Medical Supervision of Mass Sporting Events

29

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Learning Objectives

1. Understand and estimate the risk of medical encounters at mass community-based sports events.
2. Be able to define and classify medical encounters at mass community-based sports events.
3. Understand the exercise benefit-risk paradox.
4. Implement step-wise planning to reduce the risk of medical encounters at mass community-based sports events.
5. Understand the potential role of pre-event medical screening for mass sporting events.
6. Plan and implement medical care on race day for mass community-based sporting events.
7. Develop guidelines to minimize the potential negative effects of environmental stress, including air quality at mass community-based sporting events.
8. Be able to document medical encounters at community-based sporting events.

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A. Pressler, J. Niebauer (eds.), *Textbook of Sports and Exercise Cardiology*,
https://doi.org/10.1007/978-3-030-35374-2_29

29.1 Introduction

Non-communicable disease (NCDs) of lifestyle are the number one cause of death worldwide and are currently responsible for >70% of all deaths. Physical inactivity is one of the major modifiable risk factors for NCDs. Universal prescription guidelines for physical activity for all individuals include engaging in >150 min of moderate- to high intensity physical exercise weekly.

- Brisk walking, jogging, running, cycling, swimming are common endurance exercise activities that are prescribed to individuals.
- There are an increasing number of sports events around the world where large numbers of individuals engage in organized endurance sports—these can be considered "mass community-based sporting events".
- Mass community-based sporting events include park runs, road races (distances vary from 5 km to ultra-marathons), cycling events, swimming events, and events combining endurance sports e.g. triathlon
- There are data indicating that the profile of participants at these events is changing, with increasing numbers of older individuals and female participants.

There is a known risk of medical complications during moderate- to high intensity exercise, and this risk varies according to the "risk profile" of the individual. These medical complications during exercise can vary from minor to severe life-threatening and also result in death from cardiac arrest and other causes. Medical staff, that are responsible for participant safety at mass community-based sporting events:

1. need to be aware of the risk of medical encounters at events, causes and risk factors associated with medical encounters, and
2. can design and implement strategies to reduce the risk of medical encounters at these events.

29.1.1 Risk of Medical Encounters at Mass Sporting Events

- In a recently published international consensus paper, general definitions and more specific definitions of medical encounters (by severity, timing and type) were outlined [1].

29.1.1.1 General Definitions

A mass community-based endurance sports event is defined as

- "*a planned and organised endurance sports event, usually with > 1000 entrants (recreational and/or elite), at a specific location, for a specific purpose, and for a defined period of time (single day/stage or multiple stages/several consecutive days)*" [2, 3].

A "community-based" event is typically planned and organised by a community sports organisation with a committee that includes a race director. We refer to "mass participation" as a mass-gathering with >1000 race entrants [2, 3], but also recognise that events of a smaller size (<1000 race entrants) can be managed and collect data.

An "endurance sports event" is an event that includes one or more of the following sport types:

(a) distance running
(b) cycling
(c) swimming
(d) triathlon
(e) biathlon
(f) duathlon
(g) canoeing/kayaking
(h) cross country skiing
(i) mixed ultra-endurance events
(j) other similar activities that combine any of these disciplines or function with more than one athlete as a team of entrants.

The medical team is defined as

- the "*team responsible for the medical care during the event and is made up by officially designated medical staff (medical physicians, emergency medical and basic first aid providers, registered nurses, physiotherapists, athletic trainers, and others), typically led by a medical director (or equivalent)*".

29.1.2 Definitions of Medical Encounters

Athletes participating in endurance events may develop a "medical problem" during the event, and this "medical problem" may or may not be reported by the athlete to the medical team providing medical care at the event. Therefore, not all medical problems are reported by the participants.

- A "non-reported medical problem" is defined as "*a medical problem experienced by an athlete participating in an event, where the athlete decides to either seek no assistance, or seek assistance outside of the event medical team"*.

The term "medical encounter" is used as the standardised term to define any reported "medical problem" at an event, including both illnesses and injuries. Medical encounters can be classified by severity into:

(a) minor,
(b) moderate,
(c) serious/life-threatening,

(d) sudden cardiac arrest,
(e) sudden cardiac death, and
(f) sudden death.

The detailed definitions of medical encounters as well as the definitions of medical encounters classified by severity are listed in Table 29.1 and depicted in Fig. 29.1. A medical encounter at a sports event can occur at different times during or following the event, and documenting the timing of the encounter is clinically important. Three time periods for the timing of a medical encounter have been defined:

- *during the event (from the official start to completion of the event).*
- *immediately post-finish (from the time the athlete completes the event to 1 h after the athlete completes the event).*
- *delayed presentation (between 1 and 24 h after the athlete completes the event).*

29.1.3 The Exercise Benefit-Risk Paradox

Moderate- to high-intensity regular physical activity, including distance running, is widely recommended for health [4], there is also equally strong evidence that moderate- to high-intensity exercise acutely, and transiently, increases the risk of a range

Table 29.1 Definitions of medical encounters and medical problems. (Reproduced with permission from [1])

Terminology	Definition
Non-reported medical problem	A medical problem experienced by an athlete participating in an event, where "*the athlete decides athlete decides not to seek assistance from the event medical team, or seeks assistance outside of the event medical team*"
Medical encounter	A reported medical problem that is an "*interaction between the medical team and a race participant requiring medical assistance or evaluation* [68, 69]*, taking place from the official start of the event, up to 24 h after the official cut-off time of the event*"
Minor medical encounter	A medical encounter that: 1. *is not significant or severe enough to result in withdrawal of the athlete from the event following assessment by the medical staff,* **or** 2. *does not require admission and supervised medical care at race medical facilities (on the race course, or at the end of the event) or transfer to a hospital for supervised medical care*

Table 29.1 (continued)

Terminology	Definition
Moderate medical encounter	A medical encounter that: 1. *is significant (severe) enough to result in withdrawal of the athlete from the event following assessment by the medical staff,* **or** 2. *is non-life threatening but requires medical assessment and admission to the event medical facilities with supervised medical care,* **or** 3. *is non-life threatening but requires referral or transfer to a hospital*
Serious/life-threatening medical encounter	A medical encounter that is known to be life- threatening and requires immediate emergency medical treatment with 1. *either admission to a high-care (intensive care and observation) medical area at the event,* **or** 2. *transport (with or without admission) to a hospital*
Event related sudden cardiac arrest (SCA)	A medical encounter (cardiac arrest) that requires immediate cardiopulmonary resuscitation (including defibrillation), where the medical problem resulting in cardiac arrest was: 1. *deemed to be directly related to the event,* **and** 2. *the onset of the medical problem occurred during the event or within 1–24 h of the finish time* [20, 70, 71][a]
Event related sudden cardiac death (SCD)	A medical encounter that resulted in sudden cardiac death (SCD) from a SCA, where the medical problem resulting in SCD was: 1. *deemed to be directly related to the event,* **and** 2. *the onset of the medical problem occurred during the event or within 1–24 h of the finish time* [20, 70, 71][a]
Event related sudden death	A medical encounter that resulted in sudden death from non-cardiac causes, where the medical problem resulting in death was: 1. *deemed to be directly related to the event,* **and** 2. *the onset of the medical problem occurred during the event or within 1–24 h of the finish time* [20, 70, 71][a]

[a]In order to compare sudden cardiac arrest (SCA), sudden cardiac death (SCD) and event related sudden death data to previously reported data it is critical to record, the timing of the cardiac arrest or death in one of three possible time periods as follows: (a) during the event, (b) immediately after finishing and up to 1 h after the event, and c) between 1 and 24 h after the event

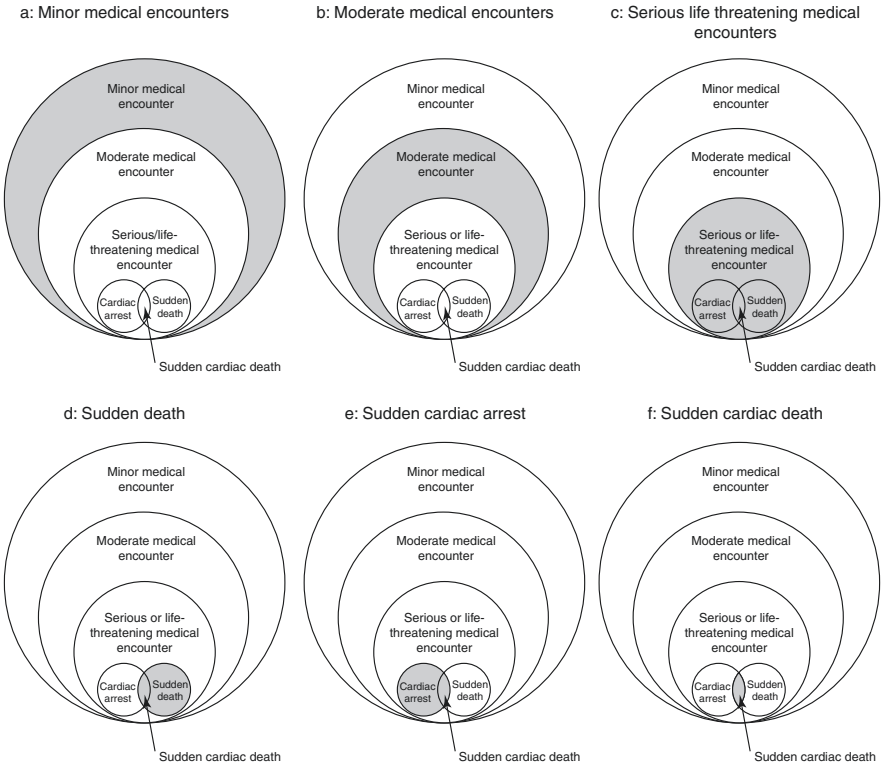

Fig. 29.1 Classification of medical encounters by severity. (Reproduced with permission from [1])

of acute medical complications [5, 6], including acute myocardial infarction and sudden cardiac death [7–11].

- **Exercise benefit-risk paradox 1**: Regular moderate-to high-intensity physical activity is both associated with substantial long-term health benefits, there are also potential negative health consequences during an acute exercise session [7–11].
- **Exercise benefit-risk paradox 2**: The greatest health benefits of regular exercise are frequently observed in
  - sedentary individuals that transition to becoming physically active, and
  - patients with known chronic disease [12]

but these groups also have a higher risk of potential acute medical complications during an exercise session [7, 9, 13–16].

It is important that the exercise benefit-risk paradoxical observations need to be placed into perspective. Data from >30 meta-analyses unequivocally support the recommendation that, from a population perspective, *the participation*

in regular physical activity in these two groups of individuals still far outweighs the potential negative health consequences of an acute exercise session [7–9, 14, 15].

29.2 Planning to Reduce the Risk of Medical Encounters at Mass Community-Based Sports Events

Race medical teams/race medical directors have a responsibility to reduce the risk of medical encounters at mass community-based sports events. Three pre-race planning and implementation steps are important to reduce this risk:

1. Quantify the risk of acute medical encounters during exercise.
2. Identify causes, risk factors and the frequency of "at-risk" individuals for medical encounters.
3. Design and implement measures to reduce the risk of acute medical encounters during an exercise session.

29.2.1 Step 1: Quantifying the Risk of Acute Medical Encounters During Exercise

Physical exercise can trigger acute cardiovascular in both younger and older athletic populations [7, 11, 13, 17–22]. The relative risk of an acute cardiovascular event during exercise, compared with sedentary activity, varies from 2 times in young athletes [11] to as much as 56 times in older individuals who are at risk for cardiovascular disease or who have existing cardiovascular disease [7, 11, 16]. The absolute risk of an acute cardiovascular event during an exercise session is consistently reported as being very low (1 in 50,000 to 1 in 200,000 annually) [7–9, 11, 14, 15]. The risk of sudden death during mass community-based distance running events such as the half-marathon (21 km) and the marathon (42 km) are well described [11, 17, 23–29], and there is considerable variation in the reported absolute risk of sudden death during marathons and similar races (between 1 in 30,000 to 1 in 250,000 race entrants); generally this risk is 1 in 114,000 race entrants (calculated cumulative risk) [11] and therefore also reported as being very low.

Besides sudden death during marathon running, sudden cardiac arrest (including non-fatal cardiac arrest) and other serious medical complications can also occur. In Table 29.2, the absolute risk of medical complications during distance running by severity (sudden death, sudden cardiac arrest, serious medical complications, and any medical complication) is summarized [30].

- In comparison to sudden death, the risk of sudden cardiac arrest during a marathon race is 2–3 times higher [11].
- In comparison to sudden death, the relative risk of a serious medical complication at a distance running event such as the marathon is 50–100 times higher than sudden death.

Table 29.2 The absolute risk of medical encounters during distance running by severity (sudden death, sudden cardiac arrest, serious medical encounters, any medical encounter)—rates are expressed per 100,000 race entrants and number of entrants per single incident. (Reproduced with permission from [30])

Severity of medical encounter	Event/s	Absolute risk (per 100,000 race entrants)	Absolute risk (number of race entrants per 1 incident)
Sudden cardiac death (SCD)	US Marathons (1976–1994) [72]	1.8	55,556
	US Marathons (1995–2004) [73]	0.5	200,000
	US marathons (1976–2009) [24]	0.58	171,005
	UK marathons (1981–2006) [74]	1.5	66,667
	RACER registry—US marathons and half-marathons (2000–2010) [26]	0.4	250,000
	Two Oceans races (SA)(2008–2011) [29]	3.4	29,412
	French marathons and half marathons (RACE)(2006–2012) [75]	0.4	250,000
	Tel Aviv races (2007–2013) [76]	1.4	69,000
Sudden cardiac arrest (SCA)	US Marathons (1976–1994) [72]	2.3	43,478
	US Marathons (1995–2004) [73]	1.8	55,556
	US marathons (1976–2009) [24]	1.75	57,002
	Two popular US marathons (1982–2009) [23]	2.6	38,461
	UK marathons (1981–2006) [74]	2.5	40,000
	RACER registry—US marathons and half-marathons (2000–2010) [26]	0.5	200,000
	Two Oceans races (SA)(2008–2011) [29]	4.6	21,739
	French marathons and half marathons (RACE)(2006–2012) [75]	1.8	55,556
Serious medical encounter[a]	Vancouver International Marathon (2006–2011) [31]	53	1887
	Baltimore Marathon (2002–2005) [31]	47	2128
	Baltimore Marathon (2001) [31]	155	645
	Twin Cities Marathon (1983–1994) [31]	35	2857
	Two Oceans races (SA)(2008–2011) [29]	56	1786
	Tel Aviv races (2007–2013) [76]	16.7	5988
Any medical encounter[b]	Vancouver International Marathon (2006–2011) [31]	4449	22
	Baltimore Marathon (2002–2005) [31]	3395	29
	Baltimore Marathon (2001) [31]	2282	44
	Twin Cities Marathon (1983–1994) [31]	1908	52
	Two Oceans races (SA)(2008–2011) [29]	827	121

[a]Variable definitions: generally the number of patients transferred by any means by the medical team for further investigation and/or management (Medical Transfer Rate—MTR) [31]

[b]Variable definition: generally the number of athletes that are attended to on site by the medical team (Patient Presentation Rate—PPR) [31]

- The absolute risk of any medical complication during a marathon race also varies between 1 in 22 to 1 in 121 entrants, but generally is about 1 in 50 runners.
- The clinical relevance of these data is that in a marathon with a large field of 50,000 runners, the medical staff will, on average, encounter a:
  - sudden death every 2–3 years,
  - sudden cardiac arrest every year,
  - 25 runners that present with a serious medical complication requiring specialized management or hospitalization, and
  - 1000 runners that require medical attention (Fig. 29.2) [30].

This risk continuum is an important consideration in planning medical coverage at large mass community-based sports events. Providing this coverage is a considerable undertaking and requires careful planning long in advance of the event, recruitment of a large team of specialized medical staff [31], the establishment of considerable infrastructure, and securing sophisticated equipment at race medical facilities to ensure race safety.

Many factors determine the risk of a medical encounter during mass community-based sports events including:

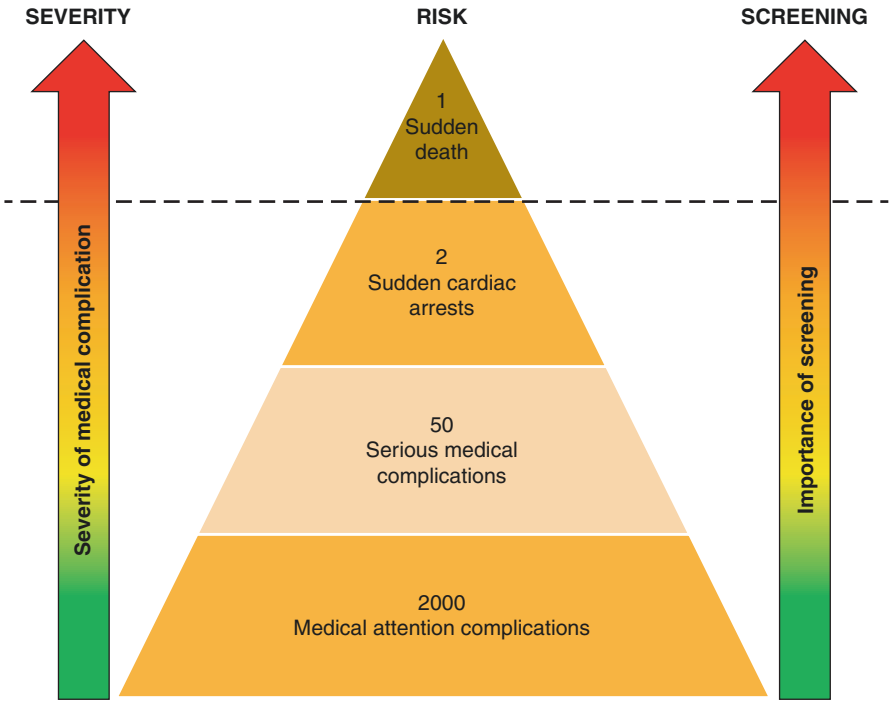

Fig. 29.2 Risk of medical complications, severity and screening continuum—estimated absolute risk (per 100,000 race entrants) of medical complications in distance running events. (Reproduced with permission from [30])

- environmental conditions on race day,
- the course and race distance, and
- the "risk" demographics of the running population (runner experience, runner education, and runners with risk factors for acute medical complications during exercise),

all of which may influence the incidence of these complications at a specific race [31].

29.2.2 Step 2: Identify Causes, Risk Factors and the Frequency of "at-risk" Individuals for Medical Encounters

The demographics of participants in mass community-based sports events is changing. In the distance running population, demographics changed over the past two to three decades, with almost 50% of current marathon entrants being older than 40 years.

29.2.2.1 Risk Factors Associated with Acute Cardiovascular Encounters

The most common cause of sudden death or cardiac arrest in older marathon runners is coronary artery disease.

- According to the European guidelines [32, 33], older runners (males >45 years; females >55 years) with one or more risk factors for CVD, and runners of younger age with two or more risk factors for CVD, require medical assessment before engaging in moderate- to high-intensity exercise such as distance running.
- Recently, it was shown that:
  - 10% of Master athletes (mean age 50 ± 9 years) have existing cardiovascular disease, and 64% have at least one risk factor for cardiovascular disease [34].
  - 16.1% of runners reported at least one risk factor for CVD, with 13.4% reporting more than one risk factor with the most common specific risk factors for CVD being males >45 years (15%), high blood cholesterol concentration (5.8%), high blood pressure (4.4%) and a family history of heart disease (4.4%).
- Risk factors associated with an acute cardiovascular complication during an exercise session are summarized in Table 29.3.

29.2.2.2 Risk Factors Associated with Other Causes of Sudden Death and Serious Medical Encounters

There are other causes of sudden death and serious medical encounters during mass community-based sports events that are not related to coronary artery disease, including the following:

(a) severe fluid and electrolyte abnormalities (mainly hyponatremia)
(b) acute renal failure

Table 29.3 Risk factors associated with an increased relative risk of acute cardiovascular complications during moderate- to high-intensity exercise. (Reproduced with permission from [30])

Risk factor	Sub-category with increased relative risk
Sex [9, 13, 14]	• Males
Age [9, 13]	• Older age (> 35 years)
Habitual exercise status [9, 13–15, 31]	• Sedentary (no exercise sessions per week) (novice runner)
Exercise duration [31]	• Unaccustomed prolonged exercise
Exercise intensity [15]	• Unaccustomed high-intensity exercise (> 80% maximum capacity)
Underlying chronic disease (known or unknown) [9, 13, 15]	• Cardiovascular disease, metabolic disease including diabetes mellitus, renal disease, other chronic disease
Presence of risk factors for chronic disease [13]	• Family history of premature CVD, dyslipidemia, increased BMI, smoking status, hypertension
Symptoms of cardiovascular disease [9, 15, 32]	• Chest pain including discomfort in the chest, neck, jaw, arms or other areas, shortness of breath at rest or with mild exertion, dizziness or syncope, orthopnea or paroxysmal nocturnal dyspnea, ankle edema, palpitations or tachycardia, intermittent claudication, know heart murmur, unusual fatigue or shortness of breath with usual activities
Acute illness and inflammation [18, 77]	• Inflammation and increased risk of plaque rupture • Infective illness associated with myo-pericarditis • Infective illness associated with exertional heatstroke • Infective illness associated with exertional rhabdomyolysis
Drugs and medication use [78–80]	• Arrhythmogenic drugs (including performance enhancing drugs, social drugs, prescribed medication) • Drugs associated with rhabdomyolysis • Drugs increasing the risk of severe electrolyte abnormalities resulting in arrhythmias (e.g. hyponatremia, hypokalemia)
Education [31]	• Poor runner education

(c) exertional heat stroke
(d) other serious encounters

Risk factors for these other non-cardiac encounters should also be considered in an intervention strategy to reduce the risk of acute medical encounters during exercise (Table 29.4). Race participants may have several intrinsic risk factors that can predispose them to serious acute cardiovascular (Table 29.3) or other serious non-cardiac medical complications (Table 29.4) on race day. The risk of a medical complication on race day in the "at risk" runner is also influenced by other extrinsic factors such as

- exposure to adverse environmental conditions (heat and humidity, altitude, pollution),
- the race distance, and
- course characteristics.

Table 29.4 Risk factors associated with an increased relative risk of other serious medical complications during moderate- to high-intensity exercise. (Reproduced with permission from [30])

Medical complication	Risk factors
Hyponatremia [81–83]	• Overdrinking (water, sports drinks and other hypotonic beverages) • Exercise duration >4 h • Event inexperience or inadequate training • Slow running or performance pace • High or low body mass index • Readily available fluids • Drugs and medication • Skeletal muscle damage (rhabdomyolysis)
Acute kidney injury and renal failure [84–87]	• Underlying chronic renal disease • Renal hypouricemia, • Sickle cell disease • Latent myopathy • Rhabomyolysis • Acute illness (viral, bacterial) • Drugs and medication (NSAIDs, analgesics) • Dehydration
Exertional heatstroke [88–92]	• History of heatstroke • Fever • Acute infective illness (upper respiratory, gastrointestinal) • Diarrhea, vomiting • Sweat gland dysfunction • Sunburn • Dehydration • Medications (diuretics, anti-depressants) • Sleep loss • Advanced age • Excessive alcohol use • Lack of heat acclimatization • Sedentary lifestyle (low physical fitness) • Overweight/obesity • Cardiovascular dysfunction • Hypokalemia

29.2.2.3 How Common Are Risk Factors Associated with Medical Encounters in Race Participants?

Over the past two decades, the demographics of the marathon participant shifted to older runners and female runners [13]. There is an increase of >12-fold in overall participation in marathon runners since 1976, with a notable increase in participation in the older age groups (>40 years); in 2015, 49% of all runners completing marathons in the USA were masters (>40 years old).

- The prevalence of risk factors in 21 km and 56 km runners was recently documented through an online pre-participation screening tool, and showed the following:
  - 2.3% of all runners reported known existing cardiovascular disease (CVD)

  - the most common CVD's were coronary artery disease (0.5%), followed by arrhythmia (0.4%)
  - 1.8% runners reported symptoms that may be suggestive of CVD.
- Four risk categories for medical encounters during participation (very high risk, high risk, intermediate risk and low risk) in participants that underwent screening with criteria, recommended interventions and frequency in runners have been published [35, 36] (Table 29.5).

29.2.2.4 Prescription Medication as a Risk Factor for Medical Encounters During Exercise

The use of prescription medication is extremely common among mass races participants (47.2% of runners) and is among the most common criteria identified by the current European guidelines [32, 33], for recommending consulting a physician before exercise. The potential risk of a medical complication during exercise, as a result of prescription medication, can vary greatly and is related to the underlying medical condition for which the medication is prescribed, and the side effect profile of the medication.

Pharmacological agents may be associated with an increased risk of developing medical complications during exercise as follows:

(a) cardiac arrhythmias [37–40]
(b) renal complications including acute renal failure [41], rhabdomyolysis [42, 43]
(c) gastrointestinal bleeding [44–46]
(d) risk of tendon injuries including acute tendon rupture [47, 48].

- **Analgesic and anti-inflammatory medications** (AAIM) use is particularly frequent among athletes due to the high injury rate (SAFER VI). A considerable number of runners (15.6%) reported ingestion of pharmacological agents, mainly anti-inflammatory medication (7.8%) and more specifically NSAIDs (4.9%), in the 7 days before or during races is of concern.
- **Stimulants** such as methylphenidate and dextroamphetamine-AMP, commonly prescribed for the treatment of attention deficit hyperactivity disorder can have severe consequences when exercising for a prolonged period of time in a hot environment. These substances increase the availability of dopamine, masking the signs and symptoms of fatigue, and allowing for a longer duration of exercise. This might lead to elevated temperature in excess of 40 °C and increased heart rate, thus predisposing to exertional heat illness [49].
- **Anti-depressants**, in particular selective serotonin reuptake inhibitors (SSRIs), have a significant impact on body temperature regulation. Thermoregulation is controlled by dopamine and serotonin. When the neurotransmitters' balance is impaired, the hypothalamic set temperature could be impacted, increasing the risk of exertional heat illness [50]. Furthermore, SSRIs have been found to reduce the serum sodium concentrations, thus, thirst. This could lead to an increased dehydration during exercise in the heat [51].

Table 29.5 Risk categories, clinical categories, and criteria for risk stratification in distance runner entrants. (Reproduced with permission from [1])

Risk category	Clinical category	Criteria for risk stratification
Very high risk	Existing CVD or symptoms of CVD	1. Any runner who answered "yes" to *one (or more)* of the following questions (below): (a) Have you ever suffered from any heart or blood vessel conditions including heart attack, undiagnosed chest pain, coronary artery bypass operation, angioplasty (balloon), heart failure, heart transplant, cardiac arrhythmia (abnormal heart beat), rheumatic fever, heart murmur, cardiomyopathy, myocarditis, use of a pacemaker, or inherited heart defect? (b) Do you use any prescribed medication on a daily weekly or monthly basis to treat heart rhythm, heart failure, or other heart disease? (c) Do you currently suffer from any symptoms of heart or blood vessel disease, including any of the following: shortness of breath when sitting or lying down, shortness of breath with mild exercise, waking up with shortness of breath at night, palpitations that make you dizzy, chest pain when sitting or performing exercise or when you are emotionally stressed, pain (or discomfort) in the neck jaw arms at rest or during exercise, dizziness during exercise or fainting spells)?
High risk	Risk factors for CVD	1. Any male runner ≥45 years or female runner ≥55 years, who answered "yes" to any **one** of the following questions (below): 2. Any runner (other than male runners ≥45 years or female runners ≥55 years) who answered "yes" to **two or more** of the following questions (below): (a) Are you aware or have you ever been diagnosed with any risk factors for heart or blood vessel disease including high blood cholesterol a family member with heart disease cigarette smoking lack of physical activity high blood pressure being overweight or having diabetes mellitus (sugar sickness)? (b) Do you use any prescribed medication on a daily weekly or monthly basis to treat high blood cholesterol, blood pressure, treat diabetes (tables or insulin)?

Intermediate risk	One risk factor for CVD **or** existing other chronic disease **or** use of prescription medication **or** use of medication before and during races **or** history of collapse during training/racing **or** known current injury **or** history of EAMC	1. Any male runner ≥45 years OR female runner ≥55 years 2. Any runner who answered "yes" to **one** of the components in the following question (below): (a) Are you aware or have you ever been diagnosed with any risk factors for heart or blood vessel disease including high blood cholesterol a family member with heart disease cigarette smoking lack of physical activity high blood pressure being overweight or having diabetes mellitus (sugar sickness)? 3. Any runner who answered "yes" to **one (or more)** of the following questions (below): (a) Do you currently suffer from any metabolic or hormonal disease including diabetes mellitus thyroid gland disorders hypoglycemia (low blood sugar) hyperglycemia (high blood sugar) or heat intolerance? (b) Do you suffer from any respiratory (lung) disease including asthma emphysema (COPD) wheezing cough postnasal drip hay fever or repeated flu like illness? (c) Do you suffer from any gastrointestinal disease including heartburn nausea vomiting abdominal pain weight loss or gain (>5 kg) a change in bowel habits chronic diarrhea blood in the stools or past history of liver or gallbladder disease? (d) Do you suffer from any diseases of the nervous system including past history of stroke or transient ischemic attack (TIA) frequent headaches epilepsy depression anxiety attacks muscle weakness nerve tingling loss of sensation or chronic fatigue? (e) Do you suffer from any disease of the kidney or bladder including past history of kidney or bladder disease blood in the urine loin pain kidney stones frequent urination or burning during urination? (f) Do you suffer from any disease of the blood or immune system including anemia recurrent infections HIV/AIDS leukemia or are you using any immunosuppressive medication? (g) Do you suffer from any growths or cancer including a past history of cancer? (h) Do you suffer from any allergies including a past history of allergies to medication plant material or animal material? (i) At the moment do you use any prescribed medication on a daily weekly or monthly basis to treat chronic (long-term) medical conditions or injuries? (j) Have you ever in your running career used medicines to treat injuries in the week before a race—including anti-inflammatory drugs cortisone (pills or injection) or painkillers? (k) Have you ever in your running career used medicines to treat injuries during a race—including anti-inflammatory drugs cortisone (pills or injection) or pain killer? (l) Do you, or did you suffer from any symptoms of a running injury (muscles tendons bones ligaments or joints) in the last 12 months? (m) Have you ever collapsed (fell down not because of an accident needing medical attention) during at the finish or after a race or training session? (n) Have you ever in your running career suffered from muscle cramping (painful spontaneous sustained spasm of a muscle) during or immediately (within 6 h) after running (in training or competition)?
Low risk	No reported medical history	1. Any runner who answered "**no**" to **all** the medical screening questions

CVD cardiovascular disease, *EAMC* exercise associated muscle cramp

- **Statins** are the most effective and frequently prescribed medications for the management of high concentrations of low-density lipoprotein cholesterol (LDL-C). Inhibition of HMG-CoA-reductase prevents the production of mevalonic acid. Mevalonate is also produced in response to heat stress and an increased production of mevalonate is associated to a greater tolerance to heat at cellular level. Therefore, preventing the production of mevalonate could potentially place an individual at risk of exertional heat stress.

The cardiovascular effects of commonly prescribed substances are extensively presented in another chapter in this book; therefore, readers are invited to refer to that specific chapter (Chap. 28). Nevertheless, some substances are particularly relevant for endurance events participants, for the severe side effects they can have.

29.2.2.5 Step 3: Design and Implement Measures to Reduce the Risk of Medical Encounters During Exercise

Introduction to Pre-exercise Screening

International guidelines to reduce the risk of acute cardiovascular risk during exercise have been developed and implemented by many sports federations [10, 52], and international bodies including the International Olympic Committee (IOC) [53] and the International Paralympic Committee (IPC) either mandate or recommend pre-participation screening [10]. However, currently these screening programs focus mostly on screening younger elite athletes [21, 54, 55], and concentrate almost exclusively on pre-participation *cardiac* screening (including a resting ECG) to reduce the risk of acute cardiovascular complications.

- In Canada, the Physical Activity Readiness Questionnaire (PAR-Q+) and the Physical Activity Readiness Medical Examination (ePARMed-X+) were developed as primary front-line pre-participation tools for physical activity [56], and are based on a systematic review of evidence (see Chap. 7) [57, 58].
- Similarly, the American Heart Association (AHA) [59] and the American College of Sports Medicine (ACSM) [15] have recommendations for pre-participation screening.
- The European Society of Cardiology together with the European Association of Cardiovascular Prevention and Rehabilitation [32] specifically developed recommendations, by consensus, for the pre-participation screening of masters and leisure athletes.
- The first step in the recommended screening process is a "self-assessment of risk", and this is based on the American Heart Association (AHA)/American College of Sports Medicine (ACSM) pre-participation screening questionnaire for individuals at Health/Fitness facilities [60] and the PAR-Q [32].
- The European guidelines recommend that this initial "self-assessment of risk" can be conducted by the individual and consists of health information related to:
  - any history of known cardiovascular disease, cardiovascular symptoms, medication use, and other health issues (Sect. 29.1), and

– known risk factors for cardiovascular disease including male gender, older age, hypertension, smoking, hypercholesterolemia, diabetes or hyperglycemia, and obesity (Sect. 29.2).

Based on the responses to questions in Sect. 29.1 (any one positive response to a question) and Sect. 29.2 (presence of ≥2 risk factors), it is then recommended that individuals undergo a thorough medical assessment by a qualified physician before participating in moderate- to high-intensity exercise, such as distance running [32].

- In one study, the ESC/EACPR screening guidelines have been applied to adult participants >40 years of age, who participated in the National Health and Nutrition Examination Survey (2001–2004) [61]. Based on "self-assessment of risk", approximately 95% of women and 93.5% were advised to consult a physician before embarking on exercise [20].
- In two other studies, full pre-participation screening incorporating medical histories, physical examination and special investigations (electrocardiography, echocardiography and blood tests) effectively identified middle-aged athletes with risk factors of cardiovascular disease (CVD) [62, 63].

However, neither study identified the links between the "risk self-assessment" and the outcome of the full screening. Although ideal, full screening of every leisure athlete older than 45 years who participate in large community events would not be cost-effective or logistically feasible.

29.2.2.6 What Is the Role of Pre-event Medical Screening for Mass Sporting Events?

A potential strategy to reduce the number of medical encounters is the development of an online pre-participation "self-assessment of risk", as currently recommended by European guidelines, during pre-race registration in community-based mass sports participation (distance running) event. International pre-exercise screening recommendations in leisure athletes [15, 32, 33] are currently not applied at community-based mass participation events and there are few data that these guidelines are indeed appropriate for pre-event medical screening of leisure athletes.

- In one study involving >15,000 recreational distance runners, the pre-race screening tool (Table 29.6) identified that over 30% of entrants for this event would, according to current European guidelines, require referral for a full medical assessment prior to participation in the distance races (moderate-to-high intensity exercise).

29.2.2.7 Does Pre-event Screening Reduce Medical Encounters?

International medical associations have produced consensus-based recommendations/guidelines to screen individuals prior to engaging in moderate- to high-intensity exercise [15, 32, 33, 56, 59]. Pre-screening must be accompanied by an individualized educational intervention program.

Table 29.6 Summary: main elements of the pre-race medical screening tool. (Reproduced with permission from [1])

Medical screening tool: self-assessment of risk[a]
1. Have you ever suffered from any heart or blood vessel conditions including heart attack, undiagnosed chest pain, coronary artery bypass operation, angioplasty (balloon), heart failure, heart transplant, cardiac arrhythmia (abnormal heart beat), rheumatic fever, heart murmur, cardiomyopathy, myocarditis, use of a pacemaker, or inherited heart defect?
2. Do you currently suffer from any symptoms of heart or blood vessel disease, including any of the following: shortness of breath when sitting or lying down, shortness of breath with mild exercise, waking up with shortness of breath at night, palpitations that make you dizzy, chest pain when sitting or performing exercise or when you are emotionally stressed, pain (or discomfort) in the neck jaw arms at rest or during exercise, dizziness during exercise or fainting spells)?
3. Are you aware or have you ever been diagnosed with any risk factors for heart or blood vessel disease including high blood cholesterol, a family member with heart disease, cigarette smoking, lack of physical activity, high blood pressure, being overweight, or having diabetes mellitus (sugar sickness)?
4. Do you currently suffer from any metabolic or hormonal disease including diabetes mellitus thyroid gland disorders hypoglycemia (low blood sugar) hyperglycemia (high blood sugar), or heat intolerance?
5. Do you suffer from any respiratory (lung) disease including asthma, emphysema (COPD), wheezing, cough, postnasal drip, hay fever, or repeated flu like illness?
6. Do you suffer from any gastrointestinal disease including heartburn, nausea, vomiting, abdominal pain, weight loss or gain (> 5 kg), a change in bowel habits, chronic diarrhea, blood in the stools, or past history of liver or gallbladder disease?
7. Do you suffer from any diseases of the nervous system including past history of stroke or transient ischemic attack (TIA), frequent headaches, epilepsy, depression, anxiety attacks, muscle weakness, nerve tingling, loss of sensation, or chronic fatigue?
8. Do you suffer from any disease of the kidney or bladder including past history of kidney or bladder disease, blood in the urine, loin pain, kidney stones, frequent urination, or burning during urination?
9. Do you suffer from any disease of the blood or immune system including anemia, recurrent infections, HIV/AIDS, leukemia, or are you using any immunosuppressive medication?
10. Do you suffer from any growths or cancer, including a past history of cancer?
11. Do you suffer from any allergies including a past history of allergies, to medication, plant material, or animal material?
12. At the moment do you use any prescribed medication on a daily weekly or monthly basis to treat chronic (long-term) medical conditions or injuries?
13. Have you ever collapsed (fell down not because of an accident needing medical attention) during at the finish or after a race or training session?
14. Do you, or did you suffer from any symptoms of a running injury (muscles tendons bones ligaments or joints) in the last 12 months?
15. Have you ever in your running career suffered from muscle cramping (painful spontaneous sustained spasm of a muscle) during or immediately (within 6 h) after running (in training or competition)?

[a]Once a participant answered "yes" to any of the main screening questions, further details were obtained using "dropdown" boxes with additional questions

- In one recently published study, such a pre-race screening and educational intervention was shown to be associated with the following [36]:
  - A reduction in overall medical encounters of 29% (21.1 km race—reduction by 19%; 56 km race—reduction by 39%).

- A reduction in serious life-threatening medical encounters by 64%.
- Registration numbers increased in the intervention period, and overall % race starters (81.5%) were similar in the control (81.0%) and intervention period (81.8%).
- The wet bulb globe temperature (WBGT) was similar in the control and intervention period.

29.2.3 Planning Medical Care on Race Day for Mass Community-Based Sporting Events

29.2.3.1 Pre-race Planning

- Race organizers should appoint a Medical Director as head of the Medical Team.
- The Medical Director is ultimately responsible for all health care services provided at all official sites, venues and accommodation areas.
- The Medical Director is in charge of the overall coordination of medical organization and represents the Medical Team of the Organising Committee.
- The Medical Director's responsibilities include:
  - Ensure recruitment and supervision of the various medical personnel.
  - Design a comprehensive health care system, making sure that adequate facilities, supplies and equipment are available for medical care at all official sites.
  - Co-ordination of community medical resources, including emergency transport services, emergency room(s) and hospital admissions.

29.2.3.2 Planning Health Care Services on Race Day

The scope of health care services on race day includes:

(a) critical care,
(b) first-aid,
(c) treatment for environmental illnesses, and
(d) general medical problems associated with endurance events.

The extent of services depends on the location, duration and type of competition, as well as the type and number of participants expected, and the nature of the injuries or illnesses which are predictable.

Health Care Services include, but are not limited to the following:

- Adequate facilities available for medical services to cover all people and all competition sites;
- Provision of primary and emergency care to all above mentioned people at the various venues and areas of the event, at no charge to all eligible persons;
- Provision of other medical support services needed to ensure the safety and health of the aforementioned, and of the spectators;
- Coordinating service with the hospital network and emergency services;
- Supervision of environmental, meteorological health and safety at all sites.

29.3 Guidelines to Minimize the Potential Negative Effects of Environmental Stress, Including Air Quality

29.3.1 Heat Stress

The risk of heat illness increases above 21 °C (70 °F) and 50% relative humidity. The WBGT, which measures the combined thermal stress from the wet bulb (WBT), dry bulb (DBT), and black globe (BGT) thermometers has been widely used to assess environmental heat stress. Several thermal stress indexes have been developed through the years and provide with further information, like the Physiologically Equivalent Temperature (PET), the modified PET (mPET) and Universal Thermal Climate (UTCI) indexes.

The thermal index and colour coded flags to indicate the risks of thermal stress are:

BLACK FLAG:	Extreme Risk—WBGT >28 °C (82 °F), PET >35 °C
RED FLAG:	High Risk—WBGT is 23–28 °C (73–82 °F), PET is 29–35 °C
YELLOW FLAG:	Moderate Risk—WBGT is 18–23 °C (65–73 °F), PET is 23–29 °C
GREEN FLAG:	Low Risk—WBGT is below 18 °C (65 °F), PET is 18–23 °C
WHITE FLAG:	No Risk for heat stress but increasing risk for hypothermia when—WBGT is below 10 °C (50 °F), PET 18 °C.

A recent publication [64] has clarified and established the relationship between environmental parameters on race day and the risk of not completing the race due to excessive heat stress. This relationship has been described through the following formula (t, temperature):

$$\%\text{Do Not Finish} = -0.59 \times t^{\circ}\text{C} + 0.02 \times t^{\circ}\text{C}^2 + 5.75$$

In general, particularly considering endurance events, better performance and less adverse results are obtained when the environmental conditions are going to improve, rather than worsen, during the event. As an example, in hot environmental conditions, start times would be better set for late afternoon rather than early morning (increased thermal stress in sunny morning), for road racing.

29.3.1.1 Air Quality

- The health impact of living and exercising in highly polluted environments have been widely demonstrated in the scientific literature [65–67].
- Therefore, the monitoring programmes of local pollution and pollen ratings before and during an endurance event should be implemented.
- Daily average of main pollutants (NO_2, O_3, particulate matter (PM2.5, PM10), CO) should be provided, before and for the entire duration of the event.

29.3.2 Medical Facilities on Race Day

Medical services must be available on the race course, and available to all participants. The medical areas should include:

(a) a pre-starting line treatment area;
(b) medical first-aid teams along the course, ideally every 5 km or located in strategic positions;
(c) a triage/emergency area at the finish line;
(d) the main treatment area at the finish line (with ambulances stationed near-by).

Advanced life support emergency ambulance with AED coverage should be available along the whole course, up to the finish line. The first-aid teams should evacuate all injured or sick athletes from the course at the earliest time, and transfer all of them to the main treatment area at the finish line. The evaluation and treatment of environmental and exercise related medical problems like dehydration, hyperthermia, hypothermia, exercise associated collapse, and problems associated with road racing, including allergic responses such as anaphylactic shock, hives, asthma exacerbation, and diabetic insulin reactions is of notable importance.

29.4 Aid Stations

- Aid stations should be located every 5 km or at pre-defined medical points along the course.
- AED and first-aid kits shall be available.
- Equipment and supplies for obtaining vital signs, performing BLSD and ACLS should be available at major on-course medical stations.

29.5 Roving Medical Vehicles and Critical Care Teams

- Roving medical vehicles and mobile medical aid, though they are impeded by runners, offer the best solution for rapid response to a collapsed athlete on a road course.
- The use of fully-equipped ambulances on the course is advantageous and increases the medical response capabilities.
- Equipment and supplies for obtaining vital signs, performing Basic Life Support—Defibrillation (BLSD) and Advanced Cardiac Life Support (ACLS) should be available in the roving medical vehicles.

29.6 First Response Teams

- AED-equipped motorcycles or bicycles have rapid access to collapsed athletes with potential cardiac arrest.
- Operators must be trained in the use of AED, and the team must be integrated with the local emergency medical system.
- Several teams must be assigned along the course to follow the main pack and separated by 2–4 km giving rapid access to most runners.
- First response teams should be prepared to evaluate and treat cardiac arrest, exertional heat stroke, hyponatremia, diabetic insulin shock, status asthma, and exercise-or allergic anaphylaxis.

29.7 Finish Line Area

It has been widely demonstrated that the number of medical encounters in the final quarter of the race is significantly higher in respect to other segments. Therefore, in the last 2 km of the course, medical staff and supplies should be increased. Usually at this stage of the race runners are tired but still try to increase their pace as they approach the finish line, thus the number of collapses increase.

- The last 500 m should have several medical staff deployed along the course to act as spotters for runners in distress.
- This is particularly important for mass road races. Equipment and supplies for obtaining vital signs, performing BLSD and ACLS should be available at the finish line.
- The finish line is usually where most medical encounters occur.
- This is the location where the majority of medical staff and volunteers should be.
- The finish line team should include:
  - A Triage Officer and team to direct the flow of casualties to the proper area for care; and
  - Sweep team/field medical personnel divided into medical care teams that can spot runners as soon as they show signs of distress, transporting them to the closest medical point or manage medical illnesses or injuries on site.

Dedicated medical areas may be organised for participants based on injury or illness. The triage team should direct runners to the proper care centre.

29.8 Documenting Medical Encounters at Community-Based Sporting Events

General race data and medical encounter data at mass community-based endurance sport events should be collected in a standardised format and this has been covered extensively in a recently published international consensus statement [1]. Research methods related to event data collection, athlete demographics, sport code, sport

participation history, medical incident data collection procedures and reporting of the data are critical for quality of any scientific studies in this field. The following categories of general race data should be collected (Table 29.7):

- race day data,
- athlete demographics,
- athlete race performance, and
- geographical data of the course.

Table 29.7 Data collection (essential and additional data) on race day, athlete demographics, athlete race performance, course geography, and environmental conditions on race day. (Reproduced with permission from [1])

Category	Minimum/essential data	Additional data
Race day data	• Location (nearest city) • Date of the race (dd:mm:yyyy) • Official starting time (hh:mm:ss) • Official cut-off (finish) time (hh:mm:ss) • Number of registrants (entrants): The number of athletes who register to participate in the event. • Number of starters: The number of registered athletes who start the event. • Number of finishers: The number of registered starting athletes who finish the event	
Athlete demographics (individual athlete data)	• Age (on registration day) • Sex	• Height (cm) • Body weight (kg)
Athlete race performance (individual athlete data)	• Race discipline (if applicable – different sporting codes) • Race registered for (if applicable – different race distances) • Race starting time (hh:mm:ss) • Race finishing time (hh:mm:ss) • Calculated total race time (hh:mm:ss)	• Previous participation in this event type (number of previous races in this event type) • No. of times previously participated in this race (number) • Personal best time for this race (hh:mm) • Qualifying time for this race (if applicable: event and time—hh:mm:ss) • No. of races participated in, in previous year (number) • Date of last race participated in (dd:mm:yyyy) • Personal best time for this event in the last 12 months year (hh:mm:ss) • Average regular training in the last 12 months (h/w)? Split times [distance (km) from the start line should be recorded in conjunction with the split time (hh:mm:ss)]

(continued)

Table 29.7 (continued)

Category	Minimum/essential data	Additional data
Geographical data of the course	• Total course distance (m) • Individual course sections (if applicable e.g. triathlons) (m) • Altitude (m) (mean, range) • Total elevation of the event course (m) • Change in elevation (m)	• Type of surface of the event course (if applicable) (tar, asphalt, off-road, grass/, gravel, sand etc.) • Nature of the event course surface (wet, dry)
Environmental conditions on race day	• Ambient temperature (°C) • Relative humidity (%) • Wind speed (km/hr) • Wind direction (degrees) • Precipitation (mm) • Wet Bulb Globe Temperature (WBGT) Index (°C) (at the start and finish of the race)	• Wet Bulb Globe Temperature (WBGT) Index (°C) (continuously throughout the race) • Pollution (air quality index) (numeric air quality index (AQI) or ppbv/ppmv or $mg.m^{-3}$/$\mu g.m^{-3}$ for PM_{10}, $PM_{2.5}$, $PM_{0.1}$) (e.g. NO_2, O_3) • Pollen count (grains/m^3) • Ultraviolet (UV) radiation Index • PET (Physiological Equivalent Temperature) index. The PET utilizes i.e. air temperature, air humidity (relative humidity, specific humidity or any other measure of air humidity), wind speed, global radiation and geographical information (latitude, longitude and elevation, sky view factor (SVF) and ground surface characteristics).
Medical team data	• Size of the medical team (total number of staff) • Qualified medical doctors(number) • Number of allied health professionals (number) • Number of nursing staff (number) • Number of first aiders (number) • Number of fixed medical stations on route (number) • Number of mobile medical stations on route (number) • Medical station at finish (yes/no) • Number of AED's on route • High care/intensive care facility at finish (yes/no)	• Medical race director/deputies (number) • Medical doctor (Sport and Exercise Medicine specialist) (number) • Medical doctor (Emergency Medicine/Intensive Care specialist) (number) • Medical doctor (Cardiologist) (number) • Medical doctor (Other specialist) (number) • Medical doctor (General Practitioner/ Family Physician) (number) • Physiotherapist (number) • Athletic trainer(number) • First Aider (Advance Life Support) (number) • First Aider (Basic Life Support) (number)

Medical encounters at mass community-based endurance sports events can be broadly classified into two main diagnostic categories:

1. *illness-related* and
2. *injury-related* medical encounters.

Illness-related medical encounters are usually classified by major organ system affected, while *injury-related* encounters are usually classified by major anatomical regions affected.

29.8.1 Illness-Related Medical Encounters

- The use of a diagnostic classification system of illness-related medical encounters by main organ system is recommended (Table 29.8).
- The severity of illness-related medical encounters can further be classified as minor, moderate, serious/life-threatening, and sudden cardiac arrest/death using the definitions described above.
- Additional information can also be collected including the following:
  - the location of the illness on the course (e.g. related to hills, course conditions),

Table 29.8 Diagnostic categories of illness-related medical encounters by main organ system and more common specific types/diagnosis of medical encounters. (Reproduced with permission from [1])

Main organ system	Illness type/diagnosis
Multiple organ systems	
	Heat Illness
	Hypothermia
	Hyperthermia/exertional heat stroke
	Sunburn
	Rhabdomyolysis
	Fluid and electrolyte disorders
	Dehydration (mild: <5% body weight loss)
	(moderate: >5% to <7% body weight loss)
	(severe: >7% body weight loss)
	Hyponatraemia
	Acid-base disorders
	Other electrolyte disorders
	Infection
	Systemic Infection (excluding pathogens localised to one area)
Cardiovascular system	
	Exercise Associated Postural Hypotension (EAPH)
	Syncope (non-specific)
	Chest pain (non-specific)
	Ischaemic heart disease
	Acute coronary syndrome (myocardial infarction, angina)
	Stable angina
	Cardiac arrest
	Sudden cardiac death
	Cardiac arrest (successfully resuscitated)
	Conduction abnormality including arrhythmias
	Supraventricular tachycardia
	Ventricular tachycardia
	Frequent ventricular extra-systoles
	Other significant arrhythmia
	Other abnormality on ECG (including non-specific)

(continued)

Table 29.8 (continued)

Main organ system	Illness type/diagnosis
	Congestive heart failure
	Hypertrophic cardiomyopathy and other cardiomyopathies
	Other congenital/inherited cardiovascular disease
	Murmurs/Valvular disease
	Acute myocarditis (viral)
	Acute pericarditis
	Venous disease
	Deep venous thrombosis
	Other venous disease including calf/ankle oedema, cause unknown
	Peripheral vascular disease
	Other cardiovascular disease
Respiratory disease and ENT (ear, nose/throat) systems	
	Respiratory tract infection (bacterial or viral)
	Other upper respiratory tract infection
	Other lower respiratory tract infection
	Asthma and/or allergy
	Allergy—rhinitis/sinusitis/hay fever (for urticaria see MDUX)
	Asthma—allergic
	Asthma—exercise induced only
	Pneumothorax
	Acute pulmonary embolus
	Vocal cord dysfunction
	Other respiratory illness not otherwise specified
Central nervous system (CNS)	
	Exercise Associated Muscle Cramps (EAMC)
	Mild EAMC (localised, no altered mental status, no systemic symptoms)
	Severe EAMC (generalized, altered mental status or with systemic symptoms
	Dizziness/nausea (non-specific)
	Coma (cause unknown)
	Confusion (non-specific)
	Stroke/Cerebrovascular Accident (CVA)
	Epilepsy
	Headaches
	Exercise related headache
	Migraine
	Cluster headaches
	Headache not otherwise specified
	Other neurological problem
	Generalised tight muscles/spasticity
Rheumatological system	
	Joint pain (non-specific)
	Joint infection—septic arthritis (excluding complications of surgery or perforating lacerations)
	Infection of bone—osteomyelitis
	Osteoarthritis (OA)—generalised (not isolated to one joint)

Table 29.8 (continued)

Main organ system	Illness type/diagnosis
	Gout
	Pseudogout
	Seronegative arthritis
	Rheumatoid arthritis
	Fibromyalgia/multiple sore muscle areas
	Rheumatological disease other/undiagnosed
Gastrointestinal system	
	Nausea/vomiting (non-specific)
	Abdominal pain (non-specific)
	Gastrointestinal infection
	Gastroenteritis (including food poisoning)
	Other gastrointestinal infection
	Gastritis
	Exercise associated gastritis/reflux
	Non-steroidal anti-inflammatory drug (NSAID) associated gastritis/peptic ulceration
	Gastritis/peptic ulceration—non exercise/NSAID related
	Diarrhoea
	Runner's diarrhoea
	Gastrointestinal bleeding (upper gastrointestinal tract) including hematemesis
	Gastrointestinal bleeding (lower gastrointestinal tract) including melena
	Surgical bowel problem (acute bowel)
	Other gastrointestinal illness
Genitourinary system (excluding infections)	
	Genitourinary infection
	Cystitis
	Other genitourinary infection
	Acute kidney injury
	Acute renal failure
	Other urinary Illness
	Haematuria
	Pregnancy
Haematological system and nutritional deficiencies	
	Anaemia
	Sickle-cell trait
Endocrine/metabolic system	
	Thyroid disorder
	Hypothyroid
	Hyperthyroid
	Hypoglycaemia (non-specific)
	Diabetes mellitus
	Type I (insulin dependent)
	Type II (non-insulin dependent)
	Other endocrine disorder
Dermatological system (excluding infections, skin lesions/tumours and sunburn MVHX)	
	Sunburn
	Skin Infection/Cellulitis/Abscess/Infected Bursa
	Skin chafing/blister

(continued)

Table 29.8 (continued)

Main organ system	Illness type/diagnosis
	Abrasion
	Laceration
	Urticaria
	Dermatitis
	Other rash not otherwise mentioned or undiagnosed
Ophthalmological system (excluding trauma)	
Dental illness	
Psychological/psychiatric illness	
	Anxiety/panic disorder, including hyperventilation
	Other psychological/psychiatric disorder not otherwise specified
Tumours/malignancies	
Drug use/overdose/poisoning	
Medical illness (OTHER or undiagnosed)	
	Tired athlete (non-specific)
	Other medical illness

  - pre-race medical history (e.g. pre-race acute illness, use of medications prior or during the event), and
  - other factors possibly contributing to the illness (e.g. weather conditions, equipment failure, athlete inexperience)

29.8.2 Injury-Related Medical Encounters

- The use of an injury-related medical encounter classification by the main anatomical region affected by the injury, is recommended (Table 29.9).
- The severity of injury-related medical encounters can further be classified as minor, moderate, serious/life-threatening, or death using the definitions described above.
- For injury-related medical encounters, additional information related to
  - the location of the injury on the course (e.g. related to hills, course conditions),
  - onset of the injury (acute injury, chronic injury, acute exacerbation of a chronic injury),
  - mechanism of the injury (e.g. traumatic, non-traumatic, contact or non-contact, nature of the contact), and
  - other factors contributing to the injury (e.g. violation of rules, weather conditions, equipment failure, athlete inexperience)

could also be collected.

The adoption of a uniform data collection procedure at the event medical facilities to record all medical encounters is recommended. Recently, a standardised

Table 29.9 Diagnostic categories of injury-related medical encounters by main anatomical region and more common injury types/diagnosis. (Reproduced with permission from [1])

Main anatomical region	Injury type/diagnosis
Head injuries	
	Head/Facial Bruising/Haematoma
	Head laceration/abrasion
	Facial Muscle and/or Tendon strain/spasm/trigger points
	Facial Joint sprain/injury
	Facial Dislocation
	Head/Facial fracture
	Concussion/Brain Injury
	Concussion
	Intracranial bleed
	Head Organ Damage (including eye, ear, mouth injury; excluding haematoma, laceration)
	Eye injury/trauma
	Ear trauma
	Dental Injury
	Head Pain/Injury (Other/not specified)
Neck Injuries	
	Neck Soft Tissue Bruising/Haematoma
	Neck Laceration/Abrasion
	Whiplash
	Neck muscle and/or tendon strain/spasm/trigger points
	Cervical Spine Facet Joint injuries
	Cervical Disc Injury
	Neck Fracture
	Cervical Fracture/s
	Laryngeal fracture
	Neck Organ Damage
	Neurological Neck Injury
	Cervical nerve root compression/stretch (proximal burner/stinger)
	Cervical spinal cord injury
	Cervical spinal column degenerative disc disease/arthritis
	Cervical Vascular Injury
	Neck Pain/Injury (Other/not specified)
Shoulder Injuries	
	Shoulder Soft Tissue Bruising/Haematoma
	AC Joint contusion
	Shoulder Soft Tissue Laceration/Abrasion
	Shoulder muscle strain/spasm/trigger points
	Shoulder Tendon Overuse Injury/Strain
	Acute Shoulder Sprains/Subluxation
	Glenohumeral joint sprains
	Acromioclavicular joint sprain
	Shoulder Osteochondral Lesion
	Acute Shoulder Dislocation
	Anteroinferior shoulder dislocation
	Inferior shoulder dislocation
	Posterior shoulder dislocation
	Chronic Shoulder instability
	Shoulder impingement/Synovitis
	Shoulder Fractures

(continued)

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
	Clavicular fracture
	Scapula fracture
	Humerus Fracture
	Shoulder Neurological/vascular injury (excl. Non mechanical nerve problems—see MNXX)
	Shoulder Osteoarthritis
	Shoulder Pain/Injury (Other/not specified)
Upper Arm Injuries (between the shoulder and the elbow)	
	Upper Arm Soft Tissue Bruising/Haematoma
	Upper Arm Laceration/Abrasion
	Upper Arm Muscle Strain/Spasm/Trigger points
	Upper Arm Tendon Injury
	Upper Arm Fracture
	Upper Arm Bony Stress/Overuse Injury
	Other Upper Arm Overuse Injury
	Upper Arm neurological injury
	Upper Arm Vascular Injury
	Upper Arm Pain/Injury not otherwise specified
Elbow Injuries	
	Elbow Soft Tissue Bruising/Haematoma
	Elbow Laceration/Abrasion
	Elbow Muscle Strain/Spasm/Trigger Points
	Elbow Tendon Injury
	Lateral epicondylopathy
	Medial epicondylopathy
	Elbow Joint Ligament Sprain
	Elbow Osteochondral Injury
	Elbow Dislocation
	Anterior elbow dislocation
	Posterior elbow dislocation
	Dislocated radial head
	Elbow Instability
	Elbow Impingement/Synovitis
	Elbow Stress/Overuse Injuries including stress fractures
	Elbow Neurological Injury/Entrapment
	Elbow Osteoarthritis
	Elbow Pain/Injury (Other/not specified)
Forearm Injuries (between Elbow and Wrist)	
	Forearm Soft Tissue Bruising/Haematoma
	Forearm Laceration/Abrasion
	Forearm Muscle Injury
	Forearm Tendon Injury
	Forearm fracture(s)
	Fracture radius and ulna midshaft
	Fracture radius midshaft
	Fractured ulna midshaft
	Other Stress/Overuse injuries to Forearm
	Forearm Neurological Injury
	Forearm Vascular Injury
	Forearm Pain/Injury (Other/not specified)

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
Wrist Injuries	
	Wrist and Hand Soft Tissue Bruising/Haematoma
	Wrist and Hand Laceration/Abrasion
	Wrist and Hand Muscle Injury
	Wrist and Hand Tendon Injury
	Wrist and Hand Joint Injury (including minor avulsion fracture)
	Wrist and Hand Osteochondral/Chondral Injury
	Wrist and Hand Dislocations (including minor avulsion fractures)
	Chronic Wrist or Hand Instability
	Wrist and Hand Impingement/Synovitis
	Wrist and Hand Fractures
	Fracture of distal radius +/− ulna
	Fracture of distal ulna
	Scaphoid fracture
	Fractured hamate
	Fractured trapezium
	Fracture other carpal bone
	Fractured thumb
	Fracture metacarpals 2–5
	Fracture finger(s) (excluding avulsion fractures
	Wrist and Hand Stress/Overuse Injuries (including stress fractures)
	Wrist and Hand Neurological Injury
	Wrist and Hand Vascular Injury
	Wrist and Hand Osteoarthritis
	Other Wrist and Hand Pain/Injury (Other/not specified)
Chest Injury	
	Chest Wall Soft Tissue Bruising/Haematoma
	Chest Wall laceration/Abrasion
	Chest Muscle or Tendon strain/spasm/trigger points
	Chest Joint Sprains
	Sternoclavicular Sprain
	Chest Dislocations
	Sternoclavicular Dislocation
	Chest Joint Instability
	Synovitis of Chest Joint
	Chest Fracture(s)
	Rib Fracture(s)
	Sternal fracture
	Fracture of costochondral margin
	Chest Cavity Injury
	Pneumothorax
	Haemothorax
	Cardiac Contusion Injury
	Chest injury (Other/not specified)
Trunk and Abdominal Injury	
	Abdominopelvic Soft Tissue Bruising/Haematoma (excluding bruised organs)
	Truncal Laceration/Abrasion
	Truncal Muscle Strain/Spasm/Trigger points
	Abdominal Tendon Injury

(continued)

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
	Abdominal Biomechanical Injury
	Abdominal Organ Injury
	Spleen trauma
	Intestinal trauma
	Liver trauma
	Pancreatic trauma
	Kidney trauma
	Multiple organ trauma
	Other organ trauma not otherwise specified
	Pelvic Organ Injury
	Genital Injury
	Bladder trauma
	Abdominal pain (Other/not specified)
Thoracic Spine Injury (including Thoracolumbar Junction)	
	Thoracic Soft Tissue Bruising/Haematoma
	Thoracic Laceration/Abrasion
	Thoracic Muscle and Tendon Strain/Spasm/Trigger Points
	Thoracic spine Joint Injury
	Thoracic Disc Injury
	Thoracic Spine Fracture
	Thoracic Postural Syndrome
	Thoracic spine Osteoarthritis
	Thoracic Pain/Injury (Other/not specified)
Lumbar Spine Injury	
	Lumbar Soft Tissue Bruising/Haematoma
	Lumbar Laceration/Abrasion
	Lumbar Spine muscle and Tendon Strain/Spasm/Trigger Points
	Lumbar Spine Joint Injury
	Lumbar facet joint sprain
	Lumbar ligament Sprain
	Lumbar Disc Injury (excluding degenerative disc disease)
	Lumbar Instability
	Spondylolisthesis any Level
	Lumbar Spine Facet Joint Pain/Stiffness
	Lumbar Spine Fracture
	Lumbar spine vertebral body fracture
	Lumbar spine transverse process fracture
	Lumbar spinous process fracture
	Lumbar pars interarticularis acute fracture
	Lumbar pedicle fracture
	Multiple lumbar spine fractures
	Other lumbar spine fracture
	Complication of lumbar fracture (including non-union, excluding spinal injury)
	Lumbar Stress Fracture
	Lumbar Spine Neurological Injury
	Lumbar spinal fracture with associated neurological injury
	Lumbar disc injury with associated neurological injury
	Lumbosacral Nerve root impingement due to foraminal stenosis bony and disc

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
	Lumbar Spinal canal stenosis
	Lumbosacral nerve stretch/traction injury
	Other lumbosacral nerve injury
	Osteoarthritis Lumbosacral spine
	Lumbar Pain/Injury (Other/not specified)
Pelvis/Buttock Injuries (excluding groin)	
	Pelvis/Buttock Soft Tissue Bruising/Haematoma
	Pelvic/Buttock Laceration/Abrasion
	Pelvic/Buttock Muscle Strain/Spasm/Trigger Points
	Buttock/Pelvis Tendon Injury
	Sacroiliac Joint Injury (excluding L5/S1 injury)
	Sacroiliac Joint Instability
	Buttock and Pelvis Synovitis/Bursitis
	Pelvic fracture(s) (excluding growth plate fractures)
	Fractured Ilium
	Fractured sacrum
	Fractured coccyx
	Fractured ischium
	Multiple fractures pelvis and sacrum
	Pelvic Stress Fracture(s)
	Buttock/Pelvic Nerve Injury
	Pelvic/Buttock Pain (Other/not specified)
Hip and Groin Injuries	
	Hip and Groin Soft Tissue Bruising/Haematoma
	Hip and Groin Laceration/Abrasion
	Hip and Groin Muscle Strain/Tear
	Hip and Groin Tendon Injuries (including hernia, excluding avulsion injuries in the paediatric population)
	Trochanteric syndrome
	Hip Joint Sprain
	Hip Joint Chondral/Osteochondral Injury
	Hip Joint Dislocation
	Hip Joint Inflammation/Synovitis/Other Biomechanical Lesion
	Hip/Groin Fractures
	Femoral fracture
	Acetabular fracture
	Fracture pubic ramus
	Hip/Groin Stress Fracture
	Other Stress/Overuse Injury Hip and Groin
	Femoroacetabular impingement
	Groin Neurovascular Injuries
	Groin Organ Damage
	Hip/Groin Arthritis
	Hip/Groin Pain (Other/not specified)
Thigh Injuries	
	Thigh Soft Tissue Bruising/Haematoma
	Thigh Laceration/Abrasion
	Thigh Muscle strain/Spasm/Trigger Points
	Proximal hamstring tendinopathy
	Hamstring muscle strain

(continued)

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
	Quadriceps muscle Strain
	Adductor tendinopathy
	Adductor muscle strain
	Thigh muscle cramping during exercise
	Hamstring cramping during exercise
	Quadricep cramping during exercise
	Adductor muscle cramping during exercise
	Thigh muscle trigger points
	Thigh muscle wasting
	Femoral Fracture
	Femoral Stress Fracture
	Other stress/Overuse Injuries to Thigh
	Thigh Neurological Injury
	Thigh Vascular Injury
	Thigh pain/Injury (Other/not specified)
Knee Injuries	
	Knee Soft Tissue Bruising/Haematoma
	Knee Laceration/Abrasion
	Knee Muscle Strain/Spasm/Trigger Points
	Knee Tendon Injury
	Patellar tendinopathy
	Quadriceps tendinopathy
	Iliotibial band syndrome (ITBS)
	Popliteus tendinopathy
	Pes anserinus tendinopathy
	Proximal gastrocnemious tendinopathy
	Biceps femoris tendinopathy
	Patellofemoral pain (Anterior knee pain) syndrome
	Knee Sprains/Ligament Injuries
	Acute ACL injury
	Acute PCL injury
	MCL injury knee
	Patellar subluxation
	Combined ligament injuries knee
	Knee Dislocation
	Patellar dislocation
	Tibio-femoral dislocation
	Knee Instability (chronic or recurrent subluxations)
	Knee Impingement/Synovitis/Biomechanical Lesion not associated with other conditions
	Knee Fractures
	Patellar fracture
	Distal femoral fracture
	Proximal tibial fracture
	Knee Stress Fracture
	Knee Osteoarthritis
	Knee Pain/Injury (Other/not specified)
Lower Leg Injuries	
	Leg Soft Tissue Bruising/Haematoma
	Lower Leg Laceration/Abrasion

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
	Lower leg muscle Injury
	Anterior compartment muscle injury
	Lateral compartment muscle injury
	Gastrocnemius muscle injury/strain
	Soleus Injury/strain
	Calf cramping during exercise
	Lower Leg Tendon Injuries (see knee or ankle depending on tendon location)
	Lower Leg Fractures
	Fractured Midshaft Tibia
	Fractured fibula
	Medial Tibial Stress Syndrome
	Lower Leg Stress Fractures
	Tibial Stress Fracture
	Fibular Stress Fracture
	Other Leg Overuse Injury
	Neurological Injury of Lower Leg
	Lower Leg Vascular Injury
	Popliteal Artery Entrapment Syndrome
	Other Lower Leg Pain/Injury (Other/not specified)
Ankle Injuries	
	Ankle Soft Tissue Bruising/Haematoma
	Ankle Laceration/Abrasion
	Ankle Tendon Injury
	Achilles tendinopathy (insertional)
	Achilles tendinopathy (mid-substance)
	Achilles tendon rupture
	Extensor tendon injuries at ankle
	Tibialis anterior injuries
	Tibialis posterior injuries
	Flexor hallucis tendon injury
	Peroneal tendon injury
	Ankle Sprains
	Ankle syndesmosis sprain
	Ankle lateral ligament sprain
	Ankle deltoid ligament sprain
	Ankle multiple ligaments sprain
	Ankle Osteochondral Injuries
	Ankle Dislocation
	Chronic Ankle Instability
	Chronic medial instability
	Chronic lateral instability
	Ankle Synovitis/Impingement/Bursitis not otherwise specified
	Ankle Fracture
	Fracture tibia and fibula at ankle joint
	Fractured talus
	Fractured calcaneus
	Ankle Stress Injuries/Stress Fractures
	Nerve Injury at Ankle
	Ankle Vascular Injury

(continued)

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
	Osteoarthritis of Ankle/Subtalar Joint
	Ankle Pain/Injury (Other/not specified)
Foot Injuries	
	Foot Soft Tissue Bruising/Haematoma
	Foot Laceration/Abrasion
	Foot Muscle Strain/Spasm/trigger Points
	Foot Tendon Injuries
	Foot Joint Sprain
	Foot Chondral/Osteochondral Lesion
	Foot Dislocation
	Synovitis/Impingement/Biomechanical Lesion of Foot
	Plantar Fasciopathy (Fasciitis)
	Foot Fractures
	Fracture tarsal bone
	Fracture Metatarsal(s)
	Fracture great toe
	Fracture lesser toes (2—5)
	Complication of fractured foot including non-union
	Stress Reactions/Fractures in Foot
	Foot Osteoarthritis
	Sesamoid injuries
	Foot Neurological Injury
	Foot Vascular Injury
	Foot Pain/Injury (Other/not specified)
Injuries Location Unspecified or Crossing Anatomical Boundaries	
	Soft Tissue Bruising/Haematoma Location Unspecified or Crossing Anatomical Boundaries
	Laceration/Abrasion Location Unspecified or Crossing Anatomical Boundaries
	Laceration/abrasion upper limb
	Laceration/abrasion lower limb
	Muscle Strain/Spasm/Trigger Points Location Unspecified or Crossing Anatomical Boundaries
	Muscle strain upper limb
	Muscle strain lower limb
	Muscle strain spine
	Tendon Injury Location Unspecified or Crossing Anatomical Boundaries
	Sprain Location Unspecified
	Chondral/Osteochondral injury Location Unspecified
	Dislocation Location Unspecified
	Upper limb joint dislocation
	Lower limb joint dislocation
	Instability of Joint Location Unspecified
	Upper limb joint instability
	Lower limb joint instability
	Fracture Location Unspecified or Crossing Anatomical Boundaries
	Fracture upper limb
	Fracture lower limb

Table 29.9 (continued)

Main anatomical region	Injury type/diagnosis
	Stress Fracture Location Unspecified or Crossing Anatomical Boundaries
	Postural Syndrome
	Upper limb synovitis/impingement lesion
	Lower limb synovitis/impingement lesion
	Neurological lesion Location Unspecified or Crossing Anatomical Boundaries
	Spinal injury location unspecified or crossing anatomical boundaries
	Upper limb neurological injury
	Lower limb neurological injury
	Vascular Injury Location Unspecified or Crossing Anatomical Boundaries
	Upper limb vascular injury
	Lower limb vascular injury
	Osteoarthritis Location Unspecified or Crossing Anatomical Boundaries (excluding generalised OA)
	Upper limb osteoarthritis
	Lower limb osteoarthritis

Race **M**edical **E**ncounter **D**ata (R-MED) form for illness-related medical encounters (Table 29.10) and injury-related medical encounters (Table 29.11) was suggested [1].

Clinical Pearls

- The health benefits of regular moderate- to high-intensity physical activity are undisputed, but during such activity there is an increased risk of medical encounters.
- Mass community-based sports events are increasing in popularity, with greater participation among older athletes—this may increase the risk of medical encounters at these events.
- Medical encounters at mass community-based sports events can vary in severity, from sudden cardiac arrest or death, to minor medical encounters.
- Planning to reduce the risk of medical encounters is the responsibility of the race medical director and requires a step-wise approach.
- Pre-race medical screening and educational intervention may reduce the risk of medical encounters.
- The potential negative effects of environmental stress, including air quality, on athlete health can be reduced by careful pre-race planning.

Table 29.10 Illness-related Race Medical Encounter Data (R-MED) form—endurance sport events. (Reproduced with permission from [1])

<EVENT NAME>

Illness-Related Race Medical Encounter Data (R-MED) Form

1. RACE DETAILS: <Pre-populate before the event>

<Race name>	Date: dd/mm/yyyy	Official start time:	Official finish time:

2. LOCATION OF THE MEDICAL FACILITY:

☐ Course Q1 ☐ Course Q2 ☐ Course Q3 ☐ Course Q4 ☐ At finish ☐ Sweeper bus ☐ Hospital ☐ Other

3. ATHLETE DEMOGRAPHIC DETAILS:

Race Number:	Male ☐ Female ☐	Race finisher: YES ☐ NO ☐	
Arrival time at medical facility (hh/mm):			

4. ATHLETE ILLNESS-RELATED MEDICAL HISTORY:

4a. Pre-race history:

Did the athlete suffer from any pre-race acute illness/symptoms (gastro/acute illness or infective illness?	YES ☐ NO ☐

Details of pre-race illness or injury (Type)

☐ URT symptoms with no systemic symptoms	☐ URT symptoms with systemic symptoms	☐ LRT symptoms
☐ Nausea/vomiting and diarrhoea	☐ Nausea only	☐ Nausea and vomiting
☐ Diarrhoea	☐ Other infective illness	☐ Other pre-raceillness

Onset of pre-race illness	☐ Race day	☐ 1 day before	☐ 2-7 days before	☐ 8-14 days before	☐ > 15days before

Analgesics/NSAIDs use **0-24 hours before** the race?YES ☐ NO ☐	Analgesics/NSAIDs use **during** the race? YES ☐ NO ☐
Prescription medication use (list please): YES ☐ NO ☐	Reason for medication use:

4b. Presenting complaint:

☐ Collapse (pre-finish)	☐ Collapse (post-finish)	☐ Confused	☐ Muscle cramps (localized)
☐ Chest pain	☐ Palpitations	☐ Fatigue/exhaustion	☐ Muscle cramps (systemic)
☐ Abdominal cramps/pain	☐ Diarrhoea	☐ Nausea/vomiting	☐ Seizure
☐ Headache	☐ Hot (suspected hyperthermia)	☐ Cold (suspected hypothermia)	☐ Difficulty breathing
☐ Wheeze	☐ Coughing	☐ Skin (chafing/ blisters)	☐ Skin (cut / laceration)
☐ Skin (other)	☐ Musculoskeletal (head/neck)	☐ Musculoskeletal (chest/trunk)	☐ Musculoskeletal (upper limb)
☐ Musculoskeletal (spine/back)	☐ Musculoskeletal (hip/pelvis)	☐ Musculoskeletal (lower limb)	☐ Deep Chest/Abdominal trauma

☐ Other:

Additional clinical notes:

4c. Location of the medical encounter on the course:

☐ Not known or not applicable	Distance from the start (km)	Nearest distance marker (km)

5. CLINICAL EXAMINATION:

5.1. Mental status (APVU):	☐ Alert	☐ Responds to voice	☐ Responds to pain	☐ Unresponsive
5.2. Glasgow Coma Scale: /15	Eye: /4	Verbal: /5	Motor: /6	
5.3. Hydration:	☐ Normal (clinically)	☐ Dry mouth (mucosa)	☐ Oedema (swollen periphery)	☐ Poor skin turgor
Fluid intake during race (ml):	Pre-race weight (kg):	Postrace weight (kg):	% Weight change: %	

5.4. Vital signs

Time of measurement	Pulse	BP Systolic/diastolic)	Core Temp	% Sats	Glucose	Other
Admission						

Table 29.10 (continued)

5.5. Other clinical findings:				
6. ORDERS/ INVESTIGATIONS:				
☐ Admit to ICU/resuscitation (medical tent or hospital)	☐ Admit medical tent for treatment	☐ Elevate legs	☐ Fluids (Oral)	☐ Fluids (IV)
☐ Cooling	☐ Warming	☐ Wound care	☐ Other:	
☐ Lab tests (glucose)	☐ Lab tests (sodium)	☐ Lab tests (potassium)	☐ Lab tests (urea/creat)	☐ Lab tests (blood gas)
☐ Lab tests (Hct/Hb)	☐ Lab tests (ECG)	☐ Lab tests (Ultrasound)	☐ Lab tests (Other)	
7. LABORATORY / INVESTIGATION RESULTS (ATTACH):				
☐ Lab tests (glucose)	☐ Lab tests (sodium)	☐ Lab tests (potassium)	☐ Lab tests (urea/creat)	☐ Lab tests (blood gas)
☐ Lab tests (Hct/Hb)	☐ Lab tests (ECG)	☐ Lab tests (Ultrasound)	☐ Lab tests (Other)	
8. TREATMENT:				
8.1. Fluids				
Oral Fluid (volume ml):	Type: Water:☐ Sports drink:☐ Hypertonic saline:☐ Other:			
IV Fluid (volume ml):	Type:	Rate: ml over min	Start time:	End time:
8.2. Medication				
Type:	Dosage:	Route (po/IM/IV):	Time (given):	
Type:	Dosage:	Route (po/IM/IV):	Time (given):	
8.3. Other treatment:				
9. PRE-DISCHARGE ASSESSMENT:				
Conscious/orientated YES ☐; No ☐; N/A ☐	Ambulatory YES ☐; No ☐; N/A ☐	Asymptomatic YES ☐; No ☐; N/A ☐	Passed urine: YES ☐; No ☐; N/A ☐	
10. FINAL DIAGNOSIS OF ILLNESS-RELATED MEDICAL ENCOUNTER:				
Main organ system				
Multiple organs ☐	Cardiovascular system ☐	Respiratory / ENT system ☐	Central nervous system ☐	
Rheumatological system ☐	Gastrointestinal system ☐	Genitourinary system ☐	Haematology / Nutrition ☐	
Endocrine / Metabolic ☐	Dermatological system ☐	Ophthalmological system ☐	Dental illness ☐	
Psychological / Psychiatric ☐	Tumour / malignancy ☐	Drug use / Overdose ☐	Other medical illness ☐	
Final diagnosis / illnesstype:	**<Enter code from Table>**			
11. ILLNESS-RELATED MEDICAL ENCOUNTER SEVERITY:				
Minor encounter ☐	Moderate encounter ☐	Serious / life threatening encounter ☐		
Sudden cardiac arrest (SCA) during race ☐	Sudden cardiac arrest (SCA) < 1hr post race ☐	Sudden cardiac arrest (SCA) 1-24hrs post race ☐		
Sudden cardiac death (SCD)during race ☐	Sudden cardiac death (SCD) < 1hr post race ☐	Sudden cardiac death (SCD) 1-24hrs post race ☐		
Non-cardiac sudden death during race ☐	Non-cardiac sudden death< 1hr post race ☐	Non-cardiac sudden death1-24hrs post race ☐		
12. DISCHARGE INFORMATION:				
☐ Discharged	☐ Hospital transfer	☐ Follow-up care needed	☐ Refusal of care	
☐ Follow up call by race medical team needed YES ☐ NO ☐		☐ Other special instruction:		
13. TRANSPORT INFORMATION:		**Authorized by: Dr**		
Hospital name:		Transported by:		
Receiving doctor:		Receiving doctor's contact details:		
Family / Next of Kin notified: YES ☐ NO ☐		Who was notified?		
14. ADDITIONAL CLINICAL NOTES:				
15: DOCTOR / CLINICIAN DETAILS:				
Doctor/ Clinician name:	**Signature:**	**Date:**	**Time:**	

Table 29.11 Injury-related Race Medical Encounter Data (R-MED) form—endurance sport events. (Reproduced with permission from [1])

<EVENT NAME>

Injury-Related Race Medical Encounter Data (R-MED) Form

1. RACE DETAILS <Pre-populate before the event>

<Race name>	Date: dd/mm/yyyy	Official start time:	Official finish time:

2. LOCATION OF THE MEDICAL FACILITY

☐ Course Q1 ☐ Course Q2 ☐ Course Q3 ☐ Course Q4 ☐ At finish ☐ Sweeper bus ☐ Hospital ☐ Other

3. ATHLETE DEMOGRAPHIC DETAILS

Race Number:	Male ☐ Female☐	Race finisher: YES ☐ NO ☐	

Arrival time at medical facility (hh/mm):

4. ATHLETE MEDICAL HISTORY

4a. Injury history:

Onset of Injury:

☐ Acute	☐ Chronic (pre-existing)	☐ Acute exacerbation of chronic injury

Mechanism of Injury:

☐Traumatic-contact with another athlete	☐ Traumatic – contact with moving object	☐ Traumatic – contact with immobile object
☐ Traumatic non-contact	☐ Overuse injury	☐ Other

Location of the injury on the course:

☐ Not known or not applicable	Distance from the start (km)	Nearest distance marker (km)

Factors Contributing to the mechanism of injury:

☐ Violation of rules	☐ Weather conditions	☐ Equipment failure
☐ Course/field of play conditions	☐ Fatigue	☐ Psychological

☐ Other:

4b. Presenting complaint:

☐ Pain	☐ Loss of function	☐ Swelling	☐ Confusion
☐ Unresponsive (coma)	☐ Head/neck injury	☐ Chest injury	☐ Trunk injury
☐ Upper limb injury	☐ Spine/back injury	☐ Hip/pelvis injury	☐ Lower limb injury
☐ Abdominal injury	☐ Injury multiple anatomical areas:	☐ Other injury:	

Additional clinical notes:

5. CLINICAL EXAMINATION

5.1. Mental status (APVU):	☐ Alert	☐ Responds to voice	☐ Responds to pain	☐ Unresponsive
5.2. Glasgow Coma Scale: /15	Eye: /4	Verbal: /5	Motor: /6	
5.3. Hydration: ☐ Normal (clinically)	☐ Dry mouth (mucosa)	☐ Oedema (swollen periphery)	☐ Poor skin turgor	
Fluid intake during race (ml):	Pre-race weight (kg):	Post-race weight (kg):	% Weight change: %	

5.4. Vital signs

Time of measurement	Pulse	BP Systolic/diastolic)	Respiratory rate	% Sats	Other
Admission					

5.5. Other clinical findings:

6. ORDERS/ RECOMMENDED INVESTIGATIONS

☐ Admit to ICU/resuscitation (medical tent or hospital)		☐ Admit to medical tent	
☐ Splint / brace	☐ Warming	☐ Wound care	☐ Other:

Table 29.11 (continued)

☐ Lab tests (Ultrasound)	☐ Lab tests (Radiology – X Rays)	☐ Lab tests (MRI scan)	☐ Lab tests (CT scan)
7. LABORATORY RESULTS			
Clinical notes:			
8. TREATMENT			
8.1. Wound care	☐ Wound dressing	☐ Suture laceration	Other:
8.2. Fluids			
Oral Fluid (volume ml):	Type: Water: ☐	Sports drink: ☐	Hypertonic saline: ☐ Other:
IV Fluid (volume ml):	Type:	Rate: ml over min	Start time: End time:
8.3. Medication			
Type:	Dosage:	Route (po/IM/IV):	Time (given):
Type:	Dosage:	Route (po/IM/IV):	Time (given):
8.4. Other treatment:			
9. PRE-DISCHARGE ASSESSMENT:			
Conscious/orientated YES ☐; No ☐; N/A ☐	Ambulatory YES ☐; No ☐; N/A ☐	Asymptomatic YES ☐; No ☐; N/A ☐	Passed urine: YES ☐; No ☐; N/A ☐
10. FINAL DIAGNOSIS OF INJURY-RELATED MEDICAL ENCOUNTER			
Main anatomical area			
Head injury ☐	Neck injury ☐	Shoulder injury ☐	Upper arm injury ☐
Elbow injury ☐	Forearm injury ☐	Chest injury ☐	Trunk / abdominal injury ☐
Lumbar spine injury ☐	Pelvis / buttock injury ☐	Hip / groin injury ☐	Thigh injury ☐
Knee injury ☐	Lower leg injury ☐	Ankle injury ☐	Foot injury ☐
Injury location unspecified or crossing anatomical boundaries:			
Final diagnosis / injury type:	**<Enter code from Table>**		
12. INJURY-RELATED MEDICAL ENCOUNTER SEVERITY:			
Minor encounter ☐	Moderate encounter ☐	Serious / life threatening ☐	
Non-cardiac sudden death during race ☐	Non-cardiac sudden death< 1hr post race ☐	Non-cardiac sudden death1-24hrs post race ☐	
12. DISCHARGE INFORMATION:			
☐ Discharged	☐ Hospital transfer	☐ Follow-up care needed	☐ Refusal of care
☐ Follow up call by race medical team needed YES ☐ NO ☐		☐ Other special instruction:	
13. TRANSPORT INFORMATION		**Authorized by: Dr**	
Hospital name:		Transported by:	
Receiving doctor:		Receiving doctor's contact details:	
Family / Next of Kin notified: YES ☐ NO ☐		Who was notified?	
14. ADDITIONAL CLINICAL NOTES:			
15: DOCTOR / CLINICIAN DETAILS:			
Doctor's / Clinician Name:	**Signature:**	**Date:**	**Time:**

Review

Questions

1. You are appointed as the chief race medical director for a large half-marathon (21.1 km) running event, where the expected number of race starters are about 45,000. The race will be held in a European city in May, and the city is at sea level. Based on current scientific data, which of the following statements are true for the type and severity of medical encounters that you may expect at this race?
   (a) I can expect that there will be 1–2 runners with sudden cardiac arrest during the race
   (b) About 5–10 runners will develop serious life-threatening medical encounters
   (c) I need to plan that there about 2000 runners will require medical attention
   (d) If the race is held at 2 pm in the afternoon rather than early in morning, it is likely that there will be fewer medical encounters
2. In your preparations for the race above (in question 1), where you are the chief medical director responsible for the medical care, which of the following are important considerations at the finish line area?
   (a) I need to deploy more medical resources and more staff at the finish line than along the course
   (b) At the finish line area, there should be a dedicated Triage Officer and team to direct the flow of casualties to the proper area for care
   (c) Equipment and supplies for obtaining vital signs, performing BLSD and ACLS should be available at the finish line.
   (d) There should be a high-care medical facility at the finish line
3. A 56-year-old female runner enters for a marathon for the first time. In preparation for the race she trained for about 10 weeks, with a weekly training distance that averages at 25 km per week. She is a type 2 diabetic, takes anti-depressant medication and has a chronic left rotator cuff impingement in the shoulder for which she uses occasional NSAIDs. What risk factors does this runner have of developing a medical complication during the race? What advice would you give her?

Answers

1. Question
   (a) Yes: The incidence of sudden death is about 1 in 100,000 entrants, but sudden cardiac arrest is 2–3 higher i.e. 1 in 30,000 to 1 in 50,000
   (b) No. The incidence of serious life-threatening medical encounters varies but is about 1 in 2000 race starters. Therefore, for a race with about 50,000 starters, you can expect about 25 serious life-threatening medical encounters
   (c) Yes. The incidence of moderate medical encounters (requiring medical attention) is about 1 in 50. You can expect about 1000 runners that will require medical attention

(d) No. If the race is held at 2 pm in the afternoon, it is likely that the environmental conditions will be less favourable in May (spring to early summer in Europe). It is likely that the WBGT will be higher, and if it is above 18°, the risk of medical encounters increases (moderate risk). Higher WBGT will increase the risk even more.

2. Question
   (a) Yes. The number of medical encounters in the final quarter of the race is significantly higher in respect to other segments. Therefore, in the last 2 km of the course, medical staff and supplies should be increased.
   (b) Yes. A Triage Officer at the finish line area is very important to direct runners with medical complications to the appropriate treatment area—this should be a senior medical doctor with previous race medical care experience.
   (c) Yes. Equipment and supplies for obtaining vital signs, performing BLSD and ACLS should be available at the finish line.
   (d) Yes. There should be a high-care medical facility at the finish line.
3. Question

   This runner has a number of factors that increase her risk of an acute medical complication during the marathon. She is over 55 years, and is a diabetic and therefore, according to international guidelines, has ≥2 risk factors. The advice would be that she requires a full medical assessment before participating in moderate- to high intensity exercise. It is also important to determine if she has concomitant cardiovascular disease and other complications associated with diabetes. She also uses medications that may increase her risk of a medical complications during exercise, including anti-depressants and NSAIDs. Finally, her training and preparation for a marathon is not optimal because she only started 10 weeks before the marathon, and her weekly training of 25 km is less that what is advised to prepare for a marathon.

References

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