MOUNTAIN BIKE AUSTRALIA

Policy for the Provision of Medical Services at MTBA Events

Revision Control

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Distribution

- MTBA Committee
- MTBA Clubs

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Policy for the Provision of First Aid and Medical Services at MTB events

1. Background

1.1. Mountain Biking

There has been a rapid increase in the popularity of mountain biking (MTB) over the past 5 years that can be compared with the running boom that occurred in the 1980's and 1990's.

Cycling is increasing in popularity in Australia with over 1 million bicycles sold annually since 2002. This activity is listed as fourth most popular amongst adult Australians by the Australian Sports Commission.

1.2. Competition

The World Governing Body, Union Cycliste Internationale (ICI) includes mountain biking events: the annual UCI Mountain Bike Championships (cross country, downhill, and four cross), Marathon and Masters Events.

The circuit cross country event (XCO) has been part of the schedule in the Olympic Games since 1996.

Mountain Biking Australia (MTBA) is the governing body of Mountain Biking in Australia and is affiliated with Cycling Australia (CA). MTBA organises National Series in various formats: cross-country (XC), downhill (DH), Marathon and 24 hr. Currently MTBA selects riders for competition in International (UCI) events.

In Australia there are numerous MTB races that are run under the auspices of MTBA. There are over 100 affiliated MTB Clubs in Australia, with about 7300 members registered with MTBA. Most clubs have regular races for members. Non-members can also participate by purchasing day licenses. Apart from these relatively small races where there may be as low as about 10 riders and sometimes as large as 100 riders, there are increasing numbers of longer races, particularly long distance or time events that have a field of over 1000 competitors; the most popular are fully subscribed within hours of entries being available online. For example there were at least a dozen 100km races in Australia in 2010. The author counted nine 24 hour mountain biking events that were available in the same period.

Most of the participants appear to be "serious recreational riders" that seek physical challenges akin to the running equivalents of the marathon or ultra-marathon.

2. Physiology of Mountain Biking

Lucia and co-workers reviewed the physiology of professional road cycling in 2001, examining scientific publications relating to riders who cycled 30 000 to 35 000 km annually.

Table 1. Characteristics of various stages in professional tour races.

	Flat stages	High mountain stages	Time Trials
Distance (km)	~200	~200	40-60
Exercise time (h)	4 – 6	5 – 6	~1
Prevailing metabolism	Aerobic (fat)	Aerobic (fat and CHO) and anaerobic.	Aerobic (CHO) and anaerobic.
Mean velocity (km/h)	~45	~20	~50
Cadence (rpm)	~90	~70	~90
Main requirements	Technical	Physiological	Physiological and aerodynamic.
Specific concerns	Crashes, muscle damage.	Moderate hypoxia.	Aerodynamics.
Estimated power output (W)	<250	>6W/kg during ascents.	350 – 400

CHO = carbohydrate, W = Watts.

In flat stages riders conserve energy expenditure by riding in bunches of up to 100 riders. It is calculated that 70% of the time in a flat stage can be spent at intensities <70% of maximal oxygen uptake (VO2max). High average speeds require cycling at high gears (e.g. 53 X 11 – 12) for hours at a time, resulting in a degree of muscle damage.

High mountain stages may include 3 – 5 passes up to 2000m elevation. The more successful climbers have high power output: body mass ratios of over 6W/kg. In addition to the physiological requirements, riders experience a degree of hypoxia at the higher altitudes. Riders perform up to 90% VO2max for prolonged periods (1 – 2hrs) at steeper sections that may be up to 10% gradient.

Impellizzeri and Marcora reviewed the physiology of mountain biking, published in Sports Medicine in 2007. Researchers concentrated on cross country circuit races. The authors noted that cross country mountain biking is a highly demanding endurance sport. Elite riders are characterised by high aerobic capacity and high power-to-weight ratio and body build similar to climbers in road cyclists. The relatively higher exercise intensity and shorter duration of mountain bikers compared with road cyclists requires specific training that should include shorter duration high intensity exercise sessions. Technical training is also important, and more research is required with this regard, as well as mountain biking in general.

3. Medical research

A literature review of scientific articles of MTB injuries was published online recently by Michael Carmont.

He summarised: “the risks of injury are 0.49% for cross-country riding and 0.51% for downhill. Injury rates are 0.37 riders per 100 h cross country and 4.34 riders per 100 h downhill racing. More serious injuries to the head and neck occur whilst falling over the handlebars rather than falling off the bike to the side, which tends to result in lower limb injuries. It was concluded that lighter female riders fall over the handlebars easier than male, tend to be more seriously injured than male riders; however, most injuries sustained mountain biking occur to young males aged 20–39 years.”

A 13y review of Spinal Column and Spinal Cord Injuries in Mountain Bikers was published by Dodwell et al in the American Journal of Sports Medicine in 2010. The provincial spine centre in British Columbia, Canada treated 102 men and 5 women. 73.8% sustained cervical injuries, while the remainder sustained thoracic or lumbar injuries. Most of the injured were young male recreational riders. 40% had injury to the spinal cord and 67% required surgery. The authors concluded that helmets protected against head injuries but not spinal injuries, and that most of the neck injuries were caused by falls over the handlebars and falls from heights. It may sound obvious but the greater the fall, the greater the injuries. Although neck (cervical spine) fractures are not as common as fractures to the limbs, the subsequent cost of medical treatment, personal and social cost is enormous. These statistics relate to the unique downhill tracks in British Columbia.

A publication of data in 2001 by Jeys et al reported on mountain biking injuries that occurred over a one year period in rural England, requiring presentation at a local hospital. 83% of the injured were males, aged 35y or under. The most common injuries were clavicular (13%), shoulder (12%) and radial (11%), mostly fractures. Ten per cent of injuries were soft tissue that were severe enough to require treatment in hospital.

A report of the incidence of serious injury and death from sporting and recreational activities in Victoria from July 2001 to June 2003 was published in the British Journal of Sports Medicine in 2005.

In order of decreasing frequency the cases were:

- Motor Sports (31.8%)
- Horse Riding (14.1%)
- Australian Football (8.6%)
- Water skiing/ power boating (8.6%)
- Swimming (7.1%)
- Aero sports (6.1%)
- Fishing (5.1%)
- Mountain biking (2.5%)

This article suggests that mountain biking and BMX riding forms the minority of deaths and seriously injured athletes in Victoria. 81% of the injured were male <45yrs, reflecting the nature of sports and recreation in men.

In relation to head injuries sustained in urban settings, a recent short report from the Royal Prince Alfred Hospital (RPAH) in Sydney analysed hospital admission data in cyclists over 16y. Dr Michael Dinh, Emergency Physician and Co-Director of the Department of Trauma Services at RPAH, and co-workers noted that although head injuries sustained while riding on urban roads was relatively low, non-helmet wearers had five times higher odds of intracranial bleeding or skull fracture compared with helmet wearers after adjusting for road type and mechanism of injury.

Kronisch and Pfeiffer reported on Mountain Biking Injuries in 2002. The authors looked at injuries relating to a large off-road bicycling competition held for 4 days each summer at Mammoth Mountain, California from 1994 – 2001. Twenty two females and 71 males who sustained an injury during a race and were unable to finish the race due to the injury, were included in the study. This represented an injury rate of 0.77% (22/2,869) for women versus 0.40% (71/17,900) for men ($p = 0.01$). Fractures were sustained by 45.5% (10/22) of female subjects versus 21.1% (15/71) of male subjects ($p = 0.03$). Odds ratios indicate that overall, women were 1.94 times more likely than men to sustain an injury and 4.17 times more likely to sustain a fracture.

A New Zealand study examined adventure activities and claims made to the Accident Compensation Corporation over a year from 2004 to 2005. Fourteen percent (2618 claims) related to mountain biking that was the second highest sport after horse riding (20% claims). Most injuries affected the shoulder. 77% of the claimants were male. Mountain biking claims were the fourth highest in cost (NZ$148) after hang gliding/ parasailing, skydiving and mountaineering. The authors concluded "These findings indicate a need to explore whether some form of regulation may be necessary to improve safety and risk management for those sectors, and to determine the extent to which such intervention might be effective in reducing injury to participants of these activities."

4. Sports Injuries in Children

With respect to exercise, children are uniquely different to adults regarding the musculoskeletal system due to immature growth plates at the ends of long bones (epiphyses) and where tendons attach to bone (apophyses). Increase in muscle strength precedes increases in bone strength that is reduced at the time of peak growth. This results in a period where stronger muscles act on bone of suboptimal strength. The skeletal system matures at different ages and children of similar ages may have differing skeletal maturation.

Excessive training and competition may lead to overuse injuries in the skeletally immature. Awareness by parents and health professionals should lead to early diagnosis and treatment.

More common growth related conditions that occur in the lower limb include:

- Slipped upper femoral epiphysis occurs in boys 10 – 16y and girls 10 – 14y. This may present as hip, groin or knee pain and occurs bilaterally in 25% cases. This condition occurs in 2 – 4 per 100 000 people. Treatment invariably involves surgery to prevent further slippage.

- Osgood-Schlatter Disease refers to pain below the knee at the tibial tubercle where the patella tendon attaches. The condition occurs in boys more than girls between 10 – 15y. Knee pain is aggravated by repetitive quadriceps contraction that occurs in running, jumping and kicking. In severe instances cycling may aggravate knee pain.

- Knee pain may be due to Sinding-Larson-Johannson Disease that relates to traction of the patella on the unfused inferior border of the patella. Incidence is similar to Osgood-Schlatter Disease. This should be differentiated from patellofemoral pain that can occur at any age. Pedalling with a seat that is too low or pedalling against high gearing can contribute to this.

- Severs Disease refers to posterior heel pain from Achilles pulling on an unfused calcaneal epiphysis. This is most commonly seen in boys 10 – 13y; heel pain is aggravated by running and jumping although cycling may cause relatively mild discomfort.

Osteochondroses refers to growth centres in children that can become painful due to a variety of reasons. It is thought that repetitive trauma may contribute to these conditions that may have a genetic predisposition.

Common osteochondroses include:

- Scheuermann's Disease affects the thoracic and lumbar spine in 13 – 17yr olds. Pain may be severe enough to limit most physical activities for a period of months. The condition is self-limiting.

- Osteochondritis dessicans can affect the elbow and knee where joint surfaces can break down. This may present as mild pain or severe pain with joint swelling and locking. Children should be able to cycle with these conditions, but not strenuously.

- Osteochondrosis of the wrist (lunate, radius or ulna bones), hand (metacarpals), or shoulder (humerus).

5. Mountain Biking injuries in children

Aleman and Meyers recently published an article in Sports Medicine regarding mountain biking injuries in children. There is a lack of publications describing injuries in children although it is assumed that the increase in adult injuries is associated with increased injuries in children. The authors cited a publication by Kim that reported a 300% increase in MTB injuries corresponding with increase in participation from 1992 to 2002 in USA.

Aleman and Meyers listed categories of injuries that I summarise or expand:

Head and neck injuries that may occur include:

- Concussion. This is generally a transient condition caused by rapid acceleration or deceleration of the head. Common symptoms include headache, dizziness, and blurred vision. If symptoms persist the rider should have medical assessment and clearance before returning to sporting activities. Wearing a helmet prevents some head injuries such as lacerations and fractures but does not prevent closed injuries such as concussion and intra cranial bleeding.

- Bleeding around (subdural) or in the brain (intracerebral) can occur when the head suddenly decelerates when striking a fixed object. Although the skull is well protected by a helmet, the brain will deform within the enclosed space when the head stops

suddenly. Bleeding around or within the brain may occur, causing headache, decreased levels of consciousness or neurological deficit that may develop over a number of hours following the injury. Urgent medical attention and referral to hospital is indicated.

- Fractured jaw (mandible) may occur from falling over the handle bars without wearing a full face helmet. Less severe injuries in this category include chipped teeth, and more severe may be degloving injuries of the oral mucosa.
- Cervical spine injuries may be overuse such as strain of neck muscles from prolonged extension, or acute fracture that may be associated with spinal cord injury.

Chest injuries include:

- Bruising to the chest wall or lung may occur from blunt trauma when the chest strikes an immovable surface such as a tree, or the ground.
- Rib fractures are painful conditions that may take a number of weeks or even months to resolve, depending on the number of ribs fractured and complications such as pneumothorax, or pneumonia.
- Pneumothorax (collapsed lung) occurs when a fractured rib punctures the lining around the lung, the pleura. Uncommon causes include puncture of the chest wall and pleura from the outside. Treatment of significant pneumothoraxes involves removing air from around the lung through aspiration or insertion of a drainage tube in hospital.

Blunt abdominal trauma is usually a result from falling onto handlebars and can result in:

- Bruising to the abdominal wall or abdominal contents.
- More significant force results in rupture of the spleen or haematomas liver.
- Other injuries include renal trauma or rupture of the diaphragm.

Upper limb injuries are reasonably common and results from placing the arm outstretched to break one's fall and to prevent injury to the face:

- Soft tissue injuries to the arm such as abrasions, and lacerations may occur. Mandatory use of gloves prevents soft tissue injury to the hands.
- Fractures of the wrist (e.g. scaphoid), forearm (e.g. radius) and clavicle are reasonably common from falling onto an outstretched hand. Landing on the shoulder with force may result in fracture of the humerus, or scapula.
- Ulnar nerve injuries of the wrist occur from compression on the handlebars. This can be alleviated with appropriate glove wear, bar grips and riding technique.

Pelvic injuries:

- Prolonged riding, especially multi-day events results in chafing of the perineum. Irritation of the skin can lead to folliculitis, and skin infections.

- Scrotal abnormalities have been noted in over 40% MTB riders. Calcifications, cysts are minor findings; more severe conditions include torsion and direct trauma.
- Fractures of the pelvis require major force and can occur from lateral compression when falling from a height while failing to unclip from the pedals.

Lower limb injuries may be overuse or acute:

- Soft tissue injury such as abrasions, lacerations, and bruising occur from falling.
- More severe force results in fractures of the femur, tibia, fibula, and foot.
- Overuse injuries of the knee is usually patellofemoral pain that also occurs in running activities. Patella maltracking or seat height that is too low may contribute to this problem. Cycling in too hard (high) gearing can also be a factor especially in children.
- External artery occlusion is thought to occur from repeated pelvic microtrauma although this condition is more common in road riders where they assume the tucked position more commonly. The affected athlete presents usually with leg pain associated with prolonged exercise, relieved by rest.

Spinal injuries are of great importance as injury to the spinal cord can lead to paraplegia or quadriplegia that can lead to lifelong problems that require huge resources to manage, as well as major challenges for the injured rider.

- Neck injuries from forced flexion or extension can lead to fracture or dislocation of the vertebrae with or without spinal cord injury.
- Forced flexion of the trunk at high speed can lead to compression fractures of the thoracic or lumber spines.

6. Injury prevention

It is well recognised that sporting activity provides many health benefits. Although risks associated with MTB are specific, there are general principles that can be applied from other sports. Klugl and co-workers analysed 12000 publications on prevention of injury. They note previous explanation from van Michelen that sport injury prevention research involves four stages:

- identifying the degree problem
- identifying risk factors involved
- developing an injury prevention program
- Testing the program.

One could list three categories of injury prevention:

1. Training: Ensuring appropriate endurance, strength, balance, and agility
2. Equipment: Protective equipment such as helmet, gloves etc are essential. However a bicycle that is working well is as important for safety.
3. Regulatory: Rules of the sport play important roles in injury prevention.

Evert and colleagues published a paper in Sports Medicine recently identifying Behaviour as the key factor in sports injury prevention. Relating this to MTB, planned behaviour can relate to intention to behave in a certain manner, and use of protective gear. Use of protective equipment can be enforced during competition but not for recreational riders. Social acceptance may also influence use of protective equipment. Competitiveness, motivation and perception of risk can affect likelihood of injury during competition.

"Risk compensation" refers to a person maintaining their risk at a level they perceive acceptable. If a track is widened to reduce congestion, the rider may go faster if they perceive less danger. One risk factor is thus replaced by another.

In 2005 McIntosh and McCrory reviewed head and neck injuries in various sports. The authors acknowledged that helmets prevent scalp lacerations and more severe head injuries such as skull fracture. In various sports neck injuries have been addressed through laws and skill developments. The authors noted that to date no helmet has been shown to be effective in preventing concussion.

7. Survey of First Aid facilities at MTB clubs in Australia

A survey was emailed to MTB clubs in Australia in November 2010 and eight clubs responded, representing an 8% response from about 100 MTB clubs. The numbers of members varied from 60 – 750. The Club president (3), secretary (1), committee (3), or booking officer (1) is responsible for first aid at club races that attract from 25 – 149 competitors for cross country and from 15 – 232 competitors for downhill races. Club races usually have 1 – 2 senior first aiders available while external organisations are hired for larger events. St John Ambulance Australia is commonly used, and there are a number of private first aid companies such as Pink in NSW and Event First Aid in Queensland. State ambulances and Rural Fire Service personnel are also used.

8. Summary of MTB injuries

- The mechanism of injury is most commonly falling over the handlebars.
- Young males are more commonly injured, reflecting the prevailing demographic, although there is greater risk of injury for female riders.
- Soft tissue injuries such as abrasions and superficial bruising are most common and mild in nature.
- The risk of injury is higher in downhill cycling compared with other forms of MTB.
- Helmets prevent serious injuries such as skull fractures but do not prevent intracranial bleeding, concussion or injuries to the cervical spine.
- Upper limb fractures are more common than lower limb fractures.

There are a number of factors that contribute to injuries:

- Nature of the course or track: MTB courses whether XC or DH have sections that are easier or more difficult to negotiate.

- Congestion of the track: More riders on a track invariably reduces the average speed although there is risk of crashes and injuries when riders overtake, especially on single track sections.

- The skill and experience of riders: This is important for race organisers as one can expect more injuries from novices, or where riders are not prepared for the technical difficulty.

- Level of fitness and skill of riders: Usually more experienced riders are fitter and more skilled. Fitness includes endurance, strength, and agility that can be obtained through training. Ideally riders will prepare appropriately for the race but recreational riders may be underprepared.

- Equipment: The state of repair of the bicycle is extremely important in ability to ride a certain course. It is usually the responsibility of the rider (or parent/ guardian) to maintain the bicycle. Safety equipment such as helmet, gloves, and protective equipment should also the responsibility of the rider. Although one may check bicycle and equipment prior to an event there is always the possibility of bicycle or equipment failure that can lead to crashes.

- Environment: Riders usually train in dry conditions and a muddy track or rain will affect riding. Extremely dry and dusty conditions may pose problems such as reduced traction or aggravation of respiratory problems such as asthma. Muddy tracks are more likely to lead to reduced traction and crashes than dry conditions and tracks will deteriorate during rain, especially in circuit races.

9. Comments on Current MTBA technical regulations (2006)

MTB events, from club to national level depend on the availability and proximity of the local ambulance service that should be notified when events are being held. For this reason MTB events should be within 15 minutes' drive for the ambulances. Even within urban areas this time span is optimistic and depends on how busy the ambulance service is at any time.

If there is one first aid officer at the event who is busy with an injured rider, the race should be stopped until the injured rider is stabilised. This appears to be standard practice for DH events but not for XC races where it may be impractical with effects on the race outcome.

The organisational guide (2006) raised questions regarding a medical plan:

- Whether there are trained paramedics, doctors or ambulance on site.

- Whether the event will rely on volunteers or staff for first aid.

- How far is the nearest hospital?

10. UCI regulations for Mountain Bike races for 2011

Pre-release of Technical Rules for 2011 stipulates that there should be at least one ambulance, one first aid post, one doctor and six first aiders for XC and eight for DH and 4X events. The Race organiser should submit an evacuation and medical plan to UCI prior to the championships. The medical co-ordinator and technical delegate must meet prior to the first training.

11. Recommendations

MTB races vary regarding numbers of participants, frequency of events, nature of the track and availability of ambulance and hospital services. Although there are recognisable differences between club races and larger (state and national) races there are minimum requirements that can be considered universal for all MTB events. These should apply to all races.

- Course design is vitally important, especially where circuit races are held. Although most clubs have existing trails there is constant need for maintenance to improve quality of riding and safety. Many courses need to accommodate recreational and elite riders for the same event. Opportunities to pass, fire trail mixed with single trail, easier line options, should be part of all track designs.

- Access for emergency vehicles to evacuate injured riders is essential for any course. If a vehicle cannot ride onto or adjacent to a course, there should be means for first aiders to carry injured riders to an emergency vehicle that should be able to drive within 25m of a course. First aiders should be able to have 4-6 stretcher bearers available at any part of the course.

- Riding skills can be improved through clinics organised by clubs or bike shops. Improving the skills of specific groups such as children and women is important as there is perception of higher rates of injuries. Events that encourage family participation on MTB tracks rather than competition will automatically improve riding skills. Some clubs have MTB equivalents of “fun runs”.

- Course familiarisation before a race will enable riders to train specifically for the event. Ability to ride parts of or the whole course should allow easier competition on race day. Races that pass through private property could arrange certain periods on which the course is open. Maps and profiles of the course should be available to competitors a number of months prior to race day.

- Maintenance of bicycles is usually the responsibility of the riders although many rely on the skills of friends or bike mechanics to maintain the bicycle. Although most learn (maintenance) skills by being taught by parents or friends there is a place for such clinics that may be part of riding skill clinics or stand-alone sessions that can be organised by shops or clubs. Examination of bicycles by officials prior to competition may not be practical if large numbers of competitors are involved although this is done in triathlon competition even for large (World Championships) competitions. There will need to be appropriate numbers of technical officials to deal with inspections if this practice is adopted.

- Protective Equipment should be checked by competitors before training and competition. Officials should check safety equipment, including helmets prior to competition at least in State and National events. This is the practice for events sanctioned by Triathlon Australia.

- There should be a briefing of race director, marshals and first aiders prior to the event, with clear delineation of responsibility regarding communication, requesting of external assistance such as ambulance services, and movement of personnel during the event.

- First Aid/ Medical Centre should be stationed near the start/ finish line. An alternative area can be used if there is easier access to the track. All competitors should be notified of the First Aid Centre and all personnel should have distinct clothing or markings.

- A Medical Plan should be part of overall planning of an event. This includes types and numbers of personnel, emergency vehicle access and communications. If a Medical Director is appointed he/she is responsible for numbers of First Aid personnel, equipment, emergency vehicles etc.

11.1. Club races

Club races should have at least two personnel who have at least Senior First Aid certificates for up to 50 riders. There should be an additional First Aider for every additional 150 riders. Clubs can employ such personnel or train club members. Riders competing in the event should not work as First Aid Officers, although First Aiders could also work as course Marshals for the event. A First Aid post should be at the start/finish and one First Aider should be able to travel to injured riders on the track.

The club should have at least one rigid stretcher/spine board, a stiff cervical collar, first aid kits, radio communication and a medical evacuation plan. There should be at least the equivalent of a St John Occupational “A”, a portable “B”, and portable pouch “B” kits at all club events where there are up to100 riders participating. More first aid equipment and kits are required if there are more participants and personnel should be trained to use equipment such as a spinal board and cervical collar. Details are available at http://www.stjohn.org.au/

Senior First Aid Certificate can be obtained through Australian Red Cross or St John that offers courses of 16 hrs.’ duration, or self-study followed by direct teaching. Certification lasts 3 years with annual CPR update.

For MTB events that are not near a major hospital (over 30 minutes’ drive), Remote Area First Aid qualifications is preferred. A pre-requisite is a Senior First Aid Certificate. St John and Australian Red Cross offer training that should equip the trainee with knowledge and skills to administer first aid in a remote situation.

11.2. Downhill races

Downhill races should have the same personnel as Cross Country races. Ideally marshals should be stationed along the course within visible distance of each other, and at least be stationed at sections where there is increased risk of crashes (high speed and technical sections).All marshals should have radio contact.

If downhill and cross country races are held simultaneously the numbers of personnel should be the same as if held separately, although equipment may be shared for both events. For example if XCO and DH events are held simultaneously, the staffing would be the total of numbers required for each event.

11.3. 2 – 8 hr events

These are events that are raced on a circuit (e.g. 10-15km loop) should have a dedicated emergency vehicle at the event. This could be a 4WD with a dedicated driver that should be able to access the course. The purpose of the vehicle is to evacuate injured riders from the course. There should be a

dedicated area to which injured riders are transported- this could be the First Aid Centre at the start/ finish area.

Apart from the emergency vehicle, staffing ratios and equipment should be the same as club ratios as detailed in 10.1. The vehicle should have at least a St John Emergeny Evacuation Kit or a Standard Workplace Portable kit from Australian Red Cross.

There should be at least two personnel with Senior First Aid certificates for up to 50 competitors, and an additional one Senior First Aider for every 150 competitors.

Race Organisers should have at least one Paramedic or Registered Nurse in the First Aid team in addition to the above personnel. The Paramedic should be able to initiate intravenous (IV) fluids, inhaled oxygen and administer inhaled analgesics (Methoxyflurane). It is recommended that there should be one paramedic per 500 competitors in attendance, but this depends on the course layout, and number of competitors.

11.4. Events over 8 hrs

Events that are over 8 hrs in duration run on a circuit or events over 80km in length, including Multi-stage Races should have at least a Paramedic or Registered Nurse in the First Aid staff. Depending on the nature of the event (history of previous injuries, expected unpleasant weather conditions, large numbers of competitors) an appropriately credentialed Medical Practitioner* may need be appointed Medical Director and be present at the race site.

11.5. 24 hr races, 100km and longer events

These events should have an appropriately qualified Medical Practitioner* who is responsible for medical staffing that will depend on the nature of the course, numbers of competitors, and distance to the nearest hospital.

Although the Medical Director should be a Medical Practitioner*, the remainder of the staff could be a combination of Medical Practitioners*, Paramedics and Senior First Aiders.

For the above race formats, the Race Director should appoint a Medical Director who should be involved with organisation of the event, specifically safety issues. The number of medical personnel depends on the number of competitors and type of race, although there will need to be First Aiders who may be a combination of Paramedics and those with Senior First Aid certificates. Consideration should be given regarding staffing for a point to point race, as opposed to a race involving multiple laps.

Due to the risks associated with prolonged and repeated exercise (dehydration, injury, hyper- or hypothermia), there should be facilities to administer IV fluids in an emergency room type setting that may be an appropriately sized tent. Key Emergency personnel should be able to distinguish between dehydration and hyponatremia (due to overhydration). There should be appropriate lighting, fans, and drinks for competitors, security and vehicular access.

The Race Director should initially appoint a Medical Director*; both should liaise regarding numbers and composition of First Aid personnel, as well as projected costs of having emergency services.

11.6. National XC, and DH Events

These should have a Medical Director at each event as well as First Aid Personnel. The Medical Director should ideally be an appropriately skilled Medical Doctor*, or an appropriately skilled Paramedic. The Medical Director* is responsible for the numbers and composition of the Medical Team.

National races should aim to adopt UCI recommendations that stipulate one Doctor and 6-8 First Aiders.

12. Types of Medical Personnel

12.1. Medical Practitioners*

Are qualified to practice in Australia and should have appropriate expertise with acute trauma, sports injuries and exercise physiology to cover MTB events. In Australia, Emergency Physicians and Sports Physicians are most likely to have these skills.

Sports Physicians are the ideal Medical Practitioners who should have the appropriate skills with MTB coverage. Sports Physician Registrars are required to cover sports events as part of their training and can be accessed via the Australasian College of Sports Physicians (https://www.acsp.org.au/modules/news/).

General Practitioners and other Medical Practitioners may also have specific interest in cycling (including MTB) and expertise that enables coverage of MTB events.

12.2. The rationale for having Medical Practitioners

For events longer in duration and distance there is greater risk of competitors having physiological problems such as dehydration and fatigue that may predispose riders to potentially serious crashes. In such scenarios there is limited time in which to stabilise a rider before an ambulance arrives. For example, if a rider with a serious injury (major abdominal injury, fractured tibia) receives prompt medical attention (within minutes of crashing), establishing an intravenous line and administering oxygen and analgesics (inhaled or intravenous) should stabilise a rider's condition relatively quickly (within 30 minutes), by which time an ambulance may be available. Although an ambulance may be 15 – 30 minutes' drive away, availability depends on numbers of ambulances available at the time. Having highly qualified medical staff at race site should guarantee prompt and appropriate attention to injured riders.

The above scenarios may be uncommon, but there is potential for serious medical emergencies, especially given the numbers of competitors in popular races. With the popularity of MTB, there is expected to be increasing numbers of "Super Masters" or >50y competitors. Within this group there may be increased risk of major cardiovascular events such as myocardial infarction (heart attack) or arrhythmias that may result in death. In mass participation events such as Sydney's "City to Surf" 14km fun run, there have been fatalities in previous years. Race Medical Doctors (Drs R & O Richards, and Whittaker) have been able to predict the numbers of casualties based on data from previous races, weather conditions (temperature), and numbers of competitors.

Although MTB races are not nearly as large as fun runs in numbers of competitors, there has been at least one publicised death in the 2009 Angry Doctor 100km race in Eurobodalla Coast, Mogo, NSW, Australia. A forty year old male was reported to have died while riding uphill in temperatures

over 300C. This scenario is relatively common in MTB races and if an unexpected emergency arises, there should be first aid staff and facilities to treat the rider as soon as possible. In order to provide the most highly qualified medical personnel, an appropriately trained Medical Practitioner, Intensive Care Paramedic, or appropriately trained Registered Nurse should be available at race site. This is most feasible for more demanding races that will be mentioned later.

12.3. Paramedics

A Paramedic as defined by the Australasian College of Ambulance Professionals is

"A Paramedic is a health care professional providing medical assessment, treatment and care in the out of hospital environment. Paramedics respond to, assess and treat patients in emergency situations, transport them to a hospital for further treatment (if necessary) or arrange alternative treatment options. In Australia, there are varying levels of Paramedic and the specific level of care and skills required is determined by the employing authority."

The term "Paramedic" is not registered, restricted or licensed, unlike the protection in UK. All Paramedics should have a Diploma in Health Science (or equivalent), employment and professional development.

There are Private Paramedic companies in Australia that provide first aid facilities for various events including MTB races. Paramedics should be able to provide Professional Emergency Health Care to those in emergency medical situations. They should be qualified to establish IV lines and administer emergency medication.

Intensive Care Paramedics have additional qualifications that enable advanced Life Support and administration of a wider variety of medications.

If Private Paramedic/ First Aid Companies are hired to cover events, the Race Director will need to ascertain whether personnel can administer IV fluids and medication in emergency situations.

12.4. Nurses

Nurses may be Enrolled or Registered and are Health Service Providers in Hospitals, Aged Care Services, or in private practices in Australia. Enrolled Nurses (EN) or Assistants in Nursing (AIN) obtain Diplomas and Certificates at TAFE, and study from 12 months to 2 years. They are considered "second tier nurses" working within a registered Health Service framework. Registered Nurses (RNs) undergo three years full-time university study and are the most prevalent Health Service Provider in Hospitals. Some RNs have training to establish IV lines although generally they work under the directions of Medical Practitioners.

12.5. St John First Aiders

St John First Aide personell vary in their qualifications and those that attend sporting events are volunteers. Eleven to 18y are Cadets while older members have Senior First Aid Certificates. There are additional courses that train members to administer advanced first aid, resuscitation, analgesic gases and semi-automatic external defibrillation.

St John Ambulance volunteers are commonly used for First Aid at various Sporting Events in Australia. Positive factors are that the Organisation is relatively inexpensive to hire (donations), are well equipped and are able to deal with minor injuries. The expertise of the volunteers is variable and composition of the First Aid team depends on who is available at any time.

The Bicycle Emergency Response Team (BERT) is a St John Ambulance unit based in Sydney that has hard-tail bicycles that can carry emergency equipment. These have been used at various MTB races. The big advantages are that the first aid is mobile and is able to access injured riders on most single tracks. This unit is not suited for downhill races unless they are able to access via side tracks.

There are physical prerequisites for paramedics before being accepted to the profession. However there are no physical pre-requisites for the other categories of medical personnel. MTB race organisers will need to consider the physical fitness of Medical Personnel who attend their races.

Some Australian MTB clubs utilise the services of Private First Aid Organisations for Club races- this is appropriate as long as there are sufficient personnel at the event. If an event is over an hour's drive from the nearest hospital, there should be appropriate Medical Services at the race venue including at least one Medical Practitioner.

13. Classification of injury and illness

Townes published a classification relating to "Wilderness Medicine" in the journal Sports Medicine in 2006.

Class	Description	Examples
Class 1	Athlete treated under direction of designated medical station team captain. Athlete must be cleared by captain before being allowed to proceed.	Minor injuries such as abrasions, sprains, environmental exposure, mild dehydration.
Class 2	Athlete treated under direction of designated medical station team captain who must communicate with race medical director if the athlete is to re-join the race.	Injury or illness requiring definitive care but not immediate evacuation. Suspected fractures, more extensive soft tissue injuries. Moderate dehydration.
Class 3	Athlete requires immediate treatment & stabilisation prior to evacuation. Medical director to be notified immediately. Medical staff to liaise with race marshals	Fracture or dislocation that prevents continuing race. Severe trauma that results in continuing distress, including head injuries. Moderate to severe illness including dehydration, respiratory distress or other illness that does not settle with simple measures.

At MTB races, such as club races there should be facilities and personnel to treat Class 1 injuries. There should be a medical plan to deal with Class 2 and 3 incidents. Large club races (>100 competitors) and other MTB races should be able to manage Class 1 and Class 2 incidents.

In all races there should be a Medical Evacuation Plan to deal with Class 3 incidents. Because of potential life-threatening nature of a major event (e.g. severe trauma), especially in events >80km, 24

hr. events, or high profile National events a Medical Director/ Practitioner should be present to stabilise the rider prior to arrival of an ambulance.

The Medical and Race Directors should have a policy regarding riders receiving medical/ first aid assistance and continuing the race. For example, for injuries that require dressing or simple medical conditions, the rider may be able to continue. In more severe conditions such as moderate dehydration that requires intravenous fluids, the rider may be able to continue after a period of recovery; if in a stage race the rider may continue the following day. The rider should withdraw if this occurs in a shorter (e.g. 100km or 24 hr.) race.

14. Summary

- Mountain Biking is an extremely demanding sport that requires endurance, high power output, and technical ability.
- In Australia Mountain Biking is relatively safe regarding serious injury and fatalities when compared with other sports.
- Falling from a height, at speed or falling over the handlebars results in serious injuries such as head or neck injuries and fractures.
- Helmets may prevent skull fractures and lacerations, but do not prevent head injuries such as intracranial bleeding, intracerebral bleeding, or concussion.
- Frequency, volume and intensity of training and competition in children (under 17 years old) should be less than adults.
- First Aid at events depends on factors including:
    - Numbers of competitors.
    - Event type.
    - Course design.
    - Availability of Ambulance transport; proximity to nearest Hospital.
- Injury prevention is multifactorial and includes:
    - Course design
    - Riding fitness and skills of participants
    - Bicycle integrity and protective equipment
    - Environmental factors such as weather conditions.
- The most appropriate Medical Practitioner* for event coverage is a Sports Physician (fully qualified or Registrar) or Emergency Physician. Sport and Exercise Medicine was granted specialist recognition by the Minister of Health and Ageing in November 2009.
- Rider safety should be paramount when organising MTB events.

Table 2. When planing your event use these requirements to assist you in making your medical servicing plans.

Event type	Senior First Aider	Paramedic/ Registered Nurse	Medical Practitioner	Other
Club Races: XC and DH.	Minimum 2 for up to 50 riders, then one for every 150 competitors over 50. e.g. 3 required for up to 200 riders.	If Race Organisers deem necessary, such as Club Champs.	N/A	Spine board, First Aid kits. Radio communication.
2 – 8hr circuit races.	Minimum 2 for up to 50 riders, then one for every 150 competitors over 50. E.g. Three for up to 200 riders.	At least one.	N/A	As above. Dedicated emergency vehicle with portable emergency kit, spine board, First Aid kits. Radio communication.
>8hr circuit and >80km races.	As above.	At least one. Recommend 1 per 500 competitors but depends on course layout.	Discretion of Race Organisers.	As above. Dedicated emergency vehicle with portable emergency kit, spine board, First Aid kits. Radio communication.
Races where single riders cover at least 100km; team and solo 24 hr. races.	As above.	Depends on course layout and number of competitors.	Doctor as Medical Director who liaises with Race Director.	As above. Composition and numbers of Medical Team at discretion of Medical Director.
National Races	As above.	At least one.	Doctor or Paramedic as Medical Director.	Spine board, First Aid kits. Radio communication. Dedicated emergency vehicle. Consider UCI recommendations.

Note that in events >100km, including multi-stage races, and 24 hr. races, the Medical Director has the discretion to vary the composition and numbers of the medical team depending on the event. One should consider factors including the history of previous injuries at the event, nature of the

course, potential for track congestion, proximity of nearest hospital, availability of transport (ambulances), environmental conditions (weather), and experience of riders. Therefore the Medical Director has the ability to increase or decrease the numbers of personnel recommended above. The numbers of Medical Personnel, vehicles, supplies etc. should be discussed with Race organisers before race entries are opened as the medical provisions may affect entry fees.

Paramedics and Registered Nurses covering MTB races should be able to establish IV lines and administer analgesics as appropriate.

All First Aid and Medical personnel should ensure that they have adequate Professional Insurance to cover this type of work.

The Medical Director, Race Director (if no Medical Director) or delegated person involved in Medical coverage should document the numbers, types of injuries, disposal of rider etc. in a report provided to the Race Director and MTBA no more than 1 month after the event. All riders entering a race should be encouraged to sign a declaration allowing the Race Medical Director to access their medical records at the time of race entry. Race Medical personnel/ teams should be prepared to provide a report (to Race Directors and MTBA) that should contain statistics regarding the numbers of riders/ people injured, and medical details without necessarily divulging personal details.

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