



ANZCOR Guideline 9.3.3 - First Aid Management of Hypothermia and Cold-Related Injuries

Summary

Who does this guideline apply to?

This guideline applies to adults, children and infants but excludes newborns in the first minutes to hours following birth.

Who is the audience for this guideline?

This guideline is for use by bystanders, first aiders and first aid training providers.

Recommendations

The Australian and New Zealand Committee on Resuscitation (ANZCOR) makes the following recommendations in managing those who have, or may have, **hypothermia**:

1. ANZCOR recommends rescuers perform cardiopulmonary resuscitation (CPR) for those who are unresponsive and not breathing normally (ANZCOR Guideline 8). This should continue until ambulance or rescue personnel take over.
2. ANZCOR suggests for those with severe hypothermia who are unresponsive and not breathing normally, where it is not possible to start CPR (for example if initially moving the person to a safer location), rescuers may consider delaying the onset of CPR for up to 10 minutes⁴ [Good practice statement].
3. ANZCOR suggests for those with severe hypothermia who are unresponsive and not breathing normally, only where it is not possible to maintain the continuity of CPR (for example during transport), performing periods of at least 5 minutes of CPR with periods of no more than 5 minutes without CPR. Uninterrupted CPR should be resumed as soon as feasible⁴ [Good practice statement].
4. ANZCOR suggests preventing further heat loss using barriers that use a combination of an insulation layer, such as woollen blankets, and a vapor barrier such as plastic wrap^{5,6,7} [Good practice statement].
5. ANZCOR suggests that if the person is not shivering the rescuer should begin active rewarming.⁸ [Good practice statement].
6. ANZCOR suggests that a person with hypothermia who is shivering will also derive benefits (comfort, reduced cardiovascular stress) from active rewarming⁸ [Good practice statement].

The Australian and New Zealand Committee on Resuscitation (ANZCOR) makes the following recommendations in managing those who have, or may have, **cold injury**:

1. ANZCOR suggests, if possible, remove jewellery from the affected area and elevate the affected part [Good practice statement].

2. ANZCOR suggests rewarming the affected part immediately. Affected fingers may be placed in the opposite armpit, the armpit of a companion, or a warm hand over a frostbitten cheek or ear. Feet can be rewarmed on the warm abdomen (under clothing) of a companion [Good practice statement].
3. ANZCOR suggests NOT to rub the affected tissue, use radiant heat, or break blisters⁹ [Good practice statement].
4. ANZCOR suggests avoiding walking on affected feet. Rest with the feet elevated⁹ [Good practice statement].
5. ANZCOR suggests ensuring that re-freezing does not occur. Once colour and consistency of the skin have been restored the person can safely resume normal activity provided they increase their insulation and take precautions against recurrence [Good practice statement].

Abbreviations

Abbreviation	Meaning/Phrase
ANZCOR	Australian and New Zealand Committee on Resuscitation
CoSTR	International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations
CPR	Cardiopulmonary resuscitation

1 Introduction

Exposure to cold conditions can lead to generalised cooling of the body, **hypothermia**, or localised cold injury. For normal function of most body systems and organs the human body temperature is kept controlled between narrow limits (about 37°C). Hypothermia occurs when the body gets very cold and cannot warm up on its own.

Shivering is a mechanism that the body uses to prevent hypothermia. A person who is cold and shivering with a core temperature above 35°C is *cold stressed* but does not have hypothermia. Those that are cold stressed and able to move should reduce further heat loss and take active steps to rewarm³.

Cold injury may be either **freezing cold injury** (frostbite) or **non-freezing cold injury** (NFCI) or trench foot.

2 Hypothermia

Hypothermia occurs when the body temperature is below 35°C. As the body temperature falls, systems and organs progressively fail until death occurs. Infants and elderly people are at greater risk. Hypothermia may develop acutely, for example by falling into icy water. More commonly hypothermia is a gradual process, an example of this is those who have prolonged exposure to cold conditions such as cold weather or lying on a cold floor without adequate protection.

Cooling reduces the resting oxygen consumption of most human tissues, and can protect the brain from injury due to low oxygen levels. There are reports of people with normal oxygen levels before they became hypothermic making a full recovery, even after extended periods of cardiac arrest.³ For those in cardiac arrest due to hypothermia, immediate uninterrupted CPR is the objective, but this is not always possible or may be suboptimal when evacuating a person on a stretcher, transferring into and out of a vehicle, and at altitude. Delayed and interrupted CPR may be of benefit to those with severe hypothermic cardiac arrest where uninterrupted CPR is impossible.^{3,4}

To accomplish passive rewarming the person's body temperature regulation mechanisms must be intact and they need adequate energy stores in order to create their own body heat through shivering.¹ Shivering during mild hypothermia can increase heat production by three to five times.² Drinks with a high-carbohydrate content will fuel shivering and thus heat production, which will minimize or prevent further core cooling. Warm drinks will not provide a significant thermal benefit to the body's core. In fact, a warm drink may temporarily inhibit shivering through the competing responses of increasing comfort in contrast to its effectiveness, which results in a decreased heat balance.⁸

In general, when external heat is applied to people who are vigorously shivering (mildly hypothermic), skin warming inhibits shivering heat production by approximately the same amount of heat that is donated, such that core rewarming rates are similar between shivering only and external warming. If external heat is available there is a benefit of increased comfort, decreased energy requirements and reduced stress on the heart and other body systems.⁸

People with severe hypothermia who are not shivering have a greatly reduced ability to produce their own body heat. Wrapping methods can reduce further heat loss, however, active rewarming methods are required to rewarm the person's core temperature effectively.¹

2.1 Hypothermia Prevention

Hypothermia may occur due to unavoidable circumstances but in many cases it can be prevented.

When planning outdoor activities ensure:

- adequate equipment and protection from cold, wind and moisture. Wear appropriate clothing, stay dry and be aware of any potential for 'wind chill'
- a regular intake of food and non-alcoholic drinks. Eat appropriate energy food such as fruit or warm sweet fluids, if available, and drink regularly
- a plan for the terrain and environment, that everyone is adequately trained, and that there is experienced leadership.

Further information on prevention, refer to:

- New Zealand Mountain Safety Council www.mountainsafety.org.nz
- Snow Safe www.snowsafesafe.org.au

2.2 Hypothermia Recognition

If temperature measurement is not possible, rescuers should use the following criteria to assess the hypothermic status of the affected person:

Mild hypothermia (32-35°C):

- shivering
- pale, cool skin
- impaired coordination
- slurred speech
- responsive, but possibly with delayed responses.

Moderate (28-32°C) to severe (less than 28°C) hypothermia:

- absence of shivering
- increasing muscle stiffness
- confusion and/or a progressive decrease in responsiveness
- slow/irregular pulse
- low blood pressure.

In more severe cases there may be dangerous heart rhythms and cardiac arrest. The person may have fixed and dilated pupils and appear dead, particularly if they have a weak slow pulse.

2.3 Management

ANZCOR recommends:

- rescuers perform CPR for those who are unresponsive and not breathing normally (ANZCOR Guideline 8). This should continue until ambulance or rescue personnel take over.

ANZCOR suggests:

- for those with severe hypothermia who are unresponsive and not breathing normally, where it is not possible to start CPR (for example if initially moving the person to a safer location), rescuers may consider delaying the onset of CPR for up to 10 minutes⁴ [Good practice statement]
- for those with severe hypothermia who are unresponsive and not breathing normally, only where it is not possible to maintain the continuity of CPR (for example during transport), performing periods of at least 5 minutes of CPR with periods of no more than 5 minutes without CPR. Uninterrupted CPR should be resumed as soon as feasible⁴ [Good practice statement]
- moving the person to a warm, dry shelter as soon as possible. Keep the person lying flat and minimise their physical activity³

- removing any wet clothing and replace with dry clothes and protect the person against wind and draughts. Whenever possible, the ambient temperature should be raised to reduce further heat loss³
- sending for an ambulance or rescue team
- preventing further heat loss using barriers that use a combination of an insulation layer, such as woollen blankets, and a vapour barrier such as plastic wrap^{5,6,7} [Good practice statement]
- if the person is responsive, they should be given glucose containing (“sugary”) oral fluids^{7,8} and food, avoiding alcohol and caffeine [Good practice statement]
- if the person is not shivering, the rescuer should begin active rewarming⁸ [Good practice statement].
Active rewarming may include:
 - the use of body-to-body contact by maximizing skin-to-skin contact between the back of the person who is hypothermic and the front of a person with a normal temperature⁸
 - chemical heat packs applied inside insulation/vapour barrier material.⁷ Charcoal-burning heat packs, hot water bags and electrical heating blankets may also be used in a safe manner. External heat should be applied to the armpit and on the chest and/or back (if possible) as these are the locations that provide the most efficient heat transfer.³ Some external rewarming methods pose a risk of burning the skin if they are applied directly. The manufacturer’s directions must be followed, especially those that suggest placing appropriate insulation between the heat source and the skin⁸
- active rewarming should also be applied to people with hypothermia who are shivering, due to benefits of increased comfort, decreased energy requirements and reduced cardiovascular stress⁸ [Good practice statement]
- rescuers should be aware of their own risk of developing hypothermia in cold environments and should monitor their own status and that of any companions as well as that of the affected person [Good practice statement].

3 Cold Injury

Freezing Cold Injury (Frostbite)

Frostbite occurs when tissues freeze. This happens in cold environments when blood vessels constrict and reduce blood flow and oxygen to the tissues. Frostbite usually affects body parts that are farther away from the body core, and therefore normally have less blood flow. These include the feet, toes, hands, fingers, nose, and ears. However, it can affect any part of the body. When there is less blood flow and internal heat delivered to body tissue this results in ice crystals forming in cells, which causes cell death. Damage to the affected tissue is worst when there is prolonged cold weather exposure and the tissue slowly freezes.

Frostbite injury is classified as either superficial or deep, depending upon the depth of injury. Deep frostbite extends beyond the superficial skin tissues and involves tendons, muscles, nerves and bone.

Non-Freezing Cold Injury

There are some conditions that occur without freezing the skin, such as chilblains and frostnip. Prolonged exposure of limbs to low temperatures above zero degrees may lead to “trench foot” or “immersion foot”. The injured part may be pale, pulseless, immobile and lack feeling, but is not frozen. Although there is no formation of ice crystals in the tissue, the cold temperature alone may cause damage to nerves and to the lining of small blood vessels, leading to poor or no blood flow.

3.1 Management

ANZCOR suggests:

- applying general management principles regarding shelter, ambient temperature, and sending for help, as outlined in the management of hypothermia above
- if possible, remove jewellery from the affected area and elevate the affected part [Good practice statement]

- rewarming the affected part immediately. Affected fingers may be placed in the opposite armpit, the armpit of a companion, or a warm hand over a frostbitten cheek or ear. Feet can be reheated on the warm abdomen (under clothing) of a companion [Good practice statement]
- DO NOT rub the affected tissue, use radiant heat, or break blisters⁹ [Good practice statement]] avoid walking on affected feet. Rest with the feet elevated⁹ [Good practice statement]
- ensuring that re-freezing does not occur. Once the colour and consistency of the skin have been restored, the person can safely resume normal activity, provided they increase their insulation and take precautions against recurrence [Good practice statement].

For those specifically trained in rescue in cold environments (alpine, polar, tundra) ANZCOR suggests:

- rewarming of deeply frozen body parts only if there is no risk of refreezing^{10,11,12} [Good practice statement]. For severe frostbite, rewarming should be accomplished within 24 hours
- if tissue is frozen, best tissue outcomes can be achieved from placing the injured part in warm water with circulating water 37 - 39°C until the affected part thaws. [Good practice statement] This may take 30 minutes or more and is best achieved under hospital conditions where infection control and adequate pain relief can be provided [Good practice statement]
- chemical warmers should not be placed directly on frostbitten tissue as they can reach temperatures that can cause burns. Following rewarming, efforts should be made to protect frostbitten parts from refreezing and to quickly evacuate the person for further care¹⁰ [Good practice statement]
- if tissue has spontaneously thawed (as is often the case), the water bath is not required, but affected tissue can be cleaned and bathed at a more comfortable temperature (30-35°C) [Good practice statement].

4 References

1. McCullough L, Arora S. Diagnosis and treatment of hypothermia. *Am Fam Physician*. 2004;70(12):2325–32.
2. Eyolfson DA, Tikuisis P, Xu X, Weseen G, Giesbrecht GG. Measurement and prediction of peak shivering intensity in humans. *Eur J Appl Physiol* 2001;84 (1–2):100–6.
3. Zafren K, Giesbrecht GG, Danzl DF, Brugger H, Sagalyn EB, Walpoth B, et al. Wilderness Medical Society practice guidelines for the out-of-hospital evaluation and treatment of accidental hypothermia: 2014 update. *Wilderness Environ Med* 2014;25(Suppl. 4):S66–85.
4. Gordon L, Paal P, Ellerton J, Brugger H, Peek G, Zafren K. Delayed and intermittent CPR for severe accidental hypothermia. *Resuscitation* 90 (2015) 46–49
5. Zasa M, Flowers N, Zideman D, Hodgetts TJ, Harris T. A torso model comparison of temperature preservation devices for use in the prehospital environment. *Emerg Med J* 2016;33(6):418–22.
6. Allen PB, Salyer SW, Dubick MA, Holcomb JB, Blackburne LH. Preventing hypothermia: comparison of current devices used by the US Army in an in vitro warmed fluid model. *J Trauma-Injury Infect Crit Care* 2010;69(Suppl. 1):S154–_161.
7. Oliver SJ, Brierley JL, Raymond-Barker PC, Dolci A, Walsh NP. Portable prehospital methods to treat near-hypothermic shivering cold casualties. *Wilderness Environ Med* 2016;27(1):125–30.
8. Haverkamp F.J.C., Giesbrecht G.G., Tan E.C.T.H. The prehospital management of hypothermia — An up-to-date overview (2018) *Injury*, 49 (2) , pp. 149-164

9. McIntosh SE, Freer L, Grissom CK, Auerbach PS, Rodway GW, Cochran A, Giesbrecht GG, McDevitt M, Imray CH, Johnson EL, Pandey P, Dow J, Hackett PH Wilderness Medical Society Clinical Practice Guidelines for the Prevention and Treatment of Frostbite: 2019 Update (2019). *Wilderness Environ Med* 2019; 30(4S): S19eS32
10. Markenson D, Ferguson JD, Chameides L, Cassan P, Chung K-L, Epstein JL, Gonzales L, Hazinski MF, Herrington RA, Pellegrino JL, Ratcliff N, Singer AJ; on behalf of the First Aid Chapter Collaborators. Part 13: first aid: 2010 American Heart Association and American Red Cross International Consensus on First Aid Science. *Circulation*. 2010;122 (suppl 2):S582–S605.
11. Khan ID. On-site management of frostbite in the Himalayas. *Int J Travel Med Glob Health*. 2017;5(1):28-32.
12. Imray C, Grieve A, Dhillon S. Cold damage to the extremities: frostbite and nonfreezing cold injuries. *Postgrad Med J* 2009;85:481–488.

5 About this Guideline

Search date/s	March 2020
Method:	<p>The following search strategy for updating Guideline 9.3.6 Cold Injury was developed for the EMBASE.com platform, which includes both the Medline and Embase bibliographic databases (Table 4.1). Search strings were developed that capture the following alternative conditions and terms:</p> <ul style="list-style-type: none"> • cold injury • frostbite • frostnip • trench foot • chilblains/perniosis • cold panniculitis <p>The EMBASE controlled vocabulary thesaurus (EMTREE) includes terms specific for cold injury, frostbite and trench foot. The records identified with these EMTREE terms and text searches for population terms were refined with limits for study subjects (not animals), publication types (conference abstracts were excluded) and publication date (2009 onwards). It was clear that filtering with generic first aid intervention terms would risk missing relevant studies of specific interventions such as tissue plasminogen activator, which was included in the 2010 ILCOR CoSTR. Therefore, no filtering with first aid terms was used on these records.</p>
Primary reviewers:	Kevin Nation, Jonathon Webber
Other consultation	Rowena Christiansen, Finlay Macneil
Approved:	31 August 2021
Guidelines superseded:	9.3.3 and 9.3.6