OVERVIEW & RECOMMENDATIONS FOR SPORTS SAFETY IN SINGAPORE

Second Edition

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EXECUTIVE SUMMARY

Sports safety plays an important role in our effort to get everyone in Singapore to live better through sport. First formed in 2007, the Sports Safety Committee aims to provide guidelines, which are practical and applicable to the Singapore context with a view to improving safety measures in organised and recreational sports. In 2007, the Committee released a comprehensive report with detailed findings on safety standards and systems taking reference from international best practices.

As part of Sport Singapore's continuing efforts to improve safety standards and coinciding with the launch of ActiveSG, the national movement for sport, the Sports Safety Committee reconvened in May 2014 to review and update sports safety guidelines. The Committee is co-chaired by Dr Benedict Tan, Chief of Changi General Hospital's Sports Medicine Department, and Mr Lai Chin Kwang, Chief of ActiveSG. The Committee comprises representatives from the medical field, sports fraternity as well as experts and stakeholders from the public and private sectors.

The main findings since the Sports Safety 2007 Report are broadly summarized as follows:

- Both abroad and in Singapore, the incidence of sudden death and serious adverse events during sports remains generally low. It is still difficult to analyse trends in Singapore due to the small numbers and lack of mandatory reporting of such events.
- The evidence that regular exercise is beneficial continues to grow. Although exercise does bring with it some transient risks, the benefits outweigh the risks on the whole.
- Pre-participation screening can reduce the incidence of sudden death.The thoroughness of pre-participation screening can vary from a simple self-administered questionnaire to a full battery of sophisticated tests, and practices differ from country to country and organization to organization. In Singapore, pre-participation screening is being done for most at risk groups but more can be done in view of increased sports participation, particularly in endurance sports.
- There is increased awareness of sports injuries and causes of sudden death. However, training in lifesaving skills, such as first-aid, cardiopulmonary resuscitation, and automated external defibrillator (AED) use, in certain groups of individuals that are likely to be first responders in emergency situations during sports and training still need to be promoted.
- AEDs have been shown to be effective in resuscitation, especially if used early. Many facilities where Singaporeans participate in moderate to vigorous activities are currently equipped with AEDs but more can be done to improve their accessibility and visibility.
- Sports event medical coverage needs to be improved to ensure prompt and competent medical aid and resuscitation.
- Surveillance, evaluation, and follow up are important for systematically improving the sports safety framework. However, these are still lacking.

To further strengthen our sports safety framework, the Committee would like to highlight that:

- The benefits of habitual exercise outweigh the risks. *Regular* physical activity is a defence against exercise-related cardiovascular events.
- Pre-participation screening should be done on selected at-risk populations. Risk stratification, in turn, should be based on:

  - The individual's intrinsic risk of sudden death or serious injuries
  - The level of competition
  - The risk of the sport or activity

  Pre-participation screening should be enforced in at-risk populations, but should not be so cumbersome as to deter sports participation.
- Individuals identified to be at risk of sudden death should have their activities guided by the 36th Bethesda Conference consensus.
- Participants should assume individual responsibility for their safety and heed medical advisories.
- Likely first responders including sports trainers, coaches and sports organisers, should be trained and certified in first aid, CPR, and AED use.
- Health and fitness facilities should adhere to the staffing, equipment, and practice recommendations suggested by the Committee (adapted from the jointly issued recommendations by the American Heart Association and American College of Sports Medicine). This includes the provision of AEDs.
- At organized sports events, the level of medical support should be commensurate with the risk of adverse events. All events, apart from those stratified as low risk, should have a designated Chief Safety Officer, a comprehensive medical support plan, competent and certified safety personnel, adequate equipment (including AEDs), a comprehensive risk management system, and post-event review.
- Systems should be put in place to conduct injury surveillance and capture data on sudden death and other serious adverse events during sports, using a common minimum data set. This is to allow systematic review and improvements to sports safety.
- All National Sports Associations are encouraged to have their own sport-specific medical committees or at least a designated doctor to assist them with injury surveillance, review data on sudden death and adverse events, customize pre-participation screening protocols, plan event medical coverage, and advise on other sports safety and medical matters.

Marginal markings in each chapter of this 2015 edition indicate important changes or additions since the 2007 edition.

The Committee recognises the difficulty of implementing all the above recommendations in the guidelines. Successful implementation will require:

- Ownership and leadership by an accountable agency
- Continual consultations with the stakeholders
- Implementation in stages so that the stakeholders are able to cope
- Firm minimum standards

1. SUDDEN DEATH AND OTHER ADVERSE EVENTS IN SPORTS

Key Messages:

- The risk of adverse health events during sports is low and the benefits of regular exercise outweigh these risks.
- Exercise-related adverse events tend to occur in the least physically active individuals performing unaccustomed vigorous physical activity.
- The majority of adverse events in are preventable, therefore measures should be taken to minimise risk.

New Highlights:

- Nearly 1 in 1,000 participants risked experiencing a heat injury during marathon running event.

1.1 Incidence of Sudden Death

1.1.1 Sudden death refers to unexpected death from non-traumatic causes. In Singapore, there were no studies done to specifically investigate the incidence of sudden deaths occurring in sports. Nevertheless, from the data available, it is quite clear that sudden death in sports is relatively uncommon in Singapore, as is the case in other parts of the world. From the beginning of 2005 to the end of June 2007 (i.e. 2.5 years), the Department of Forensic Medicine, Health Sciences Authority reported 21 deaths that occurred during sports - nine exercise-related deaths occurred in 2005, six in 2006, and six in the first half of 2007 [personal communication, Resource Panel reference no. 4]. In 2005 and 2006, there were a total of 32,608 deaths (all causes) [24]. Thus, the 15 exercise-related deaths during these two years accounted for only 0.046 % of deaths in Singapore, or one in 2,174 deaths. Looking at 2005, where there were nine exercise-related deaths, the annual incidence was only 1 in 239,000 people who exercised at least once a week (48% of Singaporeans exercised at least once a week in 2005, population was 4.4839 million as of mid-2006 [24]).

1.1.2 In the United States, the annual incidence of sudden death in runners >35 years old is 1 in every 15,000 to 18,000 previously 'healthy' persons [25, 29]. Table 1.1 summarizes estimates of acute cardiovascular events or sudden deaths from published data [28]:

Table 1.1: Incidence of acute cardiovascular events or sudden deaths from various publications

Annual Incidence per 100,000 person-years	Maron et al (2014)	1.2 acute cardiovascular deaths in every 100,000 athlete participation-years in college athletes
	Harmon et al (2014)	1 death in 50,000 for college level athletes 1 death in 80,000 for high school level athletes
	Siscovick et al. (1984)	1 death per year for every 18,000 previously healthy men
Incidence within Sports Facilities	Franklin et al. (2005)	1 death per 82,000 members of a large health and fitness facility chain (>2.9 million members) 1 death per 2.5 million workouts
	Malinow et al. (1984)	1 acute cardiovascular event per 2,897,057 person-hours of physical activity at YMCA sports centres (USA)
Incidence during Physical Activity	Vander et al. (1982)	1 non-fatal event per 124,200 hours of recreational physical activity 1 fatal event per 887,526 hours of recreational physical activity
	Gibbons et al. (1980)	1 non-fatal event per 187,399 hours of exercise
	Thomson et al. (1982)	1 death per 396,000 person-hours of jogging 1 death per year for every 7,620 joggers 1 death per 792,000 person-hours of jogging for previously healthy individuals (i.e. no known cardiovascular disease) 1 death per year for every 15,260 previously healthy joggers (i.e. no known cardiovascular disease)

1.1.3 A three-year study conducted in Singapore from October 2001 to October 2004 of all cardiac arrest patients brought to public Emergency Departments by Singapore Civil Defence Force (SCDF) ambulances revealed 52 persons who collapsed during exercise related physical activity, with an average of 17 – 18 per annum [unpublished, personal communication, Committee Member reference no. 1]. This formed 2.14 % of all cardiac arrests (2,428 cases) brought to public hospitals for that period, or just over 0.1% of all deaths that occurred in the country. Of these 14 were in swimming pools or during swimming events, four during military training and 34 during other sporting activities (badminton = 6, soccer = 5, gymnastics = 5, running/jogging = 5, mixed exercises = 4, golf = 3, tennis = 2 and 1 each from bowling, squash, table tennis and sports day). Males constituted 49 of these. Six were of age 20 or below. There were only two survivors. Fourteen collapses occurred in school compounds (two students, seven members of staff, and five members of the public who were using the school for sports activities).

1.1.4 In the Netherlands, a similar three-year study[32] done from January 2006 to January 2009 of out-of-hospital cardiac arrest cases in the province of Northern Holland (population of 2.4million), exercise related cardiac arrest was noted to be 5.7%, with an incidence of 2.1 per 100, 000 person-years.

1.1.5 From 2007 to 2013, there were a total of 38 exercise-related deaths at our public sports facilities, namely Sport Singapore's stadia, gym, sports halls, squash courts, tennis courts, hockey pitch and swimming pools (Table 1.2). Generally, the incidences are relatively low, given the high attendance rates at these facilities.

Table 1.2: Summary of exercise-related deaths at public sports facilities 2007-2013 provided by Sport Singapore

Facilities	Deaths	Attendances	**Incidence per 100,000 attendances)**
Stadia	8	1,688,972	**0.47**
Gyms	1	13,511,248	**0.0074**
Sports halls	7	13,511,872	**0.052**
Squash courts	1	439,380	**0.23**
Tennis courts	2	3,684,372	**0.054**
Hockey pitches	0	653,730	**0**
Swimming pools (drowning 14 cases / collapsed in toilets 4 cases)	18	49,039,694	**0.037**
Dual Usage Scheme (School field)	2	1,788,486	**0.11**
Dual Usage Scheme (School sports hall)	1	1,807,200	**0.055**
Others (walkways)	1	NA	**NA**
Total	**38**	-	**-**

1.1.6 The small number of adverse events annually makes it difficult to analyse the trends reliably, since a single incident can result in a 100% increase or decrease in the annual incidence in the case of exercise-related deaths occurring in public squash or tennis courts. The incidence of sudden death in young athletes is much lower than in adults. Of 20 exercise-related deaths that occurred at Sport Singapore's dry sports facilities, 5 (28%) were below 35 years of age. Van Camp et al. (1995) estimated an absolute rate of exercise-related death (cardiac and non-cardiac causes) among high school and college athletes of only 1 : 133,000 males and 1 : 769,000 females [30]. Corrado et al. (2003), in a prospective study in Italy, reported an incidence of approximately 1 sudden death per 33,000 young athletes (mean age 23 years) per year [8].

1.1.7 Indeed, data from SCDF reported above revealed that of the 14 collapses at school premises that were attended to by SCDF ambulances between 2001 and 2004, only two were students while the rest were adults. From 1999 to June 2007, there were an estimated three reported deaths during MOE organized activities: a 17 year old girl died of "septicaemia," (blood infection) and two junior college students drowned during an outdoor adventure club outing (personal communication, Resource Panel reference no. 29). These figures suggest that the incidence of sudden death in activities organized by schools is probably low.

1.2 Causes of Sudden Death

1.2.1 There are a variety of causes of sudden death and their prevalence varies with the age group. In all age groups, acute illness and external factors such as heat stroke, trauma to the chest (commotio cordis) and infection involving the heart (myocarditis) can cause sudden death in otherwise fit individuals with no previous heart disease. Doping (use of performance-enhancing drugs) with substances such as amphetamines and erythropoietin can potentially cause sudden death as well.

1.2.2 In the younger age-group from 15 to 35 years old, the known causes include cardiomyopathy (heart muscle disease, including hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy, and dilated cardiomyopathy), congenital coronary artery anomalies (e.g. anomalous coronary artery origin, acute angle takeoff, ostial ridges, or intramyocardial course), abnormalities of the heart valves (e.g. aortic stenosis, mitral valve prolapse), myocarditis, aortic dissection and rupture (probably associated with connective tissue defects such as Marfan's syndrome), and arrhythmias (e.g. Wolff-Parkinson-White syndrome, Long-QT syndrome, catecholaminergic polymorphic ventricular tachycardia, Brugada syndrome). Non-cardiac causes of sudden death are less common than cardiac causes, and these include cerebral arteriovenous malformation and pulmonary embolism. On the whole, the prevalence of the above conditions is low, and as documented by Van Camp et al. (1995), the incidence of sudden deaths in young athletes is around 1 in 133,000 males and 1 in 769,000 females [30]. Half of these deaths were due to hypertrophic cardiomyopathy, with the others due to coronary artery anomalies, myocarditis, aortic stenosis and other less common causes.

1.2.3 In the older age group (above 35 years), in contrast to the young athletes, coronary artery disease resulting in acute myocardial infarction (heart attack) is the most common cause. It is important to recognize the different causes of sudden death in those above and below 35 years of age as they have implications on pre-participation screening and exercise recommendations.

1.2.4 Of the 21 exercise-related coroner's cases in Singapore from 2005 to June 2007, one death was due to head injury, and the rest were due to natural causes (non-traumatic). All of the 20 non-traumatic deaths were males, with a mean age of 43 years (range 14 – 59 years). Of those above 35 years of age (n = 16), the cause of death was ischaemic heart disease in all cases. Of those below 35 years of age (n = 4), the frequency and cause of death were: one cardiomyopathy, one anomalous coronary artery, one congenital heart disease, and one pending (coronary artery disease has been excluded in this pending case).

1.2.5 In the Singapore Armed Forces, 10 cases of exercise-related deaths occurred from 1997 to June 2007. Four fatalities (40%) were full-time national servicemen, four (40%) were army regulars, one (10%) was a reservist, and one (10%) was a non-military personnel (defence executive officer). Six of these cases (60%) occurred during or after running, either on its own or as part of a physical test / biathlon. Distances of the runs ranged from 2.4 km to 10 km. One (10%) occurred during an Individual Physical Proficiency Test Remedial Training (IPPT RT), but the exact activity is not known. One case (10%) occurred during a reconnaissance exercise, and one case (10%) occurred after range training. Among the 10 exercise-related deaths in the military, five were from acute

myocardial infarction or coronary artery disease, two from heatstroke, one from sudden cardiac arrhythmia, one from cardiorespiratory failure, and one from acute myocarditis. There is no accurate way to determinate the denominator to calculate the rate of sudden death. As the estimated 34,000 active SAF personnel and 98,000 NSmen who participate in IPPT each year also engage in various physical activities throughout the year, the denominator (in terms of man-hours of physical activity) is therefore likely to be large, indicating that the incidence of exercise related deaths in the SAF is probably very low.

1.3 Does Exercise Increase the Risk of Acute Cardiovascular Events?

1.3.1 The risk of a cardiovascular event is acutely and *transiently* increased during or soon after exertion, in young people with congenital heart problems and adults with occult or known coronary heart disease. However, evidence from a Seattle study shows that the benefits of regular exercise outweigh the risks for healthy subjects: men who spent < 20 minutes per week exercising had a relative risk of exercise-related cardiac arrest that was 56 times greater than at rest, while men who spent > 140 minutes per week exercising had a relative risk that was only five times greater than at rest [27]. It is highly noteworthy that while the relative risk of cardiac arrest was greater during exercise than at rest, the *total incidence of cardiac arrest, both at rest and during exercise, decreased with increasing physical activity levels*. As a comparison, the total incidence of cardiac arrest in the least active group was 18 events per 1,000,000 person-hours, whereas in the most active group, it was only 5 per million person-hours.

1.3.2 Even in those who have had acute myocardial infarction, exercise is a key pillar in the cardiac rehabilitation programme. In an analysis of four contemporary exercise-based cardiac rehabilitation programmes, the estimated incidences are 1 cardiac arrest per 116,906 patient-hours, 1 myocardial infarction per 219,970 patient-hours, 1 fatality per 752,365 patient-hours, and 1 major complication per 81,670 patient-hours of participation [27]. This demonstrates that with a proper pre-participation medical evaluation and serial surveillance, the incidence of cardiac events can be kept low even in a high-risk population.

1.3.3 Sedentarism is a major risk factor for cardiovascular disease, and exercise intervention is effective in managing cardiovascular risk factors as such as hypertension, diabetes / insulin resistance, hyperlipidaemia, obesity, as well as coronary artery disease itself. Burke et al. showed that the majority (56 %) of exertion-related deaths occurred during unaccustomed exertion, while 28 % occurred during emotional stress and only 16 % occurred during habitual exercise [6].

1.4 Other Adverse Events

1.4.1 Sports injuries range from minor to serious. For the purpose of this report, our discussion will be limited to serious / life-threatening injuries such as heat stroke, hyponatraemia, and major trauma.

1.4.2 Overseas data shows that the rate of heat related injuries ranges from 0.08% to 24% (Table 1.3). Local data from the Singapore Marathon showed that despite Singapore's high ambient temperatures and humidity, heat injury incidence is relatively low, ranging from 0.05% to 0.14% over 2010 to 2014 (Table 1.4).

Table 1.3: Incidence of Heat-related Injuries in Athletes and Sports Participants

References	Event	Incidence	Comments
Weiss et al. 1988	1984 Olympic Games (Los Angeles)	• 516 cases total • 24% of 1,373 during the games.	
Wetterhall et al. 1998	1996 Atlanta Olympics	• 95 cases of HRI • 5.3% of medical cases	• Includes all heat illnesses.
Burke et al. 1997	1988 USA Youth Soccer cup.	34 heat exhaustion	• The WBGT exceeded those recommended by the ACSM of 28ºC
	1931 to 1966	26 American Football players died of EHS	
	1966 to 1975	50 EHS deaths in sports	
Bailes et al. 2002	1965 to 1974	44 deaths EHS	• National Centre for Catastrophic Sports Injury Research. • Summer pre-season training.
	1975 to 1984	17 EHS fatalities.	
	1985 to 1994	6 EHS deaths	
	1995 to 2001	15 fatalities	
Hughson et al 1980	10.3 km race on 11 Jun 1978 in Waterloo, Canada	15 / 1,250 runners (1.2%)	• Ambient temperature of 24.3ºC and 49% RH.
	10 km race on 13 Aug 1978 in Toronto, Canada	• 11 / 1,658 runners (0.7%) • Females only race.	• Ambient temperature was 31.8ºC and RH was 61%
Hanson et al. 1979	Four running events: 10km, 20km, 32km and marathon in 1978	One case cited from each of the race.	• All races took place in Madison, Wisconsin (USA). • These were cases that required hospitalization.
Nicholson and Somerville, 1978	11km "run-for-fun" race, late summer of 1977. Auckland (New Zealand)	• 200 cases of HRI out of 20,000 runners (1%). • 16 cases of heat stroke (0.08%).	• Ambient temperature was 21.3ºC and RH was 73%. • Pamphlets on appropriate preparation and training for the run were handed out to runners.
Richards and Richards. 1987	"Sun"city to surf run (1971)	29/1600 runners (1.76%)	
	(1972 to 1977)	11/ 38,500 runners (0.27%)	• Average of 1.8 cases per year.
Roberts. 1989	Twin Cities Marathon (1986, 1987, 1988)	268	• Average of 89 cases annually.
Armstrong et al. 1996	11.5km race	21/8,000 runners (0.26%)	• These were treated on site.
Asrseth et al. 1986	Oslo Marathon, 1983. (Norway).	4 Cases of heat stroke evacuated to the hospital.	• Temperature 23ºC and RH 42%. • More than 50 injured runners received treatment; 4 sent to hospital for heat stroke.
Beard et al. 1979	12 km jog in New Zealand	7 runners evacuated to the hospital for heat stroke.	• Temperature 30ºC; RH 25%.
HRI: Heat related injuries EHS: Exercise-induced heatstroke RH: relative humidity			

Table 1.4: Singapore Marathon Heat Injury Cases 2010 to 2014 (Sport Singapore)

Total number of participants (all distances)	2010	2011	2014
	54,992	55,707	47,516
Exertional Heat Exhaustion	15	29	64
Exertional Heat Stroke	14	3	2
Total	**29**	**32**	**66**
Heat Injury Incidence (per 1,000 participants)	**0.5**	**0.6**	**1.4**

1.4.3 For hyponatraemia, the incidence ranges from 0% (in New Zealand and South Africa) up to 13% (in USA). In a local study done in 2011, the incidence of hyponatraemia in a marathon was 1.8 in 10,000 (1 out of 5593 runners) participants and in the ultramarathon section was 33.8 in 10,000 (2 out of 602 runners) participants [31]. The incidence appears to be related to fluid intake habits. Generally, if participants drink according to a regime, the rate of hyponatraemia appears to be higher, whereas if they drink according to their thirst, the rate of hyponatraemia appears to be lower [personal communication, Committee Member reference no. 7].

1.5 Recommendations

1.5.1 As the benefits of regular exercise outweigh the risks, and as a disproportionate number of exercise-related adverse events occur in the least physically active individuals performing unaccustomed vigorous physical activity, habitual physical activity should be encouraged – in those where there are no contraindications – as a defence against exercise-related cardiovascular events.

1.5.2 While the absolute risk of sudden death and adverse events during sports is low, the majority of events are preventable. Participants, event organizers, and healthcare professionals should take measures to manage the risks.

1.5.3 Organisers of outdoor sporting events should provide advisories on the prevention of heat injuries and hyponatremia by making the information available to their participants effectively. Organisers should also provide on-site risk assessment for heat injury based on the ambient temperature and relative humidity (see Figure 2.1).

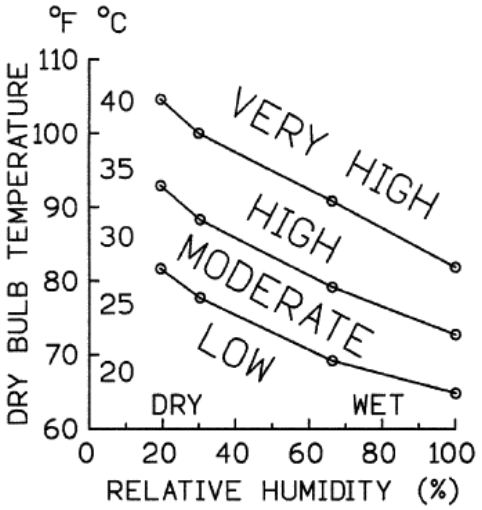

Figure 1.1: Risk of heat exhaustion or heat stroke while racing in hot environments. (Convertino et al. American College of Sports Medicine position stand: exercise and fluid replacement. Med Sci Sports Exerc 1996; 28: i–vii.)

1.5.4 Athletes competing in hot and humid environment (especially Singaporeans training in air-conditioned gyms and foreigners from temperate countries intending to compete in Singapore) should take the necessary steps to mitigate the degree of heat strain when

exercising in such environments. Heat strain mitigation measures include undergoing a progressive physical training and heat acclimatisation programme before the actual event and minimising severe fluid deficit and overload during exercise.

a. Heat acclimatisation enhances the responsiveness of the thermoregulatory mechanisms during exercise in the heat. Heat acclimatisation involves 10 to 14 days of daily exposure to the environmental conditions of the event / competition. Such exposures can be performed in an environmental chamber or can be achieved by training in the location of competition for 2 to 3 weeks before the event.

b. Most athletes lose about 1 L of body fluid through sweating when exercising in hot and humid environment, and some athletes have recorded sweat volumes of > 2 L/h. A fluid deficit of > 3% of body weight (e.g., 1.8 L of water for a 60 kg person) may compromise physical performance and temperature regulation. Athletes should drink enough water during exercise to prevent a deficit of 3% of body weight. Fluid requirement for each athlete is best determined individually by measuring nude body weight before and after exercise during routine training sessions. Based on the estimate that a 1 kg loss in body weight is equivalent to 1 L of fluid deficit, each athlete should determine the volume of water they need to drink during the sport event (spaced out over duration of exercise) to prevent a fluid deficit of > 3% of body weight.

1.5.5 Controlling heat stress alone is not enough to prevent heat injuries because heat injuries are triggered by a multitude of factors other than heat stress. A key factor contributing to heat exhaustion is an overload in exercise intensity i.e. exercise intensity > fitness level. While experienced athletes are more capable of matching exercise intensity with their fitness level, novice athletes tend to pace themselves faster than their routine training pace during races. Heat stroke may be caused by a combination of heat stress and immune disturbance, which can occur if athletes start an event with a compromised immune system e.g., exercise-induced immune suppression, recent bout of infection or sub-clinical infection. Athletes must be advised to pace themselves according to their fitness level, and those with signs of a compromised immune system (e.g., running nose, cough, sore throat etc) should not be exercising intensely, or be advised to refrain from physical exertion if necessary.

1.5.6 All athletes should be educated to recognise the early signs of heat injury and to take precautionary measures when these signs are observed,

1.5.7 Sport event organisers should advise athletes about the causes, danger and prevention of heat related injuries and hyponatremia. They should adapt international guidelines to local environments and ensure that adequate water points and supply of water is provided for the participants, especially during later parts of endurance events. Using the recommendations given in paragraph 1.5.4b will also help to prevent heat related injuries and hyponatremia.

2. FUNDAMENTAL PRINCIPLES OF SPORTS SAFETY

Key Messages:

- All sports organizations and sports events organizers must have a sound and pro-active safety and health management system in place, and these must be effectively implemented.
- Risk assessment should be done by sports organizations and sports events organizers to identify sources of risks, with steps taken to minimize foreseeable risks.

New Highlights:

- Resources on Risk Assessment and Management Systems are currently available on Sport Singapore website.

2.1 Safety and Health Management

2.1.1 It is essential for all sports organizations and sports events organizers to have a safety and health management system in place. The safety and health management system should be rigorous and benchmarked against the best practices. With effective implementation of the system, a world-class sports safety culture can be established, which is a key to sustaining high standards of sports safety in Singapore. A proactive approach should be adopted, rather than waiting for a serious event/accident to occur before measures are implemented. Most adverse events occur due to unsafe attitudes, behaviours and acts, rather than unsafe equipment or conditions. A sound safety and health management system ensures that involved personnel do not become complacent due to a long accident-free period, which can result in safety measures being overlooked or neglected.

2.1.2 A sports safety culture should be inculcated in every stakeholder, including participants, event organizers, sports organizations, coaches, teachers, instructors, parents and all members of the public. It is important for all to realize that they have a part to play in sports safety. Sports participants should be aware that they are responsible for their own safety, and take measures to ensure as such. Sports associations and event organizers should also realize that they are accountable for each participant's safety in every sport event, and as such should take measures to manage sport safety.

2.1.3 Effort should be made to pre-empt all possible adverse outcomes that can happen in any sport event, and measures should be devised to prevent or provide a solution to these outcomes. This will ensure that all involved in sports, from the sports associations to the participants to the members of the public, will be well prepared to handle any problems that may arise, and to act before any adverse event occurs.

2.2 Risk Assessment

2.2.1 Risk assessment is an integral component of the safety and health management system. All sports facilities should conduct risk assessments to identify the source of risks and take all reasonably practicable steps to eliminate any foreseeable risk to any person who may be affected by its activities. Where it is not reasonably practicable to eliminate the risk, other reasonably practicable measures must be taken to minimize the risk. Risk assessment, together with communication of risks, review and monitoring of the risk assessment, is part of the risk management process.

2.2.2 Currently, some organisations utilise risk management plans in the planning of their sports/activities. An example will be the Ministry of Defence, Sport Singapore and MOE's use of the Risk Assessment Management System (RAMS), comprising hazards identification, risk management, risk control options and decisions, implementation of control measures and effective supervision [see appendix 4: MOE RAMS or http://www.sportsingapore.gov.sg/sports-education/sports-safety/safety-resources-and-useful-links]. Other examples of risk management plans include the '5A-way' [see appendix 5: 5A-way to sports safety]. These risk management frameworks are by no means exhaustive or all-inclusive, and serve mainly to show the possible outlines of risk management plans.

2.2.3 In order to establish an "Incident-free Sports Safety Culture", sports organizations need to establish an appropriate safety and health management system with its framework addressing the following areas as minimum:

a. Management commitment on safety and health
b. Safety attitudes, policy and principles
c. Goals and objectives
d. Setting high standards for sustainable performance
e. Clear roles and responsibilities
f. Safety organization and structure
g. Encompass pre-event, intra-event, and post-event safety measures
h. Incident reporting and documentation, investigation, evaluation, and corrective action
i. Supportive safety personnel
j. Emergency response and planning
k. Risk assessment and management
l. Integrity of equipment
m. Training and development
n. Effective communication
o. Pre-event and post-event safety review
p. Change management (people, equipment, technology)
q. Regular review of the Safety and Health Management System

2.2.4 Sports organizations and event organizers should establish or upgrade their safety and health management system to meet the above framework. A sound safety and health management system alone does not guarantee a good performance of the sports safety. Implementation is necessary, and the system must be run effectively, which is essential to building an incident-free sports safety culture. A sustainable performance in sports

safety can only be achieved with a sound safety and health management system and effective implementation of it going hand in hand.

2.2.5 With the preceding framework in mind, this report now looks at each of the five broad areas of sports safety.

a. Pre-participation Screening
b. Training and Education
c. Exercise and Training Facilities
d. Event Medical Coverage
e. Surveillance, evaluation and follow up

3. PRE-PARTICIPATION SCREENING

Key Messages:

- Pre-participation screening aims to pick up existing conditions that may cause harm during strenuous activities.
- Risk stratification of athletes enables optimal use of limited resources for the screening of athletes.
- Individuals should, at regular intervals, complete a pre-participation questionnaire prior to embarking on physical activities.

New Highlights:

- Athletes and the clubs and schools they belong to are instrumental in ensuring that proper pre-participation screening is adhered to.
- Primary healthcare providers should be empowered and resourced to improve their competency in performing pre-participation screening.

General health screening is aimed at picking up common treatable conditions, such as diabetes, hypertension, high cholesterol, and early cancers. However, in sports, pre-participation screening or clearance is aimed more towards reducing the risk of injury or harm during strenuous exercise.

There are generally three main parts to a pre-participation screening:

1. Cardiovascular clearance, since this can cause sudden death
2. Musculoskeletal screening to identify injuries that need to be managed to prevent aggravation or to identify factors that may predispose the athlete to future injuries
3. Identifying factors that may limit performance, e.g. anaemia, drugs

Pre-participation screening can range from a simple self-administered questionnaire to a full medical check-up by a doctor. Unless otherwise stated, in this document, pre-participation screening refers to the latter.

Pre-participation screening practices vary from country to country, and from sport to sport. The most systematic and rigorous is in Italy, where Italian law mandates that every participant engaged in competitive sports activity must undergo a clinical evaluation an obtain eligibility. A nationwide screening programme has been in place there since 1982. Competitive athletes under the programme include those who participate in organized sports that require regular training and competition. This includes all school athletes that compete at the regional or national school championships, but not school athletes competing at the local level. Professional athletes are clearly included in the programme [personal communication, Resource Panel reference no. 6].

The Italian programme requires that the screening be conducted by a Sports Medicine Specialist doctor (i.e. Sports Physician) that is licensed to issue a "competitive sports fitness

certificate." The screening protocol varies between sports, and most (e.g. soccer, swimming, water polo, track and field, cycling rowing, basketball, volleyball, tennis, sailing) includes a history, physical examination, lung function test, resting electrocardiogram (ECG), ECG after a three-minute step test (Master's test), and urinalysis. Some sports require less (e.g. cross country motor biking and golf do not require the lung function test and Master's test) while others require more (e.g. diving, downhill skiing, boxing). Based on the initial screening, the Sports Physician may order additional tests such as an echocardiogram. The certificate is valid for a year, except for certain sports like archery, where it is valid for two years.

The programme does not cover non-competitive athletes, such as recreational gym users. However, non-competitive athletes are encouraged to undergo a medical examination by their family doctor. No investigations are required, unless the doctor feels they are indicated.

3.1 Current Practices

3.1.1 Currently in Singapore, individuals in certain groups undergo compulsory pre-participation screening, including:

a. All carded athletes (i.e. those national athletes receiving Sport Singapore grants)
b. S-League soccer players and other professional athletes
c. Students enrolling into Singapore Sports School
d. Those attending certain courses (e.g. Outward Bound School) and lifeguards prior to taking their Lifeguard Proficiency Award test
e. National Service Pre-enlistees, active national servicemen (NSmen) and Singapore Armed Forces (SAF) regulars

3.1.2 The annual pre-participation screening that the carded athletes undergo comprise of history, physical examination, chest X-Ray, resting ECG, urinalysis, urine microscopy, full blood count, and for contact sports, hepatitis screen. The breakdown and outcome of the screening conducted by the Singapore Sports Medicine Network is shown in table 3.1. In FY 2012 (an Olympics Games year), 1238 (87%) out of 1,422 carded athletes were screened, while in FY 13, 413 (29%) out of 1,452 carded athletes were screened. While it is compulsory for all carded athletes to undergo annual pre-participation screening, there is only partial compliance, for various reasons.

Table 3.1: Number of Medical Clearances done in SMRC for FY 12 and FY 13

Carding Level	**FY 12**	Percent	**FY 13**	Percent
T.E.A.M - A1	24	1.9	2	0.5
T.E.A.M - A2	83	6.7	20	4.8
T.E.A.M - B1	196	15.8	42	10.2
T.E.A.M - B2	747	60.3	94	22.8
T.E.A.M – B4	186	15.1	196	47.5
Temporarily Carded Athlete	0	0	48	11.6
Non-carded Athlete	2	0.2	11	2.6
Total	1238	100	413	100

Source: Sports Medicine & Research Centre

3.1.3 Since 2000, S-League soccer players undergo annual screening before the start of each season. The test protocols are set by the Football Association of Singapore Medical Committee, and comprise history, physical examination, chest X-ray, resting ECG,

urinalysis and blood tests. Blood is taken to test for haemoglobin and serum creatinine levels, as well as to screen for HIV, hepatitis B and syphilis. A few potential foreign sign-ups failed the screening process and were not allowed to play in the League.

3.1.4 In the Singapore Sports School, pre-enrolment screening is similar to the pre-participation screening for carded athletes. Pre-enrolment screening identified 11 cases in 2006 and 2007, of which seven were cleared but sent for further investigations and three were not cleared. Of the seven which required follow-up, there were two cases with haematuria, one with haematuria and low body weight (weight for height at 80-90%), one with obesity, one with abnormal blood pressure, two with exercise-induced asthma, one with normochromic normocytic anaemia. Of the three cases that were not cleared, one had Wolf Parkinson White syndrome, one had mild pulmonary stenosis, and one had Marfanoid features and bullae in the middle and lower zones of his/her right lung. Without comprehensive pre-participation screening, such cases would not have been detected and serious consequence averted.

3.1.5 All of the above compulsory pre-participation screening programmes are limited to small segments of the population. Nationwide pre-participation screening programmes include (a) SAF's comprehensive pre-participation screening and (b) the School Health Services' school-based screening programme. Although the latter is not truly a pre-participation screening, there are elements of it as the medical officers who examine the students do auscultate the heart for murmurs and refer suspicious cases to the Student Health Centre for further screening, with subsequent referrals to the paediatric cardiologist if necessary.

3.1.6 All individuals serving in the SAF, whether full-time National Servicemen (NSF) or Regulars, undergo a pre-enlistment medical screening and are additionally reviewed when undergoing specific courses or undertaking certain forms of training - also known as the Fitness For Instruction or FFI review. Subsequently, health screening is required at milestone ages, with annual screening after the age of 35. The SAF protocol comprises a screening questionnaire, investigations and clinical examination by an SAF Medical Officer covering a broad set of indications including cancer and chronic diseases. More detailed investigations such as stress testing and advanced imaging are mandated for service personnel with identified cardiovascular risk factors.

3.1.7 The School Health Service (SHS) is responsible for the school-based health screening and immunisation programme. The two main objectives of the department are: (a) to detect common health conditions among the primary and secondary school population, and (b) to prevent illness from communicable diseases through immunization [personal communication, Resource Panel reference no. 25]. The department has 11 primary and 12 secondary school health teams, each comprising three nurses, and serving approximately 500,000 students in 187 primary schools and 170 secondary schools, including 20 special schools and 6 religious schools (Madrasahs). Several medical officers visit the schools to provide quick medical examinations for primary one and primary five pupils. Unlike in Italy, there is no mandatory pre-participation screening specifically directed at our competitive school athletes.

3.1.8 With the SHS programmes in place, all Singaporeans would have been medically screened at ages 6 and 12. In addition, National Servicemen would have additional

screening upon enlistment, at age 35, and annually thereafter while still in active service.

3.1.9 The general population undergoes general health screening, for example when purchasing insurance policies, when taking up a new job (i.e. pre-employment screening), as part of their corporate benefits, or on their own volition. The screening protocols vary, and they may have some elements of pre-participation screening (especially the cardiovascular clearance components), such as resting ECG and exercise stress testing. Unfortunately, the majority of these does not emphasize the musculoskeletal component, is not done at regular intervals, and have only sporadic coverage. They may suffice for the recreational athlete, but may not be adequate for the competitive athletes.

3.1.10 "Opportunistic" pre-participation screening via questionnaires can be done on joining a gym. A survey of two major gym operators in Singapore revealed that members joining the gyms are required to complete a pre-participation questionnaire. In one of those gyms, approximately 30-40% of members refused to complete the pre-participation questionnaire [personal communication, Resource Panel reference no. 17]. As a comparison, a survey of 65 health clubs in the Ohio, United States, revealed that 28% of the clubs failed to use pre-entry cardiac screenings [27]. Another survey of 110 facilities in Massachusetts, United States, found that nearly 40% of responding facilities do not use a screening interview or questionnaire to evaluate new members [3].

3.2 Effectiveness of Pre-participation Screening

3.2.1 Since sports injuries and sudden death are often related to underlying medical conditions, the concept of pre-participation screening appears sensible. However, there are some challenges to general non-selective screening of a large population [16]. These include:

a. The very low incidence of underlying conditions that predispose to sudden death and hence the need to screen large populations
b. The variety of causes of sudden death, thus requiring different diagnostic tests
c. The limited accuracy of available tests results in large numbers of false positive test results, obliging further (usually costly) investigations and possibly leading to the inappropriate exclusion of fit individuals from exercise
d. The resources required to screen large populations

3.2.2 Screening has other limitations. It is of limited value in preventing acquired or environmental causes of sudden death or injury due to acute illness, such as heat-stroke, infection of the heart (myocarditis) or traumatic injury. Some conditions which may cause sudden death, such as congenital anomalous origin of the coronary arteries, are not usually detectable by simple tests such as the resting or exercise ECG, and require more advanced imaging, such as cardiac magnetic resonance imaging (MRI) or computed tomography (CT) angiogram. Other causes of sudden death, such as some primary arrhythmias (abnormal heart rhythms) occur in the absence of easily detectable abnormalities of cardiac structure, and hence are not easily diagnosed even with advanced imaging technology. All of these conditions are uncommon or rare, so that large numbers of individuals would need to be screened to detect any cases.

3.2.3 In the older population of individuals above the age of 35 years, the most common cause of sudden death is coronary artery disease (CAD) resulting in acute myocardial infarction (heart attack). However, the benefits of screening for CAD and the test of choice are controversial. The resting ECG is not a useful tool for detection of CAD since many patients with CAD have normal resting ECGs and many individuals without CAD have ECG findings that are suspicious of CAD, thus unnecessarily raising alarm bells. Approximately one-third to one-half of individuals with a normal coronary arteriogram have ECG abnormalities [29] and approximately 30% of individuals with angiographically proven CHD have a normal resting ECG [11]. Most coronary events occur in individuals without resting ECG abnormalities [21]. Exercise testing (i.e. exercise stress test) has limited accuracy [14] in an asymptomatic population with a low likelihood of CAD. In a population with a prevalence of CAD of 1%, assuming the reported overall specificity of the test is 77% [13], it can be estimated that approximately 97% of 'abnormal' results would be false positive results. CT angiography has higher accuracy than ECG stress testing but is associated with radiation exposure and is not recommended for routine screening of low-risk individuals [personal communication, Committee Member reference no. 3]. The United States Preventive Services Task Force (USPSTF) examined the use of the resting ECG, exercise ECG test, or electron beam computed tomography (EBCT) scanning for coronary calcium to screen for CAD, and recommended against routine screening in adults at low risk for coronary heart disease events. They concluded that there was insufficient evidence to recommend for or against routine screening in adults at increased risk for events [22].

3.2.4 It is helpful to examine the situation in Italy, one of the few countries in the world where a compulsory national pre-participation screening program conducted by sports medicine physicians for all young competitive athletes (12 – 35 years of age) has been implemented since 1982 and been reported to be successful. In the Veneto region of Italy, this program was able to detect 879 individuals with abnormalities who were subsequently disqualified from competitive sports, including 345 cases of conduction and rhythm abnormalities, 30 cases of hypertrophic cardiomyopathy, 16 cases of arrhythmogenic right ventricular hypertrophy, and 14 cases of dilated cardiomyopathy over a 24-year period [10]. Over the same period, there was a significant and impressive 89% decline in the number of sudden deaths in this region, from 3.6 to 0.4 deaths per 100,000 athletes [10]. There was no change in deaths during this period among the unscreened non-athletes, suggesting that screening mediated the decrease. This study is the best evidence that we have to date to demonstrate the efficacy of pre-participation screening.

3.2.5 It is to be noted however, that the reduction in deaths pre- and post-screening is only statistically significant for individuals with hypertrophic cardiomyopathy. To detect the 30 cases of hypertrophic cardiomyopathy, screening of 42,386 young athletes with a general history, physical examination and resting ECG was required. In addition, over 3,900 of them who had positive findings on history, physical examination or ECG, underwent additional tests including cardiac ultrasound, 24h ECG monitoring, stress testing, cardiac magnetic resonance imaging, electrophysiological study, contrast angiography, or a combination. It is unknown how many athletes were referred for additional tests based on ECG findings specifically, and as such, difficult to evaluate the value or usefulness of ECG for picking up anomalies in this case. The European

Society of Cardiology has recommended the routine inclusion of an ECG in pre-participation screening, but this policy is not in widespread practice outside Italy [7].

3.2.6 In contrast to the European guidelines, the American Heart Association [16], the American College of Cardiology [16], and the American College of Sports Medicine do not recommend that a resting ECG is mandatory in the screening of competitive athletes, based on the limitations mentioned above.

3.2.7 Hence it is crucial that any pre-participation screening policy be based on evidence of effectiveness, the conditions being screened for, and assessment of benefit in the Singapore context.

3.2.8 It is important to remember that, even without a screening program, some individuals may already be identified as being at higher risk owing to pre-existing medical conditions, symptoms, or past episodes of events. There are published reports suggesting that many individuals with exercise-related cardiovascular events had prodromal symptoms that were ignored by the victims or their physician [27]. Maron et al. (1996) reported that of 134 young competitive athletes with sudden cardiac death, 24 (18%) had probable cardiac symptoms in the 36 months prior to their death. Among adults, 50% of joggers, 75% of squash players, and 81% of distance runners with sudden cardiac death during exercise had probable cardiac symptoms before death [27].

3.3 Recommendations

Underlying Philosophy

3.3.1 The Committee recognizes that physical pre-participation screening for all individuals involved in all sporting activities would not be practical or prudent for the reasons discussed above. Hence, the Committee's recommendations on pre-participation screening are based on:

- Selective screening of the at-risk population, to increase the pre-test probability of identifying the at-risk individuals
- The risk stratification is in turn based on:
  - The individual's intrinsic risk of sudden death or serious injuries (e.g. prodromal symptoms, positive family history)
  - The level of competition (fig. 4.1)
  - The degree of risk of the particular sport or activity (table 4.2)
- Screening protocols that are evidence-based as far as possible, graded according to the degree of risk, and customized to each sport
- Appropriate management of identified at-risk individuals
- Optimization of existing resources
- Minimizing the hindrance to sports participation and sports excellence
- The recognition that pre-participation screening is only part of the strategy to decrease the chance of sudden death and adverse events occurring. Education is the other crucial component of the overall strategy - individuals should be educated on symptoms and signs that require medical attention before embarking on sports activities or exercise.

Risk Stratification Based on Competitive Level and Type of Sport

3.3.2 Generally, the higher the level of competition, the higher the training intensity and volume, and therefore the higher the risk of sudden death and injuries. Athletes can thus be risk-stratified based on the level of competition (See Figure 3.1). Risk stratification based on competitive levels can only serve as a guide and should be used in consideration with other risk factors such as the type of sport and inherent risk factors. For example, a 55-year old novice to marathon running may over-zealously undergo high-mileage training without building up to it, and would be considered at risk of sudden death even though he is only a club runner.

3.3.3 Sports activities can also be risk-stratified based on cardiovascular demands (table 3.2). Duration of sports participation (e.g. endurance or ultra-endurance events), contact / collision risk, or environmental stress, can also affect risk, but cardiovascular activity (percentage of maximum aerobic capacity) was chosen as the main factor in this case due to its stronger association with known intrinsic risk factors.

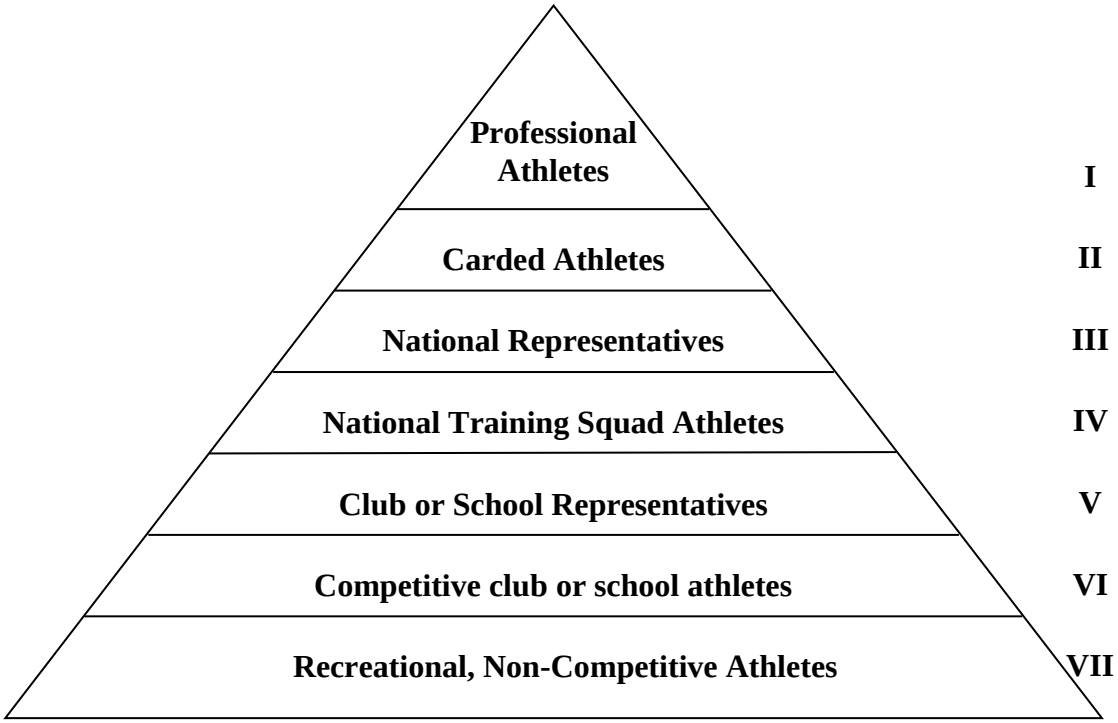

Figure 3.1 Athletes' Competitive Levels

The risk of any physical activity is an interaction of the exercise per se and the individual's fitness and medical conditions. For example, to a fit individual, a category 1 event would be easy whereas to an unfit person with congestive heart failure, a category 1 event may not be tolerable. One should also bear in mind that the competitiveness of the individual also influences the risk – a category 1 or 2 sport may cause excessive strain in an overzealous competitor. For the reasons just discussed, it is important to realize that the categorization below serves only as a rough guide, and individual sports organizations should exercise discretion with the sport-specific guidance of their medical advisors, medical committees, or international federations.

Table 3.2: Categorization of sports based on cardiovascular activity [adapted from 17]

	Category			
	1	2		
Sport	Bowling	Archery	Field events	Rowing
	Bowls	Badminton	Floorball	Running
	Chess	Baseball/	Gymnastics	Sailing
	Contract bridge	Softball	Hockey	Sepak takraw
	Cuesports	Basketball	Iceskating	Soccer
	Darts	Bodybuilding	Kayaking	Squash
	Gateball	Boxing/wrestling	Lifesaving	Swimming
	Golf	Canoeing	Martial arts	Table tennis
	Shooting	Cricket	Motor sports	Tennis
	Sport boules	Cycling	Mountaineering	Triathlon
	Weiqi	Dancesport	Netball	Underwater activities
	Woodball	Dragonboat	Pickleball	Volleyball
	Xiangqi	Equestrian	Powerboat	Waterski/wakeboard
		Fencing	Rollersports	Weightlifting

Who Should Be Screened?

3.3.4 Currently, **professional athletes (I) and carded athletes (II)** undergo compulsory annual pre-participation screening, regardless of the sport category. This practice should continue, but with stricter reinforcement.

3.3.5 As the training intensity and volume for the **national representatives (III) and national training squad athletes (IV)** are very similar to that of the professional and carded athletes, the Committee strongly recommends that National Sports Associations (NSAs) responsible for these athletes should also require them to undergo compulsory annual pre-participation screening, regardless of the sport category. Carding is not totally based on training intensity and volume (e.g. an elite athlete may not be carded because his sport is not included in the Major Games), and therefore should not be used to differentiate those national representatives who should or should not be screened.

3.3.6 As the pool of **club or school representatives (V) and competitive club or school athletes (VI)** is very large, it is not feasible to mandate compulsory annual pre-participation screening in these two groups. Furthermore, the incidence of sudden death in school athletes is relatively low. Hence the Committee recommends voluntary pre-participation screening in these two groups. Those in **category 2 sports** should be strongly encouraged by their club or school authorities to undergo pre-participation screening.

For level V and VI athletes who do not undergo pre-participation screening, a self-administered pre-participation questionnaire may be used instead, with follow up action taken as indicated by the questionnaire.

Schools under the Ministry of Education already administer a yearly questionnaire that has elements of pre-participation screening, and this should be continued. At the same time, parents/guardians/students could be educated on signs and symptoms to look out for. Clubs and schools not under MOE should follow this practice as well.

3.3.7 The exception to recommendation 3.3.5 would be the **Singapore Sports School athletes**. These athletes spend more time training than the typical school athlete (a significant number of whom are national representatives), and should therefore be

treated as level III and IV athletes, and continue to be required to undergo annual compulsory pre-participation screening.

3.3.8 For **recreational, non-competitive athletes (VII)**, pre-participation screening should not be mandated. Instead, a self-administered pre-participation questionnaire [2, 26] should be completed at least annually. The Committee recommends the use of the PAR-Q questionnaire [appendix 6] or the Wisconsin Affiliate of the American Heart Association Questionnaire [appendix 9] for adults and The Sudden Arrhythmia Death Syndrome Foundation Questionnaire [appendix 7] for children.

3.3.9 Individuals should routinely complete a pre-participation questionnaire prior to joining a club, competition, course, or organized sports activity. This must be completed before commencement of the physical activity. The questionnaires identify individuals with known conditions as well as those without any prior history of medical illness but who have symptoms or a past history of events such as chest pain, breathlessness, fainting, dizziness, or palpitations. If indicated by the questionnaire, the participant should consult a doctor. As new symptoms may develop after the completion of the questionnaire, such questionnaires should be completed at least annually. The Committee encourages all individuals involved in sports to take personal responsibility for their own health and to make use of these self-administered questionnaires.

3.3.10 The current SAF pre-participation screening requirements are comprehensive and should continue to be enforced.

3.3.11 For individuals undergoing specific courses and physical tests, the need for pre-participation screening should be guided by these guidelines. The event / course organizers shall do a risk assessment and stratification, with the aid of qualified medical advisor/s, and decide if pre-participation screening is necessary.

Screening Protocols

3.3.12 Pre-participation screening protocols should be aimed at:

- Identifying and excluding individuals with medical contraindications to exercise and sports
- Identifying injuries and risk factors for injuries that may preclude participation in the particular sport
- Identifying conditions that does not exclude an individual from sports participation, but need to be managed in order to safely participate in sports

3.3.13 For pre-participation screening, a **two- or more stage screening** process is encouraged, where the first stage consists of personal and family history taking and physical examination. Resting ECGs are not compulsory as part of the screening process, but in organisations (such as SAF) who are already including ECG as part of their screening, it should be continued. Based on the findings of the first stage, further tests such as a resting ECG (if not already done), chest X-ray, exercise stress test, echocardiogram, angiogram, blood investigations, urine tests, etc. may be ordered if indicated [2,5,7,9,10,12,16, 19, 26].

3.3.14 Generally, pre-participation screening should be conducted annually, unless there are justifications to do otherwise (e.g. athletes in category 1 sports could be perhaps be screened once every two years). Abbreviated screening protocols are acceptable in the intervening years between the full screening (as currently practiced by SAF).

3.3.15 Specifically, the committee discussed whether routine ECG screening should be extended beyond the current practice (which covers all Singaporean men at pre-enlistment age 17 and carded athletes) to all competitive athletes, as is the practice in Italy (but not the USA or other European countries). Extending ECG screening to all competitive athletes aged 12 to 35 years old, defined as those taking part in a regular training program and competition, will require considerably more resources. It is difficult to assess how much additional benefit this would provide over the existing practice of school health and pre-enlistment screening, and the proposed screening of all national athletes. There is the possibility that the requirement for more extensive screening might inadvertently discourage promotion of organized sports. The committee felt that, while it favoured consideration of such a practice, more time is needed to assess its feasibility and impact, and to consult all organizations involved in sports.

3.3.16 The screening protocol and tests should be customized to each sport. National Sports Associations should seek guidance from their respective International Federations and medical committees / designated doctors.

3.3.17 Certain sports such as SCUBA diving and flying mandate sport-specific screening. Participants are advised to adhere to these requirements.

3.3.18 In the **general population**, *health* screening for common treatable conditions such as diabetes mellitus (DM), hypertension and high cholesterol is recommended by the Ministry of Health. It is recommended that health screening for DM and high cholesterol be carried out for all adults aged 40 years and above (or 30 years for individuals with known risk factors), and screening for hypertension be done for all adults aged 21 years and older [17]. These conditions may affect the safety of exercise.

Who Should Conduct the Pre-Participation Screening?

3.3.19 As physical pre-participation screening typically involves a musculoskeletal screening to assess current injuries and identify risk factors for sports injuries, such screenings are usually conducted by sports medicine physicians, as in the Italian national pre-participation screening programme. However, owing to the limited number of sports physicians in Singapore (to date, there are 25 sports physicians listed on the MOH subspecialty register), the Committee recommends that a multi-disciplinary workgroup, comprising sports physicians, cardiologists, general practitioners, sports physiotherapists and others, be established by the Singapore Medical Association / College of Family Physicians Singapore / Exercise is Medicine Singapore to conduct courses to improve the confidence and competency of primary healthcare providers in conducting pre-participation screening.

Follow Up

3.3.20 Pre-participation screening identifies individuals at risk of sports injuries and sudden death. Pre-existing sports injuries and factors predisposing the individual to sports injuries should be addressed to prevent aggravation or onset of injuries – some injuries may preclude the individual from certain sports. Once cardiac conditions are identified, the 36th Bethesda Conference consensus can be used as a guide determining eligibility for various sports and competitive levels [15].

Enforcement

3.3.21 Pre-participation screening must not be neglected, especially for the professional and more competitive athletes, such as national athletes. There should also be accountability and responsibility for screening programmes.

4. TRAINING AND EDUCATION

Key Messages:

- A Safety culture which is proactive seeks to empower the first responder, who may be a sports organiser or a participant to deliver lifesaving CPR and / or defibrillation.
- Any CPR and AED strategy relies on strength in numbers.

- CPR and AED skills are perishable and regular refresher training is essential.

New Insights from Past Experience:

- Commitment to safety as demonstrated in the uniformed services has led to increased demand for CPR and AED competency at all levels.

- Lifesaving skills should be made part of the education curriculum.

4.1 Safety Culture

4.1.1 A proactive management is required in sports safety. It is thus essential for the public and all participants and relevant personnel to adopt a culture of safety. The human factor is the most important component of the sports safety framework. Dedicated effort must be made to

a. Generate awareness and improve knowledge regarding sports safety
b. Introduce ongoing opportunities that develop, evaluate and promote prevention of sports related injuries
c. Establish sustainable, long-term sports safety programme that will continue to reduce the risk of sports injuries to athletes

4.1.2 In addition to ongoing sports safety efforts, a comprehensive public outreach program should be developed to focus on the importance of sports safety geared towards providing guidance on healthy and safe participation. It should cover both proactive and reactive measures for athletes, coaches and even parents. The initiative should also emphasize that playing safe can enhance and extend an athlete's career, prevent injuries, improve teamwork, reduce obesity rates and create a lifelong love of exercise and healthy activity. Educational initiatives may include public safety campaigns, banners, posters, DVDs, brochures/fact sheets, newsletter, an interactive website and other online outreach. Training and education on sports safety can achieve a nationwide impact through a variety of media outlets, corporate and individual partnerships.

4.2 CPR / AED

4.2.1. Successful resuscitation of a collapsed athlete is dependent on an early response, as the risk of death increases 7-10 % per minute of delay. It is crucial that the first responder is competent in delivering cardiopulmonary resuscitation (CPR) and in using an automated external defibrillator (AED). To minimize the delay in initiating CPR and using the AED, those in the proximity of the athlete, including members of the public, fellow participants, first-aiders, sports trainers, coaches, and frontline sports officials, should be trained in administering first aid, performing CPR and / or the use of the AED, and the certification should be current. Access to an AED within three minutes of activation should be a planning target for all sporting activities and sports venues.

4.2.2. It is common for many to be hesitant in administering CPR for fear of suboptimal CPR being performed or fracturing the ribs of the collapsed person. Fracturing of ribs during CPR does not kill patients. Not doing CPR certainly kills patients. It is important to realize that CPR is performed on collapsed persons with no breathing or pulse, and who

will most certainly die if no resuscitation is done. On the other hand, it has to be understood that performing CPR has variable outcomes, and doing CPR does not guarantee survival of the person. Although there is no definitive Good Samaritan law in Singapore, Singaporeans who render CPR out of a desire to help, and do so at a competency level that is expected of his peers (e.g. a layperson will be compared against someone who is untrained, while a doctor is compared against someone who is fully trained in CPR) is protected under tort law. Under a nationwide initiative launched in 2015, when the emergency response 995 number is dialled, the caller will be guided on how to perform CPR on the patient over the phone when required, until help arrives.

4.3 Current Practices

4.3.1 The rapid growth in sports participation rates implies that there is a relatively large population of novices taking part in sports events. First-timers and inexperienced athletes may not be aware of how hard they can safely push themselves. Their knowledge with regards to hydration, nutrition, training methods and principles, and competition rules may be lacking. Except for the larger events, medical advisories are not issued to participants at most organized events, and even if issued, the information tends to be scant.

4.4 Recommendations

4.4.1 Practically all individuals, from participants to sports officials to spectators are part of the sports safety framework. While it would be ideal to have all Singaporeans trained in first aid and CPR, implementation may be challenging. Hence, the Committee recommends that all individuals should at least be aware of and conscious of sports safety. Such individuals include the public, spectators, supporters, parents, participants, coaches, teachers, and frontline sports officials (referees, umpires, volunteers). They should be educated on:

a. The common sports injuries and causes of sudden death
b. Recognizing prodromal symptoms and acting accordingly
c. The importance of complying with sports safety guidelines, e.g. self-administered pre-participation questionnaires (and seeking medical advice if warranted), heeding medical and weather advisories
d. The importance of first-aid, CPR, and AED training

4.4.2 Sports safety and core skills training could be included as a graduated training program during a student's school years, e.g. during physical education classes. The Ministry of Education has already started some work in this area as part of the revised PE Syllabus currently.

4.4.3 The onus for raising awareness resides primarily with agencies promoting and organizing sports such as the National Sports Associations (NSAs), Sport Singapore, Peoples Association, Ministry of Education and organizers of sports events. In addition, the mass media can play a very useful societal role in promoting community sports safety through regular sports safety awareness publicity / programmes. Awareness can be raised in several ways:

a. Providing medical and sports safety information on NSA / event websites
b. Providing regular medical talks / forums on sports safety
c. Issuing advisories to participants of sports events, including information advising participants to undergo pre-participation screening for certain events, as well as advising them on proper preparation for physical exertion and against participation if unwell just before / during the race. The onus is on athletes to adhere to the advisories and to develop the culture of safety when participating in their physical activities
d. Sharing of adverse events / incidents with Sport Singapore and improvements made to these events so as to increase public awareness

4.4.4 For those who are in close contact with the athletes, including coaches, teachers, frontline sports officials (referees, umpires, sports event organizers), volunteers, and fellow athletes, merely being aware is not enough. Hard skills and certification in **first-aid, CPR, and AED use** are necessary. Therefore, all such persons should be currently certified in these skills. The introductory program for all sports activities should include certification in these basic sports safety and core life-saving skills. For water sports, recognition of victims in distress and **water lifesaving skills** should be included, and personnel should be well trained to be able to perform specialised skills such as a proper search and rescue.

4.4.5 AED use has been included together with first-aid and CPR, rather than an advanced-level skill as it is simple to learn and there is adequate evidence that it is effective in saving lives and is as important as CPR during the first response to a collapsed victim. Courses are available through various providers. Examples of providers currently accredited by the National Resuscitation Council are enclosed as an appendix (see appendix 8: Examples of CPR / AED / 1st Aid Course Providers) but the list is by no means exhaustive. Those who are trained in CPR are encouraged to carry around plastic face masks (or similar devices for personal protection, if required) for use in CPR if necessary.

4.4.6 The Committee reached a consensus that the NSAs / event organizers / fitness facility managers (Singapore Armed Forces, Singapore Police Force, public and commercial gyms, schools etc.) would be held responsible for ensuring that frontline personnel of sports events and organized training are adequately trained and certified, and all certifications are current. Thus far, this has always been encouraged, but implementation has fallen short of expectations. The Committee therefore recommends that the responsible organizations (e.g. NSAs in the case of coaches, gym operators in the case of personal trainers) mandate that all frontline personnel acquire the above-mentioned certifications within a reasonable timeframe (the suggested timeframe would be within the next three years, i.e by end 2018). Serious / fatal exercise-related adverse events can occur anytime, to anyone, and thus it is important that training and education be done as soon as feasible. NSAs in particular, should approach this with some urgency, and achieve this intent within three years as a guide.

4.4.7 It is recognised that implementation of measures will not be easy (e.g. NSAs are already burdened with various targets and plans), so Sport Singapore should work with NSAs to provide support in meeting these guidelines.

4.4.8 All certifications must be current, for obvious reasons. This area tends to be neglected, and organisations should have a system to ensure trained staff undergo recertification in these skills and remain current. Being certified does not mean that the personnel will be able to perform first aid or CPR, or use the AED effectively during an emergency. Practice is necessary and all responsible organizations should conduct regular emergency drills. As fellow athletes and training partners are often the first-responder to the collapsed victim (especially in the case of adventure sports and mountaineering), sports first-aid, CPR, and AED training are desirable for athletes as well, especially those above 15 years of age.

4.4.9 Allied health personnel (sports trainers, volunteer first-aiders, paramedics) should already be trained and certified in sports first-aid and CPR. They should additionally be trained in AED use and ensure that their certifications remain current and that they practice their skills regularly during emergency drills.

4.4.10. Every year, all National Service liable men are trained in CPR and the use of AEDs. Such skills are useful during their full-time service but more importantly, the training system constantly feeds into the pool of trained first-responders who are conversant with CPR and the use of AEDs. On becoming operationally ready national servicemen, there is a risk that these skills diminish. Reservist training presents an ideal opportunity for these lifesaving skills to be refreshed regularly to maintain their operational readiness and benefit the nation when they return back to their civilian lives.

4.4.11 Relevant members of sports organisations should attend basic safety management courses in order to attain the required management skills to implement a sports safety management system.

5. EXERCISE AND TRAINING FACILITIES

Key Messages:

- Exercise facilities or services should promote the use of pre-participation screening questionnaires among its users.
- Different levels of health/fitness facilities catering to different population should be staffed and equipped according to the risk profiles of their clientele.

New Insights:

- More public exercise facilities in Singapore are equipped with AED, and this trend should be encouraged.
- AED should be easily visible and accessible by the public in facilities that are already equipped with them.

Athletes spend proportionately more time training than competing. Also a substantial proportion of our exercising population do not take part in competitions. Hence health and fitness facilities need to be made safe as well.

Exercise and training facilities are defined here as organizations that offer health and fitness programs as their primary or secondary service or that promote high-intensity recreational physical activity (e.g., futsal, basketball, tennis, racquetball, and swim clubs). Ideally such facilities have professional staff, but those that provide space and equipment only (e.g., unsupervised hotel exercise rooms, exercise parks, kayak rental kiosks, open fields) are also included.

Much of the recommendations in this section are adapted from the American Heart Association / American College of Sports Medicine joint scientific statement on the recommendations for cardiovascular screening, staffing, and emergency policies at health and fitness facilities [3,4].

5.1 Current Practices

5.1.1 Since the publication of the last report in 2007, all facilities managed by Sport Singapore and the Singapore Armed Forces are equipped with AEDs, though accessibility may be a challenge in view of the large premises.

Many other exercise and training facilities are available in Singapore as well, from commercial gyms to hotel gyms to National Parks (NParks) facilities and Public Utilities Board (PUB) reservoirs. More of such facilities should be equipped with AEDs.

5.1.3 As the number of Singaporeans engaging in regular exercise increases, there will be a rising trend in the absolute number of people, including those with heart disease, utilizing exercise and training facilities.

5.2 Best Practices for Exercise and Training Facilities [adapted from 3, 4]

5.2.1 Exercise facilities should ensure that personnel are adequately trained and updated, that comprehensive programmes and safety protocols are in place, and that the facility is designed and equipped to optimise safety.

5.2.2 The onus for sports safety lies not only on the facility provider, but also on the athlete as well. Unlike competitions, where there are usually larger numbers of participants, training groups tend to be smaller, making it less cost-effective to provide comprehensive medical support during training sessions. Hence, the individual must be prepared to personally assume some of the risks. It is not realistic to expect organizers to provide full medical support during training sessions, and insisting on it would only cause organizers to withdraw and choose not to conduct training sessions.

5.2.3 The American Heart Association / American College of Sports Medicine joint scientific statement on the recommendations for cardiovascular screening, staffing, and emergency policies at health and fitness facilities [3, 4] advocates:

a. Cardiovascular screening of all persons before enrolment or participation in activities at health and fitness facilities.
b. Health and fitness facility personnel involved in management or delivery of exercise programmes must meet academic and professional standards and have the required experience as established by the American College of Sports Medicine.
c. Among the personnel in any facility providing supervised exercise sessions (i.e. excluding unsupervised exercise rooms), there should be a medical liaison who reviews the medical emergency plans, witnesses and critiques medical emergency drills, and reviews medical incident reports.
d. All exercise leaders must be trained in CPR and in AED use.
e. All health and fitness facilities must have written emergency policies and procedures that are reviewed and practiced regularly. For example, emergency drills should be practiced once every three months, or more often with changes in staff.
f. Emergency equipment depends on the size and capacity of the facility, and the services provided. At the very least, there should be a telephone, signs, and access to AED. The AED should be easily visible and accessible to the public, and should be available in health and fitness facilities that offer special programs to clinical populations (e.g. programmes for the elderly), and where the time from recognition of cardiac arrest until the first shock is delivered by the emergency medical service is anticipated to be in excess of three minutes.

5.3 Recommendations

5.3.1 All facilities offering exercise equipment or services should encourage pre-participation questionnaire use in all new members at enrolment. The primary purpose of pre-participation screening is to identify both those not known to be at risk and those known to be at risk for a cardiovascular event during exercise. Evidence suggests that simple pre-participation questionnaires can identify many persons at risk and increase the safety of exercise, including non-supervised ones [23].

5.3.2 It is important to balance the pros and cons of different modalities of pre-participation screening. Pre-participation screening needs to be simple and easy to perform. As most

of the health benefits of exercise occur during moderate intensity exercise [18], screening should not be so prohibitive such that persons will be discouraged from participating in exercise, thereby going against the goal of encouraging regular exercise.

5.3.3 For facilities requiring membership or signing in to use its equipment / services, pre-participation questionnaires should be given to prospective members / users at sign up / signing in. For facilities where there is free uncontrolled usage of its equipment (e.g. fitness parks or unsupervised hotel fitness centres), such questionnaires should be available easily (e.g. through websites or by means of signs at the facility itself) and the public should be educated of its presence.

5.3.4 Examples of simple pre-participation questionnaires that are self-administered include:

a. Physical Activity Readiness Questionnaire PAR-Q [appendix 6]. This questionnaire focuses mainly on the symptoms suggesting angina pectoris, with a question included to identify musculoskeletal problems which should be evaluated before participation in an exercise programme, and which may warrant changes in the exercise programme itself. Individuals who answer 'Yes' to one or more questions should seek medical advice before increasing their activity level.
b. Wisconsin Affiliate of the American Heart Association Questionnaire [appendix 9]. This questionnaire uses history, symptoms and risk factors for assessment, and directs individuals to seek medical advice if necessary. Individuals at higher risk are also advised to exercise at facilities with appropriate levels of supervision.

5.3.5 Individuals with known cardiovascular disease who do not comply with medical recommendations or who refuse to complete the health questionnaire when requested, may be refused the use of exercise facilities or participation in health / exercise programmes. This also applies to those who are asymptomatic and have no history of cardiovascular disease, and who refuse to sign a release / waiver / indemnity document. Individuals in the latter category who sign a release / waiver / indemnity document may be allowed to utilise exercise facilities / equipment, but should be advised to partake in moderate- or lower-activity exercise, and should also be educated on the signs and symptoms of an impending cardiovascular event. It is understandable that legal difficulties may arise from disallowing interested individuals from participating in exercise programmes or using exercise / fitness facilities. As such, public education is of utmost importance, to allow individuals to understand and adopt the culture of sport safety, and thus more willing undergo pre-participation medical screening.

5.3.6 Different levels of health/fitness facilities are available, catering to different groups of the population (table 5.1). They should be accordingly staffed and equipped based on the risk profiles of their clientele. Emergency plans should be available and present at these facilities as well.

Table 5.1: Health/fitness facilities – staffing and equipment

	Level 1	**Level 2**	**Level 3**	**Level 4**	**Level 5**
Type of facility	Unsupervised exercise room, exercise parks	Single exercise leader	Fitness centre for general membership	Fitness centre offering special	Medically supervised clinical exercise programme

				programmes for clinical populations	(e.g. cardiac rehabilitation)
Personnel	None	Exercise leader *Recommended: medical liaison*	General manager Health/fitness instructor Exercise leader *Recommended: medical liaison*	General manager Exercise specialist Health/fitness instructor Medical liaison	General manager Exercise specialist Health/fitness instructor Medical liaison
Emergency equipment	Telephone in room/close proximity in parks Signs *Encouraged: PAD plan with AED as part of the composite PAD plan in the host facility (e.g. hotel, commercial building, apartment complex, park)*	Telephone Signs *Encouraged: blood pressure kit, stethoscope, PAD plan with AED*	Telephone Signs *Encouraged: blood pressure kit, stethoscope, PAD plan with AED. PAD plan with AED strongly encouraged in facilities with >2500 members and those in which EMS response time is expected to be >**5**(?)min from recognition of arrest*	Telephone Signs Blood pressure kit Stethoscope *Strongly encouraged: PAD plan with AED*	Telephone Signs Blood pressure kit Stethoscope Oxygen Crash trolley Defibrillator

AED = automatic external defibrillator
PAD = public access to defibrillator

5.3.7 Personnel in health and fitness facilities must meet professional standards and have the training and experience required for their designation (table 5.2).

Table 5.2: Personnel and requirements

Designation	**Requirements / job scope**
General manager / executive director	Overall management of facility, design and delivery of exercise programmes
Medical liaison	Review of medical emergency plans and incident reports, witnessing and critique of emergency drills. Level 2 and 3 facilities: physician or registered nurse trained in advanced cardiac life support Level 4 and 5 facilities: physician
Fitness director	Design and management of exercise and fitness programmes, training and supervision of staff Level 3 facilities: ACSM health fitness instructor certification or equivalent Level 4 and 5 facilities: ACSM exercise specialist certification or equivalent; trained in CPR and AED use. At least one year's experience in supervision in fitness industry
Fitness professionals (including professional exercise leaders, personal trainers etc.)	Provide instruction and leadership in professional exercise programmes Level 1-3 facilities: ACSM exercise leader certification or equivalent Level 4 facilities: ACSM health fitness instructor certification or equivalent Level 5 facilities: ACSM exercise specialist certification or equivalent, or health fitness instructor under direct supervision of exercise specialist Trained in CPR and AED use, desirable to be trained in 1st aid, prior supervised internship or experience in health/fitness industry

5.3.8 Each health / fitness facility should have its own medical emergency plan, tailored to the risk profile of its user population. Plans should be carried out and reviewed

regularly, with drills conducted every three months (or more frequent in cases of change of staff). All staff directly supervising exercise participants should be trained in basic life support. It is also important that all staff are briefed about and are familiar with the emergency response plan, as well as the individual roles each of them plays in the plan.

5.3.9 Staff members should also be well trained and experienced to readily handle emergencies and use emergency equipment competently and comfortably. Level 5 facilities in particular, should be fully equipped according to the recommendations of the AHA [20] and the American Association of Cardiovascular and Pulmonary Rehabilitation [1], including oxygen, a defibrillator and a crash trolley. Trained staff that are medically and legally empowered to handle such devices should be available during the centre's operational hours. The emergency plan should also aim to provide easy access to the casualty as well as rapid transport to emergency facilities.

6. EVENT MEDICAL SUPPORT PLAN

Key Message:

- This set of guidelines for medical support plans in mass participation amateur sports events establishes the appropriate medical support services required, based on the event risk assessment.

- The medical support plans should be clearly communicated to the participants and working personnel for its effective implementation.

New Insights from Past Experience:

- Increased participation at all levels combined with heightened awareness for sports safety mean that medical support planning is now standard practice for mass participation events.

6.1 Event Medical Support: Goals and Principles

6.1.1 The ethos of sport simultaneously embraces participation and competition to promote health and provide entertainment. The communities built around sport are woven into the fabric of our national identity. As athletes - both amateur and professional - aspire towards physical excellence, we must accept that risk-taking will go hand in hand with the pursuit of health and happiness. Safe sporting practices, both during training and at competitions, are essential to sustainability. Failure to manage these risks can prove detrimental to the conduct of sports and games, thus jeopardising the real and intangible benefits of having a vibrant sporting environment.

6.1.2 Sports safety should be a primary focus as it is the most effective measure to minimize exercise-related injuries and mortality. But even with the best preventive measures in place, injuries and incidents can still happen. The event medical support should be viewed in this perspective, as an essential support tool to good safety practices and planning. The medical support plan should complement the event safety plan.

6.1.3 The earlier chapters in this document covered sports safety in general, pre-participation screening, training safety and safe sports facilities. In addition to covering the medical support plan for events, this chapter also discusses the responsibilities of sport events' organisers, participants, and members of the public. Lastly, it provides a framework and guidelines to help planners and athletes determine the requirements for medical support for both routine and event-based sports activities.

6.1.4. A good event medical support plan will provide persons with injuries or medical conditions with timely and appropriate medical support, manage injured athletes effectively to reduce the impact of their medical condition, and reduce the exercise-related morbidity and mortality. Following principles should be observed during planning (some of which are covered in earlier chapters of the document):

a. Pre-participation baseline health assessment *(earlier chapter)*

b. Sports safety and health education *(earlier chapter)*
c. Pre-event and event day risk assessment and mitigation *(earlier chapter)*
d. Information management and risk communication
e. Robust and well-resourced medical support plan
f. Close coordination and strong execution of the medical support plan
g. Post-event feedback and review

6.2 Event Medical Support: Coverage

6.2.1 The event medical support plan should primarily cater to the event participants. In large-scale events with large number of spectators and organizing staff, the medical support plan should also cater to the possibility of casualties coming from the spectators or event organizers.

6.2.2 Sporting events vary widely according to the type of sports, the participant profile, the environment, and the number of participants. So while this document aims to cover the whole spectrum adequately, it will not be able to cover in depth some of the highly-specific areas relating to certain sports. Sports Singapore and the Sports Safety Committee will be available as a resource to the various National Sporting Associations if there is a need for sports-specific safety guidelines to be developed.

6.2.3 Event medical support plans for mass-participation amateur sports deserve a special mention because of the large number of participants they are expected to manage. It will be covered in the later part of this chapter.

6.3 Current Practices

6.3.1 Sports play an increasingly prominent role in Singapore on several fronts. (1) Increased participation in recreational sports and fitness activity as a culture and way-of-life. (2) An increasing emphasis on competitive sports and sporting excellence. (3) More regional and international sporting events held in Singapore. (4) Trend of seeking self-actualisation through participation in endurance sports.

6.3.2 There will be increased expectations from society on the governance and standards of sports safety as the role of sports increases in society and more people participate in sports across a broader range of ages. And as Singapore grows into an international sporting hub to host more and larger-scale events, there is a need to review if the current state of governance and standards for sports safety is adequate or whether there is a need to enhance it to regional or international standards.

6.3.3 The committee has acknowledged that there is a lack of good quality data at the national level to assess exercise-related morbidity. While there is little evidence available locally to link existing sports safety governance and standards to exercise-related mortality, empirical evidence available internationally point to better morbidity- and mortality-related outcomes with established event sports safety standards. The Committee elected to work on exercise-related mortality as a key indicator on the current adequateness of sports safety, as information on this aspect is more detailed and available. Accepting that exercise-related morbidity and mortality are associated, the Committee found that the recent and available exercise-related mortality data showed that levels of governance and standards for sports safety can be improved. This is

particularly relevant for mass-participation sporting events, which will be covered in detail in a subsequent section.

6.3.4 Sport Singapore published the Sports Safety Management System Guidebook[1], promoted the use of the Physical Activity Readiness Questionnaire (PAR-Q) for screening, and worked with NSAs to publish specific safety guidebooks on 12 sports[2] for outreach and education. While NSAs are encouraged to work with Sport Singapore to publish safety guidelines for their sport. NSAs who have yet to do can rely on the respective published international sports associations / federations' guidelines.

6.3.5 The Ministry of Education's Committee on Safety in School Sports concluded in December 2010 that the sports safety framework in schools is largely sound, and generally in line with international best practices. They reported that the conclusion is in-line with the relatively low sports injury rates reported in schools. The Committee recommended enhancements in three areas – (1) safety education and training, (2) preventive measures, and (3) monitoring, intervention and follow-up measures. Since then, increased emphasis had been placed on safety training for teachers-in-charge of co-curricular activities, and students are better educated on sports safety issues.

6.3.6 Sports in schools will continue to come under the governance of MOE. Sport Singapore's sports safety publications and the NSAs will continue to serve as references and points of consultation respectively for MOE.

6.4 Guidelines on Risk Assessment & Categorization

6.4.1 Sports events vary widely in terms of risk assessment and categorization, based on the type of sport, level of competition, age group and skill level of participants, and other factors. Closely referenced to international publications and reports, the Committee has selected to categorize event risk based on (1) cardiovascular risk and (2) contact / collision risk. This matrix assessment approach categorizes sporting events into low, medium and high risk categories (labelled as Category A, B and C respectively).

Legend	Category		
	A	B	C
Risk	Low	Medium	High

Table 6.1: Classification of Sports Based on Cardiovascular Activity and Contact/Collision Risk (adapted from Maron et al 2005, Rice et al 2008.)	
	Contact / Collision Risk

[1] Other relevant publications by Sport Singapore: Risk Management for the Sports Fraternity, Sports SAFE U and Sports SAFE Club guides, Safety Guidelines for children and young people in sports and recreation, heat disorders prevention guide, Sports Safety Tips for Popular Competitive Sports, Sports Concussion Guide for your Athletes, and Sports Rage Prevention Guide.

[2] As of August 2014, there are 12 published sports safety guidebooks: baseball & softball, cycling, diving, equestrian, football, judo, rugby, silat, dragon boat, running, sailing, and waterskiing & wakeboarding.

		Low	Medium	High
Cardiovascular Risk	High	Canoeing / Kayaking Dragonboat Rowing	Cycling Ice-skating (speed) Rollersports	Boxing/wrestling Muay Thai# Mixed Martial Arts#
	High Moderate	Running (mid-distance) Bodybuilding Swimming Modern Pentathlon#	Badminton# Squash# Triathlon#	Basketball Handball# Ice Hockey@ Extreme sports#
	Moderate	Running (sprint) Running (long distance) Field (throwing) Dancesport Mountaineering Pickleball Sailing Lifesaving Tennis	Field (jumping) Floorball Iceskating (figure) Waterski/wakeboard Gymnastics Snowboarding@ Wushu^ Weightlifting^	Soccer Hockey Judo Karate-do Kendo Rugby Silat Taekwondo Ultimate Frisbee#
	Low Moderate	Archery Table Tennis Underwater activities[3] Scuba#	Fencing Netball Sepak Takraw Baseball/softball Cricket^ Volleyball	Cheerleading# Equestrian^ Motor sports^ Powerboat^
	Low	Bowling/Bowls Chess Contract bridge Cuesports Darts Gateball/Woodball Golf Lawnball# Pentanque# Shooting Weiqi/Xiangqi		

@ New NSA Sports
# new sports added to table based on Committee consensus
^ previously existing sports reclassified based on Committee consensus

[3] Underwater activities carry along with them a different set of risks such as drowning, hyperbaric injuries, and an activity-specific risk assessment should be performed by the organizing committee.

6.4.2 For organized training sessions and competitions in category B and C, organizers need to conduct a risk assessment and have a medical support plan.

6.5 Guidelines on Resource Management

6.5.1 As sports events vary widely, it is not useful to have a one-size-fits-all guideline on the appropriate resourcing for sports events. Hence, the Committee recommends graded medical resourcing based on the risk assessment matrix outlined in Table 6.1, Table 6.2 details the resource recommendation for training and competition in sports from each of the three risk categories.

Table 6.2: Personnel & Facilities Recommended for Event Medical Coverage

Risk Category		**1st aid, CPR and AED trained official (e.g. coach) present**	**Dedicated first-aider or paramedic onsite**	**Doctor onsite**	**Nearest hospital informed**	**Ambulance[4] on standby**	**Medical tent / post / centre onsite[5]**
A	Training	No	No	No	No	No	No
	Competition	No	No	No	No	No	No
B	Training	Yes	No	No	No	No	No
	Competition	Yes	Yes	No	Yes	No	No
C	Training	Yes	No	No	No	No	No
	Competition	Yes	Yes	Preferred	Yes	Yes, to arrive within 5 minutes	Yes, if > 100 participants

6.5.2 In addition, it is to be noted that although the personnel in the table below are identified based on their job vocations, the underlying concept is to be skills-based. For example, it is not the presence of a paramedic that is important, but someone who has the skills to identify an athlete in distress and render first aid and CPR if necessary. This person can be anybody, from a teacher to a volunteer.

6.5.3 The recommendations in Table 6.2 apply primarily to static events. For events that are dynamic / mobile, with a large field-of-play (e.g. open-water kayaking, cycling and long-distance running), the recommendations in Table 6.2 may be inadequate as the medical support plan for both training and competition has to take into account the timely access of medical support and evacuation of casualties. For such events, the Chief Safety Officer or Event Medical Director will have to adapt the recommendations when drawing up the safety and medical support plan.

6.6 Manpower and Training

[4] In 1998, the Ministry of Health (MOH) published recommended standards for Emergency Ambulance Services. At time of writing, these standards were being revised by MOH. The reference to "ambulance" in these guidelines should be read in reference to the MOH's latest standards.

[5] The medical facility must be sited prominently, and its location known to medical planners, safety officials, event participants. and spectators. This facility should bear prominent signages, and have easy ingress and egress of casualties.

6.6.1 The event organizer or person-in-charge should designate a safety officer responsible for the event safety and medical coverage. For category B and C events held on a large scale, the event organizer should consider appointing a Chief Safety Officer to be overall in charge of the event safety and medical coverage.

6.6.2 For events that (1) involve mass participation, (2) have multiple events occurring simultaneously (e.g. Youth Olympic Games) OR (3) occur over a large field of play (e.g. road races, triathlons), the organizer should consider the appointment of an Event Medical Director to be closely involved and responsible for the planning and execution of the medical support plan.

6.6.3 The event organizer should review the experience and qualifications of the appointed safety and medical personnel to ensure that they are able to perform their duties appropriately. Different levels of personnel competencies should be available for categories of event risk, depending on whether the event is a training session or competition (Table 6.2). Sufficient numbers of trained safety personnel and first responders should be deployed to ensure that the time required for the first responder to attend to a participant in distress is three minutes or less.

6.6.4 For special events (such as water sports or disabled sports), it is essential that personnel involved in event coverage are trained adequately (e.g. lifesaving skills and surveillance techniques for water sports, volunteers familiar with disabilities for disabled sports events). For recurrent events, the event medical plan should be reviewed along with the safety plan for areas of improvement so that subsequent event can be better supported.

6.6.5 Safety and medical personnnel should be certified, and the certifications should be kept current, in accordance with the available national standards and accreditation programme (i.e. Basic Cardiac Life Support training and certification with training centres accredited by the Singapore National Resuscitation Council).

6.7 Medical Equipment

6.7.1 Each specialized personnel is expected to have full and rapid access to respective equipment required (e.g. an adequately equipped first aid box / kit for first aiders, adequately equipped and stocked medical bag for event doctor), e.g.

- First-Aid Box / Kit
- Facemask for CPR
- Automated External Defibrillator (AED)
- Oxygen *(for water sports)*
- Splints and cervical collars
- Medical Bag for event doctor
- Stretcher (regular or wheeled)
- Evacuation vehicle

6.7.2 Equipment should be visible, accessible, well-stocked, and well-maintained. The medical bags carried by doctors for field cover should contain resuscitation equipment (e.g. laryngoscopes, endotracheal tubes, drip sets and fluid for resuscitation, air viva, bandages and dressings, etc.).

6.7.3 In addition, it is recommended that all sports facilities and NSAs have one or more well-maintained AEDs that are easily accessible to users. Sports facilities should store AEDs in a transparent cabinet that is highly visible / prominent and accessible, with signages to the nearest AED. An alarm system with indicator lights will alert the public when the AED is removed. All facilities where exercise, training, and competition take place should have public access defibrillators[6] (PADs). The absolute number of AEDs/PADs in each facility is dependent on the layout and size of the facility, with the goal being to ensure that the response time (i.e. from the time of cardiac arrest to defibrillation) is three minutes or less. AEDs / PADs can be located through the Singapore Registry for AED Integration, jointly launched by the Singapore Civil Defence Force and the Singapore Heart Foundation in 2014.

6.7.4 NSAs that require additional mobile AEDs for event medical coverage may loan units from Sport Singapore.

6.7.5 Evacuation and safety vehicles need to be designed to perform their intended tasks adequately, e.g. safety / rescue boats should facilitate transfer of the casualty in and out of the boat, have adequate area to carry out resuscitation, be appropriately equipped and manned, and competently driven (to minimize the risk of propeller injuries to the victim.

6.8 Communication and Coordination

6.8.1 All key event management and event medical personnel should have a clear communications plan on:

- First aid station locations
- Signages
- Ingress and egress routes for evacuation vehicles
- Types of vehicles to be used: bikes, ambulances
- Medicare protocols and procedures
- Inclement weather and haze: to follow guidelines issued by National Environment Agency

6.8.2 To provide timely lifesaving first aid to a participant or spectator, there should be clear communication on the following procedures:

- Identification of victim
- Call for help
- Dispatch of medical team
- Transportation of medical team and equipment to victim or vice versa
- Level of on scene care

6.9 Mass-participation Amateur Sports and Events

[6] Automatic external defibrillators (AEDs) are used to analyze cardiac rhythms and, if appropriate, advise/deliver an electric counter shock to help establish a normal cardiac rhythm. AEDs are widely used by trained first responders. Public Access Defibrillators (PADs) serve the same function but are simpler to use, and can be used by members of the public.

6.9.1 Mass Participation Amateur Sports is growing in popularity. The most common activities are running, cycle and swimming – or any combination of the three. Carnival-style events like a one-day soccer, rugby-7s or softball tournaments can also have a large number of participants, but the risk assessment for these events are very different. For the purpose of this document, we will only address mass participation amateur sports and events involving:

a. Activities involving more than 1,000 participants. The Committee did not find any internationally defined cut-off for the number of participants before an event can be classified as a "mass participation event". However the publications we did reference were unanimous in agreeing that risk assessment increases along with the number of participants in the event. For the purpose of this guideline, the Committee arbitrarily set the cut-off at 1,000 participants, as the working definition of "mass participation sporting events".

AND

b. Running, cycling or swimming, or any combination of the three; or similar activities involving long distances and a large field of play (e.g. mass-participation wheelchair races). These activities take place along a route, and differ from sports carnivals where participants are confined to a static location or venue. The risk for these activities is usually higher and the medical support more demanding, as it is harder to reach each casualty.

6.9.2 In 2013 and 2014, there were more than 70 such events per year. This means that on average, there is more than 1 event per week taking place in Singapore.

6.9.3 As the medical coverage for these events is challenging, there have been calls from both event organizers and participants to establish a national event medical support guideline. After reviewing various published guidelines, the Committee recommends that (a) the United Kingdom Athletics' (UKA) Road Race Medical Services Good Practice Guide, and (b) the Emergency Medicine Society of South Africa's Practice Guideline (Mass Gathering Medical Resource Model) are suitable for adaptation to Singapore's context.

6.9.4 This Committee will establish a working group to draw up the medical support guidelines for mass participation amateur sports.

6.10 Post-Event Feedback and Review

6.10.1 Post-event feedback on the safety management and medical support plan is important to improving the organization of future events.

6.10.2 For events endorsed by Sport Singapore, event organizers are required to submit their post-mortem findings to Sport Singapore within two weeks of the event's completion.

6.10.3 For events endorsed by NSAs, organizers are strongly encouraged to send in their post-mortem to the respective NSAs.

6.10.4 The [Post-Event Feedback and Review Form] is available on the Sport Singapore website.

7. SURVEILLANCE, EVALUATION AND FOLLOW UP

Key Messages:

- Injury surveillance is integral to improving sports safety.
- NSAs and event organizers should conduct injury surveillance and perform debriefings after events

New Insights:

- A central repository to capture data for sudden deaths and serious adverse events will contribute significantly to sports safety practices.

To continually improve on sports safety, it is important that NSAs, event organisers and other relevant stakeholders have a clear system for incident reporting, evaluation, and follow up. Injuries and other adverse incident statistics should be clearly documented and evaluated.

7.1 Current Practices

7.1.1. Injury surveillance is not commonly practiced in Singapore sports, even for the most popular sports. There is no data available for the incidence of a certain adverse event in a particular type of sport (e.g. what is the incidence of anterior cruciate ligament (ACL) tears among soccer players in Singapore, and what are the factors associated with such injuries?).

7.1.2. For sports events, the situation is slightly better. Injury records are kept for major events such as the Army Half Marathon, the Singapore Marathon and Singapore International Triathlon. For the Singapore Marathon, organizers felt that the rate of heat injuries in the 2005 edition, at 1 in 525 participants, was unacceptably high and decided to increase the number of water points. This led to a drop in the rate of heat injuries to one in 1,148 participants in 2006 and with steady improvements to one in 1,896 participants in 2010.

7.2 Recommendations

7.2.1 It is recommended that Sport Singapore re-look into the possibility of setting up a central repository to capture data for sudden deaths and serious adverse events. This would allow more accurate situational analyses with subsequent improvements to safety systems. Event organizers and NSAs should cooperate with Sport Singapore by providing relevant data to Sport Singapore.

7.2.2 A minimum data set should be defined (e.g. including name / ID / age / cause of death or adverse event / circumstance or event leading up to death) and stakeholders / organisations should be encouraged to incorporate this data set into their own reporting format. This is to allow easier compilation of standardised data. It is also recommended that SSC apply measures to encourage transfer of these data to the central repository from individual stakeholder databases.

7.2.3 It is the responsibility of NSAs, stakeholders and event organizers to compile data (using their own reporting system/protocol, but also including the minimum data set) on participants with medical problems detected either during screening or sports events. They should document the follow up plan, and allow the above data to be easily accessible by relevant parties (e.g. medical personnel) while protecting medical confidentiality. The compilation and evaluation of such data in each sport will allow for more accurate risk stratification and will also provide information on the adequacy of event safety plans.

7.2.4 Each NSA is encouraged to conduct its own injury surveillance among its athletes. This allows comparisons with international benchmarks and systematic improvement of sports safety. For example, if the rate of impact injuries in soccer players sees a seasonal trend and is associated with dry weather (and hence hard pitches), interventions (e.g. watering the field an hour before practice) can then be confidently applied to reduce unnecessary injuries.

7.2.5 Pertaining to points 8.2.2 to 8.2.4 above, each NSA should establish its own sport-specific medical committee to facilitate the above recommendations, including periodically reviewing data collected on exercise-related injuries / adverse events, and also managing the data. It is suggested that all NSAs should submit sports related injury information to SSC on an annual basis. For a start, the information could be quite basic with minimal data requirements and the information could be refined / increased as the process matures).

7.2.6 NSAs and event organisers should conduct debriefings and post-mortems of sports events. They should allow for sharing of essential points amongst organisations, and invite for feedback from members of the public and participants. Improvements made can be publicised (via NSA / event websites etc.) to raise public awareness.

7.2.7 Surveillance and evaluation systems need to contain a follow-up and tracking element so as to prevent incidents of similar nature in the future.

7.2.8 It is recommended that a sports safety structure be put in place to link Sport Singapore and the NSAs in order to implement the above recommendations. With this structure, safety directives (best practices and minimum standards, haze advisories, etc.) can be effectively brought across to all NSAs with consistency. Such a structure will also serve the platform for promoting sports safety in Singapore.

7.2.9 It is also recommended that dedicated inspectorates be set up as part of the implementation process, providing the following functions:

a. To verify compliance to rules and guidelines
b. To function as a consultant for the safe conduct of activities, to spread best practices, and to promote general awareness of sports safety

8 CONCLUDING REMARKS

The sports safety framework should be viewed and treated in its entirety, and encompass the spectrum from recreational to professional athletes, healthy individuals to clinical populations, training sessions to competitions, open fields to sophisticated rehabilitation centres.

The task of this Committee was to systematically review and enhance the recommendations in its 2007 report. Although there is inadequate evidence to demonstrate an increasing incidence of sudden death and other adverse events, and although certain sectors were found to be exemplary in their safety practices, there are a number of deficiencies in the system that needs to be addressed. Some are easy to rectify while others will require time, commitment, and perseverance.

The Committee recognizes that resources are limited and many organizations are already heavily taxed. However, human life must take precedence over all other considerations. All stakeholders will need to collaborate and be resourceful in overcoming the constraints to making sports participation safer. In its efforts to improve sports safety, all stakeholders will also have to be mindful not to add barriers to sports participation and sports excellence. Some interventions will require funding, but many don't. Education and individual responsibility should always be emphasized.

The implementation of the Committee's recommendations will be a challenge, as mind-sets are never easy to change and funds are not always easy to find. Successful implementation starts with ownership and strong leadership. These recommendations and guidelines should continue to be reviewed at regular intervals, as the profile of sports participants evolve, as better surveillance data become available, and as advances in medical technology allow tests that have better positive and negative predictive values.

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APPENDICES

APPENDIX 1: TERMS OF REFERENCE

Sports Safety Committee 2007
The terms of reference for the Committee are:

1. To review the adequacy of safety measures including medical support currently adopted by NSAs and other partners and stakeholders in the sporting fraternity.

2. To propose a holistic safety framework from pre to post event. This would encompass:

    - People (injury prevention, recognising symptoms, training and rescue skills etc applicable to participants, staff, officials, spectators, contractors, first responders in event of injuries/ emergencies);

    - Systems, Procedures, Processes (training, risk assessment, incident management, standard operating procedures and guidelines applicable to different weather and other conditions);

    - Equipment (safety and rescue equipment, personal protective equipment).

3. To propose supportive environments and critical success factors for implementation of safety plans.

Sports Safety Committee 2014
The terms of reference for the Committee are:

1. To review the adequacy of safety measures and guidelines in the 2007 report and make recommendations for enhancement;

2. To evaluate any best practices and guidelines evolving from recent evidence-based research in the conduct of sports and make recommendations for sustained improvement of safety in sports and;

3. To propose a holistic safety framework for Singaporeans to continue to excel in and enjoy participating in sports, that would typically encompass:

    a. People (injury prevention, recognizing symptoms, training and rescue skills etc applicable to participants, staff, officials, spectators, contractors, first responders in event of injuries/emergencies);

    b. Systems, Procedures, Processes (training, risk assessment, incident mgt, standard operating procedures and guidelines applicable to different weather and other conditions);

    c. Equipment (safety & rescue equipment, personal protective equipment).

APPENDIX 2: SPOPRTS SAFETY COMMITTEE MEMBERS 2007

Chairperson

Dr Benedict Tan
Head and Senior Consultant Sports Physician,
Changi Sports Medicine Centre,
Changi General Hospital

Members

1. Prof Venkataraman Anantharaman
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   Department of Emergency Medicine,
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2. Mr Ang Wee Hiong
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   Chairman, Singapore Schools Sports Council

3. Dr Terrance Chua Siang Jin
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4. Ms Delphine Fong
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5. Mr Paul Fong
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8. Mr Yazed Osman
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   Singapore Sports Council

9. BG Bernard Tan
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   Singapore Armed Forces

10. Major Bob Tan
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    Singapore Civil Defence Force

11. Mr Tian Mong Chin
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12. Mr Samuel H Tso
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    DuPont Co Singapore Pte Ltd

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APPENDIX 4: MOE RISK ASSESSMENT AND MANAGEMENT SYSTEM (RAMS) GUIDELINES

INTRODUCTION

1 Risk Assessment provides teachers and principals a useful tool to assess potential risks in an activity and encourages schools to think of less risky alternatives. The most important point about effective risk management is that risks are actually evaluated prior to each activity so that deliberate management decisions can be taken to reduce risks to a minimum to ensure safety of participants.

2 The Risk Assessment Management System (RAMS) will commit schools to systematically identify possible hazards in an activity and take measures to control the risks in all phases of the activity.

3 The procedure for carrying out risk assessment in schools is :-
a) simple to operate;
b) of practical relevance to the process of ensuring safety;
c) to help in identifying how and why activities should be run in a certain way.

SCOPE

4 There is no necessity to apply RAMS to every single activity and schools will use their discretion as to its application. However, schools will be expected to apply RAMS for outdoor adventure activities and activities that need close supervision e.g. mass events.

ADMINISTRATION

5 The process of risk assessment of an activity will be administered by the teacher-in-charge. This should be done in consultation with the Principal, Vice Principal, HOD and/or other relevant members of the school staff. Other teachers involved in the activity will assist in monitoring and verifying that the control measures are appropriate.

PROCEDURES AND MANAGEMENT

6 The procedures and management of RAMS are to be implemented in concurrence with the existing guidelines on "Procedures and Safety in the Conduct of Outdoor Activities". A 5-step management process is adopted. They are :-

a) Hazards Identification
b) Risk Assessment
c) Risk Control Options and Decisions
d) Implementation of Control Measures
e) Effective Supervision

6.1 Step I : Identification of Hazards

The major elements in an activity must be examined for hazards, which are potential sources of danger. To be able to assess or

control the risk, an accurate assessment of hazards is important. The hazards may be from the surroundings or from within the group of participants. Teachers-in-charge must be vigilant during an activity as hazards not identified earlier may emerge.

Example : In the middle of a hike around MacRitchie reservoir, a group of TAF Club pupils had their path completely blocked off by a huge fallen tree. The way through is either to climb over the slippery tree trunk or go around it from the side. Going around the tree trunk will have the pupils wading in knee-deep water. Hazards not identified earlier have emerged. As such, teachers will have to remain constantly vigilant for any hazard signs, assess the situation and remove or minimise the risk.

6.2 Step 2 : Risk Assessment

The objective of Risk Assessment is to assess the level of risk and determine the potential impact of a hazard on an activity. It is to be noted that a dangerous situation will occur when both the human and environmental elements are at their highest risk levels. Hence, it is imperative that the teacher-in-charge is able to recognise the potential danger in any situation. This is best accomplished by the "What if"" question.

Example : In the scenario given in the example above, the teacher would first need to assess whether there is any imminent danger posed to his pupils, plan his alternatives and assess the risk involved. To do that, he should consider the fitness level and ability of his pupils and also his ability to provide assistance should any of his pupils face difficulty.

6.3 Step 3 : Risk Control Options and Decisions

The third step is to identify as many ways as possible to control the risks then select the most appropriate ones. The teacher-in-charge is responsible for finding the proper balance between risk control and risk taking; to eliminate or reduce the risk. If the hazard cannot be eliminated, the next best option is to control it. The teacher-in-charge should :-

a) determine whether the total level of risk is acceptable;
b) accept risks only when the benefits outweigh the costs;
c) proceed with the activity only if he concludes that the risk is acceptable.

If the overall risk is found to be unacceptable and the teacher-in-charge is unprepared to accept the risk, then the activity should not be carried out.

6.4 Step 4 : Implementation of Control Measures

The fourth step is the key activity for Risk Management. The teacher-in-charge should choose one or more appropriate control measures from among the possible control measures evaluated in Step 3 and implement the chosen control measure. The teacher may need to integrate specific control measures into operation plans, standard operation

procedures, or processes and procedures.

6.5 Step 5 : Effective Supervision

The final step for Risk Management is "Effective Supervision", which will ensure the effectiveness of risk controls. The teacher-in-charge is responsible for enforcing the control measures and will have to be vigilant at all times. School principals must monitor, follow-up, verify, and modify as appropriate the control measure which the teacher has imposed.

APPENDIX 5: 5-A WAY TO SPORTS SAFETY

THE 5A-WAY TO SAFE SPORTS

N. Krishnamurthy
Safety Consultant and Trainer, Singapore

The *"5A-Way to Safety"* formulated by the author, based on certain time-honoured principles of personal and professional management, consists of five steps of the mental process which can lead to individuals and organisations to translate a vision into action.

In coming up with this 5A-Way, the author stands on the shoulders of many all-time greats: such as Socrates, Confucius, and Gandhi. So there may be very little that is new in terms of basic ideas or goals – it is offered only as a fresh, somewhat different, sequence of thought processes in a logical sequence towards the desirable goal of promoting safety culture in Singapore.

In what follows, the technique is applied specifically to sports safety:

1. Attitude:

Make sports safety a core value, a shared concern.

2. Awareness:

Learn what can cause harm, to whom, when, and how.

3. Acceptance:

Take complete ownership of safety of athletes at all times.

4. Analysis:

Identify hazards, assess risks, and develop effective controls.

5. Action:

Enable all concerned to implement all safety measures.

1. Principles of the 5A-Way

Themes of the 5A-Way are presented in Fig. 1 – graphics a collaboration between the author and the Ministry of Manpower.

(A-1) *Attitude is believing in it.*

- It is the beginning, the foundation for all we want to do.
- In sports safety, it means that we want every one of the athletes who comes in for training or for competition, to return home safe and sound.
- It means that we wish to share information and knowledge about incidents and

accidents with all our cohorts.

- And so we can proudly tell ourselves, and tell others: *"I accept sports safety as a core value!"*

(A-2) ***Awareness is knowing what is involved.***

- Knowing what is going on around us in the relevant activities.
- In sports safety, it means we must learn what can cause harm, to whom, with what impact.
- It means that we must sense and understand the potential dangers, identify all of them, so that we can eliminate or control them.
- To save the athletes from injury or death, to save their family and friends from heartache, and our national reputation from damage.

(A-3) ***Acceptance is taking responsibility for it.***

- Being pro-active, taking initiative, leading the way.
- In sports safety, it means being accountable for the welfare and safety of all the athletes.
- It means treating all or them and all others involved in the activity as partners.
- It means making risk management part of our mission and our vision ... not only by words but also with funds and personnel to achieve our goals.

(A-4) ***Analysis is planning what to do.***

- Applying the right principles, using the right tools.
- In sports safety, it means identifying the hazards, estimating if and when accidents may happen, evaluating how bad they may be if they do, and their combined risk level.
- It means that we decide which risks are acceptable, which are unacceptable, and which are tolerable and can be managed.
- And then what and how to control, and also who and when.

(A-5) ***Action is going ahead and doing it!***

- Translating our hopes and plans to reality.
- In sports safety, it means getting all the athletes and sports officials to participate.
- It means documenting background and facts, implementing our decisions, ... getting on with the actions for safety, with safety in our actions.
- Communicating with all concerned, reviewing progress, continuing to advocate and promote safety first ... and safety last.

2. Applications to triathlon

Triathlon managers may view RA and RM by the 5A-Way as in Table 1:

Table 1. The 5A-Way in risk management of triathlons

A1. Attitude	Athletes are our family during training and on the field. Ensuring their safety is to both their and our benefit.
A2. Awareness	Risk assessment is now a pre-requisite to sports safety. Triathlon is a high-risk sport.
A3. Acceptance	We accept the extra responsibility for triathlon safety, as well as the commitment to enabling and enforcing it.
A4. Analysis	We will have a risk assessment of triathlon done to determine and rank the hazards, and find necessary controls.
A5. Action	We shall implement all recommendations of RA team, consistent with our goals. We will empower all concerned.

3. Conclusion

The 5A-Way proposed here may not be a brand-new sophisticated technique or a panacea for all our ills. But the author hopes that it will be one more route – a fresh trick if you will – to pro-actively understand and solve a safety problem right from the concept stage to completion.

4. Reference

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APPENDIX 6: PAR-Q QUESTIONNAIRE

Physical Activity Readiness Questionnaire - PAR-Q (revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO	
☐	☐	**1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	**2. Do you feel pain in your chest when you do physical activity?**
☐	☐	**3. In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	**4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	**5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	**6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	**7. Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____ DATE _____

SIGNATURE OF PARENT or GUARDIAN (for participants under the age of majority) _____ WITNESS _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

Supported by: Health Canada Santé Canada

continued on other side...

APPENDIX 7: THE SUDDEN ARRHYTHMIA DEATH SYNDROME FOUNDATION QUESTIONNAIRE

	Yes	No
Has your child fainted or passed out *during* exercise, emotion or startle?		
Has your child fainted or passed out *after* exercise?		
Has your child had extreme fatigue associated with exercise (different from other children)?		
Has your child ever had unusual or extreme shortness of breathe during exercise?		
Has your child ever had discomfort, pain or pressure in his chest during exercise?		
Has your child ever been diagnosed with an unexplained seizure disorder?		
Are there any family members who had an unexpected, unexplained death before the age of 50 (including SIDS, car accident, drowning)?		
Are there any family members who died of heart problems before the age of 50?		
Are there any family members who have unexplained fainting or seizures?		

APPENDIX 8: EXAMPLES OF CPR / AED/ 1st-AID COURSE PROVIDERS
List updated as at 18 May 2015

ACCREDITED CARDIO-PULMONARY RESUSCITATION (CPR) AND AUTOMATED EXTERNAL DEFRIBILLATOR (AED) TRAINING CENTRES

S/N	Institution/Organisation	Contact No.
1	Academic Centre & Clinic Pte Ltd	67474101
2	Alice Lee Institute of Advanced Nursing	63266239
3	Life Saving Training Centre	6758 5504 / 6759 1806
4	National Heart Centre of Singapore Pte Ltd	6704 2151/ 6704 2152
5	Primary Care Academy	6496 6682
6	Raffles Medical Group Ltd	6311 1371
7	Singapore Heart Foundation	6354 9331
8	Singapore Ambulance Service & Training Pte Ltd	6694 0110 / 6694 6644
9	Singapore General Hospital	6326 6885
10	Singapore First Aid Training Centre	6297 8123
11	Singapore Red Cross Society	6336 0269

ACCREDITED BASIC CARDIAC LIFE SUPPORT (BCLS) TRAINING CENTRES

S/N	Institution/Organisation	Contact No.
1	Academic Centre & Clinic Pte Ltd	6747 4101
2	Alexandra Hospital, Jurong Health Services Pte Ltd	63794071
3	Alice Lee Institute of Advanced Nursing	6326 6239
4	Changi General Hospital	6850 2360 / 2359
5	Emergencies First Aid & Rescue	6536 5231
6	Institute of Mental Health/Woodbridge Hospital	6389 2887
7	ITE College East	6544 9204
8	KK Women's & Children's Hospital	6394 2443
9	Khoo Teck Puat Hospital	6379 3860 / 6602 4641
10	Mount Alvernia Hospital	6347 6305
11	MHI Training Master	6440 8422
12	National Heart Centre of Singapore Pte Ltd	6704 2151 / 6704 2152
13	National University Health System	6772 5067
14	Ngee Ann Polytechnic	6460 7372 / 5
15	Primary Care Academy	6496 6682
16	Raffles Medical Group Ltd	6311 1371
17	Singapore Ambulance Service & Training Pte Ltd	6694 0110 / 6694 6644

18	Singapore Caregiving Academy	62591877
19	Singapore Emergency Responder Academy	6866 0663
20	Singapore General Hospital	6326 6884
21	Singapore First Aid Training Centre	6297 8123
22	Singapore Medical Association	6223 1264
23	Singapore Red Cross Society	6336 0269
24	Thomson Medical Centre	69338255

NB: The National Resuscitation Council is the national accreditation body for all cardiac life support training centres in Singapore. It was established in 1998 where it was given the mandate from Ministry of Health to certify and accredit Life Support training centres and to formulate a uniform approach and programme for resuscitation training.

ACCREDITED OCCUPATIONAL FIRST-AID TRAINING CENTRES

S/N	Institution/Organisation	Contact No.
1	AcademiClinic Pte Ltd Kembangan Plaza 18 Jalan Masjid #02-04	6744 9231
2	Emergencies First Aid & Rescue Pte Ltd IMM Building 2 Jurong East St 21, #04-32D Singapore 609601	6560 6060
3	ER Ambulance & Services Pte Ltd Blk 1093 Lower Delta Road #05-01 Singapore 169204	6377 1653
4	Life Saving Training Centre Blk 102 Yishun Ave 5 #02-113 Singapore 760102	6758 5504
5	NTUC LearningHub Pte Ltd TradeHub 21 18 Boon Lay Way, #04-121 Singapore 609966	6471 2223
6	Singapore First Aid Training Centre 142 Neil Road Singapore 088871	6297 8123
7	Singapore Red Cross Society 15 Penang Lane Singapore 238486	6336 0269
8	St John Ambulance Singapore 420 Beach Road and Blk 209 Jurong East St 21 #01-357	6298 0300 6566 1903/1909
9	ST Medical Services Pte Ltd 13B Teo Hong Road Singapore 088327	6327 9710

APPENDIX 9: WISCONSIN AFFILIATE OF THE AMERICAN HEART ASSOCIATION QUESTIONNAIRE (AHA/ACSM HEALTH/FITNESS FACILITY PRE-PARTICIPATION SCREENING QUESTIONNAIRE)

Assess your health needs by marking all *true* statements.

History

You have had:

-- a heart attack

-- heart surgery

-- cardiac catheterization

-- coronary angioplasty (PTCA)

-- pacemaker/implantable cardiac defibrillator/rhythm disturbance

-- heart valve disease

-- heart failure

-- heart transplantation

-- congenital heart disease

Symptoms

-- You experience chest discomfort with exertion.

-- You experience unreasonable breathlessness.

-- You experience dizziness, fainting, blackouts.

-- You take heart medications.

Cardiovascular risk factors

-- You are a man older than 45 years.

-- You are a woman older than 55 years or you have had a hysterectomy or you are postmenopausal.

-- You smoke.

-- Your blood pressure is greater than 140/90.

-- You don't know your blood pressure.

-- You take blood pressure medication.

-- Your blood cholesterol level is >240 mg/dL.

-- You don't know your cholesterol level.

-- You have a close blood relative who had a heart attack before age 55 (father or brother) or age 65 (mother or sister).

-- You are diabetic or take medicine to

*If you marked any of the statements in this section, consult your healthcare provider before engaging in exercise. You may need to use a facility with a **medically qualified staff.***

Other health issues:

-- You have musculoskeletal problems.

-- You have concerns about the safety of exercise.

-- You take prescription medication(s).

-- You are pregnant.

*If you marked two or more of the statements in this section, you should consult your healthcare provider before engaging in exercise. You might benefit by using a facility with a **professionally qualified exercise staff** to guide your exercise program.*

control your blood sugar. -- You are physically inactive (i.e., you get less than 30 minutes of physical activity on at least 3 days per week). -- You are more than 20 pounds overweight.	
-- None of the above is true.	*You should be able to exercise safely without consulting your healthcare provider in almost any facility that meets your exercise program needs.*

APPENDIX 10: SINGAPORE INTERNATIONAL TRIATHLON 2007 MSP

Triathlon Medical Support Plan

MEDICAL SUPPORT PLAN – TRIATHLON

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Triathlon Medical Support Plan

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Triathlon Medical Support Plan

1. INTRODUCTION

1.1 Event description

The triathlon is an endurance event comprising 3 disciplines competed in the following consecutive sequence – swimming, cycling and running. The Olympic distance event comprises a 1.5km swim, followed by a 40km bike and 10km run.

1.2 Field of play

The swim phase usually takes place in a body of open water, and the common layouts include a triangle, L or I-shaped course. After exiting the swim, participants proceed to Transition Area, whereby they begin the bike phase. Depending on the geographical terrain, this phase may involve several laps of the same circuit. Cyclists will then dismount and begin their run at the Transition Area.

2. EPIDEMIOLOGY

This is dependent on the multidisciplinary nature of the event, its duration, climate characteristics, the characteristics of the participating population, as well as the relatively high velocities during the bike phase.

2.1 Climate

Singapore is located one degree north of the equator, with a mean daily temperature of approximately 30 degrees Celsius and mean humidity, 75 per cent. Rainfall is slightly higher during the monsoon season, with a monthly average of 260 millimetres and 170 millimetres during the North-East and South-West monsoon respectively.

2.2 Type of casualties

Anticipated casualties include:

a. Abrasions
b. Lacerations
c. Contusions
d. Cramps
e. Exhaustion with nausea/vomiting
f. Fractures/dislocations
g. dehydration
h. Heat related illness
i. Cardiac events
j. Cerebrovascular events
k. Drowning
l. High velocity blunt chest/abdominal/pelvic trauma
m. Penetrating trauma

Triathlon Medical Support Plan

3. MEDICAL MANAGEMENT

3.1 Objectives

The medical support plan should provide a reasonable standard of pre-hospital care to participants. It must achieve the following:

Pre-hospital care of participants, including

- 3.1.1 rapid access to , and triage of casualties
- 3.1.2 resuscitation and stabilisation of life-threatening conditions (Triage category P1)
- 3.1.3 stabilisation and management of Triage category P2 casualties
- 3.1.4 management of minor injuries/conditions on site (Triage category P3)
- 3.1.5 Transport of P1 and P2 patients to hospital for further care

3.2 Components

The medical support plan involves both mobile and stationary elements, both land and water based. These are coordinated via the Operations Centre (Ops Centre), which should be manned by the Event Safety Officer, Chief Medical Officer, Ambulance Coordinator and their assistants. The Ops Centre must have direct and immediate communication channels with the race marshals, section leaders and race director. All medical personnel should be attired such that they are readily identifiable to the race officials, participants, as well as members of the public.

The roles of the various elements of the medical support plan:

3.2.1 Event Medical Director (EMD)

Responsible for formulating the support plan and liason with event organisers. The EMD is responsible for the overall medical operations of the venue, and should preferably have experience in major sport/endurance events.

3.2.2 Event Medical Operations Manager

Assist the Medical Director with the medical support plan and its execution.

3.2.3 Medical Spotters

Responsible for reporting any incident to the Event Safety Officer and for providing immediate help to the casualty. They will not be in the Field of Play, but will have immediate access to it in the event of an emergency. In the swim course, they may be stationed on suitable watercraft such as safety boats, jet skis and canoes.

3.2.4 First-Aiders

Provide basic care for Triage category P3 conditions such as abrasions, contusions and cramps. They should be equipped with first-aid kits to enable them to fulfil their role. They should also be trained in cardiopulmonary resuscitation (CPR).

Triathlon Medical Support Plan

3.2.5 Mobile Paramedics
These are the first responders and should be equipped and trained in the use of Automated External Defribillators (AEDs). They will be activated by the Medical Director/Event Safety Officer to respond to incidents along the course.

3.2.6 Medical Stations
Provide pre-hospital care including treatment of minor injuries, stabilisation and resuscitation. These should be suitably equipped and staffed by trained medical personnel, including nurses and doctors. The layout should also take into consideration accessibility, evacuation routes and the privacy of the casualty.

3.2.7 Ambulance Services
Provide transport of casualties, both to the medical posts (for non-ambulatory participants) and to the hospital if necessary. These should be suitably equipped so that resuscitation and monitoring will not be interrupted during the evacuation process. They should also be strategically placed to enable ready access to the casualty and evacuation routes.

4. EXECUTION
The various elements of the medical support plan should be strategically deployed such that personnel trained in CPR and AED use is able to reach a casualty and commence treatment within 3 minutes. Ambulance access and evacuation routes must be planned from the race site, run and bike courses. Deployment will depend on:

a. Course layout
b. Geographical characteristics
c. Transport infrastructure
d. Number of participants

4.1 Race medical management
The main principles:
a. Split the course into sectors in order to have the same communication code between the medical, safety and operations personnel
b. Attempts should be made to move casualties to one side of the course, unless the casualty is in a condition where movement by anyone will worsen their condition (eg. suspected spinal injuries – if in doubt, do not transport – request Ambulance assistance).
c. Streamline communication channels to minimise time lost between witness of an incident and its notification along the chain of command to the Ops Centre. The medical spotter/race marshal reports any incident directly to the Operations centre (manned by the Event Safety Officer and Medical Officer). The Operations centre despatches a paramedic/ambulance/doctor if necessary. When reporting an incident, the following procedure may be followed:

i. Situation
ii. Backgroun
iii. Assessment
iv. Request

All personnel must be familiar with the protocol.

d. After assessment and initial treatment/stabilisation, the paramedic/doctor will report the situation to the Operations Centre. The Ops Centre decides if an ambulance is required to transport the casualty for further treatment, either at the medical post or directly to the hospital.

e. To minimise accidents between safety vehicles and participants/members of the public, all ambulances/motorbikes should navigate with due caution while within the race route. Sirens and vehicle hazard lights should be used, and the route marshals informed prior to any impending vehicular movement. Temporary closure of a race segment may also be necessary.

4.2 Demobilisation

All medical posts and elements should remain open until directed to close down by the Safety/Medical Director or Control Centre. .Posts along the course will be progressively closed down as the Safety/Medical Director is advised of the status of the race.

4.3 Documentation

All casualties treated are to be recorded in the medical log. The information should include identification, diagnosis, condition and management given. The event organiser will receive copies of the medical log after the event.

5. MEDICAL SUPPLIES

a. Airway management
b. Medications for acute cardiac care
c. Medications for management of expected P3 conditions
d. Trauma supplies
e. Basic diagnostic equipment
f. Ice
g. Fluids
h. Blankets/towels
i. Universal precautions supplies
j. stationery

6. COMMUNICATION CHANNELS

6.1 Radio talk groups

The event communications manager shall create radio talk groups to enable the various elements to remain contactable at all times. Both a primary as

well as back-up communication channel must be present. These include the use of radios, walkie-talkies and cell phones.

6.2 Request for information
Should members of the public approach any medical staff for information, they should refer such requests to the event organisers. Any media inquiries are to be referred to the Media Centre.

7. MASS CASUALTY INCIDENT
In the event of a mass casualty incident, the medical elements on site will be the first responders. Reinforcements from the Emergency Services (i.e. Singapore Civil Defence Force, Singapore Police Force) will also be activated by the Operations Centre. The Race Director/Emergency Council are to convene and determine next course of action, which may include halting of the entire race due to the severity of the incident.

8. HEALTH AND SAFETY PRECAUTIONS
Health and Safety procedures are to be followed during the event, including universal procedures for infection control.

Medical personnel are to:

- Take responsible care for the health and safety of themselves and others;
- Cooperate with Safety/Medical Director and other members in their effort to ensure the health and safety of participants and the general public;
- Not interfere with anything provided in the interests of health and safety;
- Not obstruct attempts to prevent a serious risk to health and safety;
- Not refuse a reasonable request to assist in giving aid or preventing a serious risk to the health or safety of a person; and
- Not deliberately create a risk (or the appearance of risk) to the health or safety of other members or the general public.