

Final report

OVERVIEW AND RECOMMENDATIONS FOR SPORTS SAFETY IN SINGAPORE

A Report by the Sports Safety Committee

21 August 2007

Document Review

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EXECUTIVE SUMMARY

Sports safety is an integral part of the sporting culture and industry. It encompasses individual and group behaviours, as well as infrastructure. It is the responsibility of the individual as well as the sports organizations.

The Sports Safety Committee reviewed the sports safety framework in Singapore, during training, competition, and other organized physical activities. Specifically, the following elements of the sports safety framework were reviewed:

- Pre-participation screening
- Training and education
- Exercise and training facilities
- Event medical coverage
- Surveillance, evaluation and follow up

The findings are broadly summarized as follows:

- Both abroad and in Singapore, the incidence of sudden death and serious adverse events during sports is generally low. It is not possible to analyse trends in Singapore due to the small numbers.
- There is strong evidence that regular exercise is beneficial. Although exercise does bring with it some transient risks, the benefits outweigh the risks on the whole.
- One observational study from Italy has shown that 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 not well enforced in some at-risk groups.
- The awareness of sports injuries and causes of sudden death is not high, and training in skills known to reduce the incidence of adverse events, such as first-aid, cardiopulmonary resuscitation, and automated external defibrillator (AED) use, is not systematically conducted in certain groups of individuals that are likely to be first responders in emergency situations during sports and training.
- AEDs have been shown to be effective in resuscitation, especially if used early. Many facilities where Singaporeans participate in moderate to vigorous activities do not have AEDs.
- 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 tend to be lacking.

To address existing gaps in our sports safety framework, the Committee has made specific recommendations in various areas. The main recommendations are:

- 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 a selected at-risk population. 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 strictly enforced in the at-risk populations.
- 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 (i.e. category A) 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 should have their own sport-specific medical committees 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.

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. BACKGROUND

The National Survey on Sports Participation showed that the number of Singaporeans who exercised regularly at least once a week doubled from 24% in 1992 to 48% in 2005, while those who exercised at least three times a week more than tripled from 8% to 25% in the same period. Participation rates at mass events like the Singapore Marathon and Singapore International Triathlon have also seen exponential increases in recent years. The rapid rise in participation rates mean that we have a relatively large proportion of novices and inexperienced athletes participating in sports events. Not only is the base of the exercising population increasing, but so too is the level of competition, with athletes pushing themselves harder.

As more people participate in sports and exercise, the absolute number of injuries and sudden unexpected death can be expected to rise as well. This necessitates comprehensive sports safety practices in order to manage the risks of sports participation and exercise.

The Sports Safety Committee was appointed by the Ministry of Community Development, Youth and Sports (MCYS) to review sports safety practices in Singapore and make recommendations to minimize the incidence and consequences of catastrophic injuries and sudden unexpected death during sports participation, be it during training or competition [see appendix 1, Terms of Reference, and appendix 2, Sports Safety Committee Members]. The Committee sought information and comments from an extensive resource panel that represented various experts and stakeholders [see appendix 3, Resource Panel].

In formulating this report, the Committee took the following steps:

1. Data on sudden deaths and serious adverse events during sports and exercise that were available from various agencies were sought and compared against published data from overseas, in an attempt to understand the true incidence and pattern of such occurrences in Singapore.
2. The medical guidelines used by the National Sports Associations (NSAs), sports clubs, sports facilities, gyms and exercise facilities were also reviewed, and compared against international guidelines and norms, where possible.
3. Published research was reviewed and expert opinions were sought on pertinent issues.
4. The Committee then identified gaps in Singapore's sports safety framework and made recommendations on plugging the gaps.
5. Various stakeholders and experts were consulted on the feasibility of the recommendations. The comments and feedback were then considered and final amendments were made to the report.

The Committee's recommendations are based on the available evidence, and if this was not available, it was based on expert opinion. In making its recommendations, the Committee also considered the individual's rights and needs, practicalities, and resources

available, with the aim of striking a balance between opposing demands. *The Committee places great emphasis on safety and human life* and understands that resources may sometimes be a constraint. Where possible, recommendations were made to work around such limitations.

The recommendations are aimed at enhancing safe participation in sports – they are not intended, nor are should they be used, as a barrier to sports participation and sports excellence.

The scope of sports safety covers major areas of sports events ranging from pre-event, through the event itself, to post-event. It encompasses people, software (systems, procedures, processes), and hardware (equipment, environment, facilities). For the purpose of discussion, the Committee artificially divided the scope of sports safety into five broad areas:

1. Pre-participation screening
2. Training and education
3. Exercise and training facilities
4. Event medical coverage
5. Surveillance, evaluation and follow up

The Committee also considered water safety during the formulation of the guidelines, as water sports form a significant part of Singapore's offerings. To minimize overlap with the scope of the Water Safety Council, the Sports Safety Committee will focus on competitive water activities (i.e. prevention of drowning during training and competition).

The recommendations and guidelines are laid down in a broad, yet comprehensive manner. Though the recommendations and guidelines are not mandatory, the Committee strongly encourages that they be adhered to. It is important for NSAs, event organizers, facility operators, and other stakeholders to recognize this, and modify the guidelines as necessary to suit their own specific sport and circumstances.

At the time when these recommendations and guidelines were issued, much of the local data that the Committee required were not available owing to the lack of a systematic surveillance system. Furthermore, as medical science progresses, the sensitivity and specificity of screening tests may improve, and newer tests may become available. The Committee hopes that with better information gathering and medical advances, these guidelines can be reviewed and improved on in the future.

2. SUDDEN DEATH AND OTHER ADVERSE EVENTS IN SPORTS

2.1. Incidence of Sudden Death

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 Centre for Forensic Medicine, Health Sciences Authority reported 21 deaths that occurred during sports - nine sports-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) [29]. Thus, the 15 sports-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 sports-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 [29]).

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 [30, 33]. Table 2.1 summarizes estimates of acute cardiovascular events or sudden deaths from published data [32]:

Table 2.1. Incidence of acute cardiovascular events or sudden deaths from various publications.

Malinow et al. (1984):	1 acute cardiovascular event per 2,897,057 person-hours of physical activity at YMCA sports centres (USA)
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
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)
Siscovick et al. (1984):	1 death per year for every 18,000 previously healthy men

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 sports 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).

From 2000 to 2006, there were a total of 28 sports-related deaths at our public sports facilities, namely Singapore Sports Council's (SSC) stadia, gym, sports halls, squash courts, tennis courts, hockey pitch and swimming pools (table 2.2). Generally, the incidences are relatively low, given the high attendance rates at these facilities.

Table 2.2: Summary of sports-related deaths at public sports facilities in Singapore from 2000 - 2006.

SSC Facility	Deaths	Attendances	Incidence (death:attendances)	Remarks
Stadia	8	5,400,000	1 : 675,000	3 soccer (1 struck by lightning), 3 jogging, 1 organized sport, 1 unknown
Gyms	3	8,500,000	1 : 2,800,000	All had known heart conditions
Sports halls	3	5,600,000	1 : 1,900,000	2 had known heart conditions 1 recovering from flu
Squash courts	1	287,000	1 : 287,000	Known heart condition
Tennis courts	1	1,600,000	1 : 1,600,000	Known heart condition
Hockey pitches	1	580,000	1 : 580,000	Known heart condition
Swimming pools	11	46,500,000	1 : 4,200,000	5 had pre-existing medical conditions
All	28	68,467,000	1 : 2,445,250	

Source: Singapore Sports Council

The small number of 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 sport-related deaths occurring in public squash or tennis courts.

The incidence of sudden death in young athletes is much lower than in adults. Of 18 sports-related deaths that occurred at SSC'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 [35]. 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 [9].

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.

2.2. Causes of Sudden Death

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 viral 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.

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 [35]. 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.

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.

Of the 21 sports-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).

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.

2.3. Does Exercise Increase the Risk of Acute Cardiovascular Events?

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 [32]. 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.

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 [32]. 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.

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 [7].

2.4. Other Adverse Events

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.

Overseas data shows that the rate of heatstroke ranges from 0.08% to 24% (table 2.3). Locally, Singapore Armed Forces (SAF) data indicates that there were 96 cases of heatstroke between 1995 and 2005, out of a total of 822 heat-related injury cases.

Table 2.3: Incidence of heat stroke in athletes and sports participants.

References	Event	Incidence	Other Information
Weiss et al. 1988	1984 Olympic Games (Los Angeles)	<ul style="list-style-type: none"> • 516 cases total. • 24% of 1,373 during the main period of the games. 	
Wetterhall et al. 1998	1996 Atlanta Olympics	<ul style="list-style-type: none"> • 95 cases of HRI • 5.3% of total med. care. 	<ul style="list-style-type: none"> • It includes all heat illnesses.
Burke et al. 1997	1988 USA Youth Soccer cup.	34 heat exhaustion.	<ul style="list-style-type: none"> • The WBGT exceeded those recommended by the ACSM of 28°C.
	1931 to 1966	26 footballers died of EHS	
	1966 to 1975	50 EHS deaths in sports	
Bailes et al. 2002	1965 to 1974	44 deaths EHS	<ul style="list-style-type: none"> • All cases of American Footballers by the National Centre for Catastrophic Sports Injury Research. • All occurred during the summer pre-season conditioning and practice sessions for American Football.
	1975 to 1984	17 EHS fatalities.	
	1985 to 1994	6 EHS deaths	
	1995 to 2001	12 deaths and 3 fatalities	
Hughson et al 1980	10.3 km race on 11 Jun 1978 in Waterloo (Canada)	15 / 1250 runners (1.2%)	<ul style="list-style-type: none"> • Ambient temperature of 24.3°C and 49% RH.

Overview and Recommendations for Sports Safety – Final Report

	10 km race on 13 Aug 1978 in Toronto (Canada)	<ul style="list-style-type: none"> • 11 /1658 runners (0.7%) • Females only race. 	<ul style="list-style-type: none"> • Ambient temperature was 31.8°C and RH was 61%
Hanson et al. 1979	<ul style="list-style-type: none"> • 32 km road race in May 1978 • Marathon in June 1978. • >10km race. • 20km race. 	One case cited from each of the race.	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 200 cases of HRI out of 20,000 runners (1%). • 16 cases of heat stroke (0.08%). 	<ul style="list-style-type: none"> • Ambient temperature was 21.3°C 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%)	<ul style="list-style-type: none"> • Average of 1.8 cases per year.
Roberts. 1989	Twin Cities Marathon (1986, 1987, 1988 combined)	268	<ul style="list-style-type: none"> • Total number of runners not specified. • Average of 89 cases annually.
Armstrong et al. 1996	11.5km race	21/8000 runners (0.26%)	<ul style="list-style-type: none"> • These were treated on site.
Asrseth et al. 1986	Oslo Marathon, 1983. (Norway).	4 Cases of heat stroke evacuated to the hospital.	<ul style="list-style-type: none"> • Temperature 23°C and RH 42%. • More than 50 runners received treatment for various injuries; 4 were sent to and treated in hospital for heat stroke.
Beard et al. 1979	12 km jog in New Zealand	7/8000 runners (0.09%) were evacuated to the hospital for heat stroke.	<ul style="list-style-type: none"> • Temperature 30°C; RH 25%. • HRI that were not evacuated to hospital were not accounted for.
Lee et al. 1990	8km fun run on 27 Feb 1988 at New South Wales, Australia.	<ul style="list-style-type: none"> • A 28-year-old male case. • Axillary temperature was 42°C at the hospital. 	<ul style="list-style-type: none"> • Temperature 31°C; RH 40%. • A former athlete and had been running 4km to 7km daily for the past 5 years. • Exercised in cooler conditions than those during the race. • The race was postponed by 2.5 hours because of hot weather condition.
Savdie et al. 1991	Late March Rugby League football in Sydney Stadium.	<ul style="list-style-type: none"> • 29-year-old Rugby league football player. 	<ul style="list-style-type: none"> • Ross Fever 18 months before EHS. • Had recurrent sinusitis. Treated with oxymetazoline hydrochloride. • Had acute coryza 3 days before the game and was treated with nose drops, 8 times daily, and pseudoephedrine. • Rectal temperature was 40.7°C.
Robinson et al. 1976.	First day of football practice in the summer.	<ul style="list-style-type: none"> • 17-year-old footballer. 	<ul style="list-style-type: none"> • Temperature 34°C; RH 93%. • Among the better players in the team. • He had maintained a high degree of fitness throughout the year.

			<ul style="list-style-type: none"> • Rectal temperature was 42.2°C.
Charan et al. 1975	14.4km race in India.	<ul style="list-style-type: none"> • 34 years old elite distance runner in India. 	<ul style="list-style-type: none"> • Ambient temperature was 32.5°C. • Oral temperature was 40.3°C on admission. • Blood pressure was 130/90mmHg upon admission. • 18 hours after admission, blood pressure decreased to 70/50mmHg with reducing urine output. • Died of DIC and acute renal failure.

HRI: Heat related injuries

EHS: Exercise-induced heatstroke

Rh: relative humidity

For hyponatraemia, the incidence ranges from 0% (in New Zealand and South Africa) up to 13% (in USA). 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].

Injury surveillance data from the 2005 and 2006 Singapore Marathon (table 2.4) demonstrates a reduction of medical conditions from 2005 to 2006 despite an increase in the participation rate from 21,000 to 31,000. One participant collapsed and was responded to immediately by a fellow runner, who assisted in bringing him to the medical tent where CPR and external defibrillation was performed successfully to resuscitate him.

Table 2.4: Singapore Marathon Medical Cases Summary

	2005	2006
Total number of participants (all distances)	21,000	31,000
Medical Conditions		
Superficial injuries: abrasions/blisters/change dressing	60	63
Musculoskeletal injuries: sprains/strains/lacerations	36	36
Muscular cramps	562	329
Heat exhaustion/syncope/stroke	40	27
Nausea/vomiting	5	16
Respiratory (asthma)	3	7
Headache/migraine	13	8
Others (abdominal colic etc)	0	10
Cardiac arrest	0	1
Acute myocardial infarction	0	1
Deaths	0	0
Total	719	498

Source: Singapore Sports Council

2.5. Recommendations

- 2.5.1. 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.*
- 2.5.2. 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.
- 2.5.3. 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).

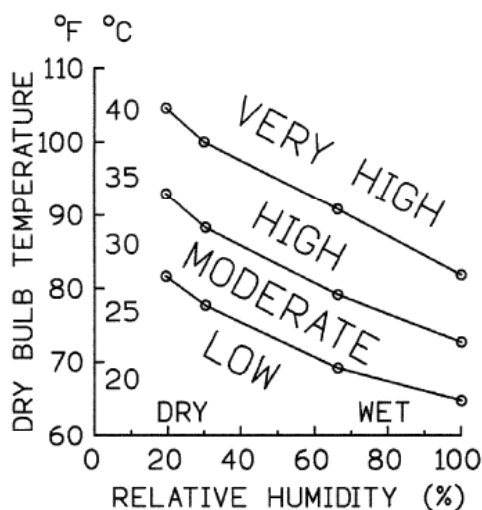


Figure 2.1: Risk of heat exhaustion or heat stroke while racing in hot environments. (Convertino et al. American College of Sports Medicine position stand: exercise and fluid replacement. Med Sci Sports Exerc 1996; 28: i–vii.)

- 2.5.4. Athletes competing in hot and humid environment (e.g. 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 heat acclimatisation programme before the actual event and minimising fluid deficit during exercise performance.
 - a. Heat acclimatisation enhances the responsiveness of the thermoregulatory mechanisms during heat stress and slows down the rate of heat storage in the body 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 > 2% of body weight (e.g., 1.2 L of water for a 60 kg person) will compromise physical performance and temperature regulation. Athletes should drink enough water during exercise to prevent a deficit of 2% of body weight. Fluid requirement for each athlete needs to be determined individually by measuring nude body weight before and after exercise during routine training sessions. Based on the equation 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 > 2% of body weight.
- 2.5.5. 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 is 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.
- 2.5.6. All athletes should be educated to recognise the early signs of heat injury and to take precautionary measures when these signs are observed,
- 2.5.7. Sport event organisers should advise athletes about the causes, danger and prevention of hyponatremia. Using the recommendations given in paragraph 4b will also help to prevent hyponatremia.

3. FUNDAMENTAL PRINCIPLES OF SPORTS SAFETY

It is essential for all sports organizations and sports events organizers to have a safety management system in place. The safety 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 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.

A sports safety culture should be inculcated in every involved member, 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.

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.

Currently, some organisations utilise risk management plans in the planning of their sports/activities. An example will be the Ministry of Defence and MOE 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]. Other examples of risk management plans include the '5A-way' [see appendix 5: 5A-way to sports safety] and the risk management plan for the Rottnest Channel Swim, an annual open water swimming event held in Western Australia [see appendix 6: Risk Management Plan for the Rottnest Channel Swim]. These risk management frameworks are by no means exhaustive or all-inclusive, and serve mainly to show the possible outlines of risk management plans.

In order to establish an "Incident-free Sports Safety Culture", sports organizations need to establish an appropriate Safety Management System with its framework addressing the following areas as minimum:

1. Management commitment on safety

2. Safety attitudes, policy and principles
3. Goals and objectives
4. Setting high standards for sustainable performance
5. Clear roles and responsibilities
6. Safety organization and structure
7. Encompass pre-event, intra-event, and post-event safety measures
8. Incident reporting, investigation, evaluation, and corrective action
9. Supportive safety personnel
10. Emergency response and planning
11. Risk assessment
12. Integrity of equipment
13. Training and development
14. Effective communication
15. Pre-event and post-event safety review
16. Change management (people, equipment, technology)
17. Regular review of the Safety Management System

Sports organizations and event organizers should establish or upgrade their safety management system to meet the above framework.

A sound safety 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 management system and effective implementation of it going hand in hand.

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

4. 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 and obtain eligibility. A nationwide screening programme has been in place 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 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. Generally, for athletes from 12 to 18 years, the pre-participation screening is funded by the Public Health Service (as a preventive medicine initiative), while those above the age of 18 pay out of their own pockets.

The programme does not cover non-competitive athletes, such as recreational gym users. However, non-competitive athletes are encouraged to undergo a history and physical

examination by their family doctor. No investigations are required, unless the doctor feels they are indicated.

4.1. Current Practices

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

1. All carded athletes (i.e. those national athletes receiving SSC grants)
2. S-League soccer players and other professional athletes
3. Students enrolling into Singapore Sports School
4. Those attending certain courses (e.g. Outward Bound School) and lifeguards prior to taking their Lifeguard Proficiency Award test
5. National Service Pre-enlistees, active national servicemen (NSMen) and Singapore Armed Forces regulars

The annual pre-participation screening that the carded athletes undergo comprise 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 Sports Medicine & Research Centre (SMRC) is shown in table 4.1. In FY 05 (a Southeast Asian Games year), 517 (30%) out of 1,705 carded athletes were screened, while in FY 06, 200 (12%) out of 1,648 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. In FY 06, two badminton players and two footballers were referred for further investigations, while none had to be referred in FY 05. None of the athletes had to be excluded from sports participation.

Table 4.1: Number of Medical Clearances done in SMRC for FY 05 and FY 06

Category	FY 05	Percent	FY 06	Percent
T.E.A.M - A1	54	9.95	43	19.5
T.E.A.M - A2	54	9.95	38	17.3
T.E.A.M - B1	156	28.7	46	20.9
T.E.A.M - B2	247	45.5	72	32.7
Foreign Sports Talent athlete (FST)	6	1.10	1	0.5
Foreign Athlete			12	5.4
NSA Athlete	26	4.8	7	3.2
National Coach – FT			1	0.5
Total	543	100	220	100

Source: Sports Medicine & Research Centre

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 test screen for HIV, hepatitis B and syphilis. A full screen is done at entry into the S-League, and an abbreviated screening is conducted annually thereafter. A few potential foreign sign-ups failed the screening process and were not allowed to play in the League.

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. Three cases were not cleared: one had Wolf Parkinson White syndrome, one had mild pulmonary stenosis, and one with Marfanoid appearance and bullae in middle and lower zones of his/her right lung.

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 Institute of Health for further screening, with subsequent referrals to the paediatric cardiologist if necessary.

All individuals serving in the SAF, whether NSF or Regulars, undergo a pre-enlistment medical screening and are additionally screened when undergoing certain courses or undertaking certain forms of training (fitness for instruction or FFI). All active serving personnel, (including NSmen) also undergo screening at milestone ages and annual screening after the age of 45. There are two screening protocols: phase I (medical examination, resting ECG, urine dipstix, fasting lipids, fasting glucose) is done at age 35, 40, 45, and annually thereafter, while phase II (medical examination, resting ECG, urine dipstix) is conducted at age 37, 39, 41, 42, 43, and 44.

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 nine primary and 12 secondary school health teams, each comprising eight nurses, and serving approximately 500,000 students in 199 primary schools and 170 secondary schools. Several medical officers visit the schools to provide quick medical examinations for primary one and primary six pupils. Unlike in Italy, there is no mandatory pre-participation screening specifically directed at our competitive school athletes.

With the SAF and SHS programmes in place, all Singaporeans would have been medically screened at age 6 and 12. In addition, males would have additional screening at age 35 and annually thereafter while still in active service.

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.

“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 [32]. 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 [4].

4.2. Effectiveness of Pre-participation Screening

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 [19]. These include:

1. The very low incidence of underlying conditions that predispose to sudden death and hence the need to screen large populations
2. The variety of causes of sudden death, thus requiring different diagnostic tests
3. 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
4. The resources required to screen large populations

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, viral 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 MRI or 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.

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 [34] and approximately 30% of individuals with angiographically proven CHD have a normal resting ECG [12]. Most coronary events occur in individuals without resting ECG abnormalities [25]. Exercise testing (i.e. exercise stress test) has limited accuracy [16] 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% [14], 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 [17]. The United States Preventive Services Task Force (USPSTF) examined the use of the resting ECG, exercise ECG test, or 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 [27].

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 [11]. 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 [11]. 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.

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 [8].

In contrast to the European guidelines, the American Heart Association [19], the American College of Cardiology [19], 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.

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.

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 [32]. 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 [32].

4.3. Recommendations

Underlying Philosophy

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

- 4.3.1. 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 4.1). 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.

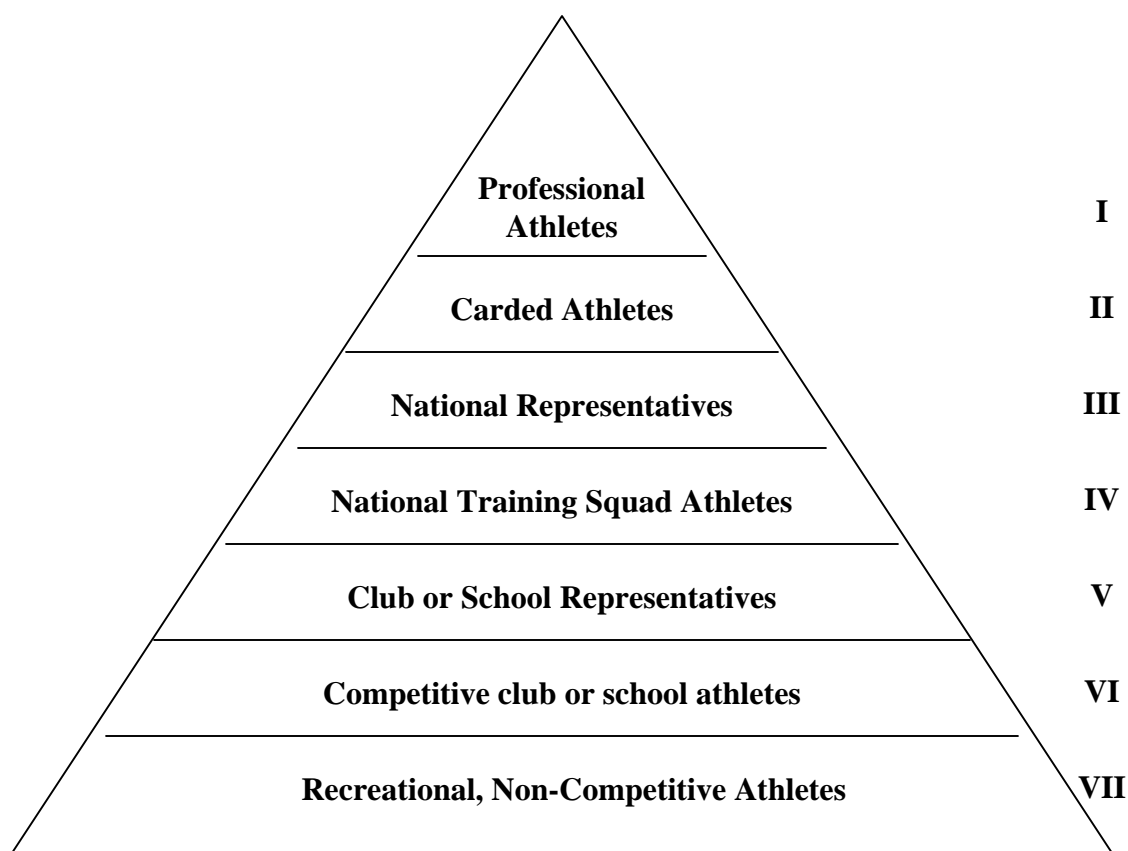


Figure 4.1 Athletes' Competitive Levels

- 4.3.2. Sports activities can also be risk-stratified based on cardiovascular demands (table 4.2). 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.

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

	Category			
	1	2		
Sport	Bowling Bowls Chess Contract bridge Cuesports Darts Gateball Golf Shooting Sport boules Weiqi Woodball Xiangqi	Archery Badminton Baseball/ Softball Basketball Bodybuilding *Boxing/wrestling (not an NSA sport) Canoeing Cricket Cycling Dancesport Dragonboat Equestrian Fencing	Field events Floorball Gymnastics Hockey Iceskating Kayaking Lifesaving Martial arts Motor sports Mountaineering Netball Pickleball Powerboat Rollersports	Rowing Running Sailing Sepak takraw Soccer Squash Swimming Table tennis Tennis Triathlon Underwater activities Volleyball Waterski/wakeboard Weightlifting

Who Should Be Screened?

- 4.3.3. 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.
- 4.3.4. 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.

- 4.3.5. 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 to undergo pre-participation screening.

For level V and VI athletes who do not undergo pre-participation screening, a self-administered pre-participation 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, and this should be continued. A validated pre-participating screening questionnaire should be added on to this questionnaire. At the same time, parents/guardians/students should be educated on signs and symptoms to look out for via pamphlets, given to students at the same time as the questionnaire. Clubs and schools not under MOE should follow this practice as well.

- 4.3.6. The exception to recommendation 4.3.5 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.
- 4.3.7. For **recreational, non-competitive athletes (VII)**, pre-participation screening should not be mandated. Instead, a self-administered pre-participation screening questionnaire [3, 31] should be completed at least annually. The Committee recommends the use of the PAR-Q questionnaire [appendix 7] or the Wisconsin Affiliate of the American Heart Association Questionnaire [appendix 10] for adults, and The Sudden Arrhythmia Death Syndrome Foundation Questionnaire [appendix 8] for children.
- 4.3.8. Individuals should routinely complete a pre-participation screening 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.

- 4.3.9. The current SAF pre-participation screening requirements are comprehensive and should continue.
- 4.3.10. 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

- 4.3.11. 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
- 4.3.12. 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 Xray, exercise stress test, echocardiogram, angiogram, blood investigations, urine tests, etc. may be ordered if indicated [3,6,8,10,11,13,19, 23, 31].
- 4.3.13. 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 FAS and SAF).
- 4.3.14. 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 favored consideration of such a practice, more time is needed to assess its feasibility and impact, and to consult all organizations involved in sports.

4.3.15. The screening protocol and tests should be customized to each sport. National Sports Associations should seek guidance from their respective International Federations.

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

4.3.17. 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 [21]. These conditions may affect the safety of exercise.

Who Should Conduct the Pre-Participation Screening?

4.3.18. 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, the Committee recommends that a multi-disciplinary workgroup, comprising sports physicians, cardiologists, general practitioners, sports physiotherapists and others, be established by the Ministry of Health / Academy of Medicine / Sports Medicine Association of Singapore to draw up clinical practice guidelines which can be used by other doctors, such as family physicians, to conduct pre-participation screening.

Follow Up

4.3.19. The outcome of these screening programs should be regularly reviewed by organizers and sports organizations (number and type of abnormal results detected) to determine their effectiveness, assess the role of different tests used and determine if other groups should be included.

4.3.20. 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 [18].

Enforcement

- 4.3.21. Enforcement of 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.

5. TRAINING AND EDUCATION

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.

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.

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 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 revival of the person. Although there is no structured law in Singapore that is equivalent to the Good Samaritan Law in the United States of America, 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.

5.1. Current Practices

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.

A survey of our National Sports Associations (NSAs) (2007, unpublished) estimated that of the 58 NSAs in Singapore, 19 do not have a single staff trained in CPR. This is despite the fact that all National Registry of Coaches (NROC) coaches are required to undergo sports first aid and CPR training before they can be registered as coaches.

All SSC facilities are equipped with AEDs, but many other health and fitness facilities, such as private condominium gyms; commercial gyms; school gyms, courts and fields; exercise parks; and other sports facilities are not. It is not enough that AEDs are available in sports facilities - besides being available, AEDs need to be visible and easily accessible as well, and first responders need to be trained to use them.

5.2. Recommendations

5.2.1. 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 would be extremely difficult. 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 regular physical activity
- d. 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
- e. The importance of first-aid, CPR, and AED training
- f. The effects of overtraining and the importance of not overtraining
- g. The idea that exercise is a total approach to general wellbeing, and not just for aesthetic purposes

5.2.2. The onus for raising awareness resides primarily with the National Sports Associations (NSAs), the Singapore Sports Council and organizers of sports events. 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 against participation if unwell just before/during the race. The onus is on athletes to adhere to the advisories
- d. Uploading statistics of adverse events and improvements made to these events on event websites, so as to increase public awareness

5.2.3. 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. For water sports,

water lifesaving skills should be included, and personnel should be well trained to be able to perform special skills such as a proper search and rescue.

- 5.2.4. AED use has been included together with first-aid and CPR, rather than an advanced-level skill as there is adequate evidence that it is effective in saving lives and is as important as CPR in the first response to a collapsed victim. For those who are trained in CPR, they are recommended to carry around plastic face masks (or similar devices for personal protection) for use in CPR if necessary, and perhaps these masks can be given to individuals whenever they undergo a CPR/AED course.
- 5.2.5. Courses are available through various providers. Examples of these providers endorsed by the National Resuscitation Council are enclosed as an appendix (see appendix 9: Examples of CPR/AED/1st Aid Course Providers) but the list is by no means exhaustive.
- 5.2.6. The Committee reached a consensus that the NSAs / event organizers / fitness facility managers (SAF, Singapore Police Force, public and commercial gyms, schools etc.) are 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, and schools in the case of teachers, gym operators in the case of personal trainers) mandate that all frontline personnel acquire the above-mentioned certifications within a reasonable timeframe. Serious / fatal sports-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 aim for three years as a guideline to achieve the above.

It is recognised that implementation of measures will not be easy (e.g. NSAs are already burdened with various targets and plans), so SSC should work with NSAs to provide support in meeting these guidelines. Likewise, the teaching curriculum in schools is already tightly packed and teachers have a multitude of responsibilities, so an efficient implementation plan will be necessary. For example, standard first-aid, CPR, and AED training could be incorporated into the NIE teaching course as a single-day module, for a start, as part of a systematic roll-out plan. Those in schools who are 15 years or older, and in uniformed groups (e.g. Red Cross Society, St John's Ambulance Brigade) are strongly encouraged to be first-aid, CPR, and AED certified as well.

- 5.2.7. All certifications must be current. This area tends to be neglected, and organisations should have a systematic process to ensure trained staff remain current.

- 5.2.8. 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.
- 5.2.9. 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.
- 5.2.10. 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.
- 5.2.11. Every year, many of our young men go through National Service. CPR and introductory lessons on the usage of AEDs can be included into the skills that are being taught to our servicemen. Such skills are useful during their stint in the SAF but more importantly, it will constantly increase the pool of trained first responders who are conversant with CPR and the use of AEDs.
- 5.2.12. Key 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.
- 5.2.13. As part of the educational (and implementations) process, the Committee recommends that a public forum be organized to publicize the findings and recommendations of this report. The forum could be jointly organized by SSC, Sports Medicine Association of Singapore, Singapore Heart Foundation, and other relevant bodies.
- 5.2.14. This report, in its current form, is meant to be comprehensive and hence inevitably technical. For effective implementation, all parties need to have a good understanding of its contents. Hence, it will have to be modified and made simpler before public dissemination.

6. EXERCISE AND TRAINING FACILITIES

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., 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 [4,5].

6.1. Current Practices

The Singapore Sports Council operates 23 swimming complexes, 17 stadia with track and field, 2 stadiums with field only, 15 sports halls for badminton, basketball & netball, 54 tennis courts, 18 squash courts, 8 outdoor netball courts, 14 petanque courts, 2 gateball courts, 1 soccer court, 11 fields for soccer & other team sports, 70 school fields, 1 rugby field, 2 synthetic hockey fields, 14 dance studios, 1 aerobic room, 1 gymnastics area, 1 fitness corner, 15 gyms, 1 sea sports centre and 1 special facility. All SSC facilities have AEDs, as do some military facilities, but accessibility may be an issue 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. Few, if any, have AEDs

As the number of Singaporeans engaging in regular exercise increases, there will be a rising trend in the number of people, including those with heart disease, utilizing exercise and training facilities. However, there is no concrete data available at the time of guidelines formulation regarding the screening, staffing and emergency policies at each of these facilities.

6.2. Best Practices for Exercise and Training Facilities [adapted from 4, 5]

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

A survival rate as high as 90% has been reported when defibrillation is achieved within the first minute of collapse, and this declines 7-10% with every minute that defibrillation is delayed, such that a cardiac arrest victim without defibrillation beyond 12 minutes has only a 2-5% chance of survival.

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.

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 [4, 5] advocates:

1. Cardiovascular screening of all persons before enrolment or participation in activities at health and fitness facilities.
2. 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.
3. 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.
4. All exercise leaders must be trained in CPR and in AED use.
5. 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.
6. 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, and should be available in health and fitness facilities with a large number of members (e.g. membership > 2,500), those 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 five minutes.

6.3. Recommendations

- 6.3.1. *All facilities offering exercise equipment or services should conduct cardiovascular screening of all new members and / or prospective users.* 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 *screening questionnaires* can identify many persons at risk and increase the safety of exercise, including non-supervised ones [28].
- 6.3.2. 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 [22], screening should not be so prohibitive such that persons will be discouraged from participating in exercise, which will go against the goal of encouraging regular exercise.
- 6.3.3. For facilities requiring membership or signing in to use its equipment / services, screening 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.
- 6.3.4. Practical examples of pre-participation screening questionnaires are as follows. These questionnaires are simple and can be self-administered:
 - a. Physical Activity Readiness Questionnaire PAR-Q [appendix 7]. This questionnaire focuses mainly on the symptoms suggesting angina pectoris, with a question included to identify musculoskeletal problems which should be evaluated before participation of 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 10]. 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.

6.3.5. Individuals with known cardiovascular disease who do not comply with recommendations for medical recommendations or who refuse to complete the health questionnaire when requested, may be refused use of exercise facilities or participation of 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.

6.3.6. Different levels of health/fitness facilities are available, catering to different groups of the population (table 6.1). 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 6.1: 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 programmes for clinical populations	Medically supervised clinical exercise programme (e.g. cardiac rehabilitation)
Personnel	None	Exercise leader <i>Recommended: medical liaison</i>	General manager Health/fitness instructor Exercise leader <i>Recommended: medical liaison</i>	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 <i>Encouraged: PAD plan with AED as part of the composite PAD plan in the host facility (e.g. hotel, commercial building, apartment complex, park)</i>	Telephone Signs <i>Encouraged: blood pressure kit, stethoscope, PAD plan with AED</i>	Telephone Signs <i>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</i>	Telephone Signs Blood pressure kit Stethoscope <i>Strongly encouraged: PAD plan with AED</i>	Telephone Signs Blood pressure kit Stethoscope Oxygen Crash trolley Defibrillator

AED = automatic external defibrillator

PAD = public access to defibrillator

6.3.7. Personnel in health and fitness facilities must meet professional standards and have the training and experience required for their designation (table 6.2).

Table 6.2: 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 1 st aid, prior supervised internship or experience in health/fitness industry

6.3.8. Each health/fitness facility should have its own medical emergency plan as well, 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.

6.3.9. 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 [24] and the American Association of Cardiovascular and Pulmonary Rehabilitation [2], 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.

7. EVENT MEDICAL COVERAGE

The need for comprehensive and elaborate medical support for sports events stems from:

- Rising participation rates and race entries, leading to large crowds and congestion
- Relatively higher proportion of novices and inexperienced athletes in our population
- Larger scale of events hosted, where the area of competition can stretch tens of kilometres
- Larger numbers of foreign entries, expecting international standards
- Increasingly competitive athletes keen to push themselves beyond their limits

7.1. Current Practices

An ever-increasing number of organized sports events are added to the local sports calendar each year. The event medical coverage at these events ranges from skeletal to comprehensive. Some events engage professional event organizers, while others are dependent on volunteers. Some organized events have no dedicated medical or first-aid personnel at all, with perhaps only a first-aid kit available at the event site. Other events are covered by a full medical support team, with a medical director and a comprehensive medical support plan, including medical advisories for participants, emergency response protocols, manning ratios, rescue vehicles and equipment, and medical support personnel and equipment. These plans take into account the event location, the numbers and characteristics of participants for the event, and the resources available. [see appendix 11: Medical Support Plan for Singapore International Triathlon 2007].

Not all international sports federations issue medical guidelines to help organizers better draw up a medical support plan, and of those that do, Singapore NSAs may not be aware of or use them. Of the 58 NSAs in Singapore, 29 reported that they do not have medical guidelines for their respective sports, and 27 admitted that they do not follow any medical guidelines. Forty-six NSAs reported that they do not have a Medical Committee to advise them on medical matters, including event medical coverage.

Sports activities in schools are guided by the CCA Safety Guidelines that are part of the Principal's Handbook. However, at our schools, teachers involved in organizing sports activities are not all trained in CPR. Schools do not have AEDs at their sports facilities. The large number of organized sports activities puts a strain on limited resources in the schools.

7.2. Recommendations

There is a wide spectrum of sports events, differing in the type of sport, level of competition, age group and skill level of participants and other factors. Thus the Committee had difficulty in composing guidelines that will suit all sports events across

the spectrum. It is not possible for the Committee to devise medical coverage guidelines for every single sport and every single event. As such, it is important for NSAs, event organisers and all other stakeholders to recognize that each event is unique, and **modify the recommendations below as necessary**. Certain individual sports have their own international guidelines, and organizers should consider these international guidelines in the formulation of their own event coverage plan as well.

Level of Medical Support

- 7.2.1. The level of medical support should be commensurate with the risks involved. Table 7.1 below aims to provide a simple overview of the medical risk of each sport based on two dimensions, namely cardiovascular activity and contact / collision risk. Sports practiced in Singapore are categorized into categories A, B, and C (see legend). This is meant only as a guide. It is of note that the cardiovascular activity (aerobic demands) associated with each sport is not indicative of the cardiovascular risk associated with the sport, as duration plays a part as well. In addition, stakeholders have to understand that the absolute risk of each sport is also dependent on other circumstantial variables, such as the participant profile and environment. Other risks pertaining to specific sports (e.g. barotrauma in underwater activities, lightning risk in golf) are also not included. Thus stakeholders are reminded to adjust the risk stratification accordingly, taking into account the characteristics of the sport or event.

Table 7.1: Classification of Sports Based on Cardiovascular Activity and Contact/Collision Risk [adapted from 1,17]

		CONTACT / COLLISION RISK		
		LOW	MEDIUM	HIGH
CARDIOVASCULAR ACTIVITY	HIGH	Canoeing/ Kayaking Rowing Running (mid distance) [#]	Cycling Iceskating (speed) Rollersports	Boxing/wrestling*
	HIGH MODERATE	Running (sprint) [#] Running (long distance) [#] Dragonboat [#] Bodybuilding Swimming	Badminton [#] Squash [#] Triathlon [#]	
	MODERATE	Field (throwing) Badminton Dancesport Mountaineering Pickleball Sailing Lifesaving Tennis Weightlifting	Field (jumping) Floorball Iceskating (figure) Squash Waterski/ wakeboard Gymnastics	Basketball [#] Soccer Hockey Judo Karate-do Kendo Rugby Silat Taekwondo Wushu
	LOW MODERATE	Archery Cricket Table tennis Underwater activities	Equestrian Fencing Motor sports Netball Powerboat Sepak takraw Baseball/softball Volleyball	
	LOW	Cuesports Bowling Chess Contract bridge Darts Gateball Golf Bowls Sport boules Shooting Weiqi Xiangqi Woodball		

* Not an NSA sport, [#] Based on consensus of the Committee

Legend	Risk	Category
	Low	A
	Medium	B
	High	C

7.2.2. The level of medical support is then based on the risks of each sport and event (table 7.2). Each sport/event risk management policy must take into account other factors as mentioned above. Even amongst the same sport, different events need to be considered on an individual basis, as factors such as location of the event and the skill level of participants will be different as well. For example, since local data shows that the risk of sudden collapse in those below 35 years of age is low (see section on “Incidence Of Sudden Death”), schools should exercise their discretion when organizing the numerous school sports events and have an ambulance on standby only in category C events.

7.2.3. 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.

The Committee considered if the event medical doctor should be certified in Advanced Trauma Life Support (ATLS) and Advanced Cardiac Life Support (ACLS), but felt that these should not be mandatory as most of the medical management on-site is Basic Cardiac Life Support (BCLS) based. Hence, a current BCLS certification would suffice.

Table 7.2: Personnel and Facilities Recommended for Event Medical Coverage

Risk category	Nearest hospital on standby	1st aid, CPR & AED trained official (e.g. coach) present	Dedicated 1st-aiders/paramedics present	Doctor present	Arrangements to immediately mobilize ambulance	Medical tent/centre on-site
Category A						
Training	No	No	No	No	Yes	No
Competition	No	No	No	No	Yes	No
Category B						
Training	No	Yes	No	No	Yes	No
Competition	Yes	Yes	Yes	No	Yes	No
Category C						
Training	No	Yes	No	No	Yes	No
Competition	Yes	Yes	Yes	Preferable	Yes, to arrive within 5min	Yes, if > 100 participants

Note: Although recommendations are not made to include the presence of first-aid, CPR- and AED-trained officials in category A events, it is recommended that all officials and coaches should be trained in first aid, CPR, and AED.

7.2.4. Special considerations should be made in the event medical coverage for certain sports. For example, personnel who are equipped in lifesaving should be considered for water sports, safety (rescue) boats should be on standby at all non-powered watercraft events, and extra provisions should be made in disabled sports events.

Equipment

- 7.2.5. 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).
- 7.2.6. In addition, it is recommended that all sports facilities and NSAs have one or more well-maintained AEDs that are accessible. Sports facilities can store AEDs in a glass cabinet on an easily located and sign-posted wall, with alarm systems and indicator lights that go off when the AED is removed. Sports facilities and NSAs with AEDs must also ensure that there are personnel available who are trained to use the AED at all times. All facilities where exercise, training, and competition take place should have a public access to AED (table 6.1), although the Committee recognizes that this will take time to implement. The absolute number of AEDs 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.
- 7.2.7. For sports events, there should be an adequate number of AEDs available (for example in all on-site ambulances).
- 7.2.8. For NSAs and event organizers that may not have the resources to purchase AEDs for sports events, the Committee recommends that SSC provides assistance, such as acquiring a central pool of AEDs that can be loaned out and shared among the NSAs, or provide grants for the purchase of AEDs as well as AED training. AEDs may also be borrowed from organizations such as St Johns Ambulance (which has a pool of four AEDs).
- 7.2.9. Other equipment such as first aid kits and medical bags should not be neglected. First aid kits / boxes 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.).
- 7.2.10. 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).

Personnel

- 7.2.11. It is recommended that for category B and C sports, a Chief Safety Officer should be appointed for each event, especially for mass events. This Chief Safety Officer may or may not be a medical doctor, but will be responsible for the formulation

and effective implementation of the medical support plan, for evaluating and following up medical incidents, and for improving the plan for subsequent events.

- 7.2.12. 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 7.2).
- 7.2.13. 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.
- 7.2.14. For special events, it is essential that personnel involved in event coverage are trained adequately (e.g. lifesaving skills for water sports, volunteers familiar with disabilities for disabled sports events).
- 7.2.15. The roles and responsibility of each personnel should be clearly stated, and there must be accountability. For example, it should be specified who has the authority to suspend a race for safety reasons and who has the authority to deploy an ambulance out of the race area.
- 7.2.16. Personnel, especially volunteers, must be thoroughly briefed before the event. The briefing should include relevant background information on the event (e.g. number of participants expected, expected weather and tidal conditions, expected challenges), the emergency response plan, the emergency evacuation plan, and communications and reporting lines.

Policies

- 7.2.17. For category B and C events, there is a need for a medical support plan.
- 7.2.18. The medical support plan should include climatic cut-offs beyond which the event should be postponed, suspended, or abandoned. Examples include storm category, lightning risk, etc.
- 7.2.19. There should be clear guidelines on the criteria for barring an athlete from continuing to compete against the athlete's wishes, for the safety of the athlete and others around him.

Risk assessment checklist

- 7.2.20. It is recommended that all NSAs and event organizers have a risk assessment checklist to assess the risks associated with their sport / event. The checklist should include the following:
 - a. Safety officer / manager / team
 - b. Medical support plan, including personnel and equipment

- c. Emergency response plan
- d. Communications plan
- e. Disclaimer / advisory to participants
- f. Safety indicators, which if breached may result in the cancellation of the event (e.g. SAF training is cancelled if the ambient temperature exceeds a pre-determined point; US marathons are cancelled if the wet bulb globe temperature (WBGT) exceeds 28 degrees Celsius)
- g. General safety measures, such as having an upper limit to the number of participants in mass events
- h. Specific safety measures for special groups of participants. For example, in events where there are paediatric participants, measures may include limiting distance of the race, limiting races to certain times of day to reduce heat stress, ensuring medical equipment is catered to these groups, and limiting the number of participants in each race to decrease the chance of collision. As another example, organizers of cycling events may wish to liaise with various agencies or select the competition venue to allow full cycling lane closures so as to minimise collision risk between cyclists and the public
- i. Measures to handle *mass casualty* events e.g. involving *spectators*
- j. Surveillance system: statistics and feedback with the aim to further adjust the risk category of the sport / event (e.g. category A may subsequently be adjusted to category B)
- k. Documentation: tracking and reporting system for athletes who seek medical attention at medical tents and first aid posts during sports events, documenting the type and severity of injuries, treatment rendered, and subsequent follow up. Near-misses should also be documented
- l. Timeout before each event to look through the safety management framework and ensure that points are adhered to
- m. Emergency drills
- n. Post-event review

Post-event review and feedback

7.2.21. The risk safety management checklist will be helpful in post-event review and evaluation. It is the onus of the NSAs and event organizers to review each event, and to propose changes in future events that are aimed at reducing any adverse events occurring.

Others

7.2.22. For certain mass events, it is recommended that participants in each category be stratified into novice and experienced participants.

8. SURVEILLANCE, EVALUATION AND FOLLOW UP

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.

8.1. Current Practices

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?).

For sports events, the situation is slightly better. Injury records are kept for major events such as 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.

8.2. Recommendations

- 8.2.1. It is recommended that SSC 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.
- 8.2.2. 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.
- 8.2.3. 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.

- 8.2.4. 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.
- 8.2.5. Pertaining to points 8.2.2 to 8.2.4 above, each NSA should establish its own sport-specific medical committee to help comply with the above recommendations, including periodically reviewing data collected on sports-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).
- 8.2.6. 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.
- 8.2.7. Surveillance and evaluation systems need to contain a follow-up and tracking element so as to prevent incidents of similar nature in the future.
- 8.2.8. It is recommended that a sports safety structure be put in place to link SSC and the NSAs in order to implement the above recommendations. With this structure, safety directives (best practices and minimum standards) can be effectively brought across to all NSAs with consistency. Such a structure will also serve the platform for promoting sports safety in Singapore.
- 8.2.9. 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

9. 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 the sports safety framework in Singapore, identify the gaps, and make appropriate recommendations to plug those gaps. We thank all our resource panel members and various agencies for their expert and valuable assistance during our deliberations. 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 mindsets are never easy to change and funds are not always easy to find. Successful implementation starts with ownership and strong leadership. The Singapore Sports Council, we are confident, will provide these during the implementation phase. Continual consultations with those on the ground will also be necessary.

These recommendations and guidelines should 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

- 1) TERMS OF REFERENCE**
- 2) COMMITTEE MEMBERS**
- 3) RESOURCE PANEL**
- 4) MOE RISK ASSESSMENT AND MANAGEMENT SYSTEM (RAMS)**
- 5) 5-A WAY TO SPORTS SAFETY**
- 6) ROTTNEST RISK MANAGEMENT FRAMEWORK**
- 7) PAR-Q QUESTIONNAIRE**
- 8) THE SUDDEN ARRTHYMIA DEATH SYNDROME FOUNDATION
QUESTIONNAIRE**
- 9) EXAMPLES OF CPR/AED/1st AID COURSE PROVIDERS**
- 10) WISCONSIN AFFILIATE OF THE AMERICAN HEART ASSOCIATION
QUESTIONNAIRE**
- 11) SINGAPORE TRIATHLON 2007 MSP**

APPENDIX 1: TERMS OF REFERENCE

Overview of the Sports Safety Committee

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.

APPENDIX 2: COMMITTEE MEMBERS

Chairperson

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

Members

1. Prof Venkataraman Anantharaman
Senior Consultant,
Department of Emergency Medicine,
Singapore General Hospital
2. Mr Ang Wee Hiong
Principal & CEO, Hwa Chong Institution
Chairman, Singapore Schools Sports Council
3. Dr Terrance Chua Siang Jin
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National Heart Centre
4. Ms Delphine Fong
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Singapore Sports Council
5. Mr Paul Fong
General Manager,
Singapore Waterski & Wakeboard Federation
6. Mr Goh Ek Piang
Principal, Hougang Primary School
Chairman, Singapore Primary Schools Sports Council
7. A/Prof Fabian Lim Chin Leong
Head, Military Physiology Lab,
Defence Science Organisation National Laboratories
8. Mr Yazed Osman
Assistant Director, Sports Events Division,
Sports Marketing Group,
Singapore Sports Council

9. BG Bernard Tan
Director, Military Intelligence,
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10. Major Bob Tan
Assistant Director, Community Preparedness Branch,
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12. Mr Samuel H Tso
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3. Dr Chiam Tut Fu
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4. Dr Paul Chui
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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 1 : 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 of 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

<i>A1. Attitude</i>	Athletes are our family during training and on the field. Ensuring their safety is to both their and our benefit.
<i>A2. Awareness</i>	Risk assessment is now a pre-requisite to sports safety. Triathlon is a high-risk sport.
<i>A3. Acceptance</i>	We accept the extra responsibility for triathlon safety, as well as the commitment to enabling and enforcing it.
<i>A4. Analysis</i>	We will have a risk assessment of triathlon done to determine and rank the hazards, and find necessary controls.
<i>A5. Action</i>	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: ROTTNEST RISK MANAGEMENT FRAMEWORK



Risk Management Plan

For the

Rottnest Channel Swim

Document Review

Update	Forum
14.11.00	Original document
28.11.01	ECO meeting
23.8.02	Draft review
15.10.02	ECO meeting
16.4.03	Draft review
20.8.03	ECO meeting
9.12.03	ECO meeting
25.10.04	Pre event review
7.11.05	ECO Meeting Feedback

Rottnest Channel Swim – Risk Management Plan

Risk Management Plan - in accordance with AS/NZS 4360:1995.

This is a three-stage process involving;

Section 1 The identification of issues

Section 2 Risk Rating - Assessment of Likelihood and Significance

Section 3 Consideration of response options and control measures

Section 1 Identifying Risks

FACTORS	PHASES			
	Pre – event	Event	Post Event	
	Human	1	4	7
	Environment	2	5	8
	Vehicle	3	6	9

Application of this framework to the RCS produced the following identified safety issues;

FACTORS	PHASES			
	Pre – event	Event	Post – Event	
	Human	1.1 Medical Condition 1.2 Ability to swim 1.3 Level of fitness 1.4 Not Registered on day 1.5 Knowledge of race 1.6 Dehydration/Toilet	4.1 Sunburn 4.2 Effect of exercise 4.3 Dehydration 4.4 Lost Swimmer 4.5 Duration in water 4.6 Hypothermia 4.7 Overcrowding 4.8 Lack of race confinement 4.9 Identification of swimmer	7.1 Dehydration/Fatigue 7.2 Cramp/Hypothermia 7.3 Exhaustion 7.4 Lost support on island 7.5 Lost swimmer
	Environment	2.1 Competitor Congestion 2.2 Parking 2.3 Hazards on start 2.4 Lighting 2.5 Dropping off on shore 2.6 Area Designation	5.1 Sun exposure 5.2 Cold 5.3 Submerged obstacles 5.4 Stingers 5.5 Sharks 5.6 Winds/Forecast 5.7 Visibility 5.8 Current/Waves	8.1 Egress from beach
	Vehicle	3.1 Boat/Ski failure to show 3.2 Congestion of boats 3.3 Ski access to beach	6.1 Poor Paddlers 6.2 Poor boat Skippers 6.3 Capsize - Boat 6.4 Capsize - Ski 6.5 Ill prepared boats 6.6 Course boundaries 6.7 Commercial Shipping 6.8 Boat Congestion	9.1 Illegal moorings 9.2 Mooring to close to finish 9.3 Boats loading/Unloading 9.4 Hitting other competitors 9.5 Ski Congestion 9.6 Designated gear area

Section 2 Risk Rating - Assessment of Likelihood and Significance

Before discussing possible safety measures, it is appropriate to put into perspective each of the identified issues. This ensures that the types of safety measures proposed were warranted, and in context. The taskforce undertook a risk management assessment of the identified issues in accordance with AS/NZS 4360:1995.

The identified issues were expressed in terms of the associated risk they presented. The associated risks were then analysed by combining estimates of likelihood and consequences in the context of existing control measures. This produces a level of risk.

Human factors - Pre-race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
1.1	Medical Condition	Almost Certain	Minor	Significant
1.2	Ability to swim	Rare	Insignificant	Low
1.3	Level of fitness	Unlikely	Moderate	Moderate
1.4	Not Registering on Day.	Unlikely	Insignificant	Low
1.5	Knowledge of race	Moderate	Moderate	Significant
1.6	Dehydration / Toilet	Likely	Insignificant	Moderate

Environmental factors – Pre-race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
2.1	Competitor Congestion	Almost Certain	Moderate	High
2.2	Parking	Moderate	Minor	Moderate
2.3	Hazards on start	Moderate	Minor	Moderate
2.4	Lighting	Almost Certain	Moderate	High
2.5	Dropping off on shore	Likely	Minor	Significant
2.6	Area Designation	Unlikely	Minor	Low

Craft/Vehicle Factors – Pre-race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
3.1	Boat/Ski failure to show	Likely	Moderate	Significant
3.2	Congestion of boats	Likely	Major	High
3.3	Ski access to beach	Unlikely	Insignificant	Low

Human factors – During race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
4.1	Sunburn	Rare	Insignificant	Low
4.2	Effect of exercise	Likely	Major	High
4.3	Dehydration	Likely	Major	High
4.4	Lost Swimmer	Likely	Catastrophic	High
4.5	Duration in water	Moderate	Minor	Moderate
4.6	Hypothermia	Likely	Major	High
4.7	Overcrowding	Almost Certain	Minor	Significant
4.8	Lack of race confinement	Almost Certain	Minor	Significant
4.9	Identification of swimmer	Likely	Minor	Significant

Environmental factors – During race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
5.1	Sun exposure	Almost certain	Minor	Significant
5.2	Cold	Unlikely	Major	Significant
5.3	Submerged obstacles	Unlikely	Minor	Low
5.4	Stingers	Almost certain	Minor	Significant
5.5	Sharks	Rare	Catastrophic	Significant
5.6	Winds/Forecast	Almost certain	Major	High
5.7	Visibility	Unlikely	Minor	Low
5.8	Current/Waves	Almost certain	Major	High

Craft/Vehicle factors – During race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
6.1	Poor Paddlers	Likely	Moderate	Significant
6.2	Poor boat Skippers	Likely	Catastrophic	High
6.3	Capsize – Boat	Unlikely	Catastrophic	High
6.4	Capsize – Ski	Likely	Minor	Significant
6.5	Ill prepared boats	Moderate	Minor	Significant
6.6	Course boundaries	Likely	Major	High
6.7	Commercial Shipping	Unlikely	Catastrophic	High
6.8	Boat Congestion	Almost Certain	Catastrophic	High

Human factors - Post-race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
7.1	Dehydration/Fatigue	Almost Certain	Moderate	High
7.2	Cramp/Hypothermia	Almost Certain	Moderate	High
7.3	Exhaustion	Almost Certain	Moderate	High
7.4	Lost support on island	Unlikely	Insignificant	Low
7.5	Lost swimmer	Likely	Catastrophic	High

Environmental factors – Post race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
8.1	Egress from beach	Rare	Insignificant	Low

Craft/Vehicle factors – Post race

Ref. No.	Identified Risk	Likelihood	Consequence	Level of risk
9.1	Illegal moorings	Likely	Minor	Significant
9.2	Mooring too close to finish	Almost Certain	Moderate	High
9.3	Boats loading/Unloading	Almost Certain	Catastrophic	High
9.4	Hitting other competitors	Unlikely	Catastrophic	High
9.5	Ski Congestion	Unlikely	Insignificant	Low

Section 3 Consideration of response options and control measures

A systematic approach based on the Australian Standard for Risk Management (AS/NZS 4360:1995) was used to assess the level of risk associated with the identified safety issues

The types of countermeasures for the different levels of risk are listed below;

High risk = detailed research and policy planning. Control of activity by Officials
 Significant risk = attention needed at a policy level. Inclusion of measures in RCS race rules
 Moderate risk = responsibility must be specified. Inclusion of information to participants.
 Low risk = manage by routine procedures. Signage, boundaries, bunting, etc

The Royal Life Saving Society has applied its knowledge and understanding of the RCS to assess, judge the value of, and discriminate between the value and merit of a range of possible safety strategies.

The proposed control measures are tabled below:

HUMAN FACTORS - PRE-RACE

Reference No. 1.1	Identified Risk Medical Condition	Rating Significant
While there is no pre-requisites to entry into the RCS for duo's and teams the medical condition of participants can affect their ability to safely participate.		
Strategies : <ul style="list-style-type: none"> - Within the entry form will be a statement that all those participating will declare themselves medically fit to compete in the race. - A series of (4-6) state and community newspaper info-articles on 'how to prepare' for the event will be run in the weeks leading up to the event. - The 10km, Cottesloe, Swanbourne and North Cottesloe ocean swims will be promoted to race entrant as valuable 'lead-up' events. - Skippers will be provided with a resuscitation flow chart and it will be recommended that all craft will carry first aid kits. 		

Reference No. 1.2	Identified Risk Ability to swim	Rating Low
While there is no pre-requisites to entry for duo's and teams, the RCS is a large (19.2km) open water event that attracts those who have a fair knowledge/background in swimming. Nevertheless the ability to swim the distance required is paramount their safety.		
Strategies: <ul style="list-style-type: none"> - Refer to 1.1. - Swimmers will be instructed on how to summons help should they get into difficulty and be unable to continue in the event. 'Raise one hand above the head.' - Within the entry a form will be a statement that all participating will declare that they have the swimming ability to complete the event. - Solo competitors to supply evidence of competency in completing the swim in less than 10 hours. 		

Reference No. 1.3	Identified Risk Level of fitness	Rating Moderate
While there is no pre-requisites to entry into the RCS for duo's and teams. The physical condition of participants can affect their ability to safely participate		
Strategies: <ul style="list-style-type: none"> - Please refer to 1.1 / 1.2 		

Reference No. 1.4	Identified Risk Not registering on day	Rating Low
While people may be on the starting list. It is possible they will not register on the morning of the start. This makes accounting for their presence impossible during the race.		
Strategies: <ul style="list-style-type: none"> - There will be constant PA announcements advising all participants to register. - A clear registration area will be available with sufficient officials to prevent excessive queuing. - There will be information on registering in the notification pack and race briefing. - Implementation of the electronic timing straps giving incentive for competitors to register and get a recorded time on completion of the event. 		

Reference No. 1.5	Identified Risk Knowledge of Race	Rating Significant
Knowledge of the race is extremely important. Entrants must be clear as to the size, scope and nature of the race. It is important they know 'what they are getting themselves and their support crews into.'		
Strategies: <ul style="list-style-type: none"> - All competitors will be made aware of race rules, as well as the race details in the race briefing. - Details of the race will include the distance, mean duration, water temp, depth as well as where the key navigational points. - PA and marine radio announcements to the competitors advising them of the effects weather conditions would have on swim duration. 		

Reference No. 1.6	Identified Risk Dehydration/Toilet	Rating Moderate
Competitors will arrive on the morning often a few hours before the race start. Facilities must be provided to ensure competitors can continue to hydrate themselves and go to the toilet.		
Strategies: <ul style="list-style-type: none"> - Hire / access of toilet facilities - Access to drinking water. (PowerAde Tent) - Constant PA announcements alerting all to the available facilities. 		

ENVIRONMENTAL FACTORS – PRE-RACE

Reference No. 2.1	Identified Risk Competitor Congestion	Rating High
The Royal Life Saving Society is aware that there will be overcrowding before the start of the event. This can cause disorientation, lose of support crew/ski paddler. Missing of allocated race time. As far as possible steps must be taken to ensure the 'start crowd' is orderly.		
Strategies: <ul style="list-style-type: none"> - Designated areas ie. Competitor marshalling. ski area, start line, registration tents. (Annexure H) - Designated areas covered in race briefing - Continuous PA announcements on location of designated areas. - Dedicated broadcast channel to support vessels as well as competitors on start line. 		
Reference No. 2.2	Identified Risk Parking	Rating Moderate
Due to the amount of spectators/competitors, traffic has to be taken into consideration.		
Strategies: <ul style="list-style-type: none"> - Permission from the Town of Cottesloe to enable road traffic controls to be placed as necessary. - Traffic wardens as necessary. 		
Reference No. 2.3	Identified Risk Hazards on Start	Rating Moderate
Rocks, syringes, drop off areas can all cause harm.		
Strategies: <ul style="list-style-type: none"> - Appropriate sign placement. - Early morning foot patrols that will sweep the beach of any hazards. (Tractor sweep with Town of Cottesloe) 		
Reference No. 2.4	Identified Risk Lighting	Rating High
The start line set up crew will commence before it is light. To erect tents, poles and PA system safety sufficient artificial light is required for the competitors and marshals.		
Strategies: <ul style="list-style-type: none"> - Town of Cottesloe to provide park lighting from 4.00 am. - The hiring of flood lights as required to enable the start and registration area visible to before sunlight. 		
Reference No. 2.5	Identified Risk Dropping off on shore	Rating Significant
Many competitors accompany their support boats from the harbour (Fremantle/Hillarys) in the morning. Landing on shore often involves a tender boat or the support boat coming very close to shore. Lack of surf knowledge and congestion in this area could cause injury.		

Strategies: <ul style="list-style-type: none"> - Rescue boats to be strategically positioned to direct boats in to shore. If surf is running offer a ferry service. - Utilise a clearly marked area protected by the Cottesloe groyne. (leave space for morning swimmers – public) - The rules and guidelines of drop-offs will be included in the notification pack.

Reference No. 2.6	Identified Risk Area designation	Rating Low
Lack of crowd control and confusion in the location of registration tents, ski areas etc could cause an injury.		
Strategies: Please refer to 2.1.		

CRAFT/VEHICLE FACTORS – PRE RACE

Reference No. 3.1	Identified Risk Boat/Ski failure to show	Rating Significant
Mishaps, breakdowns, sleeping in can all cause a ski/boat to miss the start. The first swimmer is unaware of the situation and starts the race. This leaves the swimmer without a support crew, which could lead to injury.		
Strategies: <ul style="list-style-type: none"> - Competitors, ski/boats will be able to call a phone number enabling them to ring if they are unable to make it on time/at all. This message will be broadcast over the PA system. - Competitors without support will be marshalled at the PA area awaiting the status of their support crew. - The reserved area will also be used for the linking of any swimmer to paddler. 		

Reference No. 3.2	Identified Risk Congestion of boats	Rating High
The movement of support boats waiting to link with their swimmer could lead to an unsighted swimmer being run over causing injury.		
Strategies: <ul style="list-style-type: none"> - Holding areas for support boats to be established 500m either side of the start channel. - Boats will not be able to engage with their swimmer until 1000m off shore. (ski paddlers can link after 500m) These exclusion zones will be clearly marked with buoys. - Competitors will be started in waves with colour coded swimming caps (compulsory for first swimmer). This will enable boat to search the right wave of swimmers. - Support boats will be given a starting order chart (including colours) at the race briefing. - The status of the starting sequence will be broadcast over the marine radio communication system. - Support crews are to stay in the boat holding area until their wave is due to start. An official calling of the wave to the start line marks this. - In the event of a delay, broadcasts are to be made to inform crews that a delay has occurred, and to keep the boat starting area unobstructed. 		

Reference No. 3.3	Identified Risk Ski access to the beach	Rating Low
Skis come to the beach to find their swimmer. Their size (18 feet) and the fact they are often left lying on the ground could cause some one to trip up and be injured.		
Strategies: <ul style="list-style-type: none"> - Designated areas will be set out. Refer to 2.1 - Designated area will be covered in race briefing. 		

HUMAN FACTORS – DURING RACE

Reference No. 4.1	Identified Risk Sunburn	Rating Low
The mean duration of the RCS is in excess of 5 hours. The sun in February is intense even early in the morning. Swimmers, support boats and skis need to be prepared to protect themselves from the effects of sun exposure.		
Strategies: <ul style="list-style-type: none"> - Inclusion of information at race briefing (for ski and boats as well) - Support boats will be supplied information on injury management. 		

Reference No. 4.2	Identified Risk Effect of Exercise	Rating High
The mean duration of the RCS is in excess of 5 hours. Competitors need to be informed of the effects of exercise and preventative measures. Failing to do this could cause injury.		
Strategies: <ul style="list-style-type: none"> - Rescue teams (Emergency Control Organisation) will be on the water to respond to any distress call with a maximum arrival time of 15 minutes – the average ambulance response time (Annexure A) - Race briefing will cover emergency procedures. - Support boats will be supplied information on injury management. - Inclusion of preventative information at race briefing. - Introduction of the 10km and 15km checkpoints with cut-off times to accommodate for the 5 pm deadline. 		

Reference No. 4.3	Identified Risk Dehydration	Rating High
The mean duration of the RCS is in excess of 5 hours. Each competitor will be made aware of the importance of fluid intake and the quantities required to prevent dehydration.		
Strategies: Please refer to 4.2.		

Reference No. 4.4	Identified Risk Lost Swimmer	Rating High
A swimmer lost without his support crew is an early indicator to a major emergency.		

Strategies:		
<ul style="list-style-type: none"> - There will be a prominent craft positioned a distance of 1500m from the start directly on the course to Rottneest. Competitors that have not linked with their support crew will be instructed to swim to this craft. Teams that have linked up will be instructed to alter course to swim around this focal point. The craft will have marine radio communications to assist in the location of the support crew. A swimmer without support will not be allowed to progress beyond this point. - If the swimmer is not found within 30 minutes then the ECO base will notify the Water Police to commence search proceedings - Covering of the above at the race briefing. - Refer to Annexure A – Emergency procedures. 		

Reference No. 4.5	Identified Risk Duration in water	Rating Moderate
The mean duration of the RCS is in excess of 5 hours. Each competitor will be made aware of the affects of the water. Eg. salt, skin, ears etc .		
Strategies:		
Please refer to 4.2		

Reference No. 4.6	Identified risk Hypothermia	Rating High
The mean duration of the RCS is in excess of 5 hours. Each competitor will be made aware of the affects and danger of hypothermia.		
Strategies:		
<ul style="list-style-type: none"> - Please refer to 4.2 - All rescue boats will have hypothermia blankets on board in case of emergency. 		

Reference No. 4.7	Identified Risk Overcrowding	Rating Significant
Overcrowding of swimmers especially at the start could cause an injury.		
Strategies:		
<ul style="list-style-type: none"> - Buoys will be positioned to ensure that there are distinct swimming/boating areas. Inflatable rescue boats to patrol the starting area. - Competitors will be sent off in waves to reduce the size of field at the start. - Competitor wave sizes to be limited (as appropriate). - Please refer to 3.2 		

Reference No. 4.8	Identified Risk Lack of race confinement	Rating Significant
While the race has a set length of 19.2km. If the field spreads width-ways this has a multiplier effect on the area to be covered by emergency crews. Excessive spread of the race field could hinder and water down the effectiveness of the Emergency Control Organisation.		

Strategies:

- Please refer to Annexure H
- Indicative race boundaries will be put in place for support crews to navigate by. (maximum width of 1000m).
- To control the length-wise spread of the race field, prognostic cut of times will be set at various coordinates. Competitors that fail to make the prognostic cut off times will be approached by race officials and notified of their removal from the race. The decision to continue to swim is still their own but only at their own risk (Annexure H).
- Markers are to be positioned at the 10km and 15km points large enough for good visibility.
- Minimum height of markers is 2m.

Reference No. 4.9	Identified Risk Identification of swimmer	Rating Significant
Difficulty in identifying your swimmer can cause panic by support crews leading to unsafe behaviors.		
Strategies: <ul style="list-style-type: none"> - Please refer to 3.2/4.4 		

ENVIRONMENTAL FACTORS – DURING RACE

Reference No. 5.1	Identified Risk Sun exposure	Rating Significant
Please refer to 4.1		

Reference No.5.2	Identified risk Cold	Rating Significant
Please refer to 4.6		

Reference No. 5.3	Identified Risk Submerged obstacles	Rating Low
As swimmers enter the water it is possible submerged obstacles (exposed reef) could injure them.		
Strategies: <ul style="list-style-type: none"> - Start line will be located in a area free from obstacles. If this is not possible information will be provided to swimmers on the start line of any submerged obstacles. - Inflatable Rescue boat with lifesavers will patrol the start area. (Annexure H) 		

Reference No. 5.4	Identified Risk Stingers	Rating Significant
Being stung by marine stingers can cause reactions as mild as slight discomfort too as severe as allergic reactions. The RCS is conducted in February when it is possible marine stingers will be present.		

Strategies: <ul style="list-style-type: none"> - Rescue teams (Emergency Control Organisation) will be on the water to respond to any distress call with a maximum arrival time of 15 minutes – the average ambulance response time (Annexure A) - Race briefing will cover treatment of marine stingers. - Support boats will be supplied information on injury management. - Inclusion of information at race briefing.

Reference No. 5.5	Identified Risk Sharks	Rating Significant
While the chance of injury is very low, with little or no injury being recorded during the RCS. The consequence could be catastrophic. A shark attack is classified as a major emergency.		
Strategies: <ul style="list-style-type: none"> - Rescue teams (Emergency Control Organisation) will be on the water to respond to any distress call with a maximum arrival time of 15 minutes – the average ambulance response time (Annexure A) - Race briefing will major emergency response procedure. - Support boats will be supplied information on first aid. - Inclusion of information at race briefing. 		

Reference No. 5.6/5.7/5.8	Identified Risk Winds/Visibility/Current/Waves	Rating High
Poor weather conditions can make progress in the RCS very slow to the point where many teams will be subjected to an event that they are not prepared for, which has the potential to cause injury. While this point will depend the ability of each individual team. A bottom line must be draw by the RCS.		
Strategies: <ul style="list-style-type: none"> - Deciding on the weather conditions needs to objective so that the Race Director is not placed in a position where he must make a subjective decision. - Reference to the weather rating matrix (Annexure H). - Inclusion of policy in race notification packs. - Inclusion of information at race briefing. - Inclusion of 5, 10 & 15km cut-off times - Decision to proceed given by the ECO race committee, consisting of, Race Director, Race Referee, RLSA Representative, ECO Director & RCS Representative, RCSA member - ECO to make regular announcements (30 minutes apart) over the airwaves reminding teams to stay inside the northern markers 		

CRAFT/VEHICLE FACTORS – DURING RACE

Reference No. 6.1	Identified Risk Poor Paddlers	Rating Significant
With no pre-requisites to being a support paddler it is possible that a support paddler could get into difficult and need assistance.		
Strategies: <ul style="list-style-type: none"> - Race briefing for 'skippers' will include 'paddlers'. - Information on preparation and safety precautions will be covered at the briefing. - Wearing a personal flotation device will be recommended. 		

Reference No. 6.2	Identified Risk Poor Boat Skippers	Rating High
With no pre-requisites to being a support boat skipper it is possible that a support boat could create its own incident by running over swimmers, boat breaking down etc.		
Strategies: <ul style="list-style-type: none"> - Recommended that all support boat skippers attend a 'Boat Smart' course. - Rescue teams will be on hand for emergency (Refer to Annexure A) - Race briefing for all skippers that will cover all areas of the race. - Information provided to skippers on how to supervise swimmers, extraction from water, first aid kits, radio communication, responsibilities of a skipper (maritime law) etc. - Creation of a list of compulsory items on support boats including emergency equipment, seasickness equipment and procedures for treatment. - Support vessels are required to take responsibility of minor illness on board. - Vessel size restrictions introduced – 10m and larger vessels must use a tender craft to communicate with the swimmer. 		
Reference No. 6.3	Identified Risk Capsized boat	Rating High
Strategies: Please refer to 6.2		
Reference No. 6.4	Identified Risk Capsized ski	Rating Significant
Strategies: Please refer to 6.1		
Reference No. 6.5	Identified Risk Ill prepared boats	Rating Significant
With no pre-requisites to being a support boat skipper it is possible that a support boat could fail to prepare for the event effectively and ultimately endanger the health of their swimmer/s and/or support crews.		
Strategies: <ul style="list-style-type: none"> - Please refer to 6.2 		
Reference No. 6.6/6.7/6.8	Identified Risk Boundaries/shipping/congestion	Rating High
The RCS course is not closed. It is open to outside users such as major shipping liners and commercial vessels. Their lack of awareness of the RCS could cause injury.		
Strategies: <ul style="list-style-type: none"> - Gain permission form Fremantle Port Authority, WA Water Police and Dept Fisheries Marine Safety. - Support craft will be advised of commercial vessels expected to pass through the field. - Dept Fisheries Marine Safety identified as controlling authority for vessels travelling through the field. - A designated race course will be established within which other traffic can expect event support craft to be. 		
Reference No. 6.9	Identified Risk Communication	Rating Significant

Communication is the key to a safe and enjoyable event. In case of emergency it is an essential element in a quick response time.

Strategies:

- Phone lines / Radio channels created to enable communication between organisers, support crews and emergency control organisation. Refer to Annexure A.
- One channel to be dedicated for information broadcasts from officials to support boats only.
- A central station is to be introduced for communication regarding the locations of swimmers, withdrawals from the event and incidence reports.

HUMAN FACTORS – POST-RACE

Reference No. 7.1/7.2/7.3	Identified risk Dehydration/fatigue/cramp etc...	Rating High
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Although a competitor may have finished the event, the effects may manifest into an injury shortly after completion.

Strategies:

- A manned first aid tent will be set up on the finish line.
- The Rottneest Island nursing post to be part of the ECO.
- The Rottneest Island nursing post to be informed of all conditions.

Reference No. 7.4	Identified Risk Lost support on island	Rating Low
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The finish line may be fairly congested as the swimmers come in. It is important that they can find their support crew on the beach to supply clothes, fluids, food etc.

Strategies:

- A PA system will be put in place so that constant announcements can be made regarding finishing teams and any lost support/swimmers.
- A recovery area is set up as a meeting area.
- Post event planning information required as part of entry, eg: mooring destination

Reference No. 7.5	Identified Risk Lost Swimmer	Rating High
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Just as competitors had to register at the start, all competitors will be crossed off at the finish. If after all competitors (visible) have finished and some names have not been crossed off, this is a sign of a possible incident to either support crew or swimmer.

Strategies:

- Support crews for swimmers that fail to finish will be instructed to contact the RCS to advise of withdrawal (inclusion of information at briefing and race pack.)
- Competitors will try to be located on the island.
- Support crew will try to be located on marine radio
- Refer to Annexure A. Major emergency - Lost support crew swimmer.

Reference No. 7.6	Identified Risk Delineating between competitors and visitors	Rating High
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At the conclusion of the event competitors who are no longer involved in the event become injured or ill.

Strategies:

- Refer 7.1
- Visitors to the island to be the responsibility of the RIA nursing post

ENVIRONMENTAL FACTORS – POST-RACE

Reference No. 8.1	Identified Risk Egress from beach	Rating Low
The finish area includes pathways, rocks and potentially syringes etc which all pose a risk to competitors and spectators..		
Strategies: <ul style="list-style-type: none"> - Gain permission from the Rottneest Island Authority - Sweep beach of any hazards before finish. - Sign post fixed hazards - First Aid tent at finish line. 		

CRAFT/VEHICLE FACTORS – POST-RACE

Reference No. 9.1	Identified risk Illegal Moorings	Rating Significant
While illegal moorings is not the role of the RCS. It is an area of potential risk not so much to the competitors but more so to the reputation of the race organisers		
Strategies: <ul style="list-style-type: none"> - Information on expected mooring location will be gathered from participants entry form applications - Evidence of craft expecting to moor in crowded areas will be advised to locate to other areas prior to race day. - The Rottneest ranger will be alerted and on hand to police any illegal moorings. - RCS will assist RIA Rangers by supplying additional rangers for the day 		

Reference No. 9.2	Identified Risk Moorings to close to finish	Rating High
When some teams have finished and have moored other competitors will be still finishing. In the final stages of the race, competitors will swim through the moorings. This congestion could cause an incident.		
Strategies: <ul style="list-style-type: none"> - Course markers will be in place from the 15 km mark to guide craft along safest route. - Finish lanes will be constructed through the moorings. - Two rescue boats will patrol the finish area to assist in control. - An area will be set aside for support crew unloading and swimmer loading. - Movement around the finish area will be controlled. Refer to Annexure H. 		

Reference No. 9.3	Identified Risk Boats loading/unloading	Rating High
Please refer to 9.2		

Reference No. 9.4/9.5	Identified Risk Hitting Competitors / Ski Congestion	Rating High
Please refer to 9.2		

APPENDIX 7: 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	
<input type="checkbox"/>	<input type="checkbox"/>	1. Has your doctor ever said that you have a heart condition <u>and</u> that you should only do physical activity recommended by a doctor?
<input type="checkbox"/>	<input type="checkbox"/>	2. Do you feel pain in your chest when you do physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	3. In the past month, have you had chest pain when you were not doing physical activity?
<input type="checkbox"/>	<input type="checkbox"/>	4. Do you lose your balance because of dizziness or do you ever lose consciousness?
<input type="checkbox"/>	<input type="checkbox"/>	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?
<input type="checkbox"/>	<input type="checkbox"/>	6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
<input type="checkbox"/>	<input type="checkbox"/>	7. Do you know of <u>any other reason</u> 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.



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APPENDIX 8: THE SUDDEN ARRHYTHMIA DEATH SYNDROME FOUNDATION QUESTIONNAIRE

	Yes	No
Has your child fainted or passed out <i>during</i> exercise, emotion or startle?		
Has your child fainted or passed out <i>after</i> 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 9: EXAMPLES OF CPR / AED/ 1st-AID COURSE PROVIDERS

ACCREDITED AUTOMATED EXTERNAL DEFRIBILLATOR (AED) TRAINING CENTRES

<u>S/N</u>	<u>Institution/Organisation</u>	<u>Contact No.</u>
1	Academic Centre & Clinic Pte Ltd	67474101
2	Alice Lee Institute of Advanced Nursing	-
3	Life Saving Training Centre	6758 5504 / 6759 1806
4	National Heart Centre of Singapore Pte Ltd	6236 7410
5	Parkway Hospitals Singapore Pte Ltd	6317 2345
6	Raffles Medical Group Ltd	-
7	SAF Medical Training Institute	-
8	Singapore Civil Defence Force/Civil Defence Academy	6794 5604
9	Singapore General Hospital	6326 6884
10	Singapore First Aid Training Centre	6297 8123
11	Tan Tock Seng Hospital	-

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 BASIC CARDIAC LIFE SUPPORT (BCLS) TRAINING CENTRES

<u>S/N</u>	<u>Institution/Organisation</u>	<u>Contact No.</u>
1	Academic Centre & Clinic Pte Ltd	6747 4101
2	Alexandra Hospital	6379 4801/ 4082
3	Alice Lee Institute of Advanced Nursing	-
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	-
9	Life Saving Training Centre	6758 5504 / 6759 1806
10	Mount Alvernia Hospital	-
11	Nanyang Polytechnic	In-house training only
12	National Heart Centre of Singapore Pte Ltd	6236 7410
13	National University Hospital	-

Overview and Recommendations for Sports Safety – Final Report

14	Ngee Ann Polytechnic	6460 7372 / 5
15	Parkway Hospitals Singapore Pte Ltd	6317 2345
16	Raffles Medical Group Ltd	-
17	Ren Ci Hospital and Medicare Centre	In-house training only
18	SAF Medical Training Institute	-
19	Singapore Civil Defence Force/Civil Defence Academy	6794 5604
20	Singapore General Hospital	6326 6884
21	Singapore First Aid Training Centre	6297 8123
22	Singapore Medical Association	-
23	Singapore Red Cross Society	-
24	Tan Tock Seng Hospital	-

ACCREDITED OCCUPATIONAL FIRST-AID TRAINING CENTRES

<u>S/N</u>	<u>Institution/Organisation</u>	<u>Contact No.</u>
1	Academic Centre & Clinic Pte Ltd Kembangan Plaza 18 Jalan Masjid #02-04	6747 4101/4102/4802
2	Diagnamedic Pte Ltd SINDA 1 Beatty Rd	6324 8062
3	Emergencies First Aid & Rescue Apollo Centre 2 Havelock Rd #04-10	6536 5231
4	EMS Life Savers Training Centre Pte Ltd Bylands Building 135 Middle Road #04-12	6484 4110
5	ER Ambulance & Services Pte Ltd Tiong Bahru Industrial Estate Blk 1093 Lower Delta Road #05-01/02	6377 1653
6	Health & Safety Training Centre Pte Ltd 21 Moonstone Lane #04-03	6392 5992
7	Life Saving Training Centre Blk 102 Yishun Ave 5 #02-113	6758 5504 / 6759 1806
8	Parkway Shenton Pte Ltd International Plaza 10 Anson Road #36-01	-
9	Shell Learning & Development Centre Shell Eastern Petroleum Pte Ltd (Pulau Bukom)	-
10	Singapore First Aid Training Centre (formerly PECTAC) Phase Z.Ro Technopreneur Park, 151 North Beach Road and 275 Beach Road #03-00	6297 8123
11	Singapore General Hospital Life Training Support Centre Outram Road	6326 6883

Overview and Recommendations for Sports Safety – Final Report

12	Singapore Red Cross Society 15 Penang Lane	6336 0269
13	St John Ambulance Singapore 420 Beach Road and Blk 209 Jurong East St 21 #01-357	6298 0300 6566 1903/1909
14	ST Medical Services Pte Ltd 492 Airport Road	6488 0632

APPENDIX 10: WISCONSIN AFFILIATE OF THE AMERICAN HEART ASSOCIATION QUESTIONNAIRE (AHA/ACSM Health/Fitness Facility Preparticipation 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

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.

Symptoms

- You experience chest discomfort with exertion.
- You experience unreasonable breathlessness.
- You experience dizziness, fainting, blackouts.

Other health issues:

- You have musculoskeletal problems.
- You have concerns about the safety of exercise.
- You take prescription medication(s).
- You are pregnant.

- 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 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 11: SINGAPORE INTERNATIONAL TRIATHLON 2007 MSP

Triathlon Medical Support Plan

MEDICAL SUPPORT PLAN – TRIATHLON

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Triathlon Medical Support Plan

Table of Contents

- 1. INTRODUCTION**
 - 1.1 Event description
 - 1.2 Field of play
- 2. EPIDEMIOLOGY**
 - 2.1 Climate
 - 2.2 Type of casualties
- 3. MEDICAL MANAGEMENT**
 - 3.1 Objectives
 - 3.2 Elements
- 4. EXECUTION**
 - 4.1 Race medical management
 - 4.2 Demobilisation
 - 4.3 Documentation
- 5. MEDICAL SUPPLIES**
- 6. COMMUNICATION**
- 7. MASS CASUALTY INCIDENT**
- 8. HEALTH AND SAFETY PRECAUTIONS**

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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

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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 liaison 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).

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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 Defibrillators (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:

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Triathlon Medical Support Plan

- i. Situation
- ii. Background
- 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

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Triathlon Medical Support Plan

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.

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