Ministry of Defence

JSP 539

HEAT ILLNESS AND COLD INJURY:

PREVENTION AND MANAGEMENT

Part 2: Guidance

JSP 539 V3.1 Feb 19

Foreword

Part 2 of this JSP provides guidance in accordance with the policy set out in Part 1 of this JSP; the guidance is sponsored by the Defence Authority for Healthcare and Medical. It provides policy-compliant business practices which should be considered best practice in the absence of any contradicting instruction. However, nothing in this document should discourage the application of common sense.

Surgeon General
Defence Authority for Healthcare and Medical

Preface

How to use this JSP

1. This JSP is the Joint Service code of practice for the prevention, through Force Protection measures, of heat illness and cold injury either due to the direct effects of hot or cold environments or heat illness from physical activity in any environment. Whilst primarily written for land based activities, including training, exercises and operations, the principles are to be applied to the air and maritime environments. The JSP will be supported, where necessary by single Service instructions and other guidance. It cannot cover every possible eventuality; however it states the principles which should be applied at all times in order to minimise the risks of heat illness and cold injury in accordance with Defence Safety Authority (DSA) policy[1]. Commanders should note that it is entirely possible to be at risk from both heat illness and cold injury within the same theatre of operations.

2. The JSP also contains guidance on the initial medical management and treatment of climatic casualties relevant to all levels of Pre-hospital Emergency Care practitioner. The management of climatic casualties by Secondary Health Care, is beyond the scope or intent of this JSP and covered in Clinical Guidelines for Operations.

3. The JSP is structured in two parts:

   a. Part 1- Directive, which provides the direction that must be followed in accordance with statute or policy mandated by Defence or on Defence by Central Government.

   b. Part 2 - Guidance, which provides the guidance and best practice that will assist the user to comply with the Directive(s) detailed in Part 1.

Training

4. **All personnel.** All personnel are to be made aware of:

   a. Heat illness.

   b. Cold Injury.

   c. Methods of prevention.

   d. Identification.

   e. First-aid management.

5. **Individuals.** Individuals are to receive education and training during:

   a. Basic training.

[1] DSA 01.1 - Defence Policy for Health, Safety and Environmental Protection.

b. Periodic mandatory training in accordance with single-Service policy.

c. Targeted refresher training, to be conducted immediately prior to operating in environments, or undertaking tasks, including in the UK and other temperate areas, where there is a risk of heat illness or cold injury.

6. **Commanders and training staff.** Commanders and training staff at all levels should receive appropriate update training:

a. During leadership courses.

b. Prior to assignment to a training post.

7. **Defence Medical Service (DMS) personnel.** DMS personnel are to be trained in the prevention and management of climatic illness/injury, including medical planning (appropriate to their level of competency and responsibility). This should be part of initial medical training for DMS personnel, with appropriate refresher training periodically thereafter, targeted by Career Employment Group and clinical speciality.

8. **Wet Bulb Globe Temperature (WBGT).** Training on the use of the WBGT monitor is to be provided during the following courses:

a. DMS Defence Medic training[2].

b. All Arms Physical Training Instructors Course.

c. Specialist Training for RN, RM, Army and RAF Physical Training Qualifying Courses.

d. BSc Environmental Health for Environmental Health Technicians.

9. **Mounting instructions and planning directives.** JSP 539 is to be incorporated as a mandatory reference in Exercise and Operational mounting instructions and planning directives. It should be emphasised that heat illness and cold injury frequently occurs in the temperate environment of the UK and Northern Europe.

10. **Approved training material.** Current and approved training material (written and audio-visual) that supports this JSP can be sourced through the British Defence Film Library catalogue accessed via https://www.defencegateway.mod.uk/ and the Millie online portal via http://millie2.web.logis.r.mil.uk/Account/Logon. The following DVDs are available:

a. **Climatic injuries**

(1) Don't be Your Worst Enemy (C5196/10).

(2) Battlefield Casualty Drills *Aide Memoire* (Army Code 71638).

(3) Team Medic Casualty Drills *Aide Memoire* (Army Code 72007)

[2] After Jan 18 there will be no further Defence Medic courses delivered. Training requirements for replacement course being scoped by JMTRA.

b. **Heat**

(1) Heat Prevention & WBGT (C5181/09).

(2) Living With Heat (A2727).

(3) Tri-Service video 'Keep your cool' (A3876).

(4) Clinical Guidelines for Operations – Treatment guidelines for heat illness (JSP950 Vol 11, Section 3, 11c.)

c. **Cold**

(1) Deadly by Degrees (A3904).

(2) Cold Water Casualty (A3788).

(3) The Ice Cold War - Local Cold Injury (A3942).

(4) Feet First (D041/07).

(5) Arctic Survival (A2549).

(6) Clinical Guidelines for Operations – Treatment guidelines for hypothermia (JSP950 Vol 11, Section 3, 11a.)

(7) Clinical Guidelines for Operations – Treatment guidelines for frostbite (JSP950 Vol 11, Section 3, 11b.)

11. **Other training and education resources**

a. **Guides:** Heat illness/cold injury guides (Commander's AC64562 and Individual AC64563 4th edition[3])

b. **Posters:** Sun awareness; Cold hurts; Cold Reality Bites; NFCIs.

Coherence with other Defence Authority policy and guidance

12. Where applicable, this document contains links to other relevant JSPs, some of which may be published by different Defence Authorities. Where particular dependencies exist, these other Defence Authorities have been consulted in the formulation of the policy and guidance detailed in this publication.

Further advice and feedback – contacts

13. For further information on any aspect of this guide, or questions not answered within the subsequent sections, or to provide feedback on the content, contact:

[3] MSN 091LAN1386469

Job title/email	Domain	Telephone
HQ JMG Medical Policy & IS: SO1 Occupational Medicine SG-DMed-Med-Pol-GpMailbox@mod.gov.uk	Policy	Mil 94422 4647 Civ 01543 434647

Amendments table	Version
Preface	
11. Update to guide references	3.1 Jan 19
13. Update contact details	3.1 Jan 19
Section 1	
7. Highlight risk assessment must be conducted in accordance with JSP 375	3.1 Jan 19
7.a. State risk assessment must be recorded on MOD Form 5015	3.1 Jan 19
36.a. Comment that WBGT should be monitered at location of greatest heat risk	3.1 Jan 19
36.b. Highlight WBGT Index Upper Limit applies for duration of exercise activity	3.1 Jan 19
51. Key points: Risk assessment must be in accordance with JSP 375 and recorded on MOD Form 5015 WBGT Index Upper Limits apply for entire duration of activity and should be measured at site of maximal heat risk	3.1 Jan 19
Annex A. Reiterate risk assessment must be in accordance with JSP 375 and recorded on MOD Form 5015	3.1 Jan 19
Annex C. Reiterate WBGT Index Upper Limits apply for entire duration of activity and should be measured at site of maximal heat risk	3.1 Jan 19
Annex E. Table E-1. Reiterate WBGT Index Upper Limits apply for entire duration of activity and should be measured at site of maximal heat risk	3.1 Jan 19
Annex F. 2. Update calibration support detail.	3.1 Jan 19
Major review – to include change of title and restructure into Part 1 Direction and Part 2 Guidance	3.0 May 17
Section 1 – Heat: Guidance for Defence Personnel	
Change of title, content reviewed and revised	3.0 May 17
Individual risk factors aligned with medical section	3.0 May 17
Table 1 - Individual Risk Factors added	3.0 May 17
Summary added	3.0 May 17
Key Points added	3.0 May 17
Annex A – Commanders Heat Illness Risk Assessment Checklist revised	3.0 May 17
Annex B – Heat Illness First Aid Treatment Guidelines revised	3.0 May 17
Annex C – WBGT Index Limits table simplified	3.0 May 17
Annex D – Max work rate examples separated from WBGT Index Limits table	3.0 May 17
Annex E – Guidance for reducing heat illness risk on the MATT2 annual fitness test (AFT) and RAF loaded march added	3.0 May 17
Section 2 – Heat: Guidance for Medical Personnel	
Change of title, content reviewed and revised	3.0 May 17
Responsibilities outlined	3.0 May 17
Individual risk factors aligned with medical section	3.0 May 17
Table 1 - Individual risk factors added	3.0 May 17
Table 2 - Heat Illness Signs and Symptoms added	3.0 May 17
Table 3 - Heat Illness Investigations added	3.0 May 17
Annex A - Exertional Heat Illness First Responder Treatment Guidelines revised	3.0 May 17
Annex B - Exertional Heat Illness Treatment Guidelines Role 1 And Role 2/3 revised	3.0 May 17
Section 3 – Cold: Guidance for Defence Personnel	
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Table 1 - Individual Risk Factors added	3.0 May 17
Table 2 - Wind Chill Chart replaced	3.0 May 17
Summary added	3.0 May 17

Key Points added	3.0 May 17
Annex A – Commanders Cold Injury Risk Assessment Checklist revised	3.0 May 17
Annex B – Hypothermia First Aid Treatment Guidelines revised	3.0 May 17
Annex C – Freezing Cold Injury First Aid Treatment Guidelines added	3.0 May 17
Annex D – Non-Freezing Cold Injury First Aid Treatment Guidelines added	3.0 May 17
Section 4 – Cold: Guidance for Medical Personnel	3.0 May 17
Change of title, content reviewed and revised	3.0 May 17
Responsibilities added	3.0 May 17
Table 1 - Individual Risk Factors added	3.0 May 17
Hypothermia entries reviewed and revised	3.0 May 17
Table 2 - Staging and management of accidental hypothermia added	3.0 May 17
Annex A - First Responder: Initial Treatment of Hypothermia Under Field Conditions revised	3.0 May 17
Annex B - Emergency Doctors and Professional Rescuers: Treatment of Hypothermia added	3.0 May 17
Frostbite entries reviewed and revised	3.0 May 17
Table 3 - Summary of Field Treatment of Frostbite (>2 hours from definitive care) added	3.0 May 17
Non-Freezing Cold Injury (NFCI) extracted from NFCI Tiger-Team Report	3.0 May 17
Annex C – Management of Pain in Non Freezing Cold Injury (NFCI) added	3.0 May 17
Section 5 – Reporting and Recording	
Chain of Command reporting Joint Forces Command section added	3.0 May 17
Annex A – Heat Illness Medical Recording Form reviewed and revised	3.0 May 17
Annex B – Cold Injury Medical Recording Form reviewed and revised	3.0 May 17
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Chapter 1 Direction for Commanders revised	2.5 May 16
Meteorological Office Planning Forecasts revised	2.5 May 16
Table 1 WBGT Index Limits revised	2.5 May 16
Figure 4 Cold Injury First Aid added	2.5 May 16
Chapter 5 Reporting and Recording revised	2.5 May 16

Contents

SECTION 1 – HEAT: GUIDANCE FOR DEFENCE PERSONNEL

What is Heat Illness?

1. Heat illness is a spectrum of illness which includes heat exhaustion and heat stroke. In practice it is difficult to distinguish between the conditions and they may coexist. For the purposes of this policy the term heat illness refers to those individuals who become incapacitated as a result of a rise in core body temperature. In the military environment the vast majority of cases of heat illness or injury are exertional in nature, rather than the classical heat illness or injury seen in the general population. For the purposes of clarity and consistency all cases will be referred to in this policy as heat illness. Heat illness may present with mild signs and symptoms, such as muscular weakness, headache, and fatigue through to more severe signs and symptoms, such as collapse, coma and death.

2. Heat illness is a serious problem for the Armed Forces. The incidence of heat illness depends on numbers exposed to the risk and how well that risk is managed. The overall incidence rate of heat illness cases has not changed over the past five years[1] and 3 soldiers died from heat illness on exercise in the UK in 2013. There were 333 UK Armed Forces personnel who were identified as having a heat illness during the period October 2015 – September 2016 (86 of which were in the UK winter).[2] Rates are higher in the untrained and the young (16-19 years).[3] Exertional heat illness is frequently diagnosed in temperate climates outside of summer months.[4] Many of these cases can be prevented by greater awareness of the risk by commanders at all levels. The severity of cases can be reduced with good management, effective first aid measures and evacuation to medical care, however, prevention is the main aim.

3. Heat is generated internally while exercising/working and from the surrounding environment, eg solar radiation. In warm or hot environments heat can be lost through sweating and a small amount will be lost to the surrounding air or ground etc. However, if the body gains more heat than it can lose the core body temperature will rise and this may result in heat illness.

Core body temperature = heat gained – heat lost

Sunburn

4. Personnel may also be at risk of sunburn. Minor sunburn causes reduced performance while severe sunburn may require hospitalisation. Sunburn can be prevented with appropriate clothing and headwear and by working in the shade. The application of water resistant Sun Protection Factor (SPF) 30[5], or higher, sunscreen protects against UVA and UVB rays to exposed parts of the body, such as the face and hands; it should be re-applied at least two hourly or more frequently if immersed in water, and when personnel are excessively sweating, or concurrently applying insect repellent. Sunscreen should never be used to prolong the duration of sun exposure. Sunburn increases the risk of heat

[1] Defence Statistics (Health) Report to Heat Illness Working Group, 5Jan17; rate of cases reported for the first time by UK Regular Armed Forces personnel only, 2011/12-2015/16 – 1.8 vs 1.7 per 1,000 personnel.
[2] Defence Statistics (Health) Report to Heat Illness Working Group, 5Jan17; based on the average number of UK Regular Armed Forces personnel on strength. Rates are highest for 16-19 age group across the majority of all years over the five year period (2011/12 to 2015/16). Rates are highest for untrained personnel across all years over the five year period.
[3] Defence Statistics (Health) Report to Heat Illness Working Group, 5Jan17
[4] Stacey, M, Exertional Heat Illness & Hospitalisation Risk in the British Army: 2007-2014, DGAMS Annual Health Report on the Health of the Army 2014/2015, 13-14
[5] NSN 6508-99-579-7950 Moisturising sun lotion SPF 30 x 15ml bottle NSN 6508-99-748-7891 Lip salve SPF 30 x 4g.

illness. Commanders may need to consider restricting the on-going duties of sunburned personnel.

5. **UV forecasts.** Forecasts of Solar UV Index are available daily, for Europe and the Mediterranean, at http://www.metoffice.gov.uk/. These indicate on a scale of 1-20, the daily strength of the sun's ultraviolet rays. Typically a clear day on the equator would have an index of approximately 16. In the UK it is unlikely to be higher than 8. Levels of 9 or 10 are common in the Mediterranean. The risk of burning varies according to skin type.

Prevention of heat illness

6. The key to preventing heat illness is the effective assessment and management of risk by commanders. Commanders should ensure they are fully aware of the conditions to which their subordinates are exposed. Any operational, training or recreational task involving physical activity (particularly military selection and fitness tests, log runs etc), the wearing of protective clothing (particularly Chemical, Biological, Radiological and Nuclear Individual Protective Equipment (IPE), body armour, fire retardant or impermeable clothing) or exposure to a raised environmental temperature should be considered to be an activity with a risk of heat illness.

Risk management

7. Commanders at all levels should ensure that a suitable and sufficient risk assessment is undertaken in accordance with JSP375[6] prior to every activity carrying a risk of heat illness, whether involving a single individual or multiple personnel. Commanders should consider seeking medical advice for all aspects of the risk management process. Risk may be tolerated, treated, transferred or terminated. Commanders should:

a. **Assess the risk associated with the planned activity**. It is the commander's duty to ensure that they have sufficient information to undertake an appropriate risk assessment. All factors should be considered together in order to obtain a meaningful overall assessment. It is inappropriate just to consider one factor, such as the environmental conditions, in isolation. The Commander's Heat Illness Risk Assessment Checklist (Annex A) provides a guide to some of the risk factors to be considered. The full risk assessment must be recorded on MOD Form 5015[7]. Commanders should assess, as a minimum:

(1) **Work type, rate and duration of the planned activity.** To include provision of adequate rest periods.

(2) **Individual risk factors.** Consider these risks factors on an individual basis and their prevalence across the group as a whole.

(3) **Clothing, equipment and load to be carried for the activity.**

(4) **Water.** Ensure the provision of appropriate drinking water supplies.

(5) **Environmental/ thermal conditions.** This should include weather forecast and Wet Bulb Globe Temperature (WBGT) Index.

[6] JSP 375 Management of Health and Safety in Defence
[7] MOD Form 5015

(6) **Acclimatisation**. Consider whether the group/ all individuals are acclimatised. Remember that those in the UK/ Northern Europe are NOT acclimatised.

b. **Reduce the risk**. Commanders should plan and put in place appropriate control measures to reduce the risk to As Low As Reasonably Practicable (ALARP). They should assess whether objectives could be achieved (with less risk) by rescheduling or modifying the activity. Commanders should consider additional control measures that may need to be employed in the event of changing circumstances.

c. **Record and Report**. Commanders should record their risk assessment and report identified residual risk. On completion of the risk assessment the residual risk should be ALARP. If the residual risk cannot be reduced to ALARP the activity is not to proceed without referring the case to the Chain of Command to seek further direction. Further advice may be sought from environmental health staff, Heath and Safety staff or other Suitably Qualified and Experienced Personnel (SQEP).

d. **Effective preparation**. Ensure that all personnel taking part are adequately briefed and prepared. Briefing should include the warning signs of heat illness and avoidance measures. Ensure that any standing orders or instructions regarding training restrictions are understood by all participants.

e. **Supervision**. Commanders are responsible for the adequate supervision of all personnel for the duration of the activity including the implementation of all control measures from the risk assessment, such as water provision and rest periods.

f. **Medical Plan**. When developing the medical plan for an activity, commanders should ensure that the activity is covered by an appropriate degree of first aid/medical cover, including the necessary real life medical support, and that a clear and efficient means of evacuation has been arranged and readily available in the event of a medical emergency. Every individual should be able to apply first aid measures and casualty response in accordance with Heat Illness First Aid Treatment Guidelines (Annex B). Medical personnel should be empowered to raise concerns regarding heat illness before and during any planned activity.

g **Continuous review**. Risk assessments should be dynamic and reviewed throughout the activity as circumstances can change.

Work type, rate and rest periods

8. The majority of heat illness casualties occur in temperate climates where individuals are exercising hard and the excess body heat generated cannot be lost from the body surface at a sufficient rate. High intensity activity such as running and lower intensity endurance activities such as route marches carrying a load, involve significant physical exertion with an associated increase in production of body heat. Other activities such as driving, catering and operating heavy machinery may also be risk areas for heat illness and will require an individual risk assessment of that working environment.

9. **Work Rates**. The rate of heat generation by the human body is determined by work rate. In the UK the primary cause of heat casualties has been endurance loaded activities

(eg loaded marches, log runs, stretcher races and fitness tests). Although unloaded running may generate a high heat load (ie has a greater work rate) than loaded marching, it is generally undertaken for shorter periods and in lighter clothing.

10. **Rest Periods.** If prolonged intense physical activity is planned, consideration should be given to allowing adequate rest periods for individuals to cool down. For example, the provision of a 30 minute rest (in a single session) after every hour of exercise will significantly reduce the occurrence of heat illness. Rest periods should be, where possible, in shaded and ventilated areas with removal of kit and equipment if appropriate. Provision of fans to promote air movement should be considered, especially when relative humidity is high. The use of hydration bladders eg CamelBak™ may allow continuous hydration but this does not remove the need for **cooling** through regular rest periods.

11. **Scheduling of Activities**. Where possible, activities with a risk of heat illness should be scheduled for cooler times of the day. Repeated activities over several days may increase the risk of heat illness and dehydration.

Individual risk factors

12. There is a wide variation in human tolerance to heat. In some cases of heat illness it is possible to identify factors that have caused particular individuals to become heat casualties. Table 1 Individual Risk Factors details the currently recognised individual risk factors.

Table 1 - Individual Risk Factors

Lifestyle	Health	Work constraints
Individual Volition	Previous heat illness	Inexperienced personnel
Being overweight or obese	Mild illness eg diarrhoea, common cold, fever	Air travel within the past 24 hours
Lack of physical fitness	Vaccination within the past 48 hours	Poor nutrition (missed meals within the past 24 hours)
Smoking (not ex-smokers)	Current sunburn	Lack of sleep
Alcohol intake within the past 48 hours	Prescribed and over-the-counter medication eg antihistamines and painkillers	Un-acclimatised personnel (this includes all UK and Northern Europe-based personnel)
Illicit drugs eg ecstasy		
Use of supplements	Dehydration	

13. **Fitness and body composition.** Where there is a high risk of heat illness, personnel who are known to be unfit or overweight should not be pushed to continue if it is clear that they are struggling. Individuals who are not able to pass single-Service fitness tests need careful risk assessment in order to determine their ability to undertake high risk activities (in the deployed and home environments). Where there is doubt about an individual's fitness to undertake a high risk activity, advice should be sought from a healthcare professional.

14. **Social events.** Intense physical activity should not be preceded by social events where alcohol is consumed. Personnel should be advised not to consume alcohol within 48 hours of planned, high risk activities.

15. **Illicit drugs.** Whilst Service personnel are prohibited from taking illicit drugs, the dangers of using drugs should still be emphasised as a risk factor in developing heat illness.

16. **Individual volition.** High individual volition (a determination to succeed regardless of the consequences) is an individual risk factor for heat illness. This may be driven by the individual or by perceived pressure from peers or command. Commanders should be vigilant of those attempting to push themselves too hard and should not rely on individuals' self-reporting of symptoms, but on other's observations.

17. **Soldiering On.** 'Soldiering on' through a minor illness is potentially extremely dangerous. This also applies to personnel who are pushed too hard in training or other activities where environmental conditions are assessed as presenting a risk of heat illness. Commanders should be careful not to allow cultural attitudes of 'soldiering on' to prevail where this may put individuals at increased risk.

18. **Buddy-buddy**. People with heat illness may not recognise the signs and symptoms in themselves. Commanders should emphasise the use of the **'**buddy-buddy' approach to observe, identify and report heat illness concerns to the on the spot commander. Early reporting of concerns will enable timely intervention by commanders and, if necessary, medical treatment.

19. **Experience.** Experience should be taken into account in risk assessments, as inexperienced personnel are at greater risk.

Clothing, equipment and additional load

20. **Clothing**. Appropriate clothing can help to keep the body cool by allowing the free movement of air around the body encouraging efficient sweating. A layering system will allow layers to be removed as work intensity increases, down to a final lightweight layer that optimises evaporation of sweat. Exposing skin will help to lose heat through sweating but this should be balanced against the physical protection of skin, especially from sunburn. Lightweight, wide-brimmed hats will shade the head and eyes from damaging direct sunlight.

21. **Equipment and load**. Helmets, personal load carriage equipment, Personal Protective Equipment (PPE) and CBRN IPE all restrict the movement of air around the body reducing the benefit from sweating. Load carriage also increases heat gained due to the increase in work intensity. Commanders should ensure that where possible rest periods include the opportunity to de-kit and allow base layer clothing to dry. Commanders should balance the need for realistic training against the risk of sustaining heat illness casualties and should consider measures such as removing body armour plates etc. to mitigate the risk.

a. **CBRN Individual Protective Equipment**. CBRN IPE and other protective equipment such as combat body armour will significantly contribute to the storage of heat and is a risk factor for heat illness.

b. **Body armour**. Wearing body armour will increase thermal load and commanders should maintain high vigilance, reduce work rates accordingly and apply other appropriate control measures.

NOTE: Consider whether the dress state can be modified to prevent heat gain and improve heat loss. Where this is not possible the WBGT Index upper limit should be reduced by 5°C WBGT (Annex C).

Water requirements for working and exercising in heat

22. Adequate hydration is essential to enable maximal heat loss via efficient sweating. It is the duty of commanders to ensure that adequate safe water is drunk before, during and after exercise in the heat. Water should be cool (if possible), potable and from a guaranteed safe source.

23. **High risk activity**. Allowing drinking before, during and after a high risk activity is one of the most important preventive measures that can be undertaken by a commander. Thirst may be a poor indicator of fluid requirements during exercise and therefore guidelines should be followed. It is recommended that those already well-hydrated (indicated by pale yellow urine) drink:

a. A minimum of 500ml water (half a standard water bottle) 2 hours before a high-risk task.

b. A further 300ml (third of a standard water bottle) over the 15 minutes before the task.

c. Refer to the recommended intake rate in Table 2 - Recommended Water Intake for WBGT vs activity level during the task.

d. One litre of water (full water bottle) over 1-2 hours after the activity.

24. **Continuous exposure to heat**. If personnel are exposed to heat continually eg on an overseas deployment or during a hard physical course, then they should be advised to drink water regularly during the day in order that their urine always remains pale yellow in colour. Daily water requirements will increase from 2-4 litres to as much as 8-12 litres in extreme conditions depending on physical activity levels.

25. Table 2 shows the number of litres (a standard water bottle contains 1 litre) required per hour during continuous work at various WBGTs using the exercise intensities from WBGT Index Limits. The water requirement should be spread over the hour period as many individuals find large quantities of water difficult to tolerate in one intake. Hydration bladders can aid the regular intake of water during an activity although the cautionary notes at paragraphs 10 (Rest periods) and 26 (Danger of over-hydration) should be heeded.

Table 2 - Recommended Water Intake for WBGT vs Activity Level[8,9]

WBGT Index (°C WBGT)	Work Rate (as detailed in Annex C WBGT Index Limits)			
	Low	Medium	High	Very High
≥34	1.0 L/hr	1.25 L/hr	This level of activity not normally appropriate	
30-33.9	0.75 L/hr	1.0 L/hr		
27-29.9	0.5 L/hr	1.0 L/hr	1.25 L/hr	
25-26.9	0.5 L/hr	0.75 L/hr	1.0 L/hr	1.25 L/hr
20-24.9	0.25 L/hr	0.5 L/hr	0.75 L/hr	1.0 L/hr

26. **Danger of over-hydration.** Whilst rehydration is an important preventative measure over-hydration does not further reduce the risk of heat illness. Over-hydration can cause potentially severe medical consequences (nausea, vomiting, headache, irritability and loss of consciousness) and can be fatal. Only in exceptional circumstances should the daily intake exceed 12 litres. The hourly rate of fluid intake should not normally exceed 1.5 litres per hour. Commanders are responsible for monitoring the fluid intake of their personnel. This may require systematic checks particularly where hydration bladders or similar fluid delivery systems are used. Personnel who are urinating more often than normal may be over-hydrated.

27. **Salt intake**. Acclimatised personnel eating full meals should have adequate salt intake from food to meet the body's requirement[10]. It is therefore important that personnel do not miss meals. Providing additional salt sachets, especially during the acclimatisation phase, will enable personnel to salt their food 'to taste' (salt deficiency is typically indicated by a desire for saltier food)[11]. Salt tablets are not recommended without medical supervision, nor should personnel be directed to ingest extra salt other than by salting food to taste. Excessive salt intake may cause gastrointestinal discomfort and nausea, increase water requirement and may be hazardous rather than beneficial.

28. **Electrolyte drinks**. It is recommended that electrolyte beverages should replace plain water to offset sweat salt losses during periods of prolonged work (longer than 4 hours) without additional food intake. Care should be taken to use electrolyte beverages that do not contain substances which could adversely affect Compulsory Drug Testing outcomes[12]. Where electrolyte beverages are not available, salt should be added to plain water. One sachet (1g) of salt to one litre of water or 2 x 1g sachets to 1.5 litres of water is sufficient.

29. **Drinks to avoid.** Sports drinks may assist recovery after prolonged physical activity or replenish energy where the access to food is limited but these should not replace water as the preferred option for all other circumstances. Caffeinated/ stimulant drinks are not recommended for rehydration. These drinks, and some commercially available dietary supplements, may lead to further dehydration and should be avoided. Electrolyte beverages containing sugar encourage the growth of harmful bacteria in water bottles or hydration bladders eg CamelBaks™ and these should be cleaned at least daily.

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[8] Montain SJ et al. (1999). Fluid replacement recommendations for training in hot weather. Mil. Med. 164: 502-508.
[9] Kolka MA et al. (2003). Effectiveness of revised fluid replacement guidelines for military training in hot weather. Av. Space Environ. Med. 74: 242-246.
[10] Acclimatised personnel have more efficient sweating mechanisms than the unacclimatised, whereby the sweat glands produce more sweat and retain more salt. Ongoing fluid requirements increase with acclimatisation and salt requirements decrease.
[11] Unacclimatised personnel have less efficient sweating mechanisms. Water and salt must be replaced.
[12] Refer to JSP 835 Part 1 Alcohol and substance misuse and testing.

Environmental conditions

30. Environmental factors influence the effectiveness of the body's cooling systems. The primary method of heat loss is through the evaporation of sweat. The efficiency of this is determined by the temperature, humidity and wind speed.

31. The Weather forecast should be the start point for planning with the wet-bulb globe temperature (WBGT) measurement used to validate the plan. If the actual WBGT deviates from that forecasted, the plan needs revision.

32. **Joint Operational Meteorology and Oceanographic Centre (JOMOC).** JOMOC is the single point of contact for planning forecasts for the UK and Rest of the World. If available, JOMOC will direct commanders to the Met Office within the vicinity of the planned activity. If there is no Met Office within the vicinity JOMOC will provide the planning forecast. 24-hour telephone numbers: **Mil: 9360 58112 Civ: (01923) 958112 Civ: + 44 (0)1923 958112.** **www.jomoc.net**

33. **Planning timelines.** Planning forecasts are available 24/7 from JOMOC and on an *ad hoc* basis. To ensure JOMOC can provide a bespoke service the following timelines should be followed[13]:

a. **4 weeks prior to planned activity.** Contact JOMOC with location(s) and date(s), security classification of activity and point of contact. JOMOC will discuss what Met services can be offered and are required by the commander and will also be able to provide climatic information for the location of the activity.

b. **2 weeks prior to activity.** JOMOC will finalise bespoke Met Office service with the commander.

c. **48 hours prior to activity.** JOMOC will email planning forecast. A link will also be provided to the nearest Met Office 5,000 cities location.

d. **24 hours prior and throughout activity.** JOMOC will email detailed planning forecast each day for the duration of the activity. Commanders should ensure prompt and appropriate dissemination of information where the risk level is affected. A link will also be provided to the nearest Met Office 5,000 cities location.

34. **WBGT Index.** The index most suitable for military use is the WBGT Index. When there may be an elevated risk of heat illness, commanders should ensure that WBGT monitors are readily available and used correctly in order to inform the dynamic risk assessment. The monitor is used to take measurement of several environmental parameters; the readings are then integrated to derive a WBGT Index.

35. **WBGT Index upper limits**. Annex C gives guidance on the upper WBGT limit for varying work rates. Maximum work rate examples can be found at Annex D. The upper limits should be adhered to in training, unless the implementation of additional control measures adequately reduces the risk. When Commanders require their subordinates to undertake work at intensities that exceed the guidance limits, they must manage the

[13] Ideally all communications should be via Dii, however if the commander does not have access to Dii (particularly during the activity period) planning forecasts can be emailed to a civilian email address. However, consideration should be given to operational security.

increased risk. In most instances this can be achieved by reducing the duration of the activity and/or increasing the length of rest periods. This should be recorded and the Chain of Command made aware of the decision made.

36. It should be noted that:

a. **The WBGT measurement should be monitored at the location of greatest heat risk for any given activity rather than that of most convenience.**

b. **WBGT Index upper limits apply for the entire duration of an activity and not just the time of commencement.**

c. **The WBGT Index only forms part of the overall risk assessment and it should not be used in isolation.**

d. **In the planning and execution phases of mandatory tests and activities lasting in excess of 1 hour, and where this guidance cannot be followed, commanders should pay particular attention to the whole risk assessment and the other risk factors present.** For specific guidance on the MATT2 annual fitness test and RAF loaded march see Annex E.

e. An assessment of risk using the WBGT Index is only valid or accurate if the measurement is taken at the same time and location as the proposed activity.

f. When it is not possible to take a WBGT index reading at the site or location consider the topography where the activity will be conducted. If, for example, areas of the site are more sheltered from the wind, or have more vegetation than others it is likely the WBGT index will differ considerably from the site the WBGT index has been taken. If the reading is close to the threshold it is more than likely it will have been exceeded for those areas.

37. A WBGT monitor is only reliable if used and maintained correctly. If in doubt, Units should seek further advice and assistance from medical personnel, EHT or other SQEP. Guidance on procuring, using and servicing WBGT monitors is given at Annex F.

38. Where a WBGT monitor is not available, Meteorological Office Planning Forecasts provides an alternative source of information on which to plan an exercise or work routine.

Heat acclimatisation for deployment to hot climates

39. The risk of heat illness in hot (dry or humid) climates can be reduced, but not eliminated, by prior acclimatisation. Repeated exposure to exercise in hot conditions will result in physiological adaptations to improve heat dissipation ie increased sweat rate and earlier onset of sweating. Advice on a country's climate can be sought from the JOMOC 24-hour telephone numbers: Mil: 9360 58112 Civ: (01923) 958112. www.jomoc.net

40. **Prior to deployment**. Building and maintaining a good level of aerobic fitness (VO_2 max) reduces the risk of heat illness. An indirect relationship has been demonstrated between VO_2max and the number of days required to acclimatise[14]. When a risk of heat

[14] Pandolf K et al, Physical fitness in heat acclimatisation. Ergonomics (1977); 20: 399-408.

illness has been identified in a commander's risk assessment[15], personnel should participate in a progressive physical training programme normally under the supervision of a Physical Training Instructor for approximately 6 weeks prior to departure.

a. **6 weeks before deployment.** Build or improve aerobic fitness over 3-4 weeks. Aim to increase and maintain heart rate above 65% of maximum heart rate[16] for periods of 40 min initially, then extending to an hour. Allow at least 2 days full rest per week and vary the exercise type to use different muscle groups.

b. **10-14 days before deployment.** Aim to raise and maintain an elevated body temperature for at least one hour each day; this can be checked by visual assessment of sweating. To achieve this, team or individual sport participation might be preceded by circuit training in the gym to raise body temperature. At all times care should be taken to work within the WBGT Index Limits and to ensure sufficient fluids are taken.

c. Pre-deployment heat acclimatisation training cannot always be fully completed. This can hinder an individual's physical ability to initially adapt and acclimatise to hot conditions. This risk is further increased when an individual's level of personal fitness (VO_2max) is low. Commanders are responsible for ensuring that the risk of heat illness in personnel under their command is reduced to a minimum whilst safely sustaining outputs.

d. **High Readiness Units (including Aircrew).** Personnel in units held at high readiness or who deploy regularly for short periods of time are to be aware of the causes, symptoms and signs of heat related illness. Pre-deployment heat acclimatisation training is not always possible. Opportunity to increase VO2 Max through regular exercise will help support the individual's ability to acclimatise.

41. **Arrival in theatre.** Air transit (resulting in jet lag, lack of sleep and dehydration) is likely to reduce individual tolerance to heat stress. It is imperative that no exercise is undertaken for 24 hours after arrival in theatre. Personnel should be encouraged to sleep, eat and drink plenty of fluids.

42. **Time to acclimatise**. Full acclimatisation normally requires 15 days or longer[17]. Until fully acclimatised personnel should be considered un-acclimatised and should be managed accordingly. This will take longer if travel to the hot climate has included a substantial period of travel or crossing of multiple time-zones. Living or working in air-conditioned accommodation also slows the development of acclimatisation.

43. **Expediting acclimatisation.** For risk assessment purposes a group can be considered to be acclimatised if they have undertaken regular exercise for 8 days in the same environmental conditions as the proposed activity[18]. Individuals will acclimatise at different rates; some may not have acclimatised at the end of the 8 days and will require longer. In order to expedite acclimatisation (to 8 days) a structured 7-day programme of

[15] In-theatre commanders may waive the requirement for a SP to undertake pre-deployment progressive physical training. This should only be done only after a risk assessment has been completed and a mitigation strategy put in place.
[16] Maximum heart rate can be calculated by subtracting age in years from 220.
[17] Armstrong LE, Dziados JE (1986). Effect of heat exposure on the exercising adult. In: Benhardt DE (ed.) *Sports physical therapy.* Churchill Livingstone, New York.
[18] INM Report No. 2007.007 Evaluation Of Operational Acclimatisation During Deployment To A Hot-Dry Environment. Delves S K, Fallowfield J L, Milligan G, Owen J P, Middleton M Jan 07.

incremental physical training can commence following the 24 hour rest day. Table 3 - Recommended Acclimatisation Procedure on Arrival in Theatre, shows a progressive physical training programme that has been validated for use in military populations and should be followed as far as practicable. Exercise should be undertaken during times of day where the WBGT Index is within the range stated in Annex C. Examples of activities can be found at Annex D. **During this period, individuals should not undertake additional personal physical training.** Water intake should be managed in accordance with the previous section 'Water requirements for exercising in heat.' Table 3 is for fit personnel; those less fit may have to progress more slowly.

44. Personnel will acclimatise only to the prevailing environmental temperature to which they are exposed. A move to a hotter location will need a further period of acclimatisation.

45. **Loss of acclimatisation.** Personnel moving to cooler locations (eg return to the UK or move within theatre to higher altitude) gradually lose acclimatisation over 14 days after which they are no longer acclimatised. Loss of acclimatisation is slowed if regular exercise is undertaken whilst away. A minimum of one training session is needed in the first 7 days[19] of absence followed by 5 in the second week.

46. **Re-acclimatisation** On return to a hot climate individuals should re-acclimatise. The period of re-acclimatisation will depend on the duration spent in the cooler climate, the environmental temperature in that climate and the fitness of the individual.

a. **Short absences (less than 14 days)**. 4-7 days is required to re-acclimatise (4 days should be sufficient for physically fit personnel). It is recommended that after an initial 24 hour period of inactivity, the procedure for days 5-8 in Table 3 – Recommended Acclimatisation Procedure on Arrival in Theatre is followed. Consideration should be given to the individual risk factors for heat illness detailed in Table 1 – Individual Risk Factors.

b. **Long absences (more than 14 days)**. Personnel should be considered as unacclimatised.

Note that UK and Northern Europe Service personnel should be considered un-acclimatised at all times.

[19] Report TTCP/HUM/97/002 Assessment of potential ergogenic aids for special operations. Annex B p54.

Table 3 - Recommended Acclimatisation Procedure on Arrival in Theatre[12,20].

Day	Dress	Target WBGT Index (°C WBGT)[21,22]	Duration (mins)	Activity[23,24]
1	**NO ACTIVITY. REST, EAT, DRINK AND SLEEP (for 24 hours)**			
2	T-shirt and shorts	26 - 30	1 x 50	Walk at 6 km/h (3.7 miles/h).
3	T-shirt and shorts	26 – 30	2 x 50	Walk at 6 km/h; rest for 15 min; resume walking.
4	T-shirt and shorts	26 – 30	100	Walk at 6 km/h.
5	T-shirt, combat jacket, lightweight trousers, and body armour	26 – 30	2 x 50	Walk at 6 km/h for 50 mins then **remove body armour**[25] **and jacket** and rest for 15 min; resume walking.
6	T-shirt, combat jacket, lightweight trousers and body armour	26 – 30	100	Walk at 6 km/h.
7	T-shirt, combat jacket, lightweight trousers, body armour and webbing (10 kg)	26 – 30	2 x 50	Walk at 6 km/h; **remove webbing**, rest for 15 min; resume walking.
8	T-shirt, combat jacket, lightweight trousers, body armour and webbing (10 kg)	26 – 30	100	Walk at 6 km/h.
PERSONNEL UNDERTAKING ACCLIMATISATION SHOULD BE ALLOWED FLUIDS AS REQUIRED				

Recognition of heat illness and initial response

47. **Signs and symptoms.** An individual should be presumed to have heat illness if they experience any of the signs or symptoms of heat illness as detailed in Table 4 - Heat Illness Signs and Symptoms, if they are; undertaking physical activity, in a hot environment, wearing protective clothing, or any combination of these.

Table 4 - Heat Illness Signs and Symptoms

Collapse or loss of consciousness	Inappropriate or unusual behaviour eg behaving as if drunk	Disturbed vision
Seizure(s) (fitting)	Anxiety and/or agitation	Headache
Nausea (feeling sick)	Impaired judgement	Dizziness
Vomiting	Confusion	Weakness or fatigue
Diarrhoea	Staggering or loss of coordination	Pins and needles
Thirst	Cramps or muscle pain	Hyperventilation (rapid breathing)
●These symptoms can occur singly, in any combination, and in any order. ●Not all heat illness will present typically. ●Some casualties may display seemingly normal function interspersed with more typical signs and symptoms.		

[20] INM Report No. 2005.035 The Implementation Of Acclimatisation Guidelines Prior To, During And After Operational Deployment To A Hot-Dry Environment In A British Regiment. Delves S K, Wade A, Fallowfield J L Dec 05.
[21] Note that the WBGT temperature needs to be monitored at the time and location used for the training activity.
[22] In cooler conditions below WBGT of 26 the clothing and /or load should be increased.
[23] Note that achieving this as part of Exercise activity is adequate providng the WBGT is correct.
[24] Alternative activities may be used to achieve the same effect, programmes must be discussed with INM and recorded in the risk assessment.
[25] The aim is to raise body temperature and initiate sweating to promote acclimatisation.

48. **Immediate actions**. Commence first-aid as detailed in Heat Illness First Aid Treatment Guidelines (Annex B). **A single case is a warning that other personnel are at risk.** The commander should carry out a dynamic risk assessment of the activity, check for other heat casualties and consider other control measures including stopping the activity.

49. **Medical treatment.** Further detailed advice to medical personnel is contained at Section 2.

50. **Incident and case reporting.** All incidents and cases of heat illness(less those that do not meet the threshold criteria) should be reported in accordance with procedures at Section 5.

Summary

51. Heat illness is a recognised hazard of military activity. The reduction of risk to ALARP is a command responsibility at every level both during training and on operations.

Key Points
●Where there is a risk of heat illness, the risk should be mitigated to ALARP.
●Risk assessment must be undertaken in accordance with JSP 375 and recorded on MOD Form 5015.
●A plan for the management of heat illness cases must be in place (to include medical treatment and dynamic risk assessment).
●All cases must be reported.
●WBGT Index upper limits apply for the entire duration of any activity and should be measured at sites of maximal heat risk.

COMMANDERS HEAT ILLNESS RISK ASSESSMENT CHECKLIST — ANNEX A

Risk assessments should be conducted continuously reviewed throughout the activity in accordance with JSP 375. Note that this checklist supports but does not replace MOD Form 5015 where the risk assessment should be recorded.

Ser	Risk Factor	Results	Guidance	Notes / Control Measures
1	**Maximum work rate** What is the maximum work rate of the planned activity?	Low ☐ Medium ☐ High ☐ Very High ☐ Extreme ☐	Assessment of the maximum work rate should take account of the available time, loads carried and previous activity. The higher the work rate the greater the risk (see JSP 539 Section 1 Annex D for maximum work rate examples). Ensure all personnel are rested and recovered.	
2	**Duration of activity**. What is the planned duration of the activity?	<30 mins ☐ <1 hr ☐ <2 hrs ☐ >4 hrs ☐	Environmental conditions (including consideration of time of day) may change over the duration of the activity. Extension of the planned activity requires a review. Longer duration activities have more risk.	
3	**Individual Risk Factors**.	Yes ☐ No ☐	Are any of the participants in the activity subject to the individual risk factors detailed in JSP 539 Table 1- Individual risk Factors? What individual risk factors are present in personnel; individually and as a group?	
4	**Casualty response**.	Yes ☐ No ☐	Is there adequate medical support and a robust evacuation plan? Early treatment is critical in the response to heat illness.	
5	**Preparatory education**.	Yes ☐ No ☐	Are participants sufficiently aware of heat illness? Knowledge of risk factors, signs and symptoms will encourage early identification.	

6a	**Environmental conditions** Has an accurate weather forecast been obtained?	Yes ☐ No ☐	JOMOC 24-hour telephone numbers: Mil: 9360 58112 Civ: (01923) 958112 Civ: + 44 (0)1923 958112	
6b	**Establish WBGT Index upper limit for the Service personnel undertaking the activity.** Does the WBGT Index exceed the upper limit?	Yes ☐ No ☐	See Annex C - WBGT Index Limits. The WBGT Index upper limit takes account of site specific climatic conditions. Consideration should be given to differences between the WBGT reading site and the topography and geography where the activity is planned.	
7	**Dress for activity**.	Yes ☐ No ☐	Is PPE or equipment that may significantly reduce heat loss being worn or used? Can the dress state be modified to prevent heat gain and improve heat loss? Where this is not possible then the WBGT Index upper limit should be reduced by 5°C WBGT.	
8	**Water intake**. See JSP 539 Table 2 - Recommended Water Intake for WBGT vs Activity Level.	Yes ☐ No ☐	Has sufficient drinking water been planned for? Dehydration can occur rapidly and will increase the risk of heat illness,.	
9	**Acclimatisation** See JSP 539 Table 3 - Recommended Acclimatisation Procedure on Arrival in Theatre.	Yes ☐ No ☐ Mixed ☐	Are the participants acclimatised? Un-acclimatised participants are at greater risk.	

What to look out for

●collapse or loss of consciousness ●fitting / seizures ●staggering or loss of coordination
●impaired judgement ●inappropriate or unusual behaviour eg behaving as if drunk ●anxiety and/or agitation
●confusion ●headache ●dizziness ●weakness or fatigue ●feeling sick or vomiting ●disturbed vision
●thirst ●hyperventilation (fast breathing) ●diarrhoea ●cramps and muscle pain ●pins and needles

❍These symptoms can occur singly, in any combination, and in any order.
❍Not all heat illness will present typically.
❍Some casualties may display seemingly normal function interspersed with more typical signs and symptoms.

PAUSE ACTIVITY

●INDIVIDUAL - pause for at least 30 minutes ●GROUP- pause to assess others, then recommence activity
●A single case is a warning that other personnel are at risk, the commander is to carry out a dynamic risk assessment of the activity, and is to consider other control measures including stopping the activity
●Check for other cases; there could be several over a dispersed geographical location
●Remove the individual from immediate danger and prevent any further casualties from occurring
●Initial assessment should always address airway, breathing and circulation problems first

- Lie the casualty down in the shade
- Elevate feet if conscious
- Strip casualty to underwear
- Sponge or spray casualty with cool water and fan the skin

Is the casualty conscious?

yes

Give water to drink

Rest and monitor, continue active cooling for 30 mins
Have symptoms fully resolved?

yes

Discuss with medical chain, consider return to duty

no

Place the casualty in the recovery position

no

Evacuate to medical care as quickly as possible

NOW REPORT IT

	WBGT INDEX UPPER LIMIT (°C WBGT)	
Maximum work rate	**Un-acclimatised**	**Acclimatised**
Extreme	20 **Max 30 mins duration only**	20
Very high	20	25
High	24	27
Medium	26	30
Low	32	34

WBGT Index Upper Limits - Notes

1. Adherence to the WBGT Index Limits will minimise the risk of heat illness, for 95% of normal, healthy Service Personnel. As the WBGT Index Upper Limit increases, the maximum work rate should be decreased in order to minimise the risk of heat illness. **Heat illness can still occur, and all personnel should remain vigilant to this risk.**

2. The WBGT Index SI unit is °C WBGT. The readings are in °C but these should not be confused with ambient temperatures as reported on weather forecasts.

3. If the operational imperative requires that the activity should be undertaken outside the guidance levels, then consideration should be given to reducing the duration of work to less than an hour and increasing frequency and duration of rest periods. Conduct commanders risk assessment. Medical advice should be sought, as needed.

NOTE: In the planning and execution phases of mandatory tests and activities lasting in excess of 1 hour, and where this guidance cannot be followed, commanders should pay particular attention to the whole risk assessment and the other risk factors present (see paragraphs 6-11 of Section 1 main text). For AFT guidance see Annex E.

4. Values in the table are applicable to:

   a. Service Personnel wearing a single layer uniform with sleeves rolled up and without helmets.
   b. Men and women equally, given comparable levels of physical fitness.

5. CBRN protective clothing or body armour:

   a. Use the **un-acclimatised WBGT Index Upper Limit** for all personnel.
   b. Reduce the WBGT Upper Index limit value by 5 °C.
   c. If CBRN clothing is worn, it is not safe to perform activities at the ‘high’, ‘very high’ or ‘extreme’ work rate or to run in any environment without medical advice.

6. For unfit Service Personnel (ie those who cannot pass their mandatory fitness test): the WBGT Index Upper Limit should be lowered.

7. Commanders should anticipate changes to WBGT during the course of a duty/ training period or activity. For example, the WBGT may be within the upper limit at the start of an early morning activity but exceed the limit by the end. Regular re-assessment of WBGT should be undertaken when available to inform dynamic risk assessment.

8. Activities shown in the Maritime and Air domains are evidence-based examples. Examples of activities shown in the Land domain have been adapted from other sources.

Remember for UK and Northern Europe based personnel use the UN-ACCLIMATISED WBGT at all times.

WBGT Index upper limits apply for the entire duration of any activity and should be measured at sites of maximal heat risk.

MAXIMUM WORK RATE EXAMPLES ANNEX D

Maximum work rate	Maritime examples	Land examples	Air examples
	One hour of the activity followed by 30 minutes rest.		
Extreme	●Fire-fighting[1]	●Running in sports kit ●Speed marching 9.7 kph (6 mph) 15kg load	●Loading/unloading heavy cargo (23 kg aircraft strops)
Very high	●No example available	●Marching 8 kph (5 mph) no load ●Marching 5.6 kph (3.5 mph), 30 kg load	●Heavy aircraft repair[2]
High	●Transiting around ship/ boat	●Marching 5.6 kph (3.5 mph) with a 20kg load. ●Patrolling, digging, field assaults.	●Rear crew tasks eg flight preparations, landing and low level transit tasks, trooping, under-slung loads, refuelling, fast roping and door gunning ●FJ pilots air combat manoeuvres, aerobatics
Medium	●Rounds ●Manning upper deck/gangway duty	●Marching 3.6 kph (2.3 mph) 30 kg load	●Rear crew walking to the aircraft ●RW pilots (medium) routine flight[3] ●RW pilots (light) complex flight phases ●FJ pilots take off and standard manoeuvres[4] ●RW pilot pre-flight checks[5]
Low	●Working seated[6]	●Lying ●Guard duty	●RW pilots (light) routine flight[7,8] ●FJ pilots aspects of routine flight (climb, cruise, descent and circuits)[9] ●Rear crew transit

[1] Bilzon, J. (2000) Characteristics of the Metabolic Demands of Shipboard Royal Navy Firefighting Tasks: An Interim Report. INM Report No 1999.067.
[2] Macdill Airforce Base Instruction 48-102. April 2015.
[3] Hodgkinson, P. (2014) Prevention of Hypoxia in Helicopter Aircrew – Acceptable Compromises. PhD Thesis, University of Cambridge.
[4] Harding, R.M. Human Respiratory Responses During High Performance Flight. AGARDograph No.312.
[5] Thornton, R. and Brown, G. (1982) The energy expenditure of helicopter crewmen. Aircrew Equipment Report No 469.
[6] INM Unpublished Data.
[7] Staab JE, Kolka MA, Cadarette BS. Metabolic rate and heat stress associated with flying military rotary-wing aircraft: US Army Research Institute of Environmental Medicine, Natick, Massachusetts. Report No. TN98-3, 1998.
[8] Thornton R, Brown GA, Higenbottam C. The Energy-Expenditure of Helicopter Pilots. Aviat Space Envir Med 1984; 55(8):746-50.
[9] Lorentzen (1965) Oxygen consumption during flight at moderate G. Aerospace Med., 26:282-285.

ANNEX E

GUIDANCE FOR REDUCING HEAT ILLNESS RISK ON THE MATT 2 ANNUAL FITNESS TEST (AFT) AND RAF LOADED MARCH

Background

1. Army and RM personnel undertake the AFT in accordance with MATT 2. RAF Regt personnel undertake the RAF Regt Fitness Standard Loaded March (LM), which is the same test, but conducted in accordance with RAF policy (AP 3342 Lflt 405). For simplicity, both tests will be referred to as the AFT. Both MATT 2 and AP 3342 specify the AFT must comply with JSP 539. The WBGT Index table (Annex C) applies directly to any event lasting up to 1 hour: the AFT lasts a minimum of 1hr 55min.

Guidance

2. This Annex aims to provide additional guidance to commanders (especially junior leaders) running an AFT on the risk management of heat illness in order to deliver that training effectively. It is to be read in conjunction with Section 1.

3. Commanders are reminded that MATT 2 requires an AFT to have an OIC to command the event, separate from the PTI who controls the pace.

4. The commander should consider all factors when undertaking their risk assessment (see Annex A) and reduce them to as low as reasonably practicable (ALARP). Commanders should foster a culture where it is normal for heat illness risk control measures to be applied to the AFT (which may include postponement, termination or amending the route).

5. **For the AFT WBGT Index Limits, Table E-1 (below) should be used in place of the WBGT Index Limit table (Annex C).** Commanders are reminded that the WBGT reading should not be used in isolation as the sole measure of risk:

   a. The commander should be aware that the only way to compensate for the internal heat generated by the exercise associated with the AFT is to reduce the duration, reduce the pace, add in breaks or reduce the weight carried (or any combination of these) during the exercise. Such modifications would invalidate a standardised test. As a consequence, <u>if the WBGT reading is above (or is predicted to be above) the limit the AFT should not proceed</u>, and should be postponed until the WBGT reading is within limits.

   b. If the WBGT reading is below the limit, commanders should still be satisfied that other risk factors are adequately controlled before proceeding.

6. The WBGT index limits at Annex C have been calculated for physical activity lasting up to 1 hr followed by a 30 min break and are based on current evidence. As the AFT is a 2 hr test the risk of heat illness is increased in the second hour. Therefore it is necessary to take an additional WBGT reading immediately prior to the start and periodically during the AFT, as appropriate to the conditions. Subsequent readings may be taken in the same location as the first if it is not practical to move the WBGT meter along the AFT route. If any reading shows the temperature to be beyond the limits in Table E-1 the AFT commander should terminate the AFT.

7. Commanders are reminded that Risk Assessments (see Annex A and MoD Form 510) must be tailored to the location and climatic conditions in which the AFT takes place, and control measures detailed in the Risk Assessment must be understood and considered by AFT OICs.

8. If the AFT is due to take place during warm weather it is advisable to obtain a WBGT forecast in advance of the event (Section 1, paras 30-32). The forecast should be used as a planning tool to inform decisions on postponement/cancellation of the AFT. This **must take into account any forecast rise in WBGT after the proposed start of the event**.

9. WBGT readings should be taken as close as reasonably possible to the AFT route.

10. If the WBGT reading is below, but close to, limits (which are those for activities up to one hour), OICs should consider additional measures in order to reduce heat illness risk (such as, amending the route to exploit shaded areas and/or open areas with good airflow or advancing the AFT to take advantage of cooler times of day.). **If a heat casualty is sustained during the test (either suspected or confirmed), the test is to be terminated**, all personnel are to be moved into a shaded area and a full assessment of all participants conducted.

Table E-1: WBGT Index Limits for AFT

MAXIMUM PERMITTED WORK RATE FOR SERVICE PERSONNEL UNDERTAKING ACTIVITIES AT A GIVEN WBGT INDEX

For UK and Northern European based Service Personnel use the un-acclimatised WBGT
WBGT should be measured, as a minimum, immediately before the event and again at the 1 hour point

Maximum Permitted Work Rate	WBGT Index Upper Limit (°C WBGT) - not to be exceeded		MARITIME	LAND	AIR
	Un-acclimatised	Acclimatised			
AFT/LM	20	25	• Combat Fitness Test – 3 Cdo Bde personnel only • See Annex A to MATT 2 • Marching 6.4kph average (4 mph) • Weight carried 25kgs • Duration 1:55-2:00 hrs	• Marching 6.4kph average (4 mph) • Weight carried 15-25kgs – see MATT 2 (B.2.1) • Duration 1:55-2:00 hrs	• RAF Regt Fitness Standard Loaded March (RAF Regt Only) • See Annex A to AP3342 Lflt 405 • Marching 6.4kph average (4 mph) • Weight carried 25kgs • Duration 1:55-2:00 hrs

- Despite preventive measures, heat illness can still occur, and all personnel should remain vigilant to this risk.
- This guidance applies to Service Personnel wearing a single layer uniform with sleeves rolled up and without helmets.
- There is little difference in heat tolerance between men and women of equal physical fitness.

- WBGT Index upper limits apply for the entire duration of any activity and should be measured at sites of maximal heat risk.

ANNEX F

WBGT MONITOR PROCUREMENT AND OPERATING GUIDELINES

1. **Demanding.** The QuesTemp QT–34 WBGT monitor (NSN 6685-99-665-9590) is the ratified method of measuring heat stress indices and is an accountable item. Initial demands may be submitted by any Unit or Organisation which identifies a requirement through the normal logistics process (AFG 8088).

2. **Re-calibration.** WBGT monitors require annual calibration to ensure that readings remain accurate. Calibration support is provided via Defence Electronics & Components Agency (DECA), Sealand (Tel: 95541 7365 or 01244 847365). Any monitor submitted for calibration should be accompanied with a MOD Form 1773 'Request for Calibration'. On the procurement of a WBGT Monitor, DSG Sealand will automatically be notified and the demanding Unit will subsequently be sent a reminder approximately 1 month before annual calibration is due. However it is a unit responsibility to ensure that the WBGT remains in date for calibration.

3. **Through-life support.** Any repairs, spares or deficiencies should be directed to Babcock DSG Donnington, Through Life Support Cell, Building 15 (Tel: 94480 3727 or 01952 673727). For Operational Theatres, the reverse supply chain should be utilised, ensuring that the WBGT monitor is tracked to its final destination, and will be returned as A1 stock.

4. Further advice and training can also be accessed via local uniformed Environmental Health personnel.

Measurement

5. **Sensors.** The sensors provided with the WBGT monitor are very sensitive and should be handled with care. Each sensor performs the following function:

a. **Wet Bulb Thermometer (WB).** The wet bulb thermometer gives an indication of the effects of humidity on an individual. Relative humidity and wind speed are taken into account by measuring the amount of evaporative cooling taking place at a thermometer covered with a moistened wick. The QUESTemp 34 uses a cotton wick immersed into a reservoir containing distilled water. Ordinary tap water should **not** be used, as the contaminants that are left behind after evaporation will shorten the life of the wick and cause high readings. Distilled water may usually be obtained from the local medical centre, Medical & Dental Servicing Section (MDSS) or Mechanical Transport Maintenace Section (MTMS). If the wick is discoloured it should be replaced. To replace the wick slide the old wick off the top of the sensor. Place a new wick over the sensor making sure that the bottom of the wick is immersed in the reservoir.

b. **Globe Thermometer (G).** The globe thermometer gives an indication of the radiant heat exposure on an individual due to either direct sunlight or hot objects in the environment. This is accomplished by placing a temperature sensor inside a blackened copper sphere and measuring the temperature rise. For this reason, WBGT measurements may be taken in direct sunlight or indoors.

c. **Dry Bulb Thermometer (DB).** The dry bulb thermometer measures the ambient air temperature. This measurement is used in the outdoor WBGT calculation

when a high solar radiant heat load may be present. The series of white plates surrounding the sensor shield it from radiant heat and should not be removed.

d. **Relative Humidity Sensor (RH).** A relative humidity sensor is located in a compartment inside of the sensor bar housing. Slots in the housing allow air to circulate around the sensor.

6. **Calculation.** The QUESTemp 34 combines the 4 measurements and calculates the WBGT reading through the weighted average of the 3 temperature sensors as follows (no calculations are required from the operator:

a. WBGT (indoor) = 0.7WB + 0.3G

b. WBGT (outdoor) = 0.7WB + 0.2G + 0.1DB

7. **Interpretation.** The resulting WBGT reading can be compared to WBGT Index Limits (Annex C) which shows the maximal appropriate work rate for acclimatised and un-acclimatised personnel, based on a 60 min work and 30 min (minimum) rest cycle. Whilst the readings given are in °C, this should not be confused with normal ambient temperatures which are often reported on weather forecasts. It is also re-iterated that this is only a small component of the commander's overall risk assessment and **should not be used in isolation** to determine what activities can or cannot be undertaken.

Basic operation

8. **Daily checks.** The following actions should be undertaken on a daily basis before use to ensure that the WBGT monitor is ready for operation:

a. Make sure the wet bulb's wick is clean. Fill the reservoir with distilled water and ensure the bottom of the wick is immersed in the reservoir and that the cotton wick is fully wetted.

b. Turn the unit ON. If the battery voltage displayed during the power-on sequence is ≤6.4 volts, replace or recharge the batteries. If the monitor is not in regular use then it is recommended that the batteries be recharged on a weekly basis.

c. Use the arrow keys to set the display to the desired parameters.

9. **Monitoring.** Before monitoring is undertaken, ensure the daily checks have been performed. Monitoring should be undertaken as follows:

a. Place the WBGT monitor in the work area in a safe location approximately 1m (3.5') off the ground for standing individuals or 0.6m (2') for seated individuals in an area representative of the environment to be measured.

b. Tripod mounting is recommended to site the unit away from obstructions to radiant heat or airflow. A 1/4" x 20 threaded bushing on the bottom of the instrument allows mounting to a standard photographic tripod.

c. Avoid 'sun traps', hard reflective surfaces or areas with reduced air movement which may give unrepresentative readings, unless it is necessary to monitor in such areas to investigate or advise on specific issues.

d. Turn the unit ON. Allow 10 minutes after switching the unit on, adding distilled water or moving the unit to allow the sensors to stabilize to the environment.

e. Do not stand close to the unit during monitoring as this may influence the reading.

f. Press VIEW to display measured data. Press the RUN STOP key to begin logging data if required.

10. The Heat Stress values produced by the Met Office, or from any other source, are only an approximation to WBGT. Forecasts of WBGT are issued for planning purposes only; the element of the risk assessment, based on theWBGT Index, is only valid if the temperature measurement is taken in the same location as the proposed activity using a WBGT meter. All written Heat Stress forecasts will carry the warning “For planning purposes only. Direct measurements of Heat Stress are required to assess maximum permitted work rate in accordance with JSP 539.”

SECTION 2 – HEAT: GUIDANCE FOR MEDICAL PERSONNEL

Responsibilities

1. All medical personnel should advise the Chain of Command on the prevention and management of heat illness (appropriate to their level of competence and responsibility).

2. In the event of a single case of heat illness medical personnel should consider the other members of the group or party. If one individual has been affected there is a high likelihood that others may also be affected. The Chain of Command should be alerted that other personnel may be at risk.

What is heat illness?

3. **Definition.** Heat illness is a spectrum of illness which includes heat exhaustion and heat stroke. In practice it is difficult to distinguish between the conditions and indeed they may coexist. For the purposes of this JSP the term 'heat illness' includes those individuals who become incapacitated as a result of a rise in core body temperature. Heat illness may present with mild symptoms such as muscular weakness, headache, and fatigue through to more severe symptoms such as collapse, coma and death.

4. **Pathophysiology.** The pathophysiology of heat illness is complex, incompletely understood and may vary according to the circumstances surrounding incapacity (e.g. workload; hydration state; acclimatisation status). The most serious form of heat illness, heat stroke, is defined pathophysiologically as a form of hyperthermia associated with a systemic inflammatory response, leading to a syndrome of multiorgan dysfunction in which encephalopathy predominates[1]. Tissue injury and organ dysfunction may be widespread and involve the gut, skeletal muscle, liver and kidneys. Lesser forms of heat illness may arise as cardiovascular insufficiency, either from significant fluid-electrolyte losses or autonomic dysregulation. Importantly, hyponatraemia from over-replacement of fluid losses with water can also impair awareness of body temperature during exercise, with potentially fatal consequences[2]. Due to the diverse precipitants that may contribute to heat illness and possibility of progression from a milder form to frank heat stroke, immediate treatment priorities should include cooling in all cases where elevated body temperature is found or suspected. This may need to occur in parallel with treatment of other co-morbidities (e.g. volume depletion, hypoglycaemia, electrolyte imbalance).

5. **Body temperature.** Body temperature is an unreliable guide to severity. Individuals with very high rectal temperatures (for example, 42°C) may recover completely with prompt treatment whilst individuals with less elevated temperatures (for example, 39°C) may suffer complications. The first temperature measured may not be a reflection of the peak temperature. An elevated core temperature is an indication for urgent measures to instigate cooling. Rectal thermometers should ideally be used in the field as oral or tympanic thermometers are less reliable for determining core body temperature[3,45]. Disturbance of the central nervous system including seizures or a loss of consciousness

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[1] Bouchama & Knochel, 2002, Heat stroke. N Engl J Med, 346, 1978-88.
[2] Nolte, H. W., Hew-Butler, T., Noakes, T. D. & Duvenage, C. S. 2015. Exercise-associated hyponatremic encephalopathy and exertional heatstroke in a soldier: High rates of fluid intake during exercise caused rather than prevented a fatal outcome. Phys Sportsmed, 43, 93-8.
[3] J Athl Train. 2011 46(5): 566–573. Is Oral Temperature an Accurate Measure of Deep Body Temperature? A Systematic Review.
[4] J Athl Train. 2012 47(3): 329–338. Comparison of Rectal and Aural Core Body Temperature Thermometry in Hyperthermic, Exercising Individuals: A Meta-Analysis.
[5] Current scaled thermometers: Oral & rectal (32-42^{0}C) NSN 6515-99-898-2896; Tympanic (ear) (20-40^{0}C) NSN 6515-99-874-6330

(LOC) indicate the most severe heat illness. Clinical judgement should be used if an appropriate thermometer is not available to guide management.

6. **Hydration status.** The hydration status of heat illness casualties varies widely. Some can be profoundly dehydrated whilst others may be adequately hydrated. Fluid replacement should be tailored to clinical assessment.

Individual risk factors

7. There is a wide variation in human tolerance to heat. In some cases of heat illness it is possible to identify factors that have caused particular individuals to become heat casualties. All ranks of medical personnel should be empowered to raise concerns if individuals taking part in the proposed activity have risk factors that commanders may not be aware of. Table 1 contains the currently recognised heat illness individual risk factors:

Table 1 - Individual risk factors

Lifestyle	Health	Work constraints
Individual Volition	Previous heat illness	Inexperienced personnel
Being overweight or obese	Mild illness eg diarrhoea, common cold, fever	Air travel within the past 24 hours
Lack of physical fitness	Vaccination within the past 48 hours	Poor nutrition (missed meals within the past 24 hours)
Smoking (not ex-smokers)	Current sunburn	Lack of sleep
Alcohol intake within the past 48 hours	Prescribed and over-the-counter medication eg antihistamines and painkillers	Un-acclimatised personnel (this includes all UK and Northern Europe-based personnel)
Illicit drugs eg ecstasy		
Use of supplements	Dehydration	

Recognition of heat illness and initial response

8. **Signs and symptoms.** An individual should be presumed to have heat illness if they experience any of the signs or symptoms of heat illness as detailed in Table 2 - Heat Illness Signs and Symptoms, if they are; undertaking physical activity, in a hot environment, wearing protective clothing, or any combination of these.

Table 2 Heat Illness Signs and Symptoms

Collapse or loss of consciousness	Inappropriate or unusual behaviour eg behaving as if drunk	Disturbed vision
Seizure(s)	Anxiety and/or agitation	Headache
Nausea	Impaired judgement	Dizziness
Vomiting	Confusion	Weakness or fatigue
Diarrhoea	Staggering or loss of coordination	Paraesthesia
Thirst	Myalgia, cramps, or tetany	Hyperventilation
●These symptoms can occur singly, in any combination, and in any order. ●Not all heat illness will present typically. ●Some casualties may display seemingly normal function interspersed with more typical signs and symptoms.		

9. **Immediate actions.** On recognition of heat illness, commence cooling of the casualty. Assess airway, breathing and circulation whilst stripping, soaking and fanning the casualty.

10. **Observations.** Measure rectal temperature, pulse rate, blood pressure, respiratory rate, assessment of conscious level (AVPU) and pulse oximetry. Monitor fluid balance,

including urine output, check blood glucose and urinalysis for protein, specific gravity and myoglobin if available.

11. **Interventions.** After the initial assessment the following interventions should be undertaken on any person suspected of suffering with heat illness:

a. Continue active cooling by continuous spraying with cool water and fanning. This should cease temporarily if shivering occurs to avoid generation of further internal heat.

b. **Fluid replacement.**

(1) If able to drink, administer clean water.

(2) If unable to drink or actively vomiting administer 1 litre of crystalloid fluid intravenously over 30 minutes followed by a further 1 litre over an hour if required.

c. If unconscious, administer oxygen and provide airway protection. Admission to hospital should be arranged for all casualties who do not respond appropriately within 30 minutes. Paralysis and advanced airway interventions (including rapid sequence induction, RSI) may be required for severe heat illness.

d. Rhabdomyolysis should be considered in all cases of heat illness. Severe skeletal muscle breakdown can occur in the context of severe exertion and/or heat illness, which may result in myoglobinuria and renal impairment.

e. Where cooling has proven to be ineffective and in resistant hyperthermia, if presenting to a facility with appropriately qualified staff, consider the administration of Dantrolene (in exertional heat illness), under guidance of a senior anaesthetic or critical care physician . This is given intravenously in a dose of 2.5-3 mg/kg[6].

12. **Investigations.** Individuals who are suspected to be suffering from a significant episode of heat illness require the investigations detailed in Table 3 - Heat Illness Investigations, noting that some of these may not be available in PHC / Role 1:

Table 3 - Heat Illness Investigations

FBC	Clotting screen	U&Es	Blood gases (if indicated)
LFTs	CK	Blood glucose	Serum osmolality
Urinalysis for protein, specific gravity and myoglobin			
After 24 hours, repeat U&Es, serum CK, LFTs and clotting as a minimum. If these are abnormal, repeat testing on a daily basis, continuing as necessary.			

13. **Hospital admission.** Criteria for urgent admission to hospital in the acute phase are as follows:

a. Seizure(s).

[6] Hopkins P (2007). Brit Jnl Sports Medicine 41:283-284.

b. Loss of consciousness (P or U on AVPU).

c. Persistent temperature over 40°C despite active cooling.

d. Failure to improve after 30 mins of treatment.

It is essential that cooling measures and continuous monitoring are maintained during the transfer to hospital and that suitably trained medical staff accompany the casualty.

14. An overview of the guidelines for the treatment of heat illness are shown at Annex A and Annex B.

15. **Fluid overload – hyponatraemia.** Hyponatraemia secondary to water overload can present with similar signs and symptoms to heat illness. Personnel who become unconscious during exertion **and whose rectal temperature is not raised** should be considered to have a diagnosis of symptomatic hyponatraemia and will require hospital admission. There is an increased risk of this condition where large quantities of plain water have been drunk. Intravenous fluids should be given cautiously to unconscious or semi-conscious victims of exertional-collapse who do not have an elevated rectal temperature. The same clinical picture will be seen with exertional heat syncope (collapse in the absence of raised core temperature). Intravenous fluids should be administered judiciously and hospital admission may be necessary.

16. **Further specialist referral.** Personnel who have had the following conditions should be referred for further investigation to the Heat Illness Clinic (HIC) at the Institute of Naval Medicine (INM) Environmental Medicine Unit[7]:

a. Significant derangement of CNS function.

b. Seizure.

c. Significant biochemical disturbance.

d. More than one episode of heat illness.

Once assessment at the HIC is complete the Regional Occupational Health Team should advise on JMES grading during rehabilitation.

17. **Rehabilitation and return to duty.** An individual who has sustained one episode of heat illness may be more susceptible to the effects of heat in the future. It is important to ensure that all significant heat casualties are appropriately investigated to identify whether they have any persisting heat intolerance. During this period the following restrictions to physical activity and employment grading limitations are recommended:

a. **Category A – Mild heat illness.** Heat illness not requiring admission to hospital; no evidence of biochemical abnormality[8], no concurrent predisposing illness eg gastroenteritis:

[7] Referrals to the HIC should be via DMICP (or other appropriate iEHR). If it is unclear whether a patient should be referred, please discuss with the INM. Environmental Medicine and Sciences (EMS) Civilian Medical Officer (CMO) on Mil 9380 Ext 68050 Civ 02392 768050 email NAVY INM-EMS STM CMO1 NAVYINM-EMSSTMCMO1@mod.uk

[8] Epstein Y et al, Chap 8, Medical Aspects of Harsh Environments, Vol 1.

(1) Restrict to light physical exercise for 7 days and observe, returning to normal activity under the supervision of unit medical officer. Where operationally relevant, treat as an un-acclimatised individual for 14 days.

(2) Personnel with heat illness who are admitted to hospital but after investigation have no CNS disturbance, biochemical disturbance or rhabdomyolysis should be treated as Category A.

b. **Category B – Moderate heat illness.** Heat illness requiring admission to hospital with either central nervous system disturbance (eg seizure, GCS <8 for 15 minutes or longer) and/or biochemical evidence of organ damage or rhabdomyolysis:

(1) Refer to HIC, INM for review.

(2) Apply appropriate occupational restrictions and consider amending JMES in accordance with JSP 950 Part 1 Leaflet 6-7-7 Joint Manual of Medical Fitness Section 5 Annex N Other Conditions until INM review. Personnel should not be re-graded until INM review has taken place.

(3) Until all biochemistry returns to normal, personnel should not undertake physical exercise or be exposed to heat stress.

(4) After biochemical recovery, they may resume light physical exercise for 14 days, undertaken as supervised exercise rehabilitation with an Exercise Remedial Instructor (ERI) in conjunction with medical officer review (see paragraph 19-22).

c. **Category C – Severe heat illness.** Heat illness requiring admission to intensive care. If there is evidence of residual complications discuss the case with INM EMS CMO. In all cases:

(1) Refer to HIC, INM for review.

(2) Apply appropriate occupational restrictions and consider amending JMES in accordance with JSP 950 Part 1 Leaflet 6-7-7 Joint Manual of Medical Fitness Section 5 Annex N Other Conditions until INM review. Personnel should not be re-graded until this review has taken place.

(3) Arrange continued secondary care investigation if clinically indicated.

(4) Personnel should not undertake physical exercise or be exposed to heat stress until 1 month after full recovery, including recovery from complications and achieving biochemical recovery.

(5) Return to exercise as part of rehabilitation should be supervised by an ERI in conjunction with medical officer review (see paragraph 19-22).

d. **Category D – Recurrent heat illness.** If more than one lifetime episode of heat illness discuss the case with INM EMS CMO. Following advice from INM, take the following actions, as appropriate:

(1) Refer to HIC, INM for review.

(2) Apply appropriate occupational restrictions and consider amending JMES in accordance with JSP 950 Part 1 Leaflet 6-7-7 Joint Manual of Medical Fitness Section 5 Annex N Other Conditions until INM review. Personnel should not be re-graded until INM review has taken place.

(3) Personnel should not undertake physical exercise or be exposed to heat stress until all biochemistry returns to normal.

(4) After biochemical recovery, they may resume light physical exercise for 14 days, undertaken as supervised exercise rehabilitation with an ERI in conjunction with medical officer review (see paragraph 19-22).

18. **Case recording.** The recording of cases of heat illness in the iEHR is crucial to the monitoring of the effectiveness of the treatment guidelines in this JSP. Case recording should be undertaken in accordance with Section 5.

Rehabilitation and medical follow-up

19. Patients should be referred to an ERI within a Primary Care Rehabilitation Facility for supervised exercise training and fitness maintenance prior to the appointment at INM HIC. Personnel unsure of how to manage these cases should contact INM EMS CMO.

20. Early rehabilitation should be managed in conjunction with medical follow-up. Where a significantly elevated creatine kinase (serum CK) was found, a baseline blood sample should be taken, prior to the first treadmill exercise and repeated 8 – 24 hrs following the session. Significant elevation of CK in the second sample is a contra-indication to progressive management and a further 2 weeks of relative rest is advised (ie light exercise only). This process should be repeated until the results normalise. Further guidance can be obtained by contacting INM EMS CMO.

21. The aim of supervised exercise rehabilitation is to rebuild and maintain fitness prior to INM medical review and its Heat Tolerance Assessment (HTA), without subjecting individuals to significant thermal strain. Water-based exercise such as swimming is ideal. For any other gym based exercise only PT kit should be worn and care should be taken to reduce the heat stress to a minimum. Exercise intensity for continuous exercise should not exceed 60% of predicted maximum heart rate[9] and work load should be adjusted to this target.

22. Initial aerobic exercise should be for no more than 15 minutes duration which should be gradually increased to a maximum of 30 minutes per single session. It should be conducted in the cool of the day, wearing no more than shorts and T-shirt and drinking fluids should be available. Squad PT should not be undertaken. The HTA at INM involves exercise for at least one hour, and therefore the aim of rehabilitation is for individuals to undertake 2 separate 30-minute sessions per day with a break of at least 1 hour between sessions. Individuals who suffer symptoms of muscle discomfort (delayed onset muscle soreness) following an exercise session should not undergo further training until these symptoms have subsided.

[9] Maximum heart rate can be calculated by subtracting age in years from 220.

EXERTIONAL HEAT ILLNESS FIRST RESPONDER TREATMENT GUIDELINES

Signs and symptoms
●seizure(s) ●collapse or loss of consciousness ●anxietyand/or agitation ●inappropriate or unusual behaviour eg behaving as if drunk ● nausea and /or vomiting ●headache ●staggering or loss of coordination ●disturbed vision ●confusion ●dizziness ●weakness or fatigue ●thirst ●impaired judgement ●hyperventilation ●paraesthesia ●myalgia, cramps, or tetany ●diarrhoea
Not all heat illness will present typically. Some casualties may display seemingly normal function interspersed with more typical signs and symptoms

PAUSE ACTIVITY

● INDIVIDUAL - pause for at least 30 minutes ●GROUP- pause to assess others, then recommence activity
●A single case is a warning that other personnel are at risk, Instruct the commander to carry out a dynamic risk assessment of the activity, and is to consider other control measures including stopping the activity
●Remove the individual from immediate danger and prevent any further casualties from occurring

- <C>ABC
- Lie the casualty down in the shade
- Elevate legs if conscious
- Measure body temperature (core if possible), RR, HR, BP, AVPU, O_2 sats and blood glucose.
- **If body temperature > 40^{0}C commence active cooling**:
  Strip casualty to underwear; sponge or spray casualty with cool water and fan the skin

Is the casualty conscious?

yes

Give water to drink

no

●Place the casualty in the recovery position
●Support airway
●Intravenous fluids
●1 litre crystalloid over 30 minutes.
●Further 1 litre crystalloid over 1 hour if required

●Rest and monitor
●Continue active cooling for 30 mins
●Have symptoms fully resolved?

no

Evacuate to medical care as quickly as possible

yes

Discuss with Command chain, consider return to duty

NOW RECORD IT

EXERTIONAL HEAT ILLNESS TREATMENT GUIDELINES ROLE 1 AND ROLE 2/3

Role 1

- <C>ABC
- Measure body temperature (core if available)
- RR / HR / BP / BM / GCS or AVPU
- 100% oxygen
- IV access
- 1 litre crystalloid over 30 minutes.
- Further 1 litre crystalloid over 1 hour if required
- Maintain cooling procedure

Evacuate to higher level of medical care

Role 2/3

- Re-assess <C>ABC
- RR / HR / BP / BM / ECG
- Core temperature must be recorded
- Consider intubation and ventilation
- Blood gases
- Urinary catheter / NG tube / CVP line / Arterial line
- FBC, U&Es, LFTs, blood glucose, CK, clotting screen, blood gases (if indicated), serum osmolality, myoglobin and lactate.
- Urinalysis for protein, specific gravity and myoglobin.
- If not admitted to hospital:
  - Keep bedded-down for 24-48 hours
  - After 24 hours, repeat U&Es, serum CK, LFTs and clotting as a minimum. If these are abnormal, repeat testing on a daily basis, continuing as necessary.
  - Unit MO to review day 3, 5 and 7
- Follow Guidance on rehabilitation and return to duty (see paragraphs 19-22)

Signs and symptoms

- seizure(s)
- collapse or loss of consciousness
- anxiety and/or agitation
- inappropriate or unusual behaviour eg behaving as if drunk
- staggering or loss of coordination
- impaired judgement
- confusion
- nausea and/or vomiting
- headache
- disturbed vision
- dizziness
- weakness or fatigue
- thirst
- hyperventilation
- paraesthesia
- myalgia, cramps, or tetany
- diarrhoea

Not all heat illness will present typically.
Some casualties may display seemingly normal function interspersed with more typical signs and symptoms

Complications

- Cardiac Arrest
- Fitting
- Hypoglycaemia
- Hyperkalaemia
- Acute renal failure

SECTION 3 – COLD: GUIDANCE FOR DEFENCE PERSONNEL

What is cold injury?

1. Cold injury occurs as a result of the effects of cold, in either wet or dry conditions, on the body. The cold may affect either the whole body by reducing the core body temperature (generalised cold injury) or affect a specific body part (localised cold injury). The body normally maintains a stable core temperature of 37°C by balancing the rate of heat production (predominantly through internal metabolic heat generation) with heat lost. In cold environmental conditions heat lost to the atmosphere eg through breathing, contact with cold surfaces and sweating may exceed the warmth that can be generated by the body eg by exercising and shivering.

Core body temperature = heat gained – heat lost

2. Cold injury remains a significant issue for the Armed Forces. The incidence of cold injury depends on numbers exposed to the risk and how well that risk is managed. The overall incidence rate of cold injury cases has not changed over the past five years[1]. There were 488 UK Armed Forces personnel who were identified as having a cold injury during the period Oct 2015 – Sep 2016 (120 of which were in the UK summer). Cold injury rates are higher in the untrained and the young (16-19 years)[2]. The Institute of Naval Medicine (INM) Cold Injury Clinic (CIC) saw 225 cold injury patients in FY16-17, 39 of which were new winter referrals.[3]

3. **Generalised cold injury (hypothermia).** Allowing the core body temperature to fall below 37°C, by as little as 2°C, may lead to hypothermia. It may be moderate or severe depending on the degree of cooling. There are three common mechanisms of injury for hypothermia:

a. **Immersion**. Usually caused by a severe, often rapid, cold stress; eg a sailor washed overboard in cold seas.

b. **Exposure**. Most frequently caused by a combination of windy and wet conditions with moderately low temperatures. Usually found in mountaineers or hill walkers; sometimes referred to as ‘exhaustion’.

c. **Urban**. This is caused by prolonged exposure to moderately low temperatures in those that are physically weak and malnourished.

4. **Localised cold injury.** Individual body parts exposed to the cold may become damaged resulting in one of the following cold injuries:

a. **Freezing Cold Injury (FCI)**. Parts of the body freeze as a result of exposure to the cold resulting in significant disability - the extremities (face, fingers, toes, heels and soles of the feet) are most prone. There are two types of FCI:

[1] Defence Statistics (Health) report to Cold Injuries Working Group, 5Jan17. Rate of UK Regular Armed Forces identified as having a cold injury between 2011/12 and 2015/16 – 2.8 vs. 3.0 per 1,000 personnel.
[2] Defence Statistics (Health) report to Cold Injuries Working Group, 5Jan17. Rates are highest for 16-19 age group for all years over the five year period (2011/12 to 2015/16). Rates are highest for untrained personnel across all years over the five year period.
[3] INM Cold Injury Clinic Update brief to Cold Injury WG, Jan17

(1) **Frost nip**. Superficial tissue injury - recovery of the injured part within 30 minutes of re-warming.

(2) **Frost bite**. Deeper tissue injury that may result in lasting damage.

b. **Non-Freezing Cold Injury (NFCI)**. This is an injury, often to feet or hands, caused by allowing the body part to remain cold (and/or wet) for long periods. It is the most common cold injury in land operations, and where the feet are involved, often called 'trench foot'. NFCI can occur in conditions that are not particularly cold.

Prevention of cold injury

5. The key to preventing cold related injuries is an awareness of the hazards and the assessment of risk by commanders. Commanders should ensure that they are fully aware of the conditions to which their personnel are exposed. The aim of preventive measures is to maintain a normal core temperature and protect vulnerable body parts. This will minimise the risk of hypothermia and helps maintain a good peripheral blood flow to mitigate the risk of local non-freezing cold injury.

Risk management

6. Any outdoor activity undertaken in cold environments constitutes a risk. Commanders at all levels should understand their responsibilities with regard to risk and to record and report upwards as appropriate. Commanders should consider seeking medical input for the risk management process.

7. Prior to any activity which may involve a risk of cold related injuries, commanders should:

a. **Assess the risk associated with the planned activity**. It is the commander's duty to ensure that they have sufficient information about the relevant factors to undertake an appropriate risk assessment. All factors should be considered together in order to obtain a meaningful overall assessment. It is inappropriate just to consider one factor, such as the Still Air Temperature (SAT) in isolation. Further guidance is contained in the Commander's Cold Injury Risk Assessment Checklist (Annex A). Whilst not exhaustive, the factors to be considered should include:

(1) Individual risk factors.

(2) Environmental conditions.

(3) The type, work rate, duration of the task and rest periods.

(4) Clothing, equipment and any additional load.

b. **Reduce the risk.** Commanders should assess whether the same objectives could be achieved (with less risk) by rescheduling or modifying the activity. They should plan and put in place appropriate control measures to reduce the risk to ALARP. Commanders should consider additional control measures that may need to be employed in the event of changing circumstances ("dynamic risk assessment").

c. **Effective preparation.** Ensure that all personnel taking part are adequately briefed and prepared. Briefing should include the warning signs of systemic and local

cold injury and cold injury avoidance measures. Ensure that any standing orders or instructions regarding training restrictions are understood by all participants. Commanders should ensure that all equipment, clothing etc is appropriate for the training/environment.

d. **Supervision**. Commanders are responsible for the adequate supervision of all personnel within their care for the duration of the activity.

e. **Medical plan**. When implementing the medical plan for an activity, commanders should ensure that the activity is covered by an appropriate degree of first aid and medical cover, and that a clear and efficient means of evacuation is agreed in the event of a medical emergency. Every individual should be aware of and able to apply first aid measures and casualty response, detailed in Hypothermia First Aid Treatment Guidelines (Annex B), Freezing Cold Injury First Aid Treatment Guidelines (Annex C) and Non-Freezing Cold Injury First Aid Treatment Guidelines (Annex D). Medical personnel should be empowered to raise concerns before and during any planned activity.

f. **Record**. Recording of risk assessment and communicating residual risk upwards.

g. **Continuous review**. Risk assessments should be dynamic and reviewed throughout the activity as circumstances can change.

8. On completion of the risk assessment the residual risk should be understood and a decision made whether the objectives of that activity justifies the risk to be taken and raise this to the Chain of Command. Further advice may be sought from environmental health staff or other suitably qualified and experienced personnel.

Individual risk factors

9. There is wide variation in human tolerance to cold, however all personnel are vulnerable. Table 1 – Individual Risk Factors details the currently recognised individual risk factors however the evidence base for some of these factors is not fully established.

Table 1 - Individual Risk Factors

Lifestyle / characteristics	Health	Work constraints
Smoking	Prior NFCI / FCI	Inexperienced
Alcohol in past 48 hours	Hypoxia	Sleep deprivation or fatigue
Inadequate calorie intake	Advancing age	Prolonged cold exposure
Reduced physical fitness	Systemic infection	Oscillating low temperatures and/or repeated exposure
Gender (amongst African-Caribbeans, females may be protected more than males)	Hypovolaemia eg dehydration, trauma resulting in blood/third space fluid loss	Forced convective heat loss eg wading, swimming, water sports, winter sports, high wind speeds, travel in an open-topped vehicle, motorcycling, skidoos, mountain biking etc
Race (African-Caribbeans may be at greater risk than Caucasians; NFCI only)	Hand Arm Vibration Syndrome	Damp environments and sweating (causing cooling by evaporation or loss of clothing insulating properties)
	Hypothermia	Inadequate clothing (general, or local)
	Stress or anxiety (enhancing vasoconstriction and sweating)	Constricting clothing (limiting cutaneous blood flow)
		Immobility
		Upright posture (cutaneous blood flow falls in the feet; NFCI only)

10. **African-Caribbean/Pacific-Islander personnel**. African-Caribbean/Pacific-Islander personnel have a different physiological response to cold[4] and as such may be at higher risk of cold injury[5]. Those individuals should be aware of this risk and be extra vigilant to maintaining their cold weather skills. Commanders should have a heightened awareness of the higher risk in African-Caribbean/Pacific-Islander personnel, and ensure the availability and use of kit, equipment and other control measures to mitigate the risk of cold injury in accordance with the findings of the risk assessment[6].

11. **Nutrition.** Typical energy requirements for a resting adult male increase from 2500 kcal at room temperature (20°C) to 5000+ kcal at minus 20°C. It is therefore vital that daily rations are increased accordingly. Appropriate survival rations should always be carried in cold environments in case of emergency. Regular hot meals should be made available where practicable.

12. **Hydration.** Operations in cold conditions can lead to severe dehydration just as rapidly as in hot environments. Cold weather increases respiratory water loss and will increase urinary fluid loss. Individual volition to drink fluids may be reduced. The availability of extra fluid is necessary to avoid dehydration. Alcohol can cause dehydration and personnel should be reminded of the dangers of alcohol consumption prior to or whilst operating in a cold environment. It is not true that an alcoholic drink will 'warm you up'.

13. **Experience.** Inexperienced personnel are at greater risk of cold injury. The experience levels of personnel should be taken into account in a risk assessment.

[4] Jackson RL, Roberts DE, Cote RA, McNeal P, Fay JT, Sharp MW, Kraus E, Rahman SA, Hamlet MP: Psychological and Physiological Responses of Blacks and Caucasians to Hand Cooling. Report No: T20-89. 1989, Natick: US Army Research Institute of Environmental Medicine.
[5] Burgess JE, Macfarlane F: Retrospective analysis of the ethnic origins of male British army soldiers with peripheral cold weather injury. J R Army Med Corps. 2009, 155: 11-15.
[6] Commanders should ensure that records are kept of additional protective measures taken for high-risk groups.

Environmental conditions

14. **Minimum working temperature.** Temperature is only one risk factor for cold injury. Setting a minimum working temperature could be too prescriptive and result in loss of training opportunities.

15. The rate of heat lost from the body depends on a number of environmental factors. Commanders should ensure they obtain local meteorological measurements and accurate weather forecasts[7], paying particular attention to:

a. **Still Air Temperature (SAT).** Heat will be lost from the body when the external air temperature is lower than the skin temperature: the colder the SAT the greater the effect of cooling on the body. SAT is the ambient outdoor temperature and can be measured using a dry bulb thermometer. Changes in altitude have a significant effect on SAT. SAT falls by approximately 1°C for every 150 metres of increased altitude. Commanders should note the following:

(1) Minus 5°C SAT: extra care is needed during outdoor training, gloves must be worn.

(2) Minus 13°C SAT: personnel should be advised to avoid high intensity aerobic physical activity such as running and ski-racing due to risk of damage to the lungs.[8]

b. **Wet conditions.** Wet skin will lose heat much quicker than dry skin. When estimating the severity of risk associated with cold, wet conditions should be considered as a significant risk factor.

c. **Wind chill.** Wind chill is often referred to as the 'feels like' temperature and is the temperature felt, instead of the actual air temperature shown on weather forecasts. Wind chill factor takes into account wind speeds and humidity to assess how the human body actually feels temperature. Wind speed is measured using an anemometer or where unavailable estimated using the Beaufort scale[9]. Table 2 - Wind Chill Chart[10] also provides the risk of freezing injury on bare skin. Travel in open vehicles will have the same chilling effect as exposure to the wind.

(1) Minus 30°C Wind Chill Index: all training should be avoided and shelter should be sought.

[7] See Appendix 2 to Annex B, Chapter 1 Meteorological Office Planning Forecasts.
[8] CTCRM 'Cold Weather Standing Operating Instructions' Edition 2 dated Jun 06.
[9] http://www.metoffice.gov.uk/guide/weather/marine/beaufort-scale (accessed Jan 17).
[10] Adapted from http://cui4-uk.diif.r.mil.uk/r/126/MLCoy/CWAideMemoire/20160219_MtnOpsAMpversion_WarfareEditor_P_O.pdf

Table 2 - Wind Chill Chart[10]

WINDCHILL FACTOR the risk of freezing injury on bare skin														
Wind strength			**Air temperature (°C)**											
Beaufort scale	**Wind description**	**MPH**	+10	+5	-1	-7	-12	-18	-23	-29	-34	-40	-46	-51
0	Calm	**0**	10	5	-1	-7	-12	-18	-23	-29	-34	-40	-46	-51
2	Light	**4.2**	9	3	-3	-9	-15	-21	-26	-32	-38	-44	-50	-56
3	Gentle	**8.8**	5	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71
4	Moderate	**13**	2	-6	-14	-21	-29	-36	-43	-50	-58	-65	-73	-80
4	Moderate	**17.3**	0	-8	-16	-24	-32	-40	-47	-55	-63	-71	-79	-87
5	Fresh	**22.3**	-1	-9	-18	-26	-34	-42	-51	-59	-67	-76	-84	-92
6	Strong	**26**	-2	-11	-19	-28	-36	-44	-53	-61	-70	-79	-87	-96
6	Strong	**30.3**	-3	-12	-20	-29	-37	-45	-54	-63	-72	-81	-90	-98
7	Moderate gale	**34.7**	-3	-12	-21	-30	-38	-46	-55	-64	-73	-82	-91	-100
			Low risk of Freezing Injury				**High risk of Freezing Injury**			**Very high risk of Freezing Injury**				
Wind chill accounts for loss of heat when warm air around a body is replaced with colder air. Wind chill is an indication of the effect of the combination of air temperature and wind speed on human comfort and safety.														

Work type, rate and duration

16. The nature of a task, work rate and duration of task will all influence the rate at which heat is lost. Commanders should fully appraise the work their personnel are going to undertake and the risk of cold injury posed, as part of their risk assessment.

17. **Static tasks**. Inactivity in open areas particularly when exposed to the wind may predispose an individual to the effects of the cold. Tasks which involve limited movement (sentry duties, observation roles or periods of instruction during field training) may predispose personnel to cold injury. Where possible, shelter should be provided. Regular rotation of personnel should be undertaken to minimise the duration of static activity and allow recovery. Individuals that are required to stand still for long periods should, if possible, undertake regular 10 minute bursts of exercise (eg step ups or marching on the spot) to boost blood circulation and generate heat.

18. **Physical exertion**. The sweating produced after periods of exertion and the diversion of blood to muscles and skin, away from the body core, may lead to excessive cooling. Risk can be reduced by appropriate use of clothing layering system. Clothing made wet from sweat should be changed for dry clothing at the end of high work rate activities.

19. **Activities in water**. Due to the rapid cooling effect, all activities involving partial or full immersion in water should be considered a high-risk activity for cold injury. Commanders should consider whether the activity is essential and how it might be avoided. Adequate time should be provided to allow personnel to get dry and change clothing before starting the next activity especially where this is a static task.

20. **Travel in vehicles**. Travel in open architecture vehicles, aviation/aircraft and sea craft especially at high speed and for those in exposed positions (eg on top cover and on tailgate) should be considered high-risk activities for cold injury. Commanders should plan

accordingly to mitigate the risk. Additional equipment such a face masks and encapsulated jackets should be provided to those who require it.

21. **Rest periods**. Adequate and regular rest periods to allow personnel to warm up, eat hot food and drink and rest should be scheduled. Where possible, shelter should be provided.

Clothing and equipment

22. The effect of cold is reduced by insulation such as clothing. Inappropriate clothing and equipment (or lack of training in their correct use, poor donning and doffing drills) will increase the risk of cold related injuries. Advice on suitable clothing can be found at the Defence Clothing Catalogue intranet site. Commanders should draw upon their own experience and provide advice and guidance on good clothing drills whilst giving all personnel the freedom to add or remove clothing as necessary to maintain their body temperature. Under no circumstances should commanders prevent the use of items of clothing or equipment unless doing so would present a clear safety risk to themselves or others.

23. **Headwear.** When the SAT is below minus 10°C, specialist headwear should be worn. Below this temperature the ears are vulnerable to frostbite. Head-overs or specific cold weather headdress should be worn to provide protection. Specialist headgear may also be required at higher SATs if other adverse environmental conditions are present or for those at risk of cold effects due to immobility. Helmets and berets offer minimal protection against frostbite and do not significantly reduce heat loss from the head. Individuals should be permitted to wear woolly/fleece hats/headovers if required at appropriate times in cold weather.

24. **Layered clothing.** The use of the 'layering' system should be adopted in cold conditions including an outer windproof layer and close, but not tight, fitting cuffs. Layers of clothing should be removed immediately prior to, and during, physical exercise in order to allow adequate ventilation, limit sweating and the danger of a resultant sweat-induced loss of insulation. During rest periods, add additional clothing and insulation. Individuals should be afforded the opportunity to add or remove layers as they require in order to maintain their body temperature.

25. **Footwear.** Boots should not be laced tightly in cold conditions. Socks should be changed regularly and especially when wet. Socks which are dirty, old or over-compressed have reduced insulating properties. Feet should be inspected regularly to identify problems early. Boots and socks with enhanced thermal protection are available for issue to individuals or groups at high risk following an appropriate risk assessment by the Chain of Command or recommendation by medical authorities.

26. **Handwear**. Handwear should be worn as required by the individual if their hands feel cold in any temperature and should be considered essential below a SAT of minus 5°C. Gloves (with separate fingers) may not provide sufficient insulation to the fingers to permit indefinite use in SATs below 0°C. Mittens (four fingers in a single compartment) will afford greater protection. A spare set of gloves/mittens should always be carried. Wet hand wear may contribute to risk of injury in cold conditions. All personnel should be aware of the risks of cold injury to unprotected skin by touching very cold metal and from fuel splashes on the skin.

27. **Sleeping system.** Sleeping bags should be kept dry and insulation matting used as standard. They should be adequately rated for the temperature range likely to be encountered. The use of waterproof and breathable bivvy bags is recommended.

28. **Waterproof clothing**. Waterproof clothing should be used to keep clothing and skin dry. Caution is required to avoid excessive sweating; inappropriate continuous use of waterproof clothing, eg seal-skin™ socks should be avoided.

29. **Specialist PPE**. Specialist PPE eg water-tight immersion suit, may be required for certain roles; these should be used as directed.

Recognition of cold injury and initial response

30. Early recognition of Cold Injury can be life and limb saving. All commanders should be fully conversant with the signs and symptoms and immediate actions for Cold Injury (see Annexes B, C and D).

31. **Buddy-buddy system**. Those experiencing the effects of cold injury may not recognise the signs and symptoms in themselves. All commanders should emphasise the use of 'buddy-buddy' approach to observe, identify and report early signs of cold injury to the Chain of Command. Commanders should appropriately supervise their personnel at all times when operating in cold and wet conditions and conduct periodic foot inspections to identify problems.

32. In all cases, once a cold casualty has been identified they should not be allowed to become colder. Arrangements should be made for urgent evacuation to an appropriate medical facility.

33. Always consider the other members of the group or party. If one individual has been affected by the cold then there is a high likelihood that others may also be at risk. Commanders should ensure that any other cold casualties are identified immediately, should review the risk assessment and apply additional control measures where necessary.

34. **Generalised cold injury (hypothermia).** Hypothermia can be a life-threatening condition. Commanders, at all levels, should be fully familiar with the signs and symptoms and immediate actions for hypothermia as described in Annex B. All hypothermia casualties should be urgently evacuated.

35. **FCI and NFCI.** Ensure that personnel know that they should report numbness, pain or unusual feeling (such as tingling) in hands or feet (or any extremity) colour changes, immediately. **Once a cold injury is suspected personnel should follow the First Aid and Treatment Guidelines at Annex C and D.** Note that suspected frost bite casualties should be urgently evacuated. If the frostbite casualty is going to be re-exposed to cold they **MUST NOT** be re-warmed until handed-over to medical staff.

36. **Incident and case reporting**. All incidents and cases of cold injury (less those that do not meet the threshold criteria) should be reported in accordance with procedures at Section 5.

Summary

37. Cold Injury is a recognised hazard of Defence activity. The reduction of risk to ALARP is a command responsibility at every level, and at all times.

Key Points
●Where there is a risk of sustaining cold injuries, the risk should be mitigated to ALARP
●A plan for the management of cold injury cases must be in place (to include medical treatment and dynamic risk assessment
●All cases must be reported

COMMANDERS COLD INJURY RISK ASSESSMENT CHECKLIST

ANNEX A

Ser	Risk Factor	Results	Guidance	Notes / Control Measures
Risk assessments should be continuously reviewed throughout the activity				
1	**Activity**		Risk of CI is increased when static, particularly if this follows a period of arduous activity. Immersion/ wet clothing greatly increases risk of CI	
	Is shelter available for static periods?	yes☐ no☐		
	Can long static periods be avoided?	yes☐ no☐		
	Can immersion be avoided?	yes☐ no☐		
	Are there plans to allow changing into dry clothes after any immersion?	yes☐ no☐		
2	**Duration of activity**		Exhaustion increases CI risk.	
	Can rest periods be incorporated	yes☐ no☐		
3	**Environmental conditions**		Risk of CI increases when SAT is below minus 5°C. Windy / wet conditions greatly increase risk.	
	Has an accurate weather forecast been obtained?	yes☐ no☐		
	Has wind chill factor been taken into account?	yes☐ no☐		
	Can training be carried out in warmer / more sheltered conditions?	yes☐ no☐		
4	**Supervision**		Trainers and DS provide a vital means of preventing CI / early detection of CI.	
	Are DS and training staff adequately trained and competent?	yes☐ no☐		
	Is the medical support plan adequate?	yes☐ no☐		
5	**Preparation / education**		Knowledge of risk factors, signs and symptoms should enable avoidance of CI and aid early identification.	
	Have all participants received a presentation on CI or watched the training video?	yes☐ no☐		
	Have Commander's and Individual guides been issued?	yes☐ no☐		
6	**Water intake**		Dehydration can occur rapidly in cold conditions.	
	Is sufficient safe water available throughout the intended activity?	yes☐ no☐		
7	**Food intake**		Energy requirements increase in cold conditions.	
	Have increased calorific needs been considered?	yes☐ no☐		
8	**Alcohol**		Alcohol increases susceptibility to CI.	
	Has alcohol been avoided for 48 hours prior to activity?	yes☐ no☐		

9	**Dress and equipment**		Correct clothing and equipment will reduce CI risk.	
	Is correct clothing/sleeping system issued?	yes☐ no☐		
	Do all troops have spare dry clothes?	yes☐ no☐		
10	**Predisposing factors**		Lack of: sleep; food; fluids; poor fitness; and illness all predispose to CI. Those with previous CI may be at greater risk.	
	Can the activity be postponed until personnel have rested?	yes☐ no☐		
	Have personnel been provided with food and water prior to undertaking the activity?	yes☐ no☐		
	Have unfit/ill people been excluded from the activity?	yes☐ no☐		
	Have previous CIs been declared to, and investigated by, medical staff?	yes☐ no☐		

What to look for

Moderate Hypothermia

- The casualty may say they feel very cold
- Feel cold to the touch
- Loss of manual dexterity (clumsiness)
- Loss of insight, denying having any problem
- Un-controlled shivering
- Cold, pale hands and feet
- Mild confusion, disorientation or irritability
- May reject help, could be difficult to treat

Severe Hypothermia

- Slurred speech
- Lips may turn blue
- Slow and or irregular pulse
- apathetic, confused, irrational, and clumsy.
- consciousness may be reduced.
- Shivering has stopped
- Casualty is unresponsive, breathing and pulse will be faint or even undetectable and they may look dead

PAUSE ACTIVITY

- **INDIVIDUAL-commence treatment**
- **GROUP-risk assess others, then recommence activity**
- **A single case is a warning that other personnel are at risk, the commander is to carry out a dynamic risk assessment of the activity, and is to consider other control measures including stopping the activity**
- **Remove the individual from immediate danger and prevent any further casualties from occurring**
- **Initial assessment should always address airway, breathing and circulation problems first**

Is the casualty conscious?

YES

- Gentle exercise, if able
- Give the casualty warm drinks (not alcohol) or high-energy foods, such as

NO

Place the casualty in the recovery position

- It is important to handle the casualty with hypothermia gently and carefully
- Move the casualty indoors or somewhere warm
- If you cannot move the casualty indoors find something for them to lie on to insulate them from the ground
- If casualty's clothes are wet, change them into dry clothes make sure their head is covered
- Put the casualty in a sleeping bag and cover them with blankets
- Encourage the casualty to shiver if they're capable of doing so

Evacuate to medical care as quickly as possible

NOW REPORT IT

FREEZING COLD INJURY FIRST AID TREATMENT GUIDELINES

What to look for
- Any part of the body can be affected However, the **extremities**, such as the hands, feet, ears, nose and lips are most likely to be affected.

Early signs (frost nip)
- The affected part feels cold and is painful to touch
- A tingling sensation followed by numbness
- No feeling when the affected part is moved
- Skin looks mottled– white and pink

Later signs (frost bite)
- No feeling in the affected part
- Skin white and waxy-looking
- A clear line between white and pink skin
- After re-warming, skin may appear bruised and blistered

A single case is a warning that other personnel are at risk, the commander is to carry out a dynamic risk assessment of the activity, and is to consider other control measures including stopping the activity

What to do
- **Remove the casualty** from the risk environment **Shelter** the casualty or if available help move them indoors
- Protect the affected part
- Provide **supplementary whole-body insulation** (eg Sleeping bag, extra clothing layers, hat etc)
- Once sheltered / inside, gently **remove anything constricting** like rings, gloves or boots
- **Dry affected feet and/or hands**

IF THERE IS A DANGER OF IT BEING FURTHER EXPOSED TO FREEZING CONDITIONS (RE-FREEZING), THEN DO NOT WARM IT UP YET AS THIS CAN CAUSE MORE DAMAGE

- Next, **warm the body part** with your hands on your lap, or under their armpits
- Do NOT apply direct heat (heater)
- Do NOT rub the frozen part in an attempt to thaw because this could damage their skin tissue
- Do NOT allow the casualty to smoke or take alcohol
- Do NOT use skin ointments (eg Deep Heat)
- Do NOT allow the casualty to use the limb when re-warmed
- Replace wet socks or gloves as needed
- If blistered or discoloured put on a **light dressing**, ideally a gauze bandage from your first aid kit
- Give the casualty warm drinks (not alcohol) or high-energy foods, such as chocolate

EVACUATE THE CASUALTY TO SAFETY
- Remain sheltered until evacuation can be arranged.
- Do not allow the casualty to return to the cold environment even if they appear to have recovered

NOW REPORT IT

NON-FREEZING COLD INJURY FIRST AID TREATMENT GUIDELINES

NFCI can occur in temperatures that are not particularly cold if there are other risk factors present, such as damp / wet conditions or immobility.

What to look for in hands or feet
- Numbness
- Pain
- Pins and needles

A SINGLE CASE IS A WARNING THAT OTHER PERSONNEL ARE AT RISK, THE COMMANDER IS TO CARRY OUT A DYNAMIC RISK ASSESSMENT OF THE ACTIVITY, AND IS TO CONSIDER OTHER CONTROL MEASURES INCLUDING STOPPING THE ACTIVITY

What to do
- Remove wet boots and socks and /or gloves.
- Dry affected feet and/or hands
- Replace wet socks or gloves as needed
- Change into dry kit as soon as possible
- Use foot powder
- Encourage the individual to wriggle their toes and fingers to keep them warm

If they have to stand still for long periods:
- Order 10 mins of step ups or marching on the spot to keep the circulation going
- If exercise is not possible (with help if required):
  - Gently re-warm their feet/hands
  - Try to get their feet into a dry sleeping bag – they should then massage them gently

EVACUATE THE CASUALTY TO SAFETY

Do not allow the casualty to return to the cold environment even if they appear to have recovered

NOW REPORT IT

SECTION 4 – COLD: GUIDANCE FOR MEDICAL PERSONNEL

Responsibilities

1. All medical personnel should be trained in the prevention and management of cold injury (appropriate to their level of competency and responsibility). This should be part of initial military medical training for all medical personnel in the DMS, with appropriate refresher training periodically thereafter, targeted by clinical speciality. Civilian DMS personnel should be trained to a level appropriate to their role.

2. In the event of a single case of cold injury, always consider the other members of the group or party. If one individual has been affected by the cold then there is a high likelihood that others may also be affected. **The Chain of Command should be alerted that other personnel may be at risk.**

3. This section provides medical personnel with an accessible source of information to assist them in the pre-hospital care and management of cold injuries. Cold injuries considered here are Hypothermia, Freezing Cold Injury (FCI) and Non-Freezing Cold Injury (NFCI).

Prevention

4. **Prevention.** The adage that "prevention is better than treatment" is especially true for cold injuries, which may be preventable. Risk of cold injury can also be related to underlying medical problems, and prevention should address both environmental and health-related aspects. One should both ensure adequate perfusion and minimise heat loss to prevent FCI.

5. **Maintaining peripheral perfusion.** Preventive measures to ensure local tissue perfusion include:

   a. Maintaining adequate core temperature and body hydration.

   b. Minimising effects of known diseases or medications and drugs that may decrease perfusion.

   c. Covering all skin and the scalp to avoid vasoconstriction where practicable.

   d. Minimising restriction in blood flow, such as constrictive clothing, footwear, or immobility.

   e. Ensuring adequate nutrition.

   f. Using supplemental oxygen in hypoxic conditions (eg >4000 m).

6. **Protection from cold.** Measures should be taken to minimise exposure to cold. These measures include the following:

   a. Avoiding environmental conditions with a risk of cold injury, specifically below –5°C even with low wind speeds.

   b. Protecting skin from moisture, wind, and cold.

c. Avoiding perspiration or wet extremities.

d. Increasing insulation and skin protection by layering clothes appropriately.

e. Ensuring personnel are able to take the appropriate behavioural response to changing environmental conditions (eg, not being under the influence of drugs or alcohol or suffering extreme hypoxemia).

f. Using chemical hand and foot warmers and electric foot warmers to maintain peripheral warmth (note: warmers should be close to body temperature before being activated, and should not be placed directly against the skin nor constrict flow if used within a boot).

g. Performing “cold checks” if an individual experiences extremity numbness or pain or is concerned that FCI may be developing.

h. Recognising frostnip or superficial frostbite before it becomes more serious.

i. Minimising duration of cold exposure.

The time that a digit or extremity can remain numb before developing FCI is unknown; thus, paresthesia should be addressed as soon as possible. An extremity at risk for frostbite (eg, numb, poor dexterity, pale colour) should be warmed with adjacent body heat from the person or a companion, in the axilla, or on the abdomen.

Individual risk factors

7. There is a wide variation in human tolerance to cold. In some cases of Cold Injury it is possible to identify factors that have caused particular individuals to become casualties. All ranks of medical personnel should be empowered to raise concerns if individuals taking part in the proposed activity have risk factors that commanders may not be aware of, notwithstanding appropriate professional codes of patient confidentiality. Table 1 - Individual Risk Factors details the currently recognised individual risk factors:

Table 1 - Individual Risk Factors

Lifestyle / characteristics	Health	Work constraints
Smoking	Prior NFCI / FCI	Inexperienced
Alcohol in past 48 hours	Hypoxia	Sleep deprivation or fatigue
Inadequate calorie intake	Advancing age	Prolonged cold exposure
Reduced physical fitness	Systemic infection	Oscillating low temperatures and/or repeated exposure
Gender (amongst African-Caribbeans, females may be protected more than males)	Hypovolaemia eg dehydration, trauma resulting in blood/third space fluid loss	Forced convective heat loss eg wading, swimming, water sports, winter sports, high wind speeds, travel in an open-topped vehicle, motorcycling, skidoos, mountain biking etc
Race (African-Caribbeans may be at greater risk than Caucasians; NFCI only)	Hand Arm Vibration Syndrome	Damp environments and sweating (causing cooling by evaporation or loss of clothing insulating properties)
	Hypothermia	Inadequate clothing (general, or local)
	Stress or anxiety (enhancing vasoconstriction and sweating)	Constricting clothing (limiting cutaneous blood flow)
		Immobility
		Upright posture (cutaneous blood flow falls in the feet; NFCI only)

Hypothermia[1]

8. During cold exposure, the initial response of the body is to maintain a normal core temperature (approximately 37°C) by means of active movement and involuntary shivering. Primary hypothermia occurs when heat production in an otherwise healthy person is overcome by the stress of excessive cold, especially when the energy stores of the body are depleted. In hypothermia, conscious level, breathing, and circulation are initially intact but become more impaired as the body cools.

9. Patients should be considered to have hypothermia if they have a core temperature of less than 35°C. Hypothermia can also be staged clinically using the Swiss classification system (stages HT I to HT IV) as detailed in Table 2 - Staging and Management of Accidental Hypothermia. The Swiss staging system is a valuable clinical tool to facilitate triage and emergency treatment. However, definitive assessment of the severity of hypothermia requires accurate core temperature measurement using a low reading thermometer.

[1] Cross-referenced with: Peter Paal et al (2016) Accidental hypothermia–an update Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine201624:111. https://sjtrem.biomedcentral.com/articles/10.1186/s13049-016-0303-7 (accessed Jan 17).

Table 2 - Staging and Management of Accidental Hypothermia

Stage	Clinical symptoms*	Typical core temperature†	Treatment
HT I	Conscious, shivering	35 - 32°C	Warm environment and clothing, warm sweet drinks, and active movement (if possible).
HT II	Impaired consciousness, not shivering	<32 to 28°C	Cardiac monitoring, minimal and cautious movements to avoid arrhythmias, horizontal position and immobilization, full body insulation, active external and minimally invasive rewarming techniques (warm environment; chemical heat packs).
HT III	Unconscious, not shivering, vital signs present	<28 to 24°C	HT II management plus airway management as required; ECMO or CPB in cases with cardiac instability that is refractory to medical management.
HT IV	No vital signs	<24°C	HT II and III management plus CPR and up to three doses of epinephrine (at an intravenous or intraosseous dose of 1 mg) and defibrillation, with further dosing guided by clinical response; rewarming with ECMO or CPB (if available) or CPR with active external and alternative internal
Notes			
*Hypothermia may be determined clinically on the basis of vital signs with the use of the Swiss staging system. CPB denotes cardiopulmonary bypass, CPR cardiopulmonary resuscitation, and ECMO extracorporeal membrane oxygenation. †Measurement of body core temperature is helpful but not mandatory. The risk of cardiac arrest increases as the core temperature drops below 32°C and increases substantially if the temperature is less than 28°C			

10. **Measurement of core temperature.** If possible measure core temperature using a low reading rectal thermometer. The recorded temperature can vary depending on the body site used and environmental temperature. A measured core temperature of 32-35 °C signifies mild hypothermia with severe hypothermia occurring with a core temperature below 32°. When accurate measurement of the core temperature is not feasible, as in some field settings, decisions regarding management should be based solely on the clinical Swiss staging system[2].

a. **Thermistor probe.** A thermistor probe in contact with the tympanic membrane accurately reflects brain temperature, provided that the ear canal is free of snow and wax and is well insulated against the environment.

b. **Infrared cutaneous, aural and oral thermometers.** Measurements obtained with the use of infrared cutaneous, aural and oral thermometers are often inaccurate in patients with hypothermia.

c. **Rectal probes.** Rectal probes should be inserted to a depth of 15 cm for optimum accuracy but readings may lag behind core temperature during rewarming.

11. **Pre-hospital treatment priorities.** Treatment is summarised in Annex A - First Responder Initial Treatment of Hypothermia Under Field Conditions and Annex B - Treatment of Hypothermia by Emergency Doctors and Professional Rescuers. Pre-hospital treatments include careful handling of the patient (to reduce risk of precipitating cardiac arrhythmias), provision of basic or advanced life support, passive and active external rewarming and transport to an appropriate facility.

a. Some patients with a core temperature < 28°C engage in paradoxical undressing.

[2] Current scaled thermometers: Oral & rectal (32-42^{0}C) NSN 6515-99-898-2896; Tympanic (ear) (20-40^{0}C) NSN 6515-99-874-6330

b. Detecting a pulse in a patient with hypothermia may be difficult so signs of life and pulse should be checked carefully for 60 seconds.

c. Persistent breathing or movement by the patient should prompt a strategy of watchful waiting but if no signs of life are detected cardiopulmonary resuscitation (CPR) should be started.

d. Advanced airway management should be performed if indicated to optimise ventilation, oxygenation and cerebral perfusion.

e. Atrial fibrillation is common when the core temperature is less than 32°C. Rewarming will often lead to spontaneous cardioversion to sinus rhythm.

f. The risk of cardiac arrest increases as the core temperature drops below 32°C and increases substantially if the temperature is less than 28°C.

g. Owing to the decrease in cerebral oxygen requirements with cooling, survival without neurologic impairment may be possible even when it is necessary to perform CPR for several hours.

12. **Rewarming.** Full-body insulation and rewarming should be provided for all patients as long as it does not impede CPR or delay transport. For rewarming in the pre-hospital setting well placed (junctional areas of the body not in direct contact with skin) chemical heat packs in association with 'foil' (Blizzard©) blankets should provide adequate heat transfer. Wet clothes should be removed if practical to do so (if not, ensure the patient is packaged using an impermeable layer (Blizzard©, bubble wrap or similar).

13. **Resuscitation fluids.** If intravenous fluids are indicated they should be warmed (38 to 42°C) to prevent further heat loss. It is worth noting that warm fluids have a small warming effect but cold fluids have a significant cooling effect.

14. **Transportation.**

a. **Stage HT I.** Conscious, shivering patients can be treated in the field if they are uninjured or transported to a warm environment if rewarming is not possible in the field.

b. **Stage HT II, HT III, or HT IV.** Patients with impaired consciousness should be assessed for cardiac instability.

(1) Patients with stable circulation require active external rewarming (placement in a warm environment; application of chemical heat packs and 'foil' (Blizzard©)) and should be taken to the nearest medical facility.

(2) Patients with pre-hospital cardiac instability (eg systolic blood pressure of <90 mm Hg or ventricular arrhythmias), those with a core temperature of less than 28°C, and those in cardiac arrest should be transported to a medical facility ideally capable of providing extracorporeal membrane oxygenation (ECMO) or cardiopulmonary bypass (CPB), unless coexisting conditions (eg trauma) mandate transport to a closer facility.

Other considerations

15. **Serum potassium.** A severely elevated serum potassium level is associated with non-survival and is considered a marker of hypoxia before cooling. Termination of CPR is recommended when the potassium level is > 12 mmol/l. When the potassium level is < 12 mmol/l, survival without neurologic impairment may be possible, and CPR should be continued until the patient is rewarmed. Unfortunately, a low serum potassium level does not ensure survival. Other bio markers, such as lactate and pH levels, have been reported to have prognostic significance, although less consistently.

16. **Field or en-route serum potassium testing.** If the serum potassium can be measured in the field or en-route and the level is > 12 mmol per litre, termination of CPR should be considered. If the patient is in cardiac arrest the use of a mechanical chest compression device should be used if available during the transportation phase.

Accidental hypothermia - special situations

17. **Trauma.** Shock caused by hypovolaemia and cerebrospinal injury destabilizes thermoregulation. Hypothermia increases bleeding as clotting factor activity and platelet function are reduced (a critical coagulopathy may occur with a body temp below 34°C).

18. **Avalanche burial without vital signs.**

a. Burial time < 35 minutes, life threatening hypothermia is unlikely, owing to insufficient cooling time, and trauma. Hypoxia should be suspected as the cause.

b. Burial > 35 minutes, the airway is packed with snow and the patient is asystolic, hypoxia preceded hypothermia and CPR is very unlikely to be beneficial.

c. Burial > 35 minutes **and** the airway is not blocked, severe hypothermia should be suspected and the patient should be treated accordingly.

19. **Drowning without vital signs.** Persons who have been exposed to cold water may have a better outcome than those exposed to warm water.

a. **Immersion.** If the patient's history indicates immersion in cold water (ie the body was exposed to cold water but the patient was able to breathe) and it is likely that the body cooled before the onset of hypoxia and cardiac arrest (stage HT IV), survival without neurologic impairment may be possible, and resuscitation should proceed (eg patient wearing a flotation device).

b. **Submersion.** If the history indicates submersion (head under) in cold water (ie the body was exposed to cold water and the patient was unable to breathe) before cooling, the outcome may be worse.

Frostnip

20. Frostnip is freezing of the superficial skin usually affecting the cheeks, ears or nose. Ice crystals, appearing as frost, form on the surface of the skin. Ice crystals do not form in the tissue nor does tissue loss occur in frostnip. The numbness and pallor that occur resolve quickly after covering the skin with appropriate clothing, warming the skin or gaining shelter that protects from the elements. No long-term damage occurs. The appearance of frostnip may be a precursor for frostbite and appropriate action should be undertaken immediately to prevent further injury.

21. For military purposes frostnip is defined as **a freezing cold injury which resolves completely within 30 minutes of commencing re-warming of the injured part.** Residual symptoms after 30 minutes or more of re-warming confirm a diagnosis of superficial frostbite rather than frostnip. Recurrent frostnip occurring in the same body location should result in review by a medical practitioner.

22. An individual diagnosed with frostnip (providing it is the first episode in that body area that season) may be retained in the field at the discretion of medical personnel and the local commander. Staff should be aware of the cumulative disability which can result from recurrent minor cold injuries.

23. Unit medical personnel should ensure that they review anyone who has suffered frostnip when they return from field conditions, deployment or exercise, and that the injury is correctly recorded in the patient's medical record (see Section 5). Where there is any doubt as to their continuing fitness to operate in cold environments, they should be referred to their Regional Occupational Health Team (ROHT) or the INM Cold Injury Clinic (CIC). Referrals to CIC should be via DMICP. If it is unclear whether a patient should be referred, please discuss with the INM Environmental Medicine and Sciences Civilian Medical Officer on Mil 9380 Ext 68050 Civ 02392 768050.

Frostbite

24. **Pathophysiology of frostbite.** Frostbite may be divided into 4 phases:

a. **Pre-freeze.** The pre-freeze phase consists of tissue cooling with accompanying vasoconstriction and ischaemia but does not involve actual ice crystal formation. Neuronal cooling and ischaemia cause hyperaesthesia or paraesthesia.

b. **Freeze-thaw.** In the freeze-thaw phase, ice crystals form intracellularly causing protein and lipid derangement, cellular electrolyte shifts, cellular dehydration, cell membrane lysis, and cell death. The thawing process may initiate ischaemia-reperfusion injury and the inflammatory response.

c. **Vascular stasis.** In the vascular stasis phase, vessels may fluctuate between constriction and dilatation; blood may leak from vessels or coagulate within them.

d. **Late ischaemic.** The late ischaemic phase results from progressive tissue ischaemia and infarction leading to cell death.

The initial cellular damage caused by ice crystals and the subsequent post-thawing processes are made worse if refreezing follows thawing of injured tissues.

25. **Classification of frostbite.** Frostbite has been divided into 4 "degrees" of injury. These are based on acute physical findings and confirm by advanced imaging after rewarming. These "degrees" can be difficult to assess in the field and before rewarming because the still-frozen tissue is hard, pale, and numb. **Severity of frostbite may vary within a single extremity.**

a. **First-degree frostbite** presents with numbness and erythema. A white or yellow, firm, slightly raised plaque develops in the area of injury. There may be slight skin loss. Mild oedema is common.

b. **Second-degree frostbite** injury results in superficial skin blistering; a clear or milky fluid is present in the blisters which are surrounded by erythema and oedema.

c. **Third-degree frostbite** creates deeper hemorrhagic blisters indicating that the injury has extended into the deep tissues.

d. **Fourth-degree frostbite** injury extends deep to the skin into muscle and bone.

26. **Field treatment.** If a body part is frozen in the field, the frozen tissue should be protected from further damage. Ensure the skin is dry. Remove jewellery from the body part. Do not rub tissue in an attempt to re-warm.

27. **Refreezing injury.** A decision should be made whether or not to thaw the tissue. If environmental conditions are such that thawed tissue could refreeze, it is safer to keep the affected part frozen until a thawed state can be maintained. You must avoid refreezing if field-thawing occurs.

28. **Antibiotics.** All cases in which there is a significant amount of dying or dead tissue should be considered for systemic antibiotics and anti-tetanus prophylaxis. Anyone with damaged or contaminated areas of frostbite, eg, frostbite complicating a gunshot wound, should be started on antibiotics and have anti-tetanus immediately (using an appropriate antibiotic protocol) and transferred to hospital for specialist care. When FCI is severe, the risks of anaerobic infection are significant, and gas gangrene and tetanus have killed many of those with the worst cold injuries in the past.

29. **Spontaneous or passive thawing.** Most frostbite will thaw spontaneously and should be allowed to do so if rapid rewarming cannot be readily achieved. Strategies for 2 scenarios are presented:

a. **Scenario 1**. The frozen part has the potential of refreezing and will not be actively thawed.

b. **Scenario 2.** The frozen part can be kept thawed and warm with minimal risk of refreezing until evacuation is completed.

30. **Therapeutic options for both Scenarios 1 and 2.**

a. **Treatment of hypothermia.** Hypothermia frequently accompanies frostbite. HTI (hypothermia staging) may be treated concurrently with the frostbite injury. HTII-IV should be treated effectively before treating the frostbite injury.

b. **Hydration.** Appropriate hydration is important in frostbite recovery and fluids should be administered if possible. Oral fluids should be given if the patient is alert. If the patient is nauseated, vomiting or has an altered mental status, warmed IV fluids should be given if available.

c. **Ibuprofen.** If available, ibuprofen (400-800mg TDS) should be started in the field.

31. **Specific recommendations Scenario 1.** Therapeutic options for frostbite in scenario 1 include the following:

a. **Dressings.** Apply if it is practical to do so and will not interfere with mobility. Dressings should be applied to the frozen part and between the toes and fingers.

b. **Ambulation and protection.** If at all possible, a frozen extremity should not be used for walking, climbing or other maneuvers until definitive care is reached. If using the frozen extremity for mobility is considered, a risk-benefit analysis should consider the potential for further trauma and possible poorer outcomes. Although it is reasonable to walk on a foot with frostbitten toes for evacuation purposes, it is inadvisable to walk on an entirely frostbitten foot because of the potential for resulting morbidity. If using a frozen extremity for locomotion or evacuation is unavoidable, the extremity should be padded, splinted, and kept as immobile as possible to minimize additional trauma. Measures should be taken to protect frozen tissue to prevent further trauma.

32. **Specific recommendations Scenario 2.** Therapeutic options for frostbite in scenario 2 include the following:

a. **Rapid field rewarming of frostbite.** Field rewarming by warm water bath immersion can and should be performed if the proper equipment and methods are available and definitive care is more than 2 hours away. Field rewarming should only be undertaken if the frozen part can be kept thawed and warm until the patient arrives at definitive care.

(1) Water should be heated to between 37-39°C. If a thermometer is not available, a safe water temperature can be determined by placing an uninjured hand in the water for at least 30 seconds to confirm that the water temperature is tolerable and will not cause burn injury.

(2) The affected limb should be suspended in circulating water. Because the water may cool after the rewarming process is started, the water should be continually, but carefully, warmed to the target temperature.

(3) Rewarming is complete when the involved part takes on a red or purple appearance and becomes soft and pliable to the touch. This will take approximately 30 minutes but may take a longer or shorter amount of time depending on the extent and depth of the injury.

(4) The affected tissues should then be allowed to air dry or gently dried with blotting motions to minimize further damage.

b. **Pain control.** During rewarming, pain medications (eg, NSAIDs or opiate analgesics) should be given to control symptoms as dictated by individual patient response and medication availability.

c. **Spontaneous or passive thawing.** Rapid rewarming is strongly recommended. If field rewarming is not possible, however, spontaneous or slow thawing may be unavoidable and should be allowed. Slow rewarming can be accomplished by moving into a warmer location and warming with adjacent body heat from another person.

d. **Debridement of blisters.** Debridement of blisters should not be routinely performed in the field. If a clear, fluid-filled blister is tense and at high risk for rupture during an evacuation, aspiration of the blister and application of a dry gauze dressing should be performed in the field to minimise infection. Hemorrhagic bullae should not be aspirated or debrided electively in the field.

e. **Dressings.** Substantial oedema post re-warming should be anticipated and circumferential dressings should be wrapped loosely to allow for swelling without placing pressure on the underlying tissue.

f. **Ambulation and protection.** A risk-benefit analysis should again consider the potential for further trauma and, ultimately, higher morbidity if a thawed part is used for ambulation.

g. **Elevation of extremity.** If possible, the thawed extremity should be elevated.

h. **Oxygen.** Oxygen (if available) may be delivered by face mask or nasal cannula if the patient is hypoxic (oxygen saturation SpO_2 <90%) or the patient is at high altitude (>5000 m).

Table 3 - Summary of Field Treatment of Frostbite (>2 hours from definitive care)[1]

1.	Treat hypothermia or serious injuries
2.	Remove jewelry from the body part
3.	Rapidly rewarm in water heated and maintained between 37° and 39°C until area becomes soft and pliable to the touch (approximately 30 minutes). Allow spontaneous or passive thawing if rapid rewarming is not possible
4.	Ibuprofen (400-800mg tds) if available
5.	Pain medication (opiate) as needed
6.	Air dry (ie, do not rub at any point)
7.	Protect from refreezing and direct trauma
9.	Dry dressings
10.	Elevate the affected body part if possible
11.	Maintain hydration
12.	Avoid ambulation on thawed lower extremity (unless only distal toes are affected)

33. **Photography.** Photographs should be taken as soon as possible after injury, soon after thawing, and frequently thereafter to document the disease process. Any photograph is useful, although high-quality clinical photographs are preferred. Photographs should accompany the patient when attending any specialist review. Photographs should be taken and handled in accordance with JSP 950 Part 1 Lft 2-1-3 Defence Medical Services Clinical Photographic Policy.

Cold Sensitivity

34. Cold sensitivity is a common sequellae even to mild cold injury, both FCI and NFCI. It is often the presenting complaint following a cold injury. Individuals suffering from FCI /

NFCI should be protected from further cold exposure for at least 6 weeks, until it is proven they have not been cold sensitised.

Non-Freezing Cold Injury (NFCI)[3]

35. **Background.** NFCI continues to be a significant cause of Disease and Non-Battle Injury (DNBI) casualties in personnel operating in cold and/or wet environments. This has implications for mission success, and is thus a major component of operational risk analysis. It also has implications for future employment and deployment. The evidence-base relating to NFCI's pathophysiology, risk factors, prevention, identification and diagnosis is generally weak, being largely drawn from small laboratory studies on animals and humans, case-based evidence from the field, or expert opinion. The criteria used to reach this conclusion (Scottish Intercollegiate Guidelines Network[4,5]) are not wholly appropriate for some of the areas of evidence associated with NFCI. Thus the weak or absent evidence surrounding the understanding and clinical approach to NFCI does not necessarily mean what is thought true or undertaken is wrong, but rather that the level of evidence supporting clinical activity in other conditions is lacking for NFCI.

36. **Introduction.** While local cooling of tissue to temperatures below minus 0.55°C may result in freezing cold injury (FCI, or frostbite), sustained/fluctuating tissue cooling within a temperature range from just above this point to approximately 20°C may cause NFCI which, in some cases, causes lasting debility (including numbness, paraesthesiae, pain, hyperhidrosis, cold allodynia and proprioceptive changes resulting in gait alteration). Protracted and intense vasoconstriction in response to a relatively mild cold stimulus (cold sensitivity) can also result. Thus, in contrast to FCI (where ambient temperature is likely to be below freezing), tissue temperatures associated with NFCI may occur at **any ambient environmental temperature below 20°C** (although risk rises as this ambient temperature falls and/or duration of exposure increases). NFCI affects the lower limbs more frequently than the upper, and the distal limb (digits) more than the proximal. Whilst resulting symptoms may be minor or short-lived, long-term sequelae may result. Whilst these can be asymptomatic, they can also cause symptoms, which can sometimes prove intractable and debilitating.

37. **Pathogenesis.** NFCI pathogenesis is poorly understood. Data are largely derived from case-based accounts, and from animal models of uncertain relevance to human patho-physiology. Human longitudinal histopathological data are completely lacking. However, it appears likely that impaired microvascular flow leads to neurovascular damage, resultant upon ischaemia/hypoxia and/or ischaemia-reperfusion injury. These two elements (neural and vascular injury) may interact, microvascular damage causing neural ischaemic injury, and damage to microvascular innervations leading to further ischaemia. There is also evidence that cold causes direct damage to nerve fibres, independent of ischaemia due to vascular damage.

38. NFCI is best considered as a clinical syndrome of varying severity and time course, with some patients showing full resolution of symptoms within days, and others persisting for years. It is not yet possible to predict, from initial symptoms and signs at presentation, which patients will fall into which prognostic group.

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[3] Much of the text in this section has been adapted from the following MOD commissioned publication: Non-Freezing Cold Injury - The Non-Freezing Cold Injury Review Group. Montgomery et al. January 2013. This source document contains a full list of references.
[4] Scottish Intercollegiate Guidelines Network Home page
[5] Scottish Intercollegiate Guidelines Network Methodology page

39. **Early symptoms**.

a. Local cold, often accompanied by generalised coldness.

b. Pale extremities +/- cyanosis or mottling.

c. Loss of sensation.

d. Altered sensation, for example burning/tingling/pins and needles.

e. Swelling of hands or feet may occur, but infrequently.

40. **Re-warming symptoms.**

a. Hands and feet take longer than normal to re-warm.

b. Red, hyperaemic hands or feet.

c. Pain, often described as throbbing, stabbing, and painful pins and needles, but as with all neuropathic pain the individual may have difficulty describing the character.

d. Loss of sensation.

e. Altered sensation, in particular individuals often notice that they cannot sense temperature well and that feet or hands feel particularly hot in a shower or bath.

f. Swelling of hands or feet in more severe cases.

41. **Persistent symptoms**.

a. Loss of sensation.

b. Altered sensation.

c. Possibly increased sweating; it is not yet clear whether a true hyperhidrosis may follow NFCI, or whether it is a sense of the foot feeling wet due to neuropathy.

d. Cold sensitivity may develop at any point during the 6 weeks following injury, but does not happen in all cases of NFCI, conversely cold sensitivity may exist without NFCI.

e. Cold sensitivity is an unusual response to a cold environment and may include either or both neurological and vascular symptoms such as hands and feet feeling cold in relatively temperate environments or taking much longer than normal to re-warm following cold exposure.

42. It should be noted that individuals who report full symptomatic recovery may nevertheless have persistent nerve and/or vascular damage and thus be more vulnerable to injury with further cold exposure, and may therefore require medical limitations to employment. Individuals who show full recovery of symptoms, and have a normal NFCI examination within one week of injury may be cautiously re-exposed to cold environments

with a very low threshold for removing them from risk should they develop symptoms. All other individuals should be put on restricted duties, including change of JMES where appropriate, and referred to a ROHT Regional NFCI clinic for assessment.

43. **Predisposing factors.** Cold injury rates are higher in the untrained and the young (16-19 years)[6]. Preventive strategies in support of the Chain of Command (Section 3) should be uppermost. African-Caribbean/Pacific-Islander personnel also have a different physiological response to cold[7] and as such may be at higher risk of cold injury[8]. Those individuals should be aware of this risk and be extra vigilant to maintaining their cold weather skills. In addition, medical personnel should be proactive in highlighting high-risk personnel to the Chain of Command.

44. **The importance of core temperature.** Cutaneous blood flow (CuBF) falls in response to cooling, an effect, which is amplified by a reduction in deep body temperature. However, cooling extremities to approximately 10°C results in cyclical increases in CuBF - a phenomenon known as cold-induced vasodilatation (CIVD) or the 'hunting response', which may help protect tissues from ischaemic/hypoxic injury. A normal (or above-normal) deep body temperature is essential for the CIVD response and a reduced CIVD response may be associated with increased risk of cold-injury.

45. **Future risk after NFCI.** At present, a validated test of known (and appropriate) sensitivity, specificity and positive predictive power for NFCI development does not exist[9]. Those with severe and established (post-hyperaemic phase) NFCI who go on to demonstrate cold sensitivity, neuropathy and hyperhidrosis would appear to have physiological reason to be at greater risk of future NFCI, although the magnitude of this risk increase (and the extent to which it can be mitigated) is unclear.

46. **Diagnosis.** A working diagnosis of NFCI should be made in Primary Healthcare by nominated NFCI clinicians and will be based upon comprehensive history, standardised clinical examination and specialist tests[10]. Complaints of persistent numbness, tingling, burning or pins and needles in his hands or feet, or any other peripheral body part, during cool and particularly wet conditions are consistent with NFCI. Possible alternative diagnoses for NFCI are Raynaud's phenomenon, Hand Arm Vibration Syndrome, and care should be taken not to overlook other differential diagnoses such as sickle cell disease, sinus tarsi syndrome and carpal tunnel syndrome.

a. **History.** This should focus on:

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[6] Defence Statistics (Health) report to Cold Injuries Working Group, 5Jan17. Rates are highest for 16-19 age group for all years over the five year period (2011/12 to 2015/16). Rates are highest for untrained personnel across all years over the five year period.

[7] Jackson RL, Roberts DE, Cote RA, McNeal P, Fay JT, Sharp MW, Kraus E, Rahman SA, Hamlet MP: Psychological and Physiological Responses of Blacks and Caucasians to Hand Cooling. Report No: T20-89. 1989, Natick: US Army Research Institute of Environmental Medicine.

[8] Burgess JE, Macfarlane F: Retrospective analysis of the ethnic origins of male British army soldiers with peripheral cold weather injury.

[9] The suggestion that NFCI can result in persistent changes in microcirculatory regulation and ongoing peripheral sensory neuropathy in association with hyperhidrosis (which can increase surface cooling) make it plausible that past NFCI might elevate the risk of future NFCI. There is thus a physiological rationale to suggest that past NFCI might elevate future risk. However, proof that past NFCI elevates future risk is lacking. The magnitude of any attributable risk, even if suspected, thus remains unquantified.

[10] Paragraph 12 of the March 2015 Independent Medical Expert Group (IMEG) report to Armed Forces Compensation Scheme states that neither Infra-red Thermography (IRT) or Thermal Threshold Testing (TTT) may be regarded as diagnostic and, at paragraphs 14-17, stresses the importance of a diagnosis of small fibre neuropathy (SFN) in the overall diagnosis of NFCI. Paragraph 20 states that '*NFCI should be diagnosed from the combination of clinical history, clinical examination and special tests*' and, at paragraph 23, in general '*The clinical features of chronic NFCI include persistent abnormal vascular thermal reactivity and a sensory neuropathy affecting solely or predominantly small nerve fibres and giving rise to chronic continuous or intermittent neuropathic pain, frequently accompanied by cold allodynia*'.

(1) Obtaining a detailed account of the circumstances leading to the NFCI, including environmental conditions (ambient temperature, precipitation, relative wind speed, activity, body insulation and available shelter, food and fluid availability), any predisposing factors and the number of others (if any) injured in same incident. Timings (including durations of exposures and onset of symptoms) should also be recorded.

(2) Clinical features of the affected part at the time of exposure and upon rewarming, and their subsequent progression.

b. **Examination.** For the majority of those injured there are often surprisingly few objective clinical signs. Therefore, the following specific information should be sought:

(1) **Cutaneous features.**

(a) Skin initially appearing pale/white/blotchy with prolonged nail bed capillary refilling time without evidence of swelling.

(b) Skin acquiring a mottled blue appearance with rising temperature in the hours and days after rewarming.

(c) Skin becoming hot and flushed with the possibility of:

i. Oedema and blistering in the hyperaemic phase (days to months)

ii. Hyperhidrosis after the first few weeks.

(2) **Impact on peripheral pulses.** A vascular assessment, including that of pulses and capillary refill time, should be performed.

(3) **Neurological features.** Impaired sensory and motor function over hours to days after exposure. Neurological examination should include an assessment of gait, and of large fibre sensory modalities (light touch, 2-point discrimination, vibration sense and joint position sense) and small fibre modalities (pin prick, heat and cold), with a note of the presence or absence of cold allodynia.

c. **Investigation**[11]**.** A validated test of known (and appropriate) sensitivity and specificity in diagnosing NFCI does not exist. Patients should be investigated in accordance with their symptomatology. For example, a patient with signs consistent with peripheral neuropathy should be referred for appropriate neurological testing.

47. **Clinical care pathway**[12]**.** Routine clinical management of suspected NFCI will be managed in accordance with the clinical care pathway outlined below and DPHC Guidance Note No. 14/17. This will enable appropriate initial management and referral of suspected NFCI patients, ensuring consistent advice and compliance with Joint policy. **All assessments of suspected NFCI cases and their subsequent management should be carried out in accordance with guidance in the relevant DMICP template.** DPHC NFCI

[11] All specialist tests should be reported in a standardised format, which does not 'confirm' or 'refute' a diagnosis of NFCI, rather relays the results of the tests themselves.
[12] There is an almost complete absence of well-conducted case-control or cohort studies to support any of the information presented in this section. Instead, most of the treatment regimens and advice that exist are based on personal experience or observation.

Clinic staff will support GPs, reinforce best practice and to support the Chain of Command in their efforts to minimise further harm to personnel at risk. The following tiers of care should be followed:

a. **Tier 1A - NFCI field care.**

(1) **Management.** If NFCI is suspected, you should:

(a) Remove the patient from the risk environment[13]. Shelter the patient and dry affected feet and/or hands replacing wet socks or gloves as needed. Provide supplementary whole-body insulation.

(b) Intake of fluids may help peripheral perfusion where dehydration is a contributory factor to its impairment. 'Sweet fluids', by increasing calorie intake, may help improve perfusion and ability to generate heat though exercise or shivering where this is a factor[14].

(c) In contrast to patients with FCI, those with NFCI should always have their affected parts re-warmed **slowly**, by exposure to warm air alone, and **should not be immersed in water**[8,15]. If necessary, only use paracetamol and/or ibuprofen for pain control. If there is any visible evidence of tissue damage, protocols for FCI should be followed.

(d) Alert the Chain of Command that there has been a cold injury during the activity - others may also be at risk.

(e) Evacuate the patient to safety immediately. Do not allow them to return to the cold environment even if they appear to have recovered.

(f) Arrange a routine appointment with a MO, preferably one with experience in managing NFCI. If the patient has significant skin changes, cannot walk or their pain is not controlled by paracetamol and/or ibuprofen alone an urgent appointment is required.

(2) **Recording.** You should record the episode on the DMICP NFCI template[16]:

b. **Tier 1B - NFCI primary care.**

(1) **Management.**

(a) Manage pain.

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[13] In the deployed setting, those with a significant NFCI (or FCI - excluding frostnip) should normally be evacuated to their parent unit once their condition has stabilised. Where a decision is made to retain such patients in the deployed setting then appropriate safeguards should be put in place to avoid further cold exposure. Care should be taken to ensure that personnel being evacuated back to UK are referred to an appropriate medical facility / specialist for continuation of treatment when necessary. This is especially important when the responsible primary care provider remains deployed.

[14] There are no data to show that intake of small volumes of hot fluid affect deep body temperature more than marginally, nor that they lead to vasodilatation through any other mechanism. Thus, whilst comforting to drink warm fluids (with the possible advantage of cradling a warm cup if hands are affected, and increasing the ability to dissolve sugar), maintaining hydration *per se* might seem more important, whilst calories can be ingested in a variety of other forms.

[15] The early period after re-warming can be exquisitely painful in NFCI even without any obvious tissue damage and may require strong oral analgesia. The pressure of bedclothes may cause pain, so a bed cradle may be helpful.

[16] See guidance at Section 5 - Reporting and Recording.

(b) Advise the patient to use warm foot/hand spas (30 min / 40°C / twice daily), if appropriate[17].

(c) Advise the patient on appropriate use of clothing and footwear.

(d) Authorise issue of extreme cold weather (ECW) hat and mittens.

(e) Advise smokers on benefits of cessation.

(f) Request bloods: FBC, U&Es, LFTs, random glucose, HbA1c, B12, folate, thyroid screen, auto-antibody screen and (if appropriate) haemoglobinopathy screen.

(g) Advise on appropriate occupational restrictions and consider amending JMES in accordance with JSP 950 Part 1 Leaflet 6-7-7 Joint Manual of Medical Fitness Section 5 Annex N Other Conditions. Issue the NFCI specific PAP10 App 9 (Army only) in accordance with clinical progression.

(h) Prompt the Chain of Command to complete a single Service incident form (patient consent required).

(i) Where there is not recovery within one week refer the patient to the DPHC NFCI Clinics (including INM CIC as tier 2), using a DMICP e-referral. Existing photographic records should be sent separately to the latter. Suspicion of compromised tissue viability should be discussed with the DPHC NFCI Clinic and local surgical services as a matter of urgency.

(j) Thereafter, review as clinically indicated and await DPHC NFCI Clinic appointment.

(k) At any time, consider referring the patient into the Defence Medical Rehabilitation Programme[18].

(2) **Recording.** The episode should be recorded on DMICP.

c. **Tier 2 - DPHC NFCI or INM CI clinic.**

(1) **Management.** If NFCI is suspected:

(a) You should make a working diagnosis of NFCI.

(b) You should make recommendation to award the appropriate JMES, if not already done (to be discussed with ROHT).

(c) Patients should be issued with a NFCI Patient Information Leaflet.

(d) After establishing a baseline of any cold damage/sensitisation, patients

[17] The timing of warm spa use is important. NFCI in the acute setting should **NOT** be rapidly rewarmed and whilst in the hyperaemic phase this may actually cause pain and possibly make the situation worse. It should be reserved for those with on-going neuropathy and those with cold sensitivity.
[18] Especially useful for improvement of functional ability, pain management and for the development of psychosocial coping mechanisms.

should be followed up as appropriate (at 6-12 weeks, 26 weeks and 1 year post-injury) to assess the progress of recovery, provide advice on likely long-term residual sequelae and inform future employability limitations. If the patient is seen more than one year following the index injury then only one attendance may be needed.

(e) Arrange for referral to a Specialist if needed.[19]

(f) Consider referring the patient into the Defence Medical Rehabilitation Programme[20].

(2) **Recording.** The episode should be recorded on DMICP[7].

d. **Tier 3 - specialist referral.** Cases with mild to moderate signs and symptoms of NFCI may be managed locally by suitably experienced medical staff utilising the ROHT or nominated DPHC Regional Lead for advice. More severe cases, or those in which symptoms are persistent, should be referred for tertiary assessment and care as appropriate, including: DMRC Headley Court for pain management; the NHS for specialist neurological assessment; or to the Cold Injury Clinic (CIC), INM. Referrals to these clinics should be arranged by DPHC NFCI or INM CI Clinics only and in accordance with DPHC Guidance Note No. 10/17.

(1) **Clinical assessment** against the criteria below will indicate which patients need onward referral where sequelae are persistent or problematic to treat, or where there remain questions over employment limitations:

(a) Persistent numbness or neuropathic pain, particularly overnight or other symptoms of persistent sensory loss especially temperature sensation. Sensory loss is sometimes indicated by a change of gait or evidence of a functional limitation or restriction.

(b) Evidence of tissue damage, such as skin discolouration changes and trophic changes to nail-beds.

(c) A newly acquired cold sensitivity, i.e. increased sensation of cold on exposure to a cold environment.

The above criteria are not exhaustive and further advice can be provided by INM or DPHC Leads.

(2) **Cold Injury Clinic, INM.** Those patients referred to the CIC will undertake a standardised prognostic test battery, including a neurological examination and assessment, thermal sensory thresholds and cold sensitivity to help inform the patient's future medical employability.

48. **Pain management.**

a. Transient re-warming pain lasting less than an hour or two during re-warming is generally benign. More prolonged pain, particularly overnight, may indicate that the

[19] By a suitably qualified physician
[20] Especially useful for improvement of functional ability, pain management and for the development of psychosocial coping mechanisms.

injury is likely to be non-freezing. It is common clinical experience that neuropathic pain responds poorly to non-opioid analgesics. However, there are no reported randomised clinical trials (RCT) of treatment for pain resulting from NFCI.

b. See Annex C - Management of Pain in Non Freezing Cold Injury (NFCI) and Consult the DMRC Neuropathic Pain and Medication –Teaching Guidefor Primary Care Clinicians. Clinicians can also email DMRC Pain Clinic for advice at DMRC-Pain Management (MULTIUSER) DMRC-PainManagement@mod.uk.

c. Medication used in the management of NFCI pain are commonly associated with adverse effects that may outweigh any analgesic benefit derived. For example, patients should be warned that amitriptyline may cause marked drowsiness (this usually wears off after the first few days) and hypertension (blood pressure should be checked prior to initial use and regularly thereafter). Patients should be made aware of the other side effects and important warnings associated with this (and any other) drug before use in the military setting. Use of any sedative medication will require appropriate restriction on employment.

d. Regular clinical reviews to assess and monitor the effectiveness of the treatment are essential. Each review should include and assessment of:

(1) Adequacy of control measures aimed at protection from cold conditions.

(2) Pain control – including assessment and appropriate pain score.

(3) Impact on lifestyle, daily activities (including sleep disturbance) and employment.

(4) Physical and psychological wellbeing.

(5) Adverse effects.

(6) Continued need for treatment.

49. **Hyperhidrosis.** Hyperhidrosis of the feet and hands is a common secondary issue that can affect the recovery and longer-term management of both significant FCI and NFCI, but especially the latter (see paragraph 41c). Treatment of severe hyperhidrosis can be difficult; whilst topical application of aluminium and similar salts by spray or roll-on can eliminate sweating for short periods, and may thus be useful for critical tasks, this is unsuitable for frequent use. Patients with hyperhidrosis sufficient to interfere with activities of daily living or their job should be discussed with the DPHC NFCI Clinic with a view to referral for specialist dermatological opinion. Sympathectomy (either through a temporary block or permanent surgical methods) is inappropriate for hyperhidrosis and should not be used to manage hyperhidrosis (or symptoms of chronic pain) in NFCI cases, as these individuals tend to have a poor outcome.

50. **Employability.** Once a patient has returned to their parent unit, re-exposure to the cold and / or wet should only be permitted with caution. In general, those who have suffered significant NFCI will need an appropriate JMES for at least the winter after they sustained their injury. They may be employed in sheltered environmental conditions (for example, working indoors in heated buildings only). Patients who are completely asymptomatic, with no suggestion of cold sensitivity and normal neurological examination, can be progressively

re-introduced to the cold. If they show signs of sequelae or recurrence, the re-introduction should be terminated at once. Measures to be considered for the on-going occupational management of those who have sustained cold injury include:

a. Avoidance of exposure to cold and/or wet conditions.

b. Restriction to working outdoors only when it is warm and dry[21].

c. Confinement to indoor working (in properly heated buildings) at all other times.

d. Issue with warm hand- and foot-wear (the latter including Arctic socks and specialist boots if necessary).

e. Ensuring that the patient is encouraged to wear such clothing when they feel a need rather than in accordance with prevailing dress policy.

f. Daily or more frequent re-warming using a foot spa[13,22].

g. Assiduous foot-care routines, and a high standard of personal care in field-craft.

51. For personnel undergoing initial training (both Phase 1 and Phase 2 for the Army) these restrictions may not be possible to implement. Those trainees with anything more than the most trivial NFCI that resolves rapidly post-injury and remain symptom free on re-exposure to cold are unlikely to be able to complete training.

52. **JMES.** Patients with persistent NFCI should be graded and appropriate occupational restrictions applied in accordance with JSP 950 Part 1 Leaflet 6-7-7 Joint Manual of Medical Fitness Section 5 Annex N Other Conditions until reviewed by an Occupational Medicine Consultant[23] and only after all necessary referrals have been completed. Patients with significant sequelae limiting their employability and deployability should remain in a restricted JMES until full recovery is established[24]. The JMES of personnel undergoing initial training (both Phase 1 and Phase 2 for the Army) should be discussed with the sS Occupational Physician responsible for providing advice to training establishments.

53. **Re-exposure to cold.**

a. **Trained strength.** NFCI may recover sufficiently quickly that patients can be returned to full duties at around the 3-5 month point. Although it has been common practice in the past to shelter those patients from severe cold exposure for the following winter (for instance, not deploying to Norway for approximately 12 months), those with a normal neurological examination who remain asymptomatic during the onset of the following winter can be re-exposed provided that they, and their Chain of Command, should adopt a cautious approach to re-exposing the individual. Both the Chain of Command and the individual should remain alert to and act upon the recurrence of symptoms.

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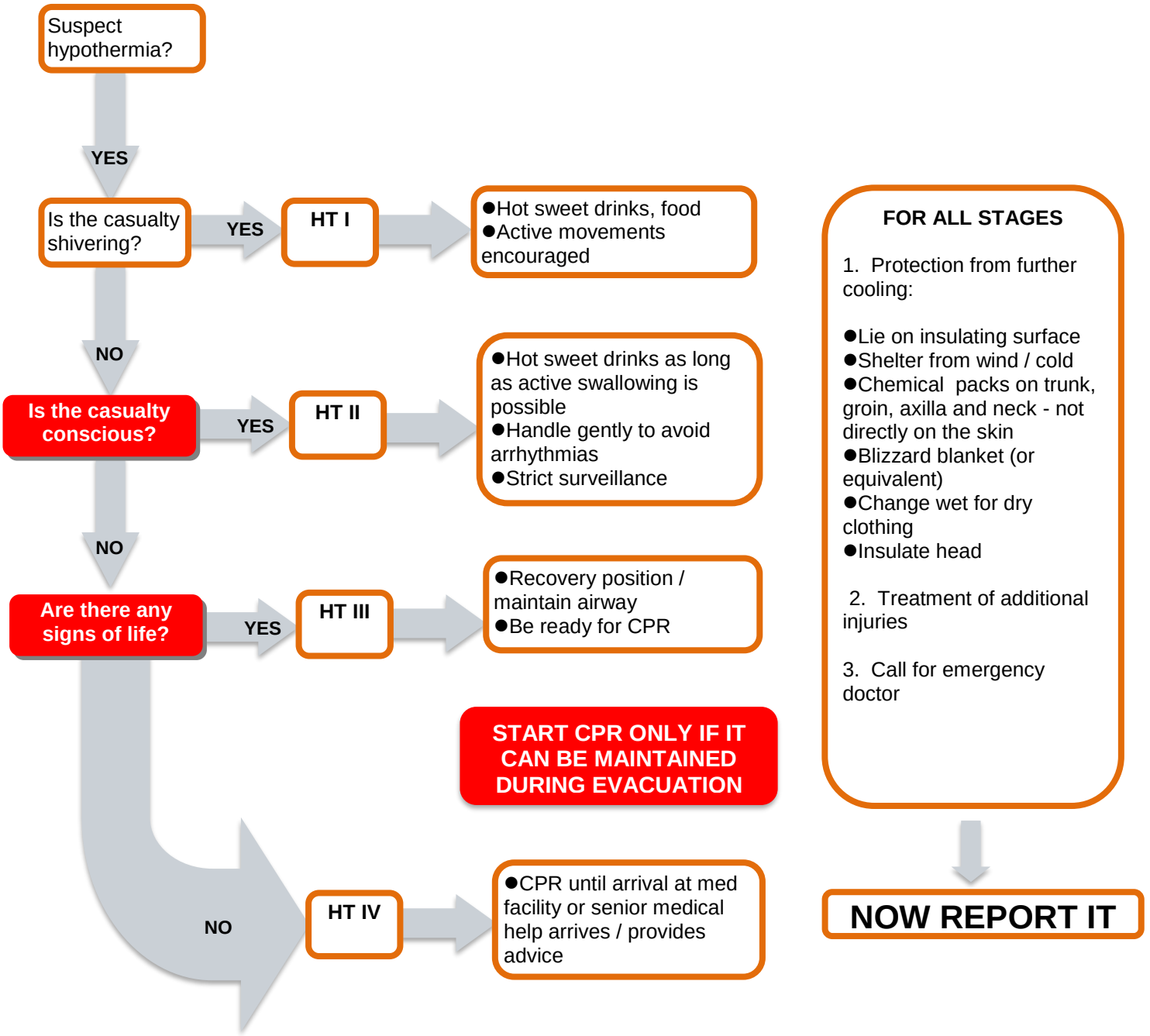
[21] Judgement must be exercised in determining ongoing exposure to cold conditions. For example, even on a cold day many NFCI patients will be able to go for a run providing they leave a warm environment, return immediately to a warm environment and wear appropriate footwear/clothing. Some units experience difficulties employing NFCI patients by recommending that they avoid many fitness and exercise training opportunities because of a misplaced concern about further exposure.
[22] Empirical evidence only.
[23] Dedicated ROMCs are responsible for recommending appropriate JMES awards for SPs with a diagnosis of NFCI.
[24] Medical grading reviews should be carried out in accordance with sS policy.

b. **Un-trained strength.** This group needs to be assessed against the requirements of their remaining training and against their likely future duties on the trained strength. Unless the trainee is entirely asymptomatic, with a normal neurological examination and no persistent skin changes they should be assessed by the consultant in occupational medicine for recruits, and ROHT NFCI clinic as indicated, but they may not necessarily be returned to normal training.

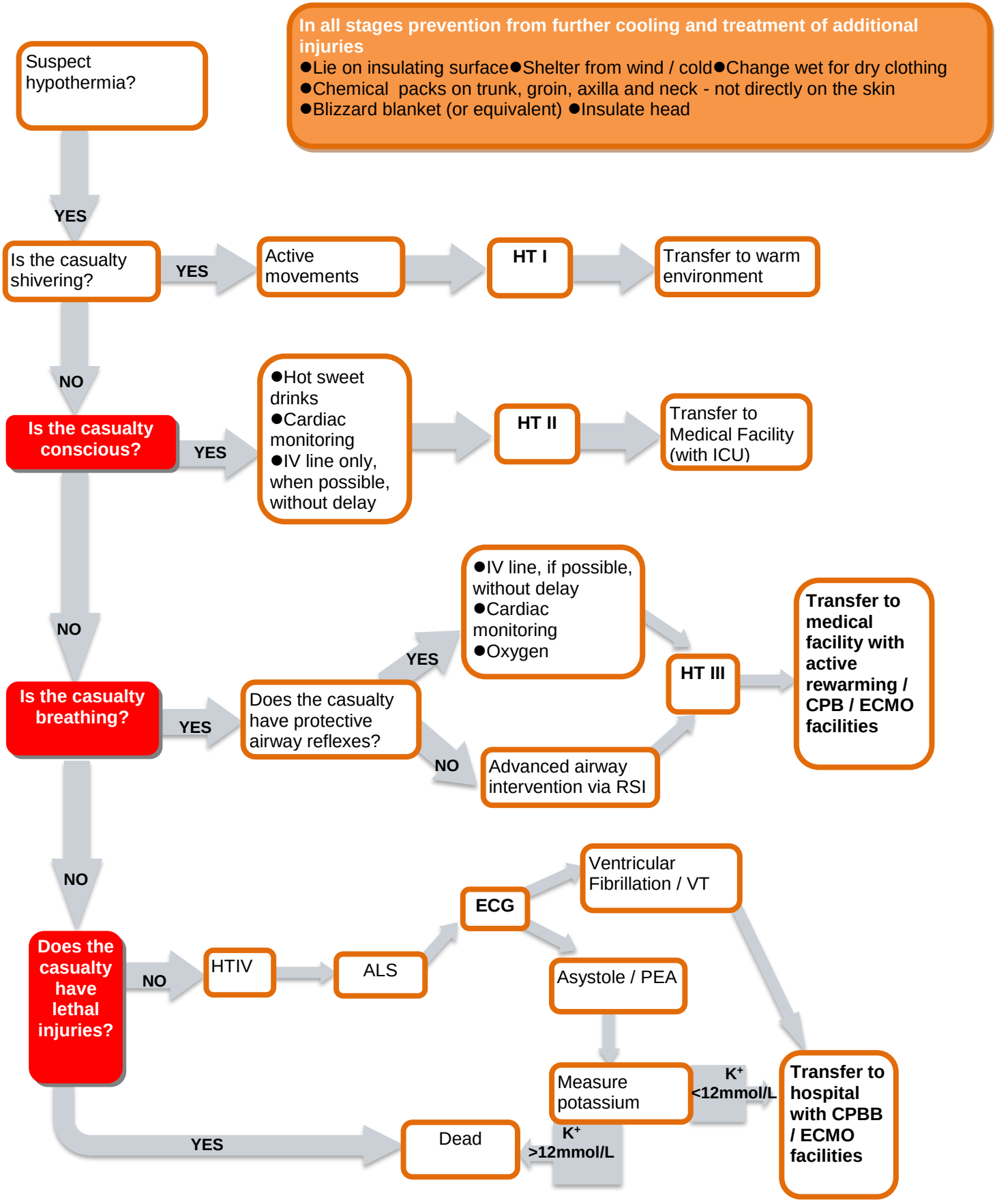
54. **Advice and information for patients.** As a minimum, patients[25] who have suffered suspected NFCI should be provided with a patient information leaflet and an Individuals Guide to Climatic Injury[26].

[25] Including patients who are sent on sick leave, or who may otherwise present to civilian medical services, Civilian medical services should be encouraged to seek advice and support from NFCI Regional Secondary Care Clinics.
[26] Available at: http://defenceintranet.diif.r.mil.uk/libraries/8/Docs2/20140621.8/20140114-DTrgA_Indiv_Climatic_Injury_Pamplet_Web.pdf

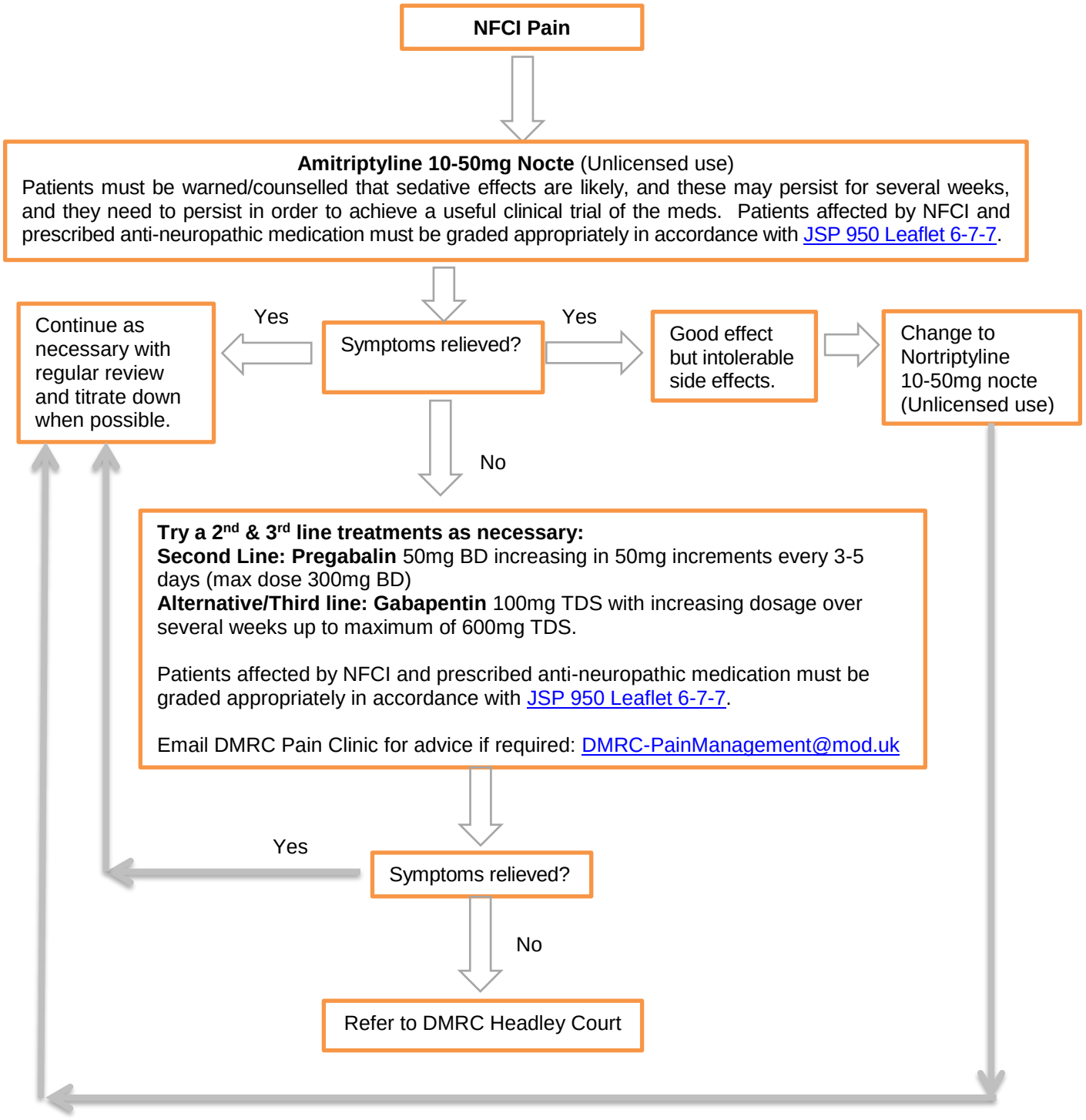
FIRST RESPONDER: INITIAL TREATMENT OF HYPOTHERMIA UNDER FIELD CONDITIONS



EMERGENCY DOCTORS AND PROFESSIONAL RESCUERS: TREATMENT OF HYPOTHERMIA



MANAGEMENT OF PAIN IN NON FREEZING COLD INJURY (NFCI)



SECTION 5 – REPORTING AND RECORDING

1. Reporting and/or recording of heat illness and cold injury is known to be an area of poor compliance in both Command and Medical chains. All cases of climatic illness/injury must be reported and/or recorded by both the:

   a. Chain of Command in accordance with paragraphs 5-8.

   b. Medical chain in accordance with paragraphs 9-11.

2. Each chain serves a different but complementary purpose and both are seen as essential to mitigating risk. Improvements in reporting of climatic illness/injury will have practical benefits for personnel. The better the scale and nature of the problem of illness/injury within Defence is understood the better Defence can take steps to minimise the risk of climatic illness/injury occurring. It will also help inform the provision of improved systems of training and treatment so that illness/injury is better recognised and treated when it does occur and is crucial to the monitoring of the effectiveness of this JSP.

3. It is important that all confirmed or suspected heat illness/cold injury cases~~,~~ are reported. Where there are multiple casualties or any fatalities an appropriate investigation must be undertaken. A functional, rapid, local alert mechanism, whereby all local units undertaking similar activities are made aware all incidents of climatic illness/injury as they arise, must be incorporated into the dynamic risk assessment process. Unit medical centres are to be notified by the CoC of all reported cases of heat illness and cold injury to ensure appropriate medical follow-up and recording takes place.

4. Reporting and/or recording of heat illness/cold injury must comply with:

   a. Statute eg Health and Safety at Work Act 1974, RIDDOR[1].

   b. Defence Lessons Identified Management System (DLIMS).

   c. Joint and Single Service (sS) reporting.

   d. Medical case recording.

Chain of Command reporting

5. **Reporting threshold.** All cases must be reported; this includes cases where individuals develop temporary or permanent incapacitation ie are unable to continue with their duties/training because of climatic illness/injury with or without the involvement of Defence Medical Services or other medical assets.

6. Commanding Officers (COs) must be aware that medical case recording **does not replace their duty to report all cases of heat illness/cold injury meeting the reporting threshold**. Specific reporting or data collation may also be required by the Chain of Command in specific Op Orders or Mounting Instructions.

[1] RIDDOR - Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013. RIDDOR type incidents are reported and captured within the MOD's own internal reporting cells, who then centrally report such incident to the HSE if they fall within the agreed categories.

7. **Statutory and Service incident reporting.** The CO must ensure that suitable local procedures for their area of responsibility are implemented in accordance with JSP 375 Management of Health and Safety Part 12 Chapter 16 Accident/Incident Reporting and Investigation

8. In addition, the following Top Level Budget (TLBs) organisations specific actions must be taken:

a. **Joint Force Command (JFC).** Incidents affecting JFC personnel should be reported using JFC/HOCS Incident Notification Form (JINF).

b. **Royal Navy.** Complete Naval Service Incident Report Form (NSIRF) available from the NLIMS Intranet Site and follow procedure detailed at BR9147 Vol 1 Chapter 6. Advice is available from the Naval Service Incident Management Cell Mil 93832 5087/5088/5089 Civ 02392 62 5087/5088/5089.

c. **Army.** Undertake **both** of the following:

(1) Inform by telephone 24 hr Duty Officer – Defence Accident Investigation Branch (DAIB) - Mil 96798 Ext 6588 or 6587 / Civ 030 67986587.

(2) Complete Army Form 510 (electronic), in accordance with Army Command Standing Orders 3216 and forward to the Army Incident Notification Cell (AINC) - Mil 96770 Ext 3661 / Civ 030 677 03661.

d. **RAF.** Complete RAF Form 7454 and RAF Form 7454A to be passed to the Station Health and Safety Officer within 48 hours of the incident.

Medical Chain recording

9. It is the duty of DMS personnel to ensure that all cases of climatic illness/injury treated under their authority are appropriately recorded. All cases of heat illness/cold injury should be recorded on the appropriate individual electronic heath record heat illness/cold injury template. Where access to the individual electronic heath record is not available, the appropriate forms at Annexes A or B must be completed. These duplicate the templates and data must be transcribed onto the individual electronic heath record at the earliest opportunity by the patient's current primary healthcare provider. Only where this is not possible should the forms must be sent to the medical point of contact detailed at paragraph 11.

10. The individual electronic heath record templates are designed to guide the clinician to the appropriate clinical care pathway and for epidemiological data collection. In addition, providing the patient consents, it is the duty of DMS personnel to record on the individual electronic heath record that they have prompted the Chain of Command to comply with paragraphs 5-8[2].

11. **DPHC HQ medical point of contact.** SO1 OH, HQ DPHC Mil 94422 Ext 4745 Civ 01543 434745 SG DPHC-OH SO1 SGDPHC-OHSO1@mod.uk

[2] Appropriate consent should first be obtained from the patient. Where there is a statutory duty to report consent is not required.

HEAT ILLNESS MEDICAL RECORDING FORM ANNEX A

OFFICIAL SENSITIVE PERSONAL
Medical in Confidence
(when completed)

Casualty's details					
Service number		Surname		Forename	
Rank		DOB		Unit	
JMES (at time of incident)		MFD☐ MLD☐ MND☐ A☐ L☐ M☐ E☐		Medical Limitations yes☐ no ☐ (if yes please list)	
Incident details					
Date of incident		Time (local)		Exercise☐ Operations☐ Sport☐ Other☐ (detail)	
Exact Location	Lat/Long or map coordinates		Safety briefing received prior to incident	yes☐ no ☐	
			Activity undertaken		
Clothing worn (detail)			Equipment carried (detail and weight)		
WBGT reading	Date	Time	WBGT Location	At scene☐ Locally☐ Provided by Met Office☐ Provided by forecast☐ Source unknown☐	

Casualty's clinical details						
Initial observations	Date		Temperature (rectal is preferred)			
	Time		Rectal☐ Oral☐ Axilla☐ Tympanic☐			
AVPU	GCS	Pulse rate	Blood Pressure	Resp Rate	SpO_2 %	Blood Glucose
A☐ V☐ P☐ U☐	/15					

Signs and symptoms	Seizure(s)☐ Collapse or loss of consciousness☐ Anxietyand/or agitation☐ Inappropriate or unusual behaviour eg behaving as if drunk☐ Nausea and /or vomiting☐ Headache☐ Staggering or loss of coordination☐ Disturbed vision☐ Confusion☐ Dizziness☐ Weakness or fatigue☐ Thirst☐ Impaired judgement☐ Hyperventilation☐ Paraesthesia☐ Myalgia, Cramps☐ Tetany☐ Diarrhoea☐ Other (detail)
Working diagnosis	

Treatment details			Disposal
Clothing removed☐ (excluding underwear) Active Cooling☐ (Spray/sponge with cool water and fan) Fluids Oral☐ IV☐	Oxygen☐ Intubation/Ventilation☐ Urinary catheter☐ Nasogastric tube☐ Central venous catheter☐ Arterial line☐	Venous Blood Sample FBC☐ U&Es☐ LFTs☐ CK☐ Clotting screen☐ Myoglobin☐ Arterial Blood Gas☐	Discharged☐ Admit Role 1☐ Admit Role 2/3☐ Refer to SHC for outpatient follow-up☐ Other☐ (detail)

Predisposing factors

Overweight/obese☐ Previous heat illness☐ Smoker☐ Lack of sleep☐ Concurrent mild illness ☐ Un-acclimatised (this includes all UK and Northern Europe-based personnel)☐ Dehydration☐ Vaccination (previous 48 hrs)☐ Poor nutritional status (missed meals within the past 24 hours)☐ Alcohol (past 48 hrs)☐ air travel (past 24hr)☐ Individual volition☐ Lack of physical fitness☐ Illicit drug use☐ Use of supplements☐ Current sunburn☐ Prescribed and over-the-counter medication eg antihistamines and painkillers☐ Inexperienced personnel☐

Medication/drugs	Prescribed	Over the counter	Supplements / herbal	Other
	yes☐ no☐	yes☐ no☐	yes☐ no☐	yes☐ no☐

Person completing form					
Service number		Surname		Forename	
Rank		Position and unit		Signature and date	

Consent

Consent given by casualty for CoC incident reporting yes☐ no☐

The information on this form should be transcribed to DMICP within 28 days by the casualty's current PHC provider. If this is not possible, send the form SG DPHC-OH SO1 SGDPHC-OHSO1@mod.uk

OFFICIAL SENSITIVE PERSONAL
(when completed)

OFFICIAL SENSITIVE PERSONAL
Medical in Confidence (when completed)

Casualty's details					
Service number		Surname		Forename	
Rank		DOB		Unit	
JMES (at time of incident)		MFD☐ MLD☐ MND☐ A☐ L☐ M☐ E☐		Medical Limitations Yes☐ No ☐ (if yes please list)	

Incident details					
Date first reported for medical care (if later than incident)					
Date of incident		Time (local)		Exercise☐ Operations☐ Sport☐ Other☐ (detail)	
Exact Location	Lat/Long or map coordinates		Safety briefing prior to incident	Yes☐ No ☐	
			Activity undertaken		
Clothing worn (detail)			Equipment carried (detail and weight)		
Weather conditions			Wind speed (or estimate)	Wind chill equivalent temperature	

Dry Bulb Air Temperature	Date	Time	Location	At scene☐ Locally☐ Provided by Met Office☐ Provided by forecast☐ Source unknown☐

Casualty's clinical details							
Observations (suspected hypothermia only)		Date	Time	Temperature (rectal is preferred)			
				Rectal☐ Oral☐ Axilla☐ Tympanic☐			
AVPU	GCS	Pulse Rate	Blood Pressure	Resp Rate	SpO_2 %	Blood Glucose	
A☐ V☐ P☐ U☐	/15						
Signs and symptoms	Pale extremities☐ Cyanosis☐ Mottling☐ Altered sensation☐ Swelling of hands or feet☐ Numbness☐ Pain☐ Skin white/ waxy-looking☐ Un-controlled shivering☐ Loss of manual dexterity☐ Mild confusion, disorientation or irritability☐ Loss of insight☐ Slurred speech☐ Apathetic☐ Confused, irrational, ☐ Other (detail)☐						
Working diagnosis	Frostnip	Frostbite	NFCI	Hypothermia			
	hands☐ feet☐ face☐ other☐	hands☐ feet☐ face☐ other☐	hands☐ feet☐ face☐ other☐	yes☐ no ☐			

Treatment details	Disposal
Re-warming☐ Analgesia☐ Antibiotics☐ Anti-tetanus☐ Photography☐ Smoking discouraged☐ Physiotherapist supervised mobilisation☐ Other☐ (detail)	Discharged☐ Admit Role 1☐ Admit Role 2/3☐ Refer to SHC for outpatient follow-up☐ Other☐ (detail)

Predisposing factors
Carbon monoxide poisoning☐ Trauma☐ Altitude Sickness☐ Smoker☐ Alcohol In Past 48 Hours☐ Inadequate Calorie Intake☐ Reduced Physical Fitness☐ Prior NFCI / FCI☐ Hypoxia☐ Advancing age☐ Systemic infection☐ Hypovolaemia☐ Hand Arm Vibration Syndrome ☐ Hypothermia stress or anxiety☐ Inexperienced☐ Sleep deprivation or fatigue☐ Prolonged cold exposure☐ Forced convective heat loss☐ Damp environments and sweating☐ Inadequate clothing☐ Constricting clothing ☐ Iimmobility☐ Upright posture (NFCI only)☐

Medication/drugs	Prescribed	Over the counter	Supplements / herbal	Other
	yes☐ no☐	yes☐ no☐	yes☐ no☐	yes☐ no☐

Person completing form					
Service number		Surname		Forename	
Rank		Position and unit		Signature and date	

Consent
Consent given by casualty for CoC incident reporting yes☐ no☐
The information on this form should be transcribed to DMICP within 28 days by the casualty's current PHC provider. If this is not possible, send the form to SG DPHC-OH SO1 SGDPHC-OHSO1@mod.uk

OFFICIAL SENSITIVE PERSONAL (when completed)