the Human Research Ethics Committee (medical), University of the Witwatersrand, Johannesburg. Clearance certificate number M120964. (Appendix J)

Approval of the topic for the research report was obtained from the School Protocol Review Committee and the Faculty Graduate Studies Committee, Faculty of Health Sciences, University of the Witwatersrand. (Appendix K)

Permission for the use of the data was obtained from the medical race director for IMSA Dr. Konrad von Hagen. (Appendix L)

Participation in this study was completely voluntary and anonymous. Participants were allowed to withdraw from the study at any time.

3.9 Conclusion

This chapter outlines the material and methods utilised to ethically and accurately complete the collection of the required data for this study. All the participants' anonymity was maintained and the data utilised to perform quantitative research as described in this study. These results may be used to give some insight to the appropriate medical staffing and management for the IMSA triathlon event taking into consideration the local trends.

CHAPTER 4 – RESULTS

4.1 Introduction

This chapter describes the data collected at the IMSA 2011 triathlon event. The data were represented with tables and figures as well as frequency data which will be used to show the type, timing and frequency of injuries/medical conditions sustained during this ultra distance triathlon race.

4.2 Demographic data description

This describes the distribution of the gender and age of those IMSA 2011 triathletes presenting for assessment and treatment during the event.

4.2.1 Gender distribution data

In the cohort of 183 (n=183) triathletes that presented for treatment during the 2011 IMSA triathlon event a total of 155 were males (84.7%) and 28 were female (15.3%).(Table 4.1)

TABLE 4.1 – Gender distribution of triathletes presenting for treatment at IMSA 2011

Gender	(n)	Percentage(%)
female	28	15.3
male	155	84.7
Total(n)	183	100

4.2.2 Ages distribution data

The age range of the183 triathletes was from 20 years old to 73 years old. The mean age of the athletes was 38.73 years old with a standard deviation of ± 9.832.(Table 4.2)(Figure 4.1)

TABLE 4.2 – Age distribution of triathletes presenting for treatment at IMSA 2011

Age in years (n=183)	Minimum	Maximum	Mean	Std. Deviation
	20	73	38.73	±9.83

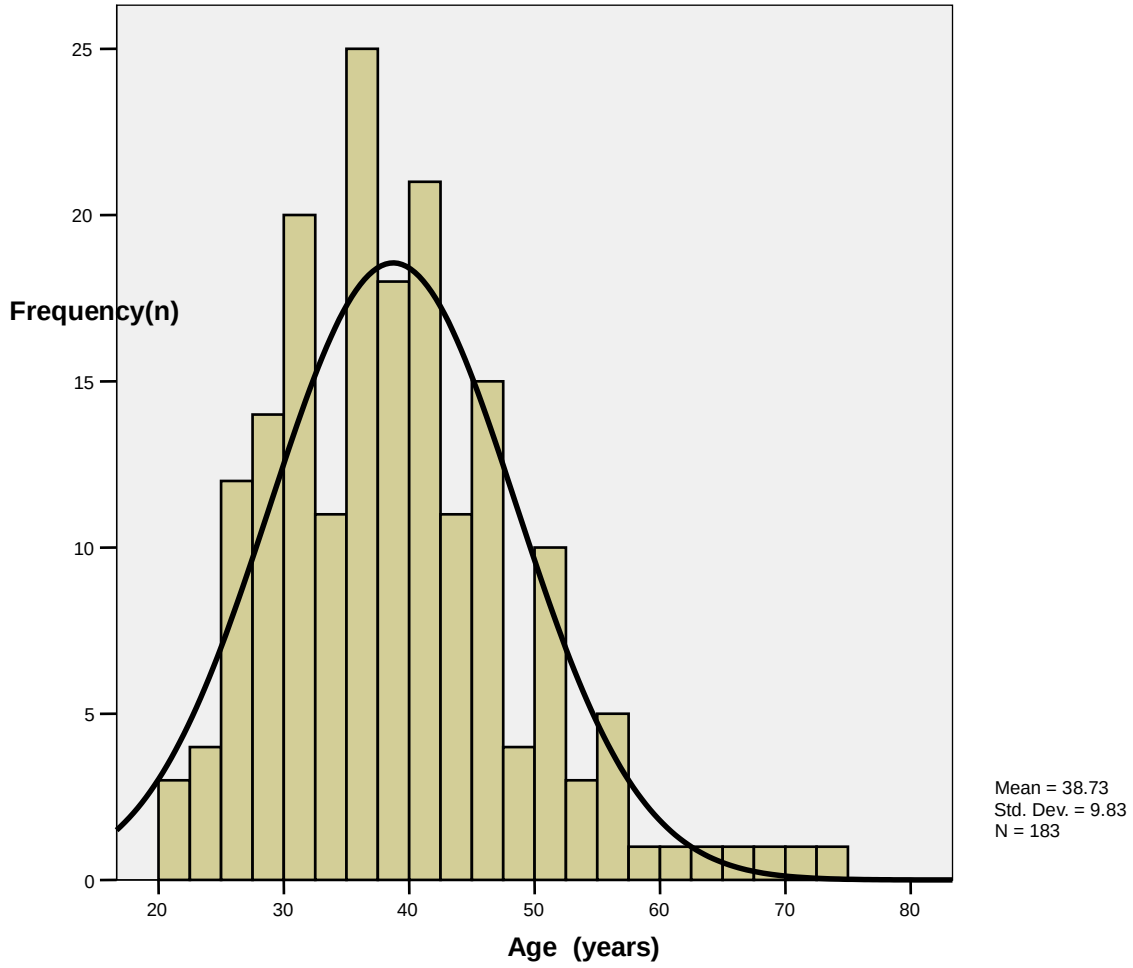

Figure 4.1 - Age distribution of triathletes presenting for treatment at IMSA 2011

4.3 Timing and duration data

This data will describe the timing of the triathletes as they presented for treatment and the duration of time spent in the medical facility as well as which part of the course they presented from.

4.3.1 Presentation of triathletes

The majority of athletes presenting for assessment were directly from the race finish line. A

total of 136 of the 183 patients (74%) presentation from this part of the course.(Table 4.3)

TABLE 4.3 - Description from where IMSA 2011 triathletes presented from.

		(n)	Percentage(%)
	Ambulance	15	8.2
	Massage tent	4	2.2
	Finish line	136	74.3
	Other	24	13.1
	Total	179	97.8
	Missing data	4	2.2
Total (n=183)		183	100.0

4.3.2 Timing data of triathletes entering IMSA 2011 medical facility

Triathletes presenting for treatment on race day of IMSA2011 began as early as the first hour. Thus, the range of time of athletes presented for treatment was from 1 to 17 hours. The mean time of presentation was 12.35 hours and a standard deviation of± 2.233.(Table 4.4)
(Figure 4.2)

4.3.3 Timing data of triathletes exiting IMSA 2011 medical facility

Similarly, triathletes exiting the medical facility at IMSA 2011 began in the first hour of the race. Therefore, the range is again from 1 to 17 hours**.** The mean time presentation of 12.89 hours and standard deviation of ±2.33.(Table 4.4)(Figure 4.3)

TABLE 4.4 – Timing and duration data of triathletes entering and exiting IMSA 2011 medical facility

	(N=181)	Minimum	Maximum	Mean	Std. Deviation
Time into facility	181	1	17	12.35	±2.23
Time out of facility	180	1	17	12.89	±2.33

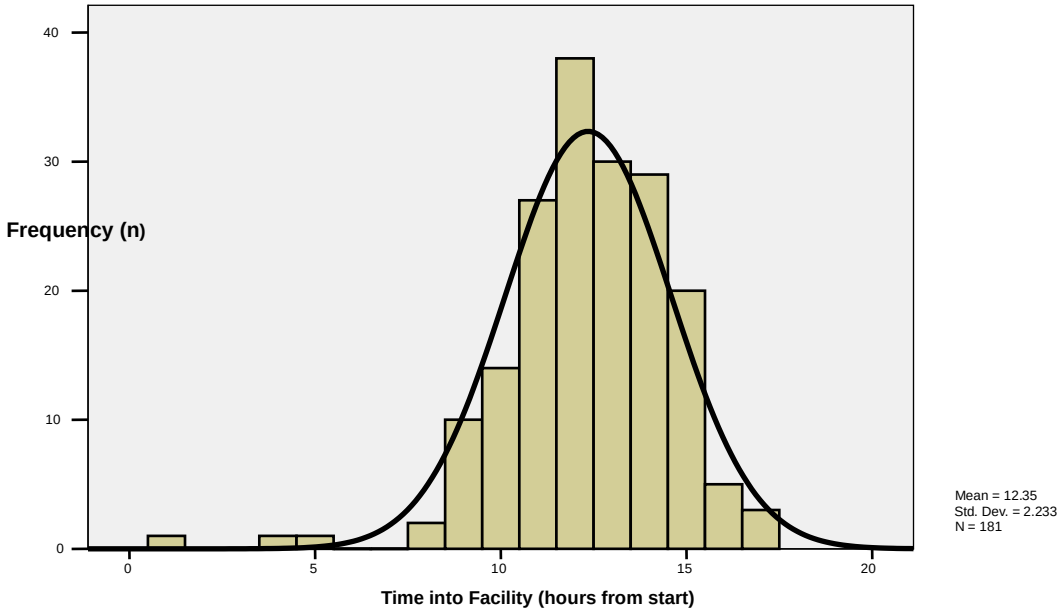

Figure 4.2 – Timing data of triathletes entering IMSA 2011 medical facility

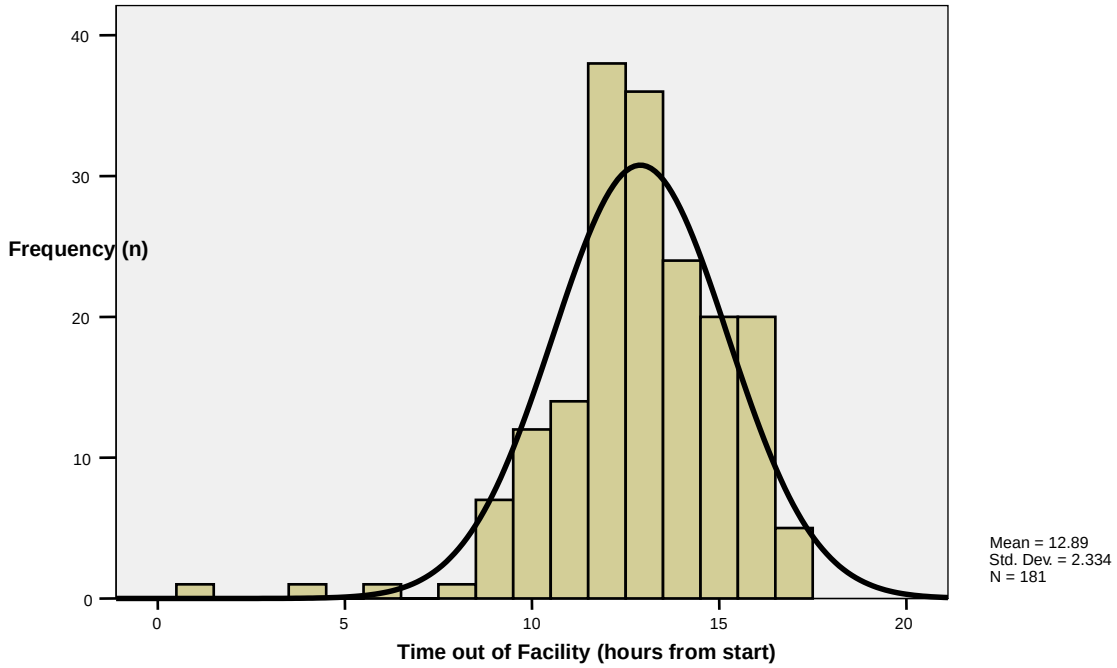

Figure 4.3 - Timing data of triathletes exiting IMSA 2011 medical facility

4.3.4 Duration of stay data for triathletes presenting for treatment during IMSA 2011

Triathletes presenting for treatment during IMSA 2011 had a stay of between 5 and 163 minutes. Mean stay was 36 minutes with a standard deviation of ±29.58.(Table 4.5) (Figure 4.4)

TABLE 4.5 - Duration of stay data for triathletes presenting for treatment during IMSA 2011

		Minimum	Maximum	Mean	Std. Deviation
In minutes	(n=179)	5	163	36.08	±29.58

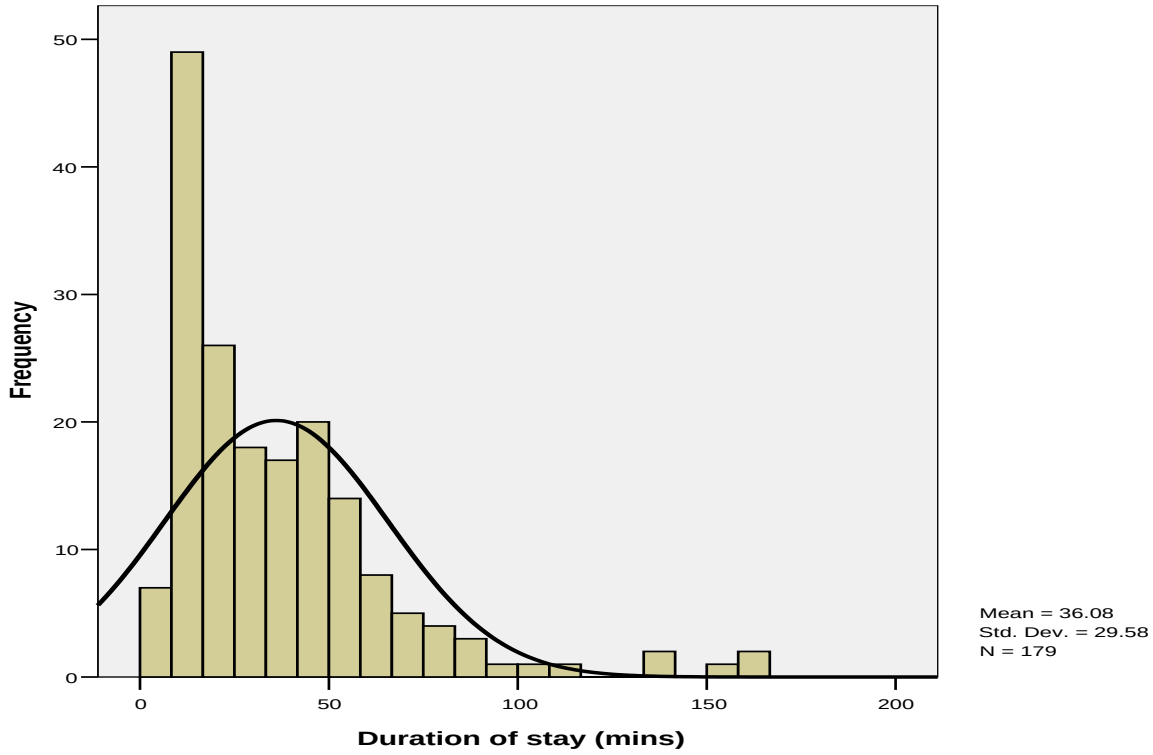

Figure 4.4 - Duration of stay data for triathletes presenting for treatment during IMSA 2011

4.4 Vital signs of triathletes presenting for treatment at IMSA 2011 medical facility

Once triathletes presented for treatment at the IMSA 2011 medical facility and triage of the patient had taken place all vital signs were documented. This was completed as per protocol and recorded on the prescribed athlete information data collection sheet. Of the presenting athletes it was deemed by the triage doctors that 17 of those patients did not need any further interventions and no further data was collected. Thus, explaining the 17 pieces of missing data. All of this data values, maximums, minimums, means and standard deviations have been tabulated. (Table 4.6)

4.4.1 Vital signs (Heart rate)(BPM)

Of the 181 triathletes who presented, 164 of those had heart rate measurements completed. Not all athletes presenting had vital signs assessed as the attending medical staff deemed it unnecessary after the athlete was triaged. The heart rates recorded were between 51bpm and 154bpm with a mean of 82.13 bpm and a standard deviation of ±15.394.(Table 4.6)

4.4.2 Vital signs (Blood pressure)(mmHg)

Of the 181 triathletes who presented, 163 of those had blood pressure measurements completed. Those blood pressures measured showed a mean systolic reading of 164.75mmHg with a standard deviation of ±18.762 and a mean diastolic reading of 72.34mmHg with a standard deviation of ±11.727. The systolic blood pressure readings were documented between 130mmHg and 198mmHg and the diastolic blood pressure readings were documented between 34mmHg and 69mmHg.(Table 4.6)

4.4.3 Vital signs (Temperature)(^{o}C)

Of the 181 triathletes who presented, 83 of those had temperature measurements recorded. The minimum temperature reading was 34.0^{o}C and maximum of 38.2^{o}C with a mean of 36.461^{o}C and a standard deviation of ±0.6981.(Table 4.6)

4.4.4 Vital signs (Capillary Blood glucose/ HGT)(mmlo/L)

Of the 181 triathletes who presented, 156 of those had a capillary blood glucose/HGT measurement recorded. The minimum reading was 2.2mmol/L and maximum of 14.2mmol.L a mean of 5.527mmol/L and a standard deviation of ±1.4256.(Table 4.6)

4.4.5 Vital signs (Pulse oximetry/Spo2)(%)

Of the 181 triathletes who presented, 78 had of those ha a pulse oximetry SpO2 completed. The minimum reading was 93% and the maximum of 100% with a range of 7%, a mean of 97.93% and a standard deviation of ±1.680.(Table 4.6)

4.5 Blood testing/Blood chemistry

Once all basic vital signs had been completed, only those patients whom were not deemed metabolically stable by their attending practitioner were then subjected to additional blood testing. This blood testing was completed by qualified medical technologists utilising critical care equipment from Instruments Laboratory®. This was done to exclude any other cause which may have worsened the athlete's medical stability. Of the 181 triathletes who presented for treatment in the IMSA 2011 medical facility, 54 had additional blood tests performed.(Table 4.7)

4.5.1 Blood testing (Blood pH)

In the 54 athletes tested pH minimum was 7.33 and maximum 7.74. A mean of 7.4641 and standard deviation of ±0.08185.

4.5.2 Blood testing (Partial pressure carbon dioxide/ pCo_2)(kPa)

In the 54 athletes tested pCo2 was minimum 2.7 and maximum 7.1. A mean of 4.765 and standard deviation of ±0.9713.

4.5.3 Blood testing (Partial pressure oxygen/pO_2)(kPa)

In the 54 athletes tested pO2 was a minimum of 2.1 and a maximum of 12.8. A mean of 5.167 and standard deviation of ±2.3017.

4.5.4 Blood testing (Blood sodium levels/Na^+)(mmol/L)

In the 54 athletes tested Na+ levels were minimum of 129.0 and maximum of 143.0. A mean of 136.074 and standard deviation of ±3.2671.

4.5.5 Blood testing (Blood potassium levels/K^+)(mmol/L)

In the 54 athletes tested minimum K^+ levels were 3.4 and maximum of 7.2. A mean of 4.404 and standard deviation of ±0.7466.

4.5.6 Blood testing (Lactate)(mmol/L)

In the 54 athletes tested minimum lactate levels of 0.9 and maximum of 5.3. A mean of 2.294 and standard deviation of ±0.9521.

4.5.7 Blood testing (Haematocrit/Hct)(%)

In the 54 athletes tested minimum Hct minimum levels of 31 and maximum of 60. A mean of 45.83 and standard deviation of ±5.507.

TABLE 4.6 – Vital signs and blood chemistry of triathletes presenting for treatment at IMSA 2011 medical facility

	n (183)	Minimum	Maximum	Mean	Std. Deviation
Heart Rate (Bpm)	164	51	154	82.13	±15.394
BP (systolic)(mmHg)	163	130	198	164.75	±18.762
BP(diastolic)(mmHg)	163	34	103	72.34	±11.727
Temperature (^{o}C)	83	34.0	38.2	36.461	±0.6981
HGT(mmol/L)	156	2.2	14.2	5.527	±1.4265
Spo2(%)	78	93	100	97.73	±1.680
pH	54	7.33	7.74	7.4641	±0.08185
pCO_2(kPa)	54	2.7	7.1	4.765	±0.9713
pO_2(kPa)	54	2.1	12.8	5.167	±2.3017
Na^+(mmol/L)	54	129.0	143.0	136.074	±3.2671
K^+(mmol/L)	54	3.4	7.2	4.404	±0.7466
Lactate(mmol/L)	54	0.9	5.3	2.294	±0.9521
Hct(%)	54	31	60	45.83	±5.507
Missing data	17				

4.6 Primary presenting diagnosis/symptoms

In this study cohort (n=183) the most frequent primary diagnosis was that of exercise associated collapse (EAC) with 82 occurrences (44%). This was followed closely by other unspecified causes with 33 occurrences (18%) which included mostly blisters, cramping and hyperventilation syndrome. Nausea was the third most common symptom with 27 (14.8%) occurrences, fourth was trauma and dehydration with 13 occurrences (7.1%) and the lesser hypoglycaemia and hyponatraemia with 5 reports (2.7%) and lastly, hypothermia at 3 diagnoses (1.6%) respectively.(Table 4.6)(Figure 4.5)

TABLE 4.7 – Primary diagnosis/symptoms of triathletes presenting for treatment at the IMSA 2011 medical facility

Diagnosis/symptom		Frequency	Percentage(%)
	EAC/Postural hypotension	82	44.8
	hypothermia	3	1.6
	hyponatremia	5	2.7
	hypoglycaemia	5	2.7
	dehydration	13	7.1
	trauma	13	7.1
	Nausea	27	14.8
	other	33	18.0
	Total	181	98.9
	Missing data	2	1.1
Total n=183		183	100.0

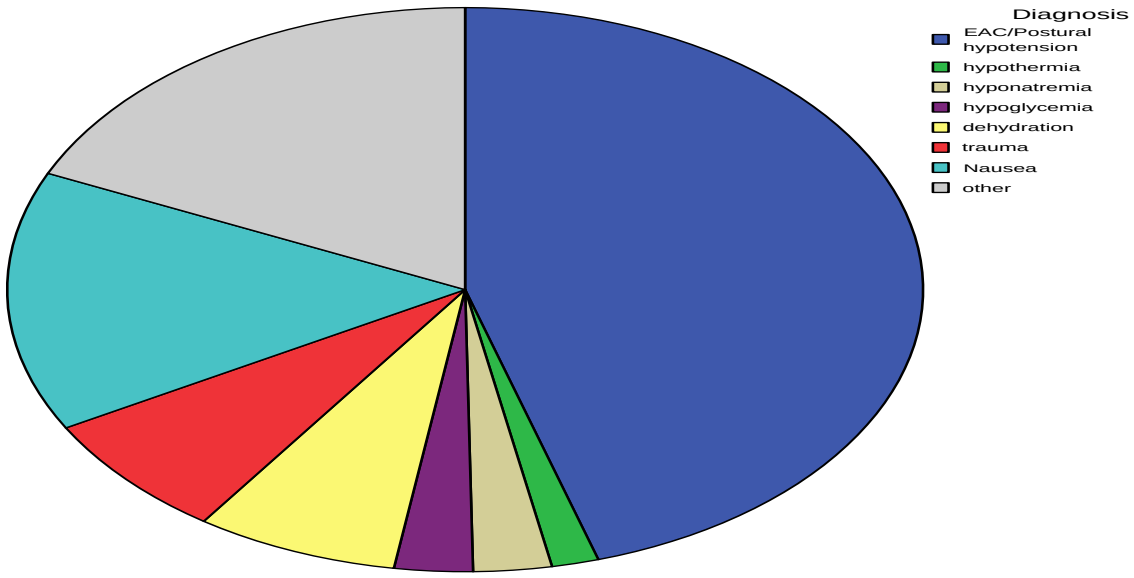

Figure 4.5 - Chart representation of the primary diagnosis/symptoms of triathletes presenting for treatment to the IMSA 2011 medical facility

4.6.1 Primary diagnosis/symptoms presentation timing

Of the 183 athletes who presented for treatment between the 9th and the 16th hour of race it is evident that the majority were treated for EAC.(Figure 4.6)

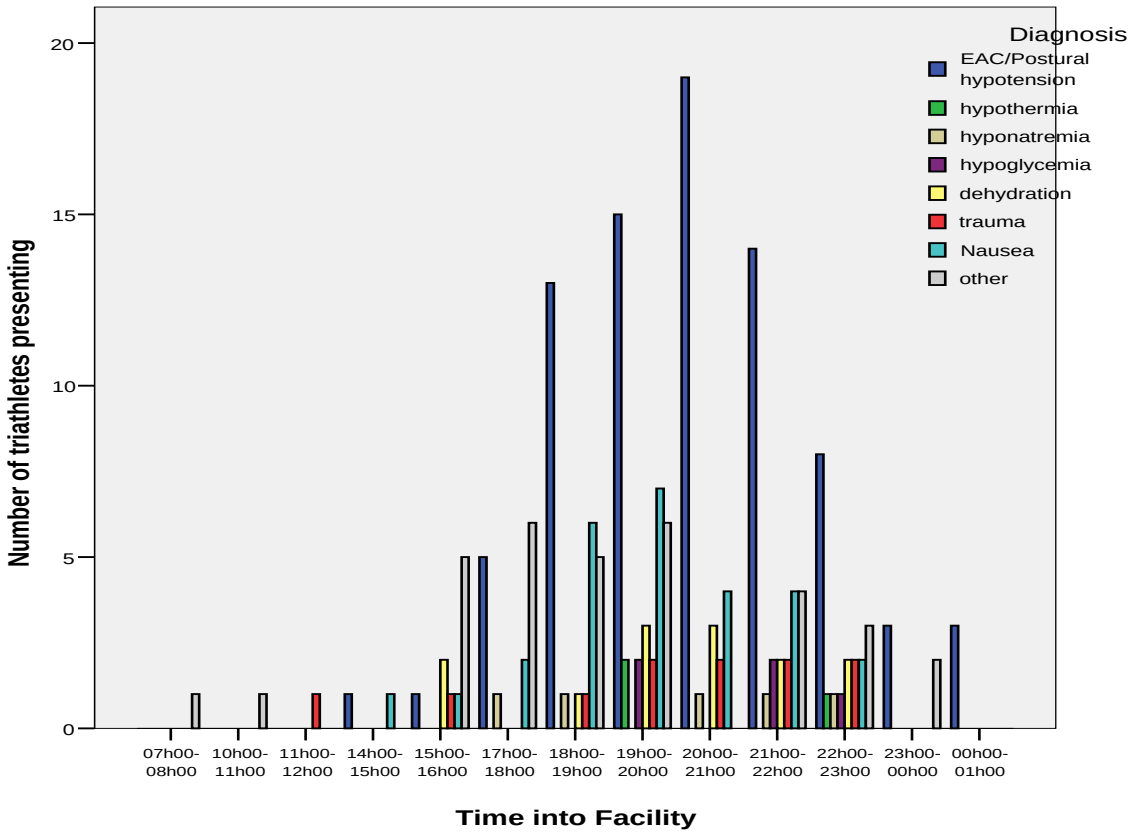

Figure 4.6 - The number of triathletes presenting during race day and the primary diagnosis/symptoms

4.6.2 Primary diagnosis/symptoms and duration of stay

It has been shown in the data that the mean duration of stay of the athlete's presentation for treatment at the IMSA 2011 was 36.08 minutes with standard deviation of ±29.58. Those athletes who were diagnosed with EAH had a longer duration of stay is comparison to the other primary diagnosis/symptoms.(Figure 4.7) What is also evident in those athletes that were diagnosed with EAH those with serum Na^+ below 135 mmol/L had longer mean duration of stay in the medical facility before discharge.(Figure4.8)

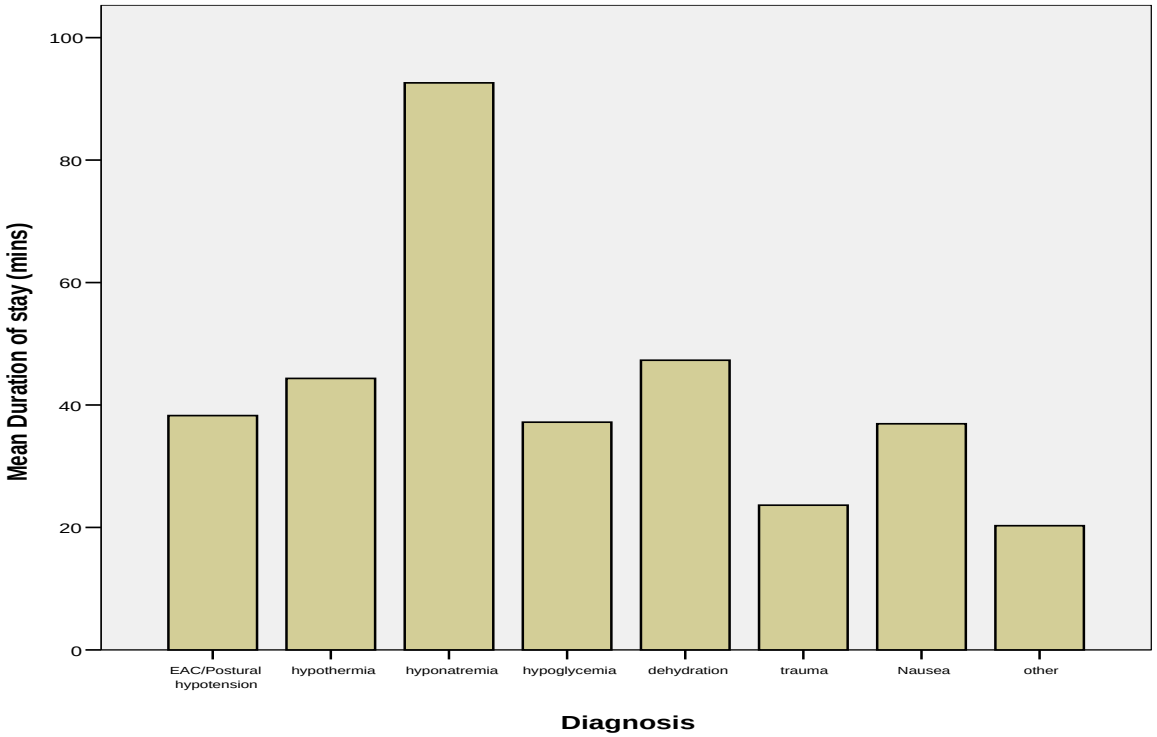

Figure 4.7 - Mean duration of stay as a function of diagnosis

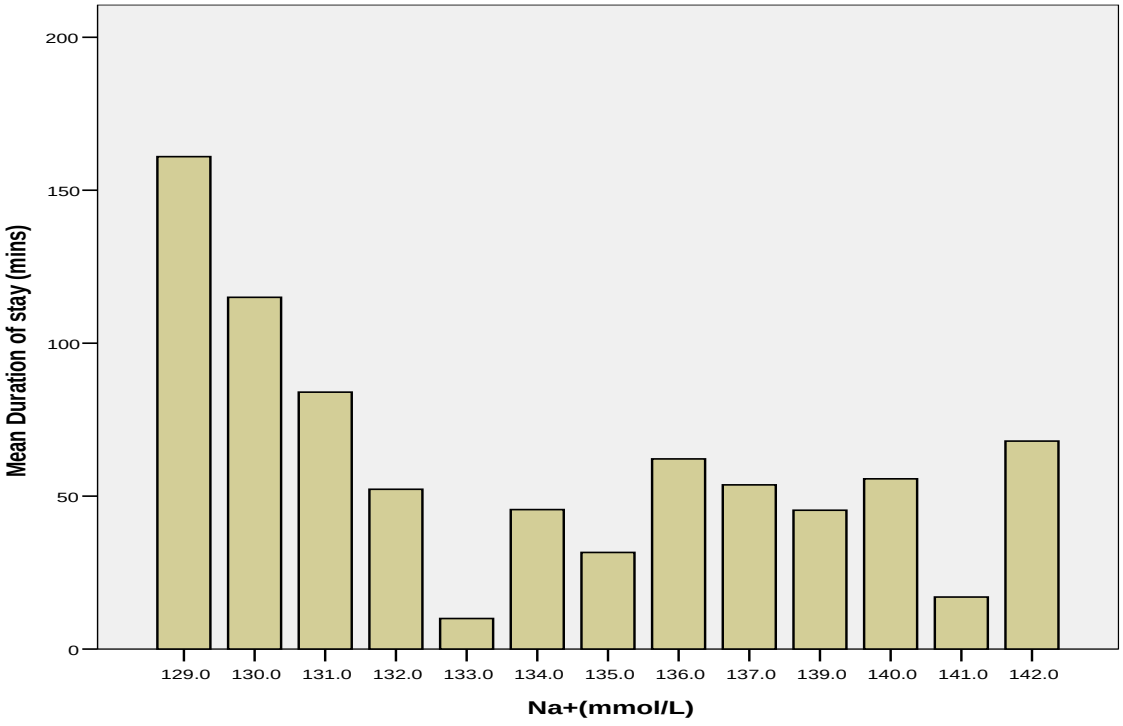

Figure 4.8 - Mean duration of stay as a function of EAH

4.6.3 Mean duration of stay as a function of time

During the 9th and 16th hours of the IMSA 2011 race day the mean duration of stay of 36.08 minutes (SD±29.58) was consistent during those peak hours.

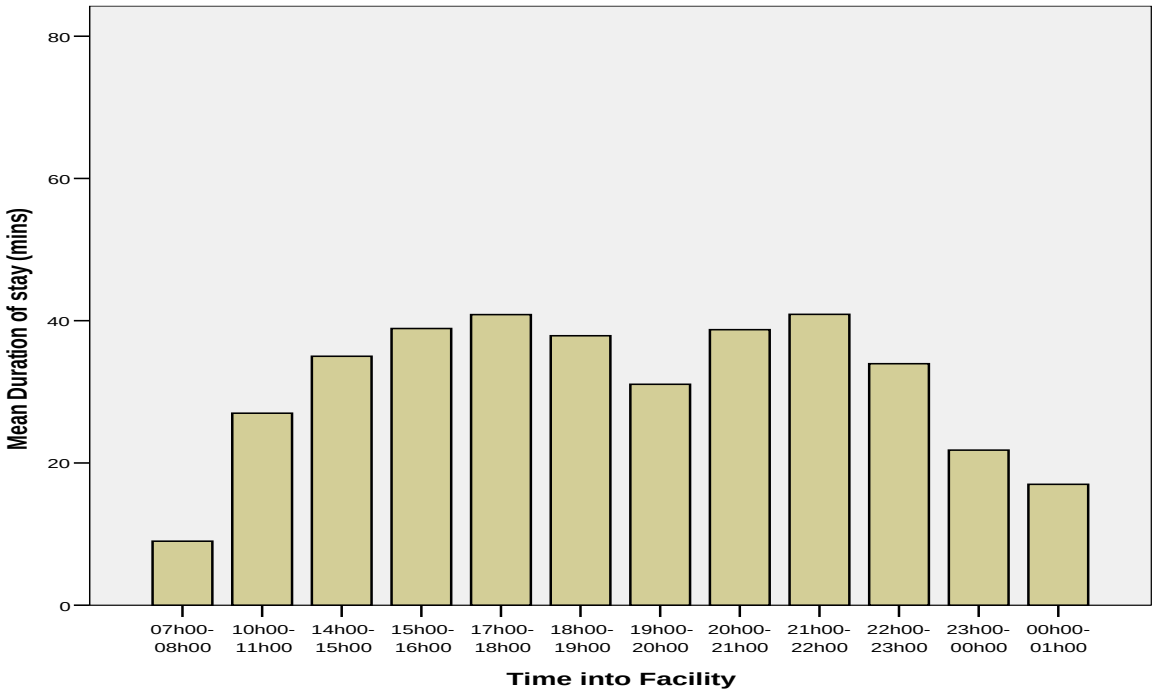

Figure 4.9 - Mean duration of stay as a function of Time presentation in to IMSA 2011 medical facility

4.7 Conclusion

This chapter describes the types, timing and numbers of injuries/medical conditions as well as the vital signs of those triathletes that presented at the IMSA 2011 medical facility. It also documented the vital signs and blood chemistry of those athletes who were assessed.

CHAPTER 5 – DISCUSSION AND CONCLUSION

5.1 Introduction

This research project from its inception had two main objectives. These were to firstly, accurately describe the type, timing and frequency of injuries presenting for treatment during the IMSA 2011 triathlon event. The second objective was to determine whether the current medical planning of staffing for this event was sufficient and if the time placement of that staff was in need of being changed.

In the case of an Ironman event special attention needs to be placed on the unique nature of this endurance triathlon. Consideration of the length of the Ironman triathlon total race distance of 226.2km and the possible length of time it may take participants to complete the event, which may be up to 17 hours in total is of importance. Also of importance is the composition, numbers, ratios of participants to medical staff and specific knowledge of the medical team recruited to assist during this type of events. Furthermore, the number of Ironman triathletes that are entered to compete in the event and the potential number of these athletes which may present for medical assessment and treatment needs to be determined. There is a need for adequate planning for unforeseen contingencies that may occur due to extreme environmental conditions. An additional consideration is the composition of the competing Ironman triathletes whom in the vast majority are non-elite competitors. This athlete will require remarkably different needs and treatments in comparison to the from their high performance elite counterpart.

5.2 Injury/Medical condition data

During the 2011 IMSA race day a total of 1742 triathletes lined up at the start line. Of those 1477 were able to complete the entire swim, cycle and run course within the allotted cut off times. This shows a completion rate of 84.8%. This rate of completion was fairly consistent with the completion rates at other Ironman triathlon events which showed completion rates between 80 % and 93%.[5]

Of those 1742 triathletes that started the IMSA 2011 triathlon data showed that 183 participants, presented for assessment and treatment to the medical facility, a total of 155

(87.4%) where male and a total of 28 (15.3%) where female with a mean age of 38.73 years old with a standard deviation of ± 9.832. This represented a treatment presentation rate of 10.5%. In comparison with other published literature this was consistent as it also showed a 2% to 15% treatment presentation rate of Ironman triathletes.[3,5] The consistency of the treatment presentation data at IMSA 2011 with other studies was encouraging as it closely resembles that data that was collected at other international Ironman events and not in South Africa.

5.2.1 Timing of injuries presenting

Current literature reports that about 85% of Ironman triathletes presenting for treatment either from the run course or from the finishing line of the event.[5,7] During IMSA 2011 76.4% (136) of the triathletes presenting for treatment presented from the finish line and run course. With the balance presenting by ambulance (8.2%)(15), from the massage tent (2.2%)(4) and other parts of the swim and cycle leg (13.1%)(24).

Most athletes presenting for treatment during IMSA 2011 did so between the 9th and the 16th hour of the race. The mean time of presentation was 12.35 hours and a standard deviation of± 2.233. This was again consistent with the published literature which also showed the similar time distributions.[3,5] The only consideration is that these publications drew data only from the United States of America and not from multiple countries worldwide. The IMSA event is part of the international Ironman calendar of events so it does draw international athletes which provide a good demographic in the competing IMSA 2011 field.

During this peak time the overwhelming presentation of EAC was evident. This high incidence is expected as this is a peak time for athletes completing the event. The data shows the overwhelming number of these athletes (74%) present from the finish line. This may also be influenced by many factors including environmental and race day weather conditions, course structure and swim currents which may be vastly different on each day.

5.2.2 Duration of stay

Some studies have shown that the duration of treatment of Ironman triathletes can be fairly long. Showing mean treatment times as high as 62.3 minutes.[3] During this study the mean

stay of athletes was shown to be 36.08 minutes with a standard deviation of ±29.58. Patients presenting with diagnosed EAH showed the longest mean duration of stay. Those triathletes who presented with serum Na^+ of less than 135 mmol/L had a longer time (160 minutes) to discharge from the IMSA 2011 medical facility. They also required more intensive management and repeated observations and additional blood chemistry testing before recovery.

5.2.3 Prevalence of injuries

The most common presenting injuries of these athletes was shown in the literature to be EAC, EAH, GI disturbances, heat stress disorders and exercise associated muscle cramping. EAC being by far the most common presentation at 44,8% followed by GI disturbances at 14.8% and then EAH 2.7%. When compared to published literature EAC presented with an incidence of between 17% and 85%.[12,24-31] While GI disturbances were documented in publications at between 5% and 59%.[7,8,46-50] EAH in Ironman triathlon and endurance athletes has been reported to be between 10% to 75%.[3,5-8, 24,33-42] This showing of the IMSA 2011 data was consistent but with a lower presentation of EAH. Those IMSA 2011 triathletes who presented with EAH also showed a marked increase in the mean duration of stay in the medical facility as these athletes were metabolically more unstable.

5.2.4 Vital signs and blood chemistry

In this cohort of IMSA 2011 triathletes measured vital signs were as follows:

Heart rate mean 82.13 bpm ±15.39 SD (51min-154max), systolic blood pressure mean 164.75mmHg ± 18.76 SD (130min-198max), Diastolic blood pressure mean 72.34mmHg ± 11.72 SD (34min-103max), HGT(serum glucose) mean 5.52mmol/L ± 1.4 SD (2.2min-14.2max), body temperature mean 36.46^oC ± 0.69 SD (34min-38.2max), serum Na^+ mean 136.07 mmol/L ± 3.27SD (129min-143max), serum K^+ mean 4.40 mmol/L ± 0.75 SD (3.4min-7.2max) and Hct mean 45.83 % ± 5.50 (31min-60max).

There are many published studies that document the vital sign and blood chemistry of Ironman triathletes and the results of those studies are as follows:[29,33,34,36,37]

Heart rate mean 81-90bpm ± 10-14 SD (60min-102max), systolic blood pressure mean 106-110 mmHg ± 8-11 SD (89min-130max), diastolic blood pressure mean 67-68mmHg ± 9-10 SD (48min-80max), HGT mean 5.8-7.6 mmol/L ±0.1-1.5 SD (4.5min-8.9max), body temperature mean 35.9-36.1^{o}C ±0.5-0.9 SD (34.8min-37.5max), Serum Na^{+} mean 137.2-143 mmol/L ± 1.5-5SD (135min-147max), serum K^{+} mean 4.2-4.4 mmol/L ± 0.5-0.6 SD and Hct mean 44.3-47.2 % ± 2.4-3.4 SD.

The vital signs and blood chemistry data published in other studies of similar Ironman triathletes closely resembles that of data collected at the IMSA 2011.(Table 5.1)

TABLE 5.1 – Vital signs and blood chemistry of IMSA 2011 triathletes in comparison with published data

	IMSA 2011 Mean(±SD)	**Published Data[29,33,34,36,37] Mean(±SD)**
Heart Rate(Bpm)	82.13(±15.394)	81-90(±10-14)
Systolic Blood Pressure(mmHg)	164.75(±18.762)	106-110(±8-11)
Diastolic BloodPressure(mmHg)	72.34(±11.727)	67-68(±9-10)
Serum Glucose (Hgt)(mmol/L)	5.527(±1.4265)	5.8-7.6(±4.5-8.9)
Body Temperature(^{o}C)	36.461(±0.6981)	35.9-36.1(±0.5-0.9)
Serum Sodium (Na^{+})(mmol/L)	136.074(±3.2671)	137.2-143(±1.5-5)
Serum Potassium (K^{+})(mmol/L)	4.404(±0.7466)	4.2-4.4(±0.5-0.6)
Hct(%)	45.83(±5.507)	44.3-47.2(±2.4-3.4)

5.3 Medical staffing requirements

With there being well established medical staffing guidelines for use at Ironman triathlon events the current staffing at IMSA 2011 was in line with this.[7] Considering the timing of injury presentation during IMSA 2011 the described medical staffing, which is at its maximum between 16h00 and 24h00, allows excellent coverage for the time of presentation of the IMSA triathletes. During this crucial time a total of 20 medical doctors, 32 nurses, 6 physiotherapists, 10 Bio kinetic interns, 2 podiatrists and 32 stretcher bearers. During the

05h00 to 12h00 midday time slot there would be no less that 5 medical doctors, 12 nurses, 2 physiotherapists, 2 podiatrists and 16 stretcher bearers. With the 12h00 to 16h00 being staffed by the same number of medical personnel but with the addition of 1 medical doctor and 2 physiotherapists. Current guidelines for the critical period between 16h00 and 24h00 is a minimum of 3 doctors, 9 nurses and other paramedical staff per 100 competitors.[3] Thus allowing the best coverage during those times when the volume and duration of treatment of athletes are at its highest between the 9th and the 16th hour of the race day.

5.4 Limitations of this study

On completion of this study a few limitations have been noted. During some of the data collection not all of the appropriate information was accurately collected by the attending medical staff. The completion of data collection sheets was in some cases incomplete. This seemed to be worsened during the peak hours of high volume patient presentation. The peak time data losses lead to a problem of missing data in some cases. In addition 17 of the athletes who presented for treatment and assessment had no data collected as they were triaged and discharged by the attending doctor due to there being no need for treatment. Future research may consider the inclusion of multiple years of data which may help to define the value of this data set better. Also better break down of those many injuries described or indicated in the "other" category which made up 18% of the described injuries. Many of these patients presentation were not alluded to in detail which may also be seen as a short coming of the data presented.

5.5 Conclusion

In conclusion this study evaluated the type, timing and frequency of injury presentation at the IMSA triathlon event and to establish if the current staffing was of sufficient capacity to deal with these injuries and medical conditions described. The results of this study suggest that current medical staffing was sufficient and thus rejects a null hypothesis in this case. Further consideration should be given to the environmental conditions which may vary considerably from year to year as well as the possibility of larger numbers of competitors and the possibility of course route changes in the future IMSA events. An evaluation of medical staffing requirements may need to be made annually dependant on the changing circumstances.

CHAPTER 6- REFERENCES

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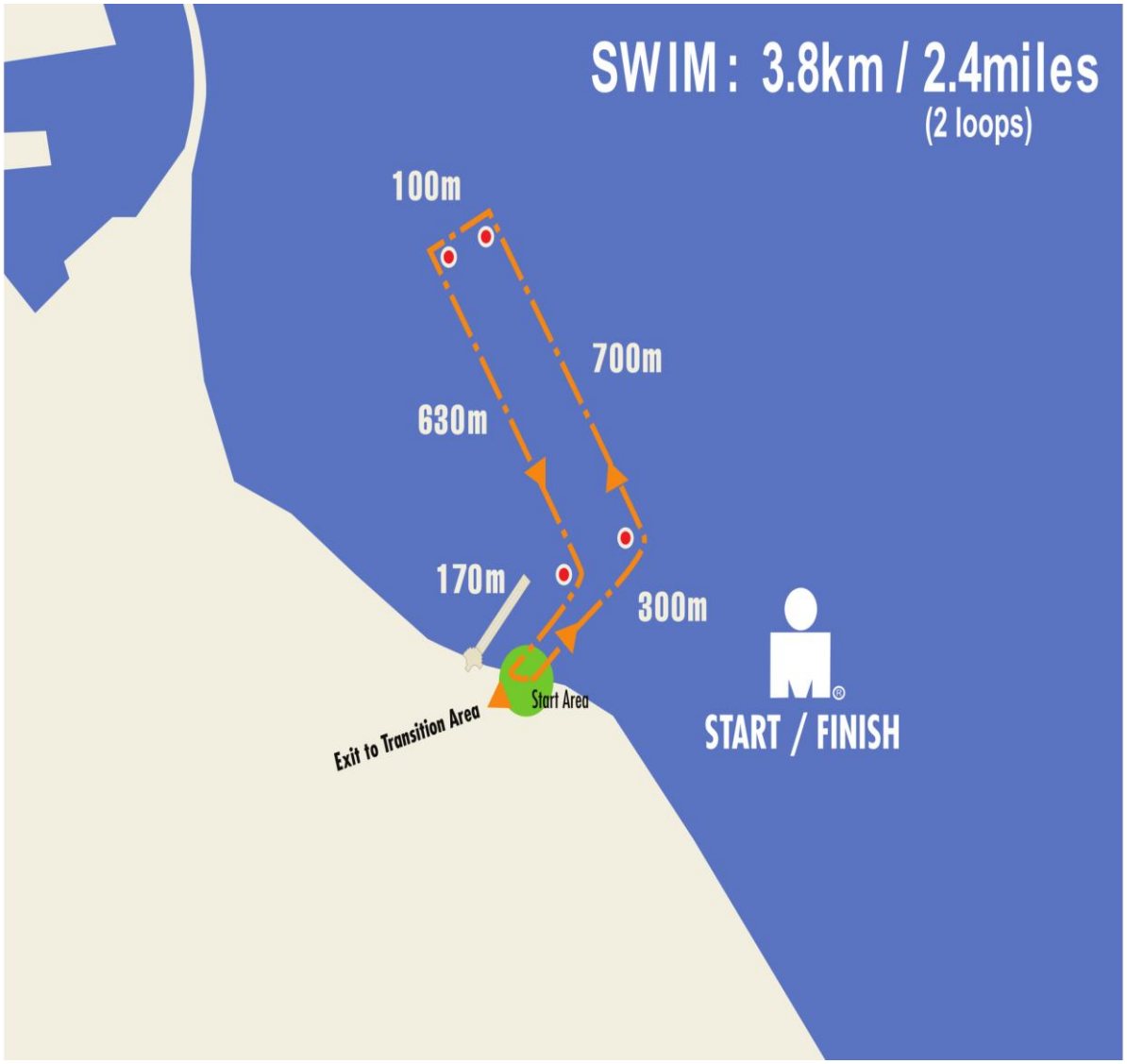
CHAPTER 7 – APPENDIX

Appendix A

Ironman South Africa Swim course layout



Appendix B

Ironman South Africa Cycle course layout



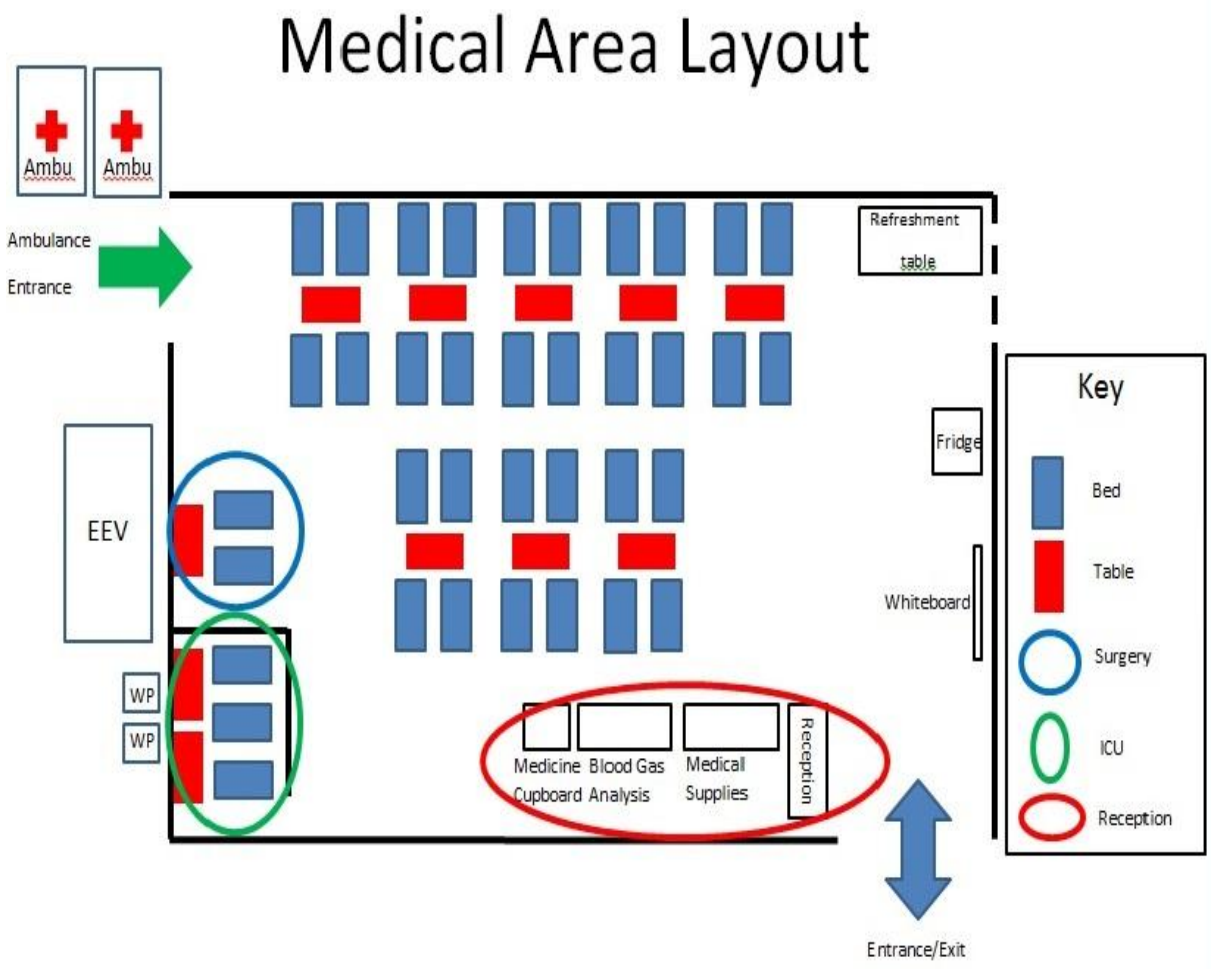
Appendix C

Ironman South Africa run course layout



Appendix D

Ironman South Africa medical facility layout



Appendix E

Equipment and medical supplies

Wound care

Adhesive dressings – Various sizes

Adhesive tape X 10

Antiseptic

Crepe bandages 100mm X 30

50mm X 30

Elastoplast 75mm X 10

25mm X 10

Collar and cuff /slings X 10

Disposable dressing packs X 40

Eye pads X 10

Eye kit

Gauze squares X 10 boxes

Gloves-non sterile SML

Local anaesthetic

Xylotox without adrenaline X 20

Xylotox with adrenaline X 10

Steristrips X 4 SML

Stitches **3.0 X 1 box**

5.0 X 1 box

Sterile instruments

- Needle holders, Scissors, forceps X 4
- Scalpel& blades nr. 15 X 4
- Syringes 20cc X 10

  5cc X 1 box

  3cc X 1 box
- Needles Assorted X 300

- Web cols X 2 boxes

Diagnostic Equipment

Appendix E continued

- Auroscope X 2
- Monitor X 10
- Banometer X 2
- Opthalmoscope X 2
- Reflex hammer X 2
- Stethoscope X 10
- Thermometers tympanic X 10
  Rectal X 2
- Torch X 10
- Tongue depressors X 2 boxes
- Glucometers X 10
- Blood chemistry analyzer (urea and sodium) X 1
- Urine specimen bottles X 40
- Urine dipstix X 1

Emergency equipment

- Airways 2/3/4/5 X 2
- Magils forceps X 2
- Jens Gower
- Introduser
- Defibrillator/AED X 2
- ECG monitor, paper X 1
- ECG electrodes X 400
- Laryngoscope X 2
- Endotracheal tubes X 2 sets
- Nebulisers X 2 and 20 masks
- Oxygen cylinders X 10

- Oxygen tubing and masks X 40
- Suction device X 2 and suction catheters nr. 8,12,14
- Ice packs X 200
- Ice bath X 1
- Giving sets(IV)

Appendix E continued

- Jelcos
- Butterflies
- Drip stands

General equipment and supplies

- Blankets X 40
- Towels X 20
- Space blanket X 250
- Bear huggers X 4
- Beds X 40
- Tables X 15
- Medical Cupboard X 1(lockable)
- Crutches X2
- Drinks – water/energy/ hot drinks
- Linen savers X 400
- Sheets X 100
- Pillow cases X 50
- Pillows X 40
- Black plastic bags
- Sanitary pads/tampons
- Sharps boxes X 10
- Medical waste
- Stationary
- White board with markers

- Bed numbers
- Computer and printer & paper
- Script pad
- Chairs X 40
- Clipboards X 40
- Vomit bowls X 20
- Fridge
- Extension cord X 10

Appendix E continued

- Adapters X 10
- Patient records X 400
- Protocols X 10
- Scale
- Rubber mats
- Anti-chafe
- Sun Screen
- After Sun
- Hand Gel

Medication

Injectable:

- Adrenaline 1:1000 X 30
- Atropine X 10
- Lasics X 10
- Diazepam 10 mg X 5
- Hydrocortisone 100mg X 10
- Lignocaine 2% 5 ml X 4
- Morphine 10 MG x 5
- Naloxone X 2
- Metoclopramide 10mg X 40

- Stemetil X 20
- Akineton X 5
- Phenergan 25mg X 5
- Novorapid X 1
- Scoline 100mg X 2
- Buscopan 20mg X 20
- Buscopan Co X 10
- Nexiam 40mg x 10
- Adrenacor 6 mg X10
- Cardorone 150 mg x 5
- Dormicum 5mg/5ml X 5

Appendix E continued

- Pavilon 4mg X 4
- Aminophylline X 10
- Zofran X 20
- Tramahexal X 20
- Magnesium sulphate 50% 10 X 2ml ampules

Oral

- Analgesics – Ibupain 30 X 3
  - Ibupain forte X 3
  - Paracetemol X 100
  - Panado syrup 2X 100ml
  - Tramacet X 30
- Anti-emetics Clopamon 10mg X 30
  - Mitil 5mg X 30
  - Zofran X 10
- Ativan 1mg Subligual X 10
- GTN sublingual spray X 1
- Disprin CV X 1box
- Gaviscon advance 200ml X 2

- Gaviscon tabs X 20
- Isordil 5 mg S/l X 10
- Deselex X 60
- Buscopan X 20
- Buscopan Co X 60
- Celestamine X 30
- Corenza C X 20

Inhaled

- Duolin X 20
- Pulmicort 0.5mg/ml X 10

Topical

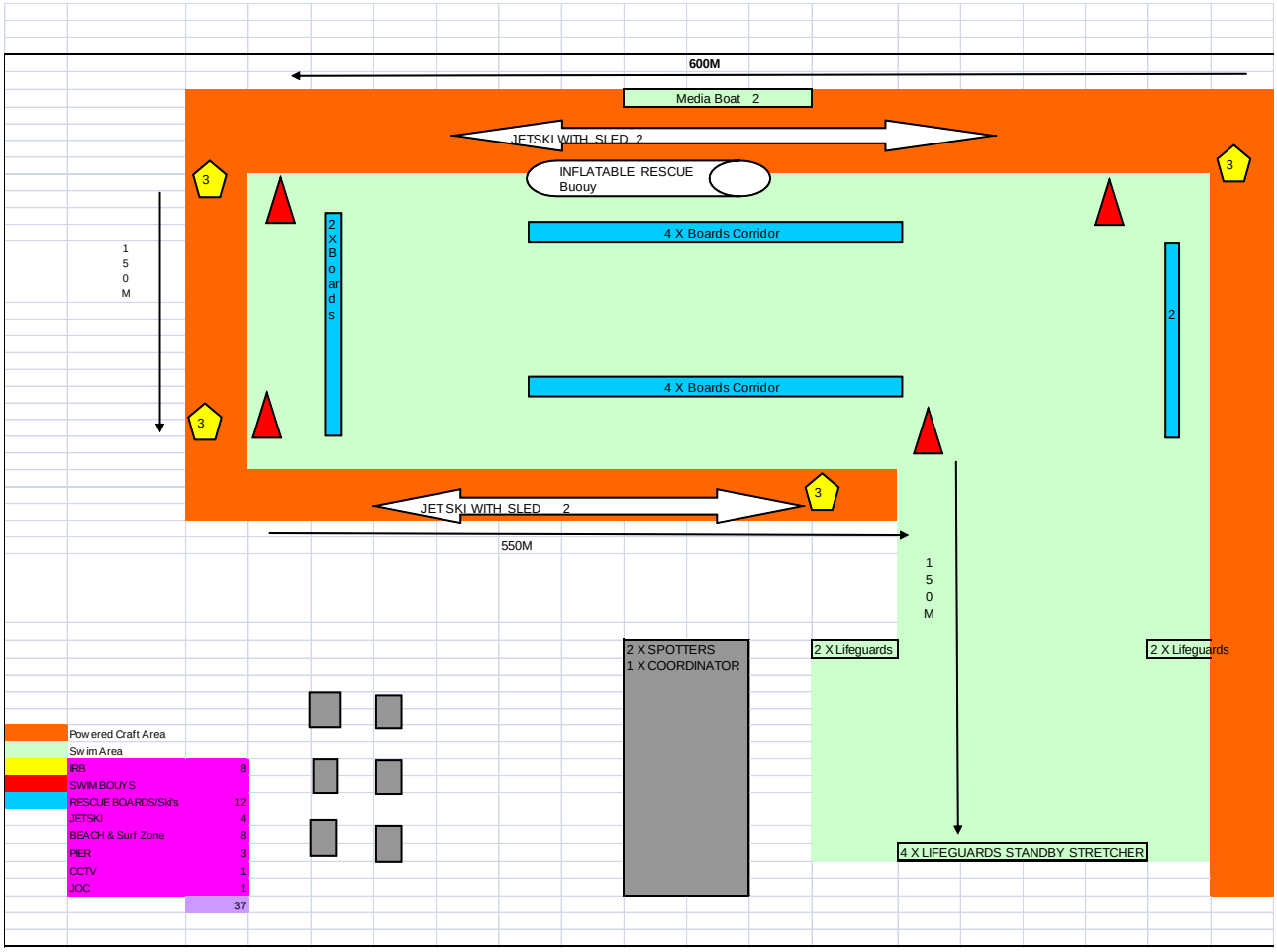
- Fluoroscein X 4
- Novocin wonder X 2
- Chloromycetin eye ointment X 10
- Bactroban 15g X 5
- Elmetasin spray X 2

IV Fluids

- 5% Dextrose 1L X 12
- 50% Dextrose 50ml X 6
- Ringers 1L X 12 boxes
- 3-5% NaCL X 5
- Sodium bicarbonate 8,5% 50ml X 2
- Calcium glugonate X 2

Appendix F

Ironman swim course staff deployment



Appendix G

Glasgow coma scale [55]

Eye opening:

4 Spontaneous

3 To voice

2 To pain

1 None

Verbal response:

5 Orientated

4 Confused

3 Inappropriate words

2 Incomprehensible

1 None

Motor response:

6 Obeys command

5 Localises pain

4 Withdraws to pain

3 Flexion to pain

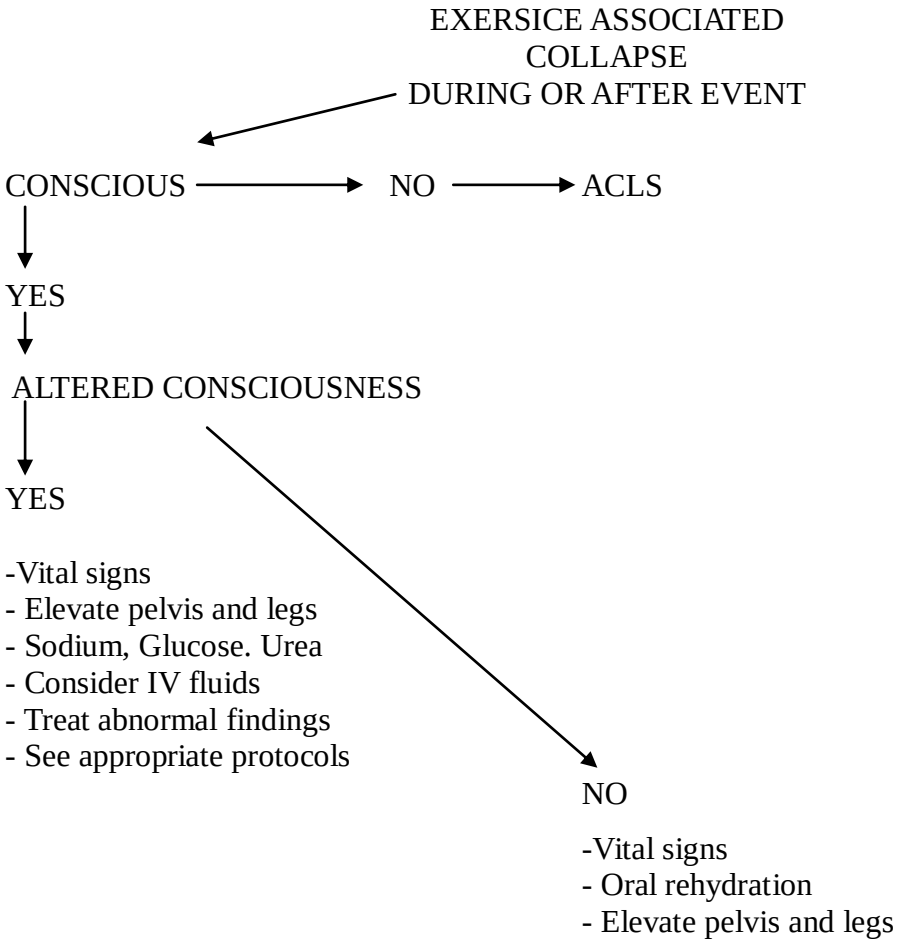
2 Extension to pain

1 None

Appendix H

Ironman South Africa 2011Treatment Protocols

Exercise associated collapse



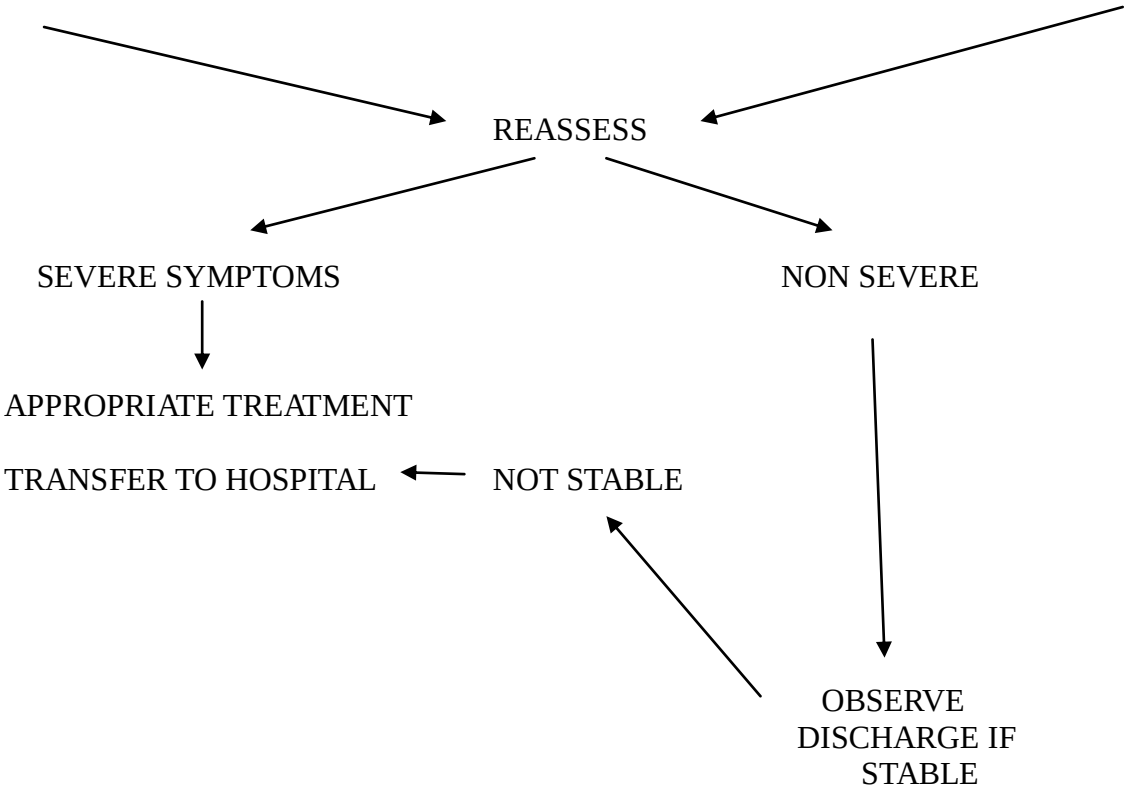
ASSESMENT	**NOT SEVERE**	**SEVERE**
MENTAL STATE	CONSCIOUS ALERT	UNCONSCIOUS CONFUSED, DISORIANTATED
RECTAL TEMPERATURE	34-36°C (93,2-96,8°F)	>40°C (104°F) < 34°C (93,2°F)
SYSTOLIC BLOOD PRESSURE	> 100mmHG	< 100mmHG
HEART RATE	< 100bpm	> 100bpm

BLOOD GLUCOSE	4-10 mmol/L	< 4mmol/L > 12mmol/L
SERUM SODIUM	135-148mmol/L	< 135mmol/L OR >148mmol/L
BODY WEIGHT LOSS	0-5%	> 10%
BODY WEIGHT GAIN	< 2%	> 2%

Appendix H

Treatment Protocols

Exercise associated collapse continued



Considerations for initiation of IV therapy

Consider IV fluid therapy if patient has:

- Obvious signs of dehydration - sunken eyes
  - parched lips and tongue
  - poor skin turgor
- Persistent tachycardia (heart rate > 100 bpm)
- Persistent hypotension (systolic BP < 110mmhg**)**

Initiate IV fluid therapy if:

- Hemodynamic instability – symptomatic tachycardia or bradycardia.
- Arrhythmia or cardiac ischaemia on ECG

Appendix H

Treatment Protocols continued

Guidelines to determine the severity of a collapsed athlete

ASSESMENT	**NOT SEVERE**	**SEVERE**
MENTAL STATE	CONSCIOUS ALERT	UNCONSCIOUS CONFUSED, DISORIANTATED
RECTAL TEMPERATURE	34-36°C (93,2-96,8°F)	>40°C (104°F) < 34°C (93,2°F)
SYSTOLIC BLOOD PRESSURE	> 100mmHG	< 100mmHG
HEART RATE	< 100bpm	> 100bpm
BLOOD GLUCOSE	4-10 mmol/L	< 4mmol/L > 12mmol/L
SERUM SODIUM	135-148mmol/L	< 135mmol/L OR >148mmol/L
BODY WEIGHT LOSS	0-5%	> 10%
BODY WEIGHT GAIN	< 2%	> 2%

HYPERTHERMIA

↓

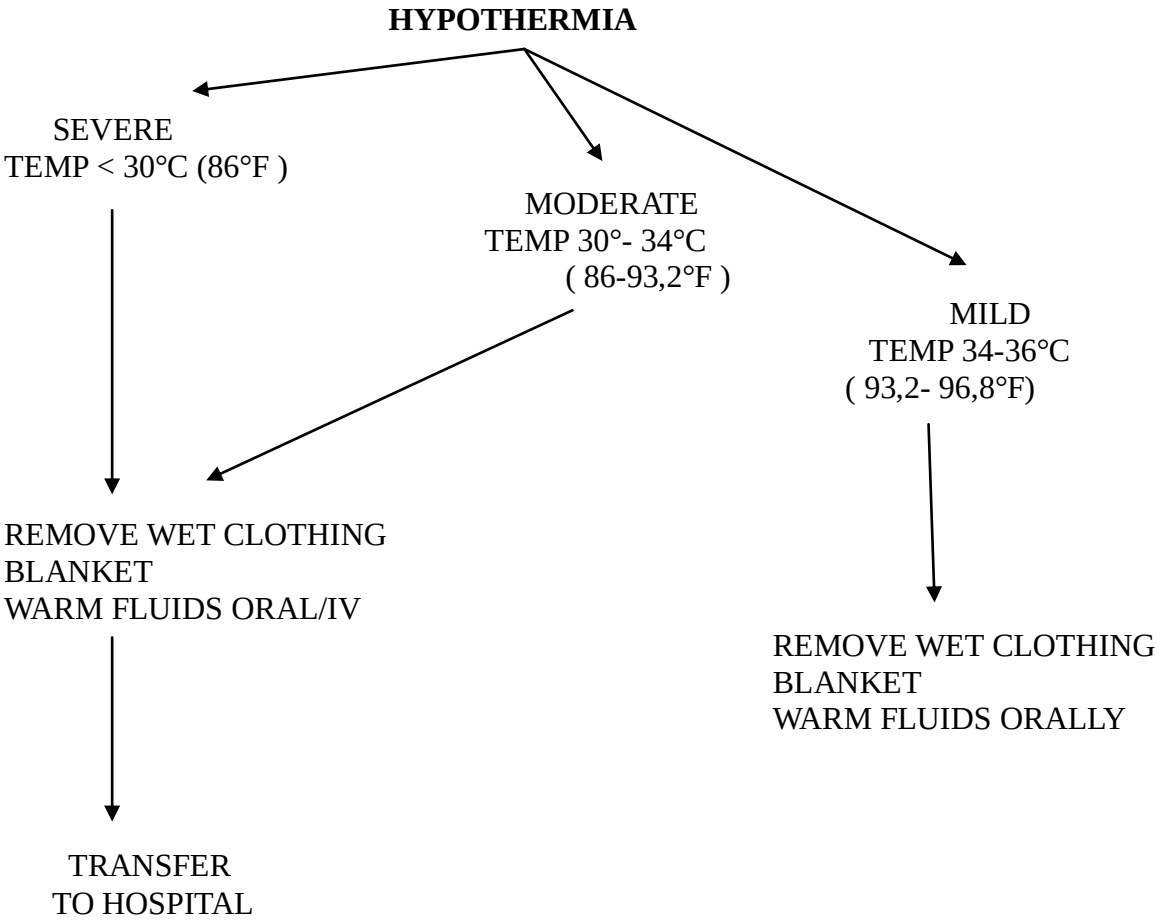
- RECTAL TEMPERATURE > 40°C (104°F)
&
- ALTERED MENTAL STATUS

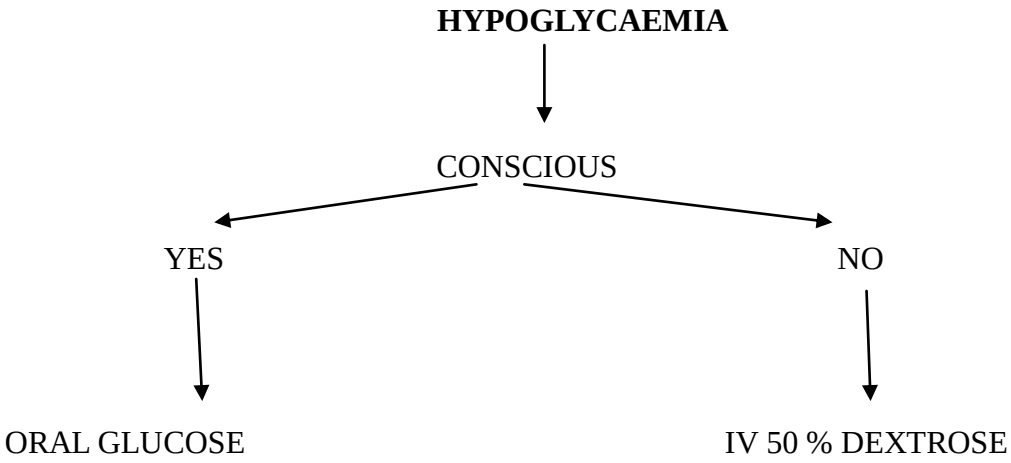
↓

- IMMERSE ATHLETE IN ICE WATER FOR 5-10 MINUTES
- THE TEMP SHOULD REDUCE WITHIN 10 MIN TO 38°C (100,4°F)
- TREAT DEHYDRATION IF PRESENT
(CHECK SERUM SODIUM FIRST)

Appendix H

Treatment Protocols continued





Appendix H

Treatment Protocols continued

MUSCLE CRAMPING



- STRETCH THE MUSCLE
- MASSAGE

Appendix I

Standardised data collection form.

Ironman South Africa Medical Record 2011

IRONMAN MEDICAL RECORD 2011

TIME IN
TIME OUT
Anonymous Athlete Reference number:_____ AGE: _____.
SEX: M □ F □ MEDICAL HISTORY:
ALLERGIES:

RACE INFORMATION:
ARRIVED FROM: □ Ambulance □ Massage □ Finish Line □ Other
MEDICATION:

.
(Before and during race)
RECENT ILLNESS: YES □ NO □

MAIN COMPLAINT:
□ Confusion □ Seizures □ Exhaustion □ Short of Breath
□ Vomiting □ Diarrhoea □ Abd Cramps □ Muscle Cramps
□ Dizziness □ Syncope □ Nausea □ Headache
□ Trauma □ Other

CLINICAL FINDINGS/ VITAL SIGNS:
MENTAL STATUS: ALERT □ VERBAL RESPONSE □ PAIN □
UNRESPONSIVE □
TIME: PULSE: BP supine BP Sitting TEMP: HGT:
U&E

DIAGNOSIS:

EAC/ POSTURAL HYPOTENSION		HYPOGLYCAEMIA	
HYPERTHERMIA		DEHYDRATION	
HYPOTHERMIA		TRAUMA	
HYPONATREMIA		OTHER	

TREATMENT:……
DISCHARGE NOTE: ……
Athlete seen by:
DOCTOR
NURSE_____PHYSIOTHERAPIST_____OTHER_____

Appendix J

Ethics clearance certificate.

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mr Stuart J Alexander

CLEARANCE CERTIFICATE	**M120964**
PROJECT	A Review of Athletes Presenting for Medical Assistance at the 2011 Ironman South Africa Triathlon Event
INVESTIGATORS	Mr Stuart J Alexander.
DEPARTMENT	Centre for Exercise and Sports Medicine
DATE CONSIDERED	28/09/2012
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 28/09/2012 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Dr Demitri Constantinou

DECLARATION OF INVESTIGATOR(S)
To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix K

Approval of title letter

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011) 717-2076

Reference: Ms Mpumi Mnqapu
E-mail: mpumi.mnqapu@wits,ac.za
07 December 2012
Person No: 331757
PAG

Mr SJ Alexander
P.O. Box 27614
GREENACRES
6057
South Africa

Dear Mr Alexander

Master of Science in Medicine (Sports Science): Approval of Title

We have pleasure in advising that your proposal entitled "*A review of athletes presenting for medical assistance at the 2011 ironman South Africa triathlon event*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

Appendix L

Letter of permission from Ironman South Africa Medical Race Director.

Intercare Port Elizabeth
Cnr of Buffelsfontein and Titian Roads, **Walmer, Port Elizabeth**
Tel. (041) 395 9620

14 August 2012

To whom it may Concern,

This letter serves to confirm that I give permission for the use of medical data obtained from athletes who participated in Ironman South Africa for the year 2011 to be used for the purpose of a research study to be conducted by Stuart Alexander (Student number : 331757).

Yours faithfully

Dr Konrad von Hagen
Medical Race Director for Ironman SA
Intercare – Port Elizabeth