HEALTH PROBLEMS IN HIGH ALTITUDE -Dr. Tashi Thinles

Moon Land Ladakh is located at the altitudes ranging from 9,000 to15,000 feet above sea level. Traveling to this altitude in a short time can lead to acute health problems. Acute mountain sickness is commonly manifested as headache and vomiting. Other symptoms include breathlessness, sleeplessness and cough. Sudden induction to such high altitude has profound effect on the body. It can lead to hypertension, blood coagulation disorders (intravascular blood coagulation, thrombo-embolism) and pulmonary hypertension.

The risk of high altitude illness depends on how quickly one ascends to high altitude. The recommendation is that one can safely ascend from sea level to 8,000 feet above sea level in 24 hours. Beyond this one should not ascend more than 1,000 feet (about 300 meters) in 24 hours. But, in practice this is difficult to follow. Traveling by road is therefore, considered safer which gives ample time for the body to get adjusted to altitude. Return by plane to lower altitudes is no problem.

Most serious problems include pulmonary edema, cerebral edema and thrombo-embolism. Pulmonary edema is manifested as severe breathlessness cough and frothy expectoration. If someone has staggering gait like drunk, headache, vomiting and sleepiness it could be due to cerebral edema. Thromboembolism can lead to acute pain in abdomen due to splenic infarction or intestinal ischemia. Sudden visual loss in one eye, usually transient, have been frequently encountered. Rarely lung infarction and venous sinus thrombosis in brain occur as severe consequences of thromboembolism. Some cases of myocardial infarction may also be the result of high altitude. Rise of blood pressure by 20-30 mm Hg diastolic blood pressure is a common observation.

One very important consideration is the presence of risk factors in the travelers. Hypertension, diabetes and compromised lung function or heart disease are risk factors, which can lead to acute mountain sickness. More importantly, acute illnesses like flue, gastroenteritis and fever are the precipitating factors for high altitude illness.

It is absolutely important to be aware of these symptoms and to seek medical assistance quickly in the cases of AMS. The following symptoms must warrant urgent medical assistance:

1. Severe Breathlessness
2. Headache
3. Vomiting
4. Ataxia
5. Staggering gait (like drunk)
6. Sleepiness
7. Unconsciousness
8. Pain abdomen
9. Visual Disturbances

There are many centers around Ladakh providing health care facilities. Major centers are the district hospitals of Leh and Kargil. Other hospitals are sub-district Hospitals at Drass, Deskit (Ph. 01982-220045), Khalsi, Padum and Primary Health centers around Ladakh. The army has many centers and major hospitals around Ladakh and emergency services are provided freely.

FIRST AID

ALTITUDE SICKNESS

Above 3000m (some say 2500m), current best practice advice for a healthy adult dictates no more than a 300m increase in sleeping altitude per day with a rest day every third day. This does not mean you can't ascend more than 300m in a day, as long as you descend again before sleeping. Following this principle, an ascent of a 6000m peak starting at around 3000m should take 10 days. However in many cases individuals will attempt such an ascent much more quickly, often leading to altitude sickness.

Normal Acclimatization
Acclimatization is the process of the body adjusting to the decreased availability of oxygen at high altitudes. It is a slow process, taking place over a period of days to weeks.

High altitude is defined as:
- High Altitude: 1500-3500m (5000-11500 ft)
- Very High Altitude: 3500-5500m (1150-18000 ft)
- Extreme Altitude: above 5500m

Practically speaking, however, we generally don't worry much about elevations below about 2500 m (8000 ft) since altitude illness rarely occurs lower than this.

Certain **normal** physiologic changes occur in every person who goes to altitude:
- Hyperventilation (breathing faster, deeper, or both)
- Shortness of breath during exertion
- Changed breathing pattern at night
- Awakening frequently at night
- Increased urination

As one ascends through the atmosphere, barometric pressure decreases and thus every breath contains fewer and fewer molecules of oxygen. One must work harder to obtain oxygen, by breathing faster and deeper. This is particularly noticeable with exertion, such as walking uphill. Being out of breath with exertion is normal, as long as the sensation of shortness of breath resolves rapidly with rest. The increase in breathing is critical. It is therefore important to avoid anything that will decrease breathing, e.g. alcohol and certain drugs. Despite the increased breathing, attaining normal blood levels of oxygen is not possible at high altitude.

Persistent increased breathing results in reduction of carbon dioxide in the blood, a metabolic waste product that is removed by the lungs. The build-up of carbon dioxide in the blood is the key signal to the brain that it is time to breathe, so if it is low, the drive to breathe is blunted (the lack of oxygen is a much weaker signal, and acts as an ultimate safety valve). As long as you are awake it isn't much trouble to consciously breathe, but at night an odd breathing pattern develops due to a back-and-forth balancing act between these two respiratory triggers. Periodic breathing consists of cycles of normal breathing which gradually slows, breath-holding, and a brief recovery period of accelerated breathing. The breath-holding may last up to 10-15 seconds. This is not

altitude sickness. It may improve slightly with acclimatization, but does not usually resolve until descent. Periodic breathing can cause a lot of anxiety.

If periodic breathing symptoms are troublesome, a medication called Acetazolamide may be helpful.

Dramatic changes take place in the body's chemistry and fluid balance during acclimatization. The osmotic centre, which detects the concentration of the blood, gets reset so that the blood is more concentrated. This results in an altitude diuresis as the kidneys excrete more fluid. The reason for this reset is not understood, though it has the effect of increasing the concentration of red blood cells and perhaps improving the blood's oxygen-carrying ability somewhat; it also counteracts the tendency for oedema formation. It is normal at altitude to be urinating more than usual. If you are not, you may be dehydrated, or you may not be acclimatizing well.

ACUTE MOUNTAIN SICKNESS

Acute Mountain Sickness (AMS) is a constellation of symptoms that represents your body not being acclimatized to its current altitude. As you ascend, your body acclimatizes to the decreasing oxygen (hypoxia). At any moment, there is an "ideal" altitude where your body is in balance; most likely this is the last elevation at which you slept. Extending above this is an indefinite gray zone where your body can tolerate the lower oxygen levels, but to which you are not quite acclimatized. If you get above the upper limit of this zone, there is not enough oxygen for your body to function properly, and symptoms of hypoxic distress occur - this is AMS. Go too high above what you are prepared for, and you get sick.

This "zone of tolerance" moves up with you as you acclimatize. Each day, as you ascend, you are acclimatizing to a higher elevation, and thus your zone of tolerance extends that much higher up the mountain. The trick is to limit your daily upward travel to stay within that tolerance zone.
The exact mechanisms of AMS are not completely understood, but the symptoms are thought to be due to mild swelling of brain tissue in response to the hypoxic stress. If this swelling progresses far enough, significant brain dysfunction occurs. This brain tissue distress causes a number of symptoms; universally present is a headache, along with a variety of other symptoms.

The diagnosis of AMS is made when a headache, with any one or more of the following symptoms is present after a recent ascent above 2500 meters (8000 feet):

- Loss of appetite, nausea, or vomiting
- Fatigue or weakness
- Dizziness or light-headedness
- Difficulty sleeping

All of these symptoms may vary from mild to severe. A scoring system has been developed based on the Lake Louise criteria (see below). AMS has been likened to a bad hangover, or worse. However, because the symptoms of mild AMS can be somewhat vague, a useful rule-of-thumb is: if you feel unwell at altitude, it is altitude sickness unless there is another obvious explanation (such as diarrhoea).

Anyone who goes to altitude can get AMS. It is primarily related to individual physiology (genetics) and the rate of ascent; there is no significant effect of age, gender, physical fitness, or previous altitude experience. Some people acclimatize quickly, and can ascend rapidly; others acclimatize slowly and have trouble staying well even on a slow ascent. There are factors that we don't understand; the same person may get AMS on one trip and not another despite an identical ascent itinerary. Unfortunately, no way has been found to predict who is likely to get sick at altitude.

HIGH ALTITUDE CEREBRAL OEDEMA (HACE)

AMS is a spectrum of illness, from mild to life-threatening. At the "severely ill" end of this spectrum is High Altitude Cerebral Oedema; this is when the brain swells and ceases to function properly. HACE can progress rapidly, and can be fatal in a matter of a few hours to one or two days. Persons with this illness are often confused, and may not recognize that they are ill.

The hallmark of HACE is a change in the ability to think. There may be confusion, changes in behaviour, or lethargy. There is also a characteristic loss of coordination. This is a staggering walk that is similar to the way a person walks when very intoxicated on alcohol. This loss of coordination may be subtle, and must be specifically tested for. Have the sick person do a straight line walk. Draw a straight line on the ground, and have them walk along the line, placing one foot immediately in front of the other, so that the heel of the forward foot is right in front of the toes behind. Try this yourself. You should be able to do it without difficulty. If they struggle to stay on the line (the high-wire balancing act), can't stay on it, fall down, or can't even stand up without assistance, they fail the test and should be presumed to have HACE.
Immediate descent is the best treatment for HACE. This is of the utmost urgency, and cannot wait until morning (unfortunately, HACE often strikes at night). Delay may be fatal. The moment HACE is recognized is the moment to start descent. A 500-1000 meter descent is a good starting point. Other treatments include oxygen, hyperbaric bag, and Dexamethasone. These are usually used as a temporary measure until descent can be achieved.
People with HACE usually survive if they descend soon enough and far enough, and usually recover completely. The staggering gait may persist for days after descent. Once recovery has been complete a cautious re-ascent is acceptable.

HIGH ALTITUDE PULMONARY OEDEMA (HAPE)

Another form of severe altitude illness is High Altitude Pulmonary Edema, or fluid in the lungs. Though it often occurs with AMS, it is not felt to be related and the classic signs of AMS may be absent. Signs and symptoms of HAPE may include any of the following:

- Extreme fatigue
- Breathlessness at rest
- Fast, shallow breathing
- Cough, possibly productive of frothy or pink sputum
- Gurgling or rattling breaths
- Chest tightness, fullness, or congestion

- Blue or gray lips or fingernails
- Drowsiness

HAPE usually occurs on the second night after an ascent, and is more frequent in young, fit climbers or trekkers.

In some persons, the hypoxia of high altitude causes constriction of some of the blood vessels in the lungs, shunting all of the blood through a limited number of vessels that are not constricted. This dramatically elevates the blood pressure in these vessels and results in a high-pressure leak of fluid from the blood vessels into the lungs. Exertion and cold exposure can also raise the pulmonary blood pressure and may contribute to either the onset or worsening of HAPE.

Immediate descent is the treatment of choice for HAPE; unless oxygen is available delay may be fatal. Descend to the last elevation where the victim felt well upon awakening. Descent may be complicated by extreme fatigue and possibly also by confusion (due to inability to get enough oxygen to the brain); HAPE frequently occurs at night, and may worsen with exertion. These victims often need to be carried.

It is common for persons with severe HAPE to also develop HACE, presumably due to the extremely low levels of oxygen in their blood (equivalent to a continued rapid ascent).
HAPE resolves rapidly with descent, and one or two days of rest at a lower elevation may be adequate for complete recovery. Once the symptoms have fully resolved, cautious re-ascent is acceptable.

HAPE can be confused with a number of other respiratory conditions:

High Altitude Cough and Bronchitis are both characterized by a persistent cough with or without sputum production. There is no shortness of breath at rest, no severe fatigue. Normal oxygen saturations (for the altitude) will be measured if a pulse oximeter is available.

Pneumonia can be difficult to distinguish from HAPE. Fever is common with HAPE and does not prove the patient has pneumonia. Coughing up green or yellow sputum may occur with HAPE, and both can cause low blood levels of oxygen. The diagnostic test (and treatment) is descent - HAPE will improve rapidly. If the patient does not improve with descent, then consider antibiotics. HAPE is much more common at altitude than pneumonia, and more dangerous; many climbers have died of HAPE when they were mistakenly treated for pneumonia.

Asthma might also be confused with HAPE. Fortunately, asthmatics seem to do better at altitude than at sea-level. If you think it's asthma, try asthma medications, but if the person does not improve fairly quickly assume it is HAPE and treat it accordingly.

TREATING ACUTE MOUNTAIN SICKNESS

The mainstay of treatment of AMS is rest, fluids, and mild analgesics: acetaminophen (paracetamol), aspirin, or ibuprofen. These medications will not cover up the symptoms. The natural progression for AMS is to get better, & often simply resting at the altitude at which you became ill is adequate treatment. Improvement usually occurs in one or two

days, but may take as long as three or four days. Descent is also an option, & recovery will be quite rapid.

Altitude headaches are usually nasty, persistent, and frequently there are other symptoms of AMS; they tend to be frontal (but may be anywhere), and may worsen with bending over. However, there are other causes of headaches, and you can try a simple diagnostic/therapeutic test. Dehydration is a common cause of headache at altitude. Drink one liter of fluid, and take some acetaminophen or one of the other analgesics listed above. If the headache resolves quickly and totally (and you have no other symptoms of AMS) it is very unlikely to have been due to AMS.

Acetazolamide (Diamox®) is a medication that forces the kidneys to excrete bicarbonate, the base form of carbon dioxide; this re-acidifies the blood, balancing the effects of the hyperventilation that occurs at altitude in an attempt to get oxygen. This re-acidification acts as a respiratory stimulant, particularly at night, reducing or eliminating the periodic breathing pattern common at altitude. Its net effect is to accelerate acclimatization. Acetazolamide isn't a magic bullet, cure of AMS is not immediate. It makes a process that might normally take about 24-48 hours speed up to about 12-24 hours.
Acetazolamide is a sulfonamide medication, and persons allergic to sulfa medicines should not take it. Common side effects include numbness, tingling, or vibrating sensations in hands, feet, and lips. Also, taste alterations, and ringing in the ears. These go away when the medicine is stopped. Since acetazolamide works by forcing a bicarbonate diuresis, you will urinate more on this medication. Uncommon side effects include nausea and headache. A few trekkers have had extreme visual blurring after taking only one or two doses of acetazolamide; fortunately they recovered their normal vision in several days once the medicine was discontinued.

Acetazolamide: - For treatment of AMS
We recommend a dosage of 250 mg every 12 hours. The medicine can be discontinued once symptoms resolve. Children may take 2.5 mg/kg body weight every 12 hours.

For Periodic Breathing
125 mg about an hour before bedtime. The medicine should be continued until you are below the altitude where symptoms became bothersome.

Dexamethasone: (Decadron®) is a potent steroid used to treat brain oedema. Whereas acetazolamide treats the problem (by accelerating acclimatization), dexamethasone treats the symptoms (the distress caused by hypoxia). Dexamethasone can completely remove the symptoms of AMS in a few hours, but it does not help you acclimatize. If you use dexamethasone to treat AMS you should not go higher until the next day, to be sure the medication has worn off and is not hiding a lack of acclimatization. Side effects include euphoria in some people, trouble sleeping, and an increased blood sugar level in diabetics.

Dexamethasone Use & Dosage: - For treatment of AMS
Two doses of 4 mg, 6 hours apart. This can be given orally, or by an injection if the patient is vomiting. Children may be given 1 mg/kg of body weight, up to 4 mg maximum; a second dose is given in 6 hours. Do not ascend until at least 12 hours after the last dose, and then only if there are no symptoms of AMS.

Oxygen
AMS symptoms resolve very rapidly (minutes) on moderate-flow oxygen (2-4 litres per minute, by nasal cannula). There may be rebound symptoms if the duration of therapy is inadequate - several hours of treatment may be needed. In most high altitude environments, oxygen is a precious commodity, and as such is usually reserved for more serious cases of HACE and HAPE.

LAKE LOUISE SCORE

There have been several scoring systems used to diagnose and quantify mountain sickness in altitude research, most consisting of questionnaires and some with an additional examination by a physician. Some such as the Environmental Symptom Questionnaire (ESQ) are long at 67 questions and an attempt has been made to simplify and standardise a scoring system to enable easy comparisons of results between studies. The Lake Louise Score is such a system arising from consensus meetings in Lake Louise in Canada in 1991 and 1993. Although primarily developed for research use, it's short, simple format, which is easy to complete in difficult situations, has led to its adoption by general trekkers and mountaineers. It is sensitive enough to detect AMS whilst having sufficient specificity not to lead to undue over diagnosis. It is however important to realise that all scoring systems can over diagnose AMS. A hangover or 'flu for instance will give a positive AMS score even at sea level, so it is important to use them in the context of a recent rise in altitude and to take allowance of any confounding illness.

Calculating the Lake Louise Acute Mountain Sickness (AMS) Score
Add up the responses to each of the questions of the self-report score (Questions 1-5) A diagnosis of AMS is based on a recent rise in altitude, the presence of a headache with the presence of at least 1 other symptom, and a total score of at least 3. (Some researchers use a threshold score of 4)

AMS = Altitude Gain AND Headache AND at least 1 other symptom AND a total score of 3 or more

SELF REPORT QUESTIONNAIRE:

	SYMPTOM	QUESTION	SCORE
1.	HEADACHE	No headache	0
		Mild headache	1
		Moderate headache	2
		Severe headache, incapacitating	3
2.	GASTROINTESTINAL SYMPTOMS	No	0
		Poor appetite or nausea	1
		Moderate nausea or vomiting	2
		Severe nausea & vomiting, incapacitating	3
3.	FATIGUE AND/OR WEAKNESS	Not tired or weak	0
		Mild fatigue/weakness	1
		Moderate fatigue/weakness	2
		Severe fatigue/weakness, incapacitating	3
4.	DIZINESS/LIGHTHEADEDNESS	Not dizzy	0

		Mild dizzy	1
		Moderate dizziness	2
		Severe dizziness/incapacitating	3
5.	DIFFICULTY SLEEPING	Slept as well as usual	0
		Did not sleep as well as usual	1
		Woke many times, poor nights sleep	2
		Could not sleep at all	3

ALTITUDE SICKNESS SIGNS, SYMPTOMS MATRIX

Sign/Symptoms	Description	Indicator of	Action
Headache		AMS HACE	• Painkillers, rest, re-evaluate after 24 hours. • Look for further symptoms. • Do not raise sleeping altitude.
Shortness of breath		AMS HAPE	• See if this stops with rest; if not treat for HAPE.
Cough		HAPE & many other problems	• Very common at high altitude due to many causes besides altitude, including dry air & infections. • Needs further evaluation.
Extreme fatigue	Having more difficulty with the activity than others.	Severe AMS HAPE HACE	• Check breathing; if rapid at rest treat for HAPE. • Check tandem walking; if poor treat for HACE. • Do not raise sleeping level.
Ataxia	Lack of coordination; Determined by the tandem walking test.	Severe AMS HACE	• Descend. • Oxygen. • Hyperbaric bag. • Dexamethasone.
Altered mental Status	An alteration in intellectual functioning, with emotional, attitudinal, psychological & personality aspects.	Severe AMS HACE	• Descend. • Oxygen. • Hyperbaric bag. • Dexamethasone.
Diarrhoea		Traveller's diarrhoea	• Hydrate. • Antibiotic. • Consider rest day.
Lack of appetite		Altitude sickness or any other illness	• Look for symptoms of other illnesses.
Feeling faint		Almost any condition	• Check ability to concentrate (do simple maths) • Check tandem walking. • Give fluids & consider rest day.

SELF ASSESSMENT FOR AMS

Record of Altitudes reached

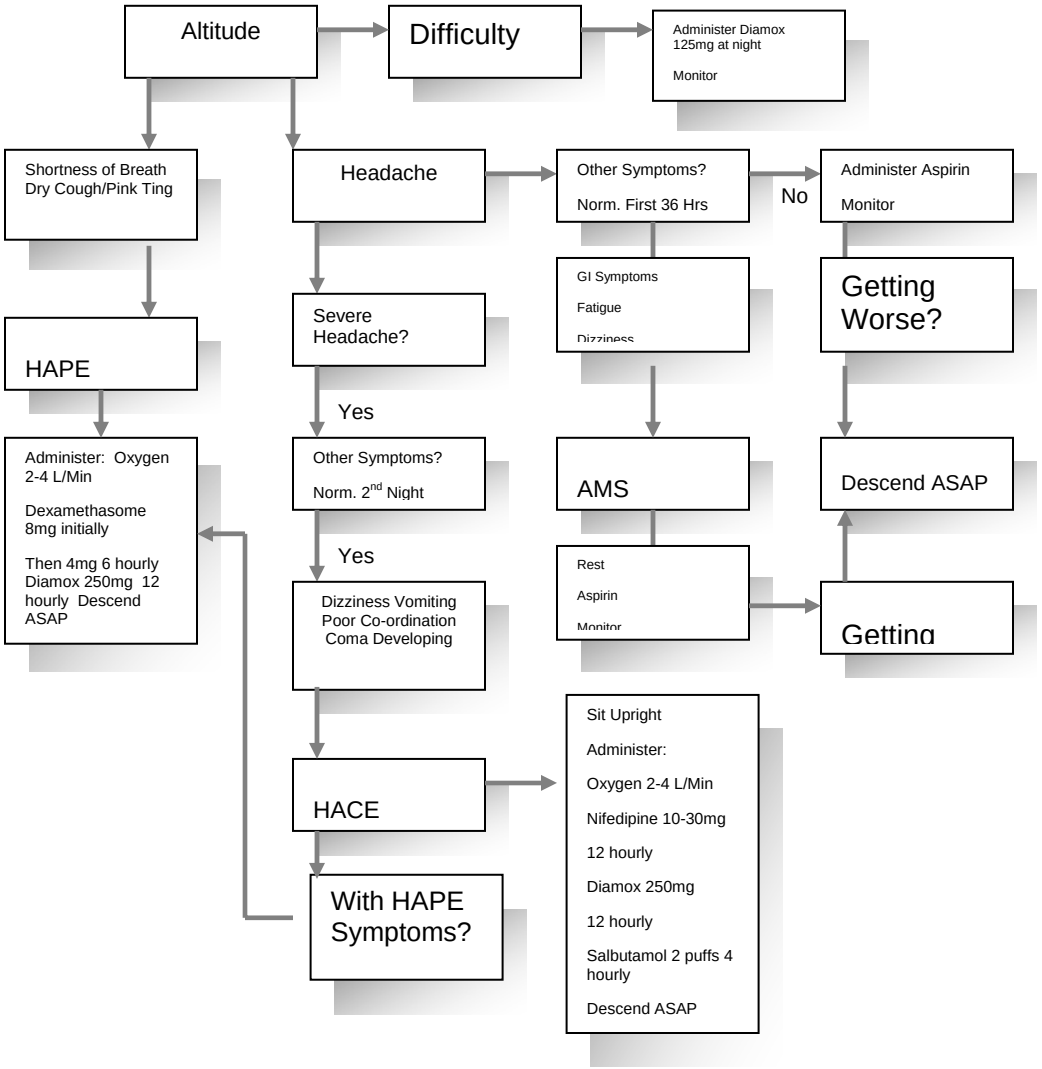
Day	Maximum altitude during the day	Sleeping altitude
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

NOTES

- The table has been redesigned to help the process of recording become quicker and easier.
- The questionnaires are designed to be completed as a self assessment by each individual at breakfast each morning. This should take no more than 5 minutes.
- Start the survey on the first day at or above 3000m – label day 1 ,2 etc Please also complete one copy of the itinerary for that period giving change in sleeping altitude and highest point reached that day.

Its effectively a screening tool, to assist the individual, or alert the leader that there is a potential problem. It is not a substitute for experience common sense etc. It allows the leader to accurately assess 25 individuals at breakfast in a couple of minutes (if they self assess) and then concentrate on say 3 individuals who score 3 or more.

ALTITUDE SICKNESS FLOWCHART



COLD WATER EMERSION

When plunged into cold water, the first hazards to contend with are panic and shock. The initial shock can place severe strain on the body, producing instant cardiac arrest. Survivors of cold water accidents have reported their breath driven from them on first impact with the water. Should your face be in the water during that first involuntary gasp for breath, it may well be water rather than air. Total disorientation may occur after cold water immersion. Persons have reported "thrashing helplessly in the water" for thirty seconds or more until they were able to get their bearings.

Immersion in cold water can quickly numb the extremities to the point of uselessness. Cold hands cannot fasten the straps of a lifejacket, grasp a thrown rescue line, or hold onto an over-turned boat. Within minutes, severe pain clouds rational thought. And, finally, hypothermia (exposure) sets in, and without rescue and proper first aid treatment, unconsciousness and death. Normal body temperature of course, is 98.6 F. Shivering and the sensation of cold can begin when the body temperature lowers to approximately 96.5. Amnesia can begin to set in at approximately 94, unconsciousness at 86 and death at approximately 79 degrees.

Cold water robs the body's heat 32 times faster than cold air. If you should fall into the water, all efforts should be given to getting out of the water by the fastest means possible. Physical exercise such as swimming causes the body to lose heat at a much faster rate than remaining still in the water. Blood is pumped to the extremities and quickly cooled. Few people can swim a mile in fifty degree water. Should you find yourself in cold water and are not able to get out, you will be faced with a critical choice - to adopt a defensive posture in the water to conserve heat and wait for rescue, or attempt to swim to safety.

Should you find yourself in the water, avoid panic. Air trapped in clothing can provide buoyancy as long as you remain still in the water. Swimming or treading water will greatly increase heat loss and can shorten survival time by more than 50%. The major body heat loss areas are the head, neck, armpits, chest and groin. If you are not alone, huddle together or in a group facing each other to maintain body heat.

First Aid Considerations For Cold Water Victims

Treatment for hypothermia depends on the condition of the person. Mild hypothermia victims who show only symptoms of shivering and are capable of rational conversation may only require removal of wet clothes and replacement with dry clothes or blankets. In more severe cases where the victim is semi-conscious, immediate steps must be taken to begin the re-warming process.

Get the person out of the water in an horizontal position and into a warm environment. Remove the clothing only if it can be done with a minimum of movement of the victim's body. Do not massage the extremities. Lay the semi-conscious person face up, with the head slightly lowered, unless vomiting occurs. The head down position allows more blood to flow to the brain. Warm humidified oxygen should be administered by face mask if available.

Immediately attempt to re-warm the victim’s body core. If available, place the person in a bath of hot water at a temperature of 105 to 110 degrees. It is important that the victim's arms and legs be kept out of the water to prevent "after-drop". After-drop occurs when the cold blood from the limbs is forced back into the body resulting in further

lowering of the core temperature. After-drop can be fatal. If a bath is not available, apply hot, wet towels or blankets to the victim's head, neck, chest, groin, and abdomen. Do not warm the arms or legs. If nothing else is available, a rescuer may use their own body heat to warm a hypothermia victim.

Never give alcohol to a hypothermia victim.

Some Important Facts To Remember

Most persons recovered in cold water "near" drowning cases show the typical symptoms of death:

- Cyanotic (blue) skin coloration
- No detectable breathing
- No apparent pulse or heartbeat
- Pupils fully dilated (opened)

Expected Survival Time in Cold Water

Water Temperature	Exhaustion or Unconsciousness in	Expected Survival Time
70–80° F (21–27° C)	3–12 hours	3 hours – indefinitely
60–70° F (16–21° C)	2–7 hours	2–40 hours
50–60° F (10–16° C)	1–2 hours	1–6 hours
40–50° F (4–10° C)	30–60 minutes	1–3 hours
32.5–40° F (0–4° C)	15–30 minutes	30–90 minutes
<32° F (<0° C)	Under 15 minutes	Under 15–45 minutes

Hypothermic Signs & Symptoms

Stage	Core Temperature	Signs & Symptoms
Mild Hypothermia	99º - 97ºF	Normal, shivering can begin
	97º - 95ºF	Cold sensation, goose bumps, unable to perform complex tasks with hands, shiver can be mild to severe, hands numb
Moderate Hypothermia	95º - 93ºF	Shivering, intense, muscle in-coordination becomes apparent, movements slow and laboured, stumbling pace, mild confusion, may appear alert. Use sobriety test, if unable to walk a 30 foot straight line, the person is hypothermic.
	93º - 90ºF	Violent shivering persists, difficulty speaking, sluggish thinking, amnesia starts to appear, gross muscle movements sluggish, unable to use hands, stumbles frequently, difficulty speaking, signs of depression, withdrawn.
Severe Hypothermia	90º - 86ºF	Shivering stops, exposed skin blue of puffy, muscle coordination very poor, inability to walk, confusion, incoherent/irrational behaviour, but may be able to maintain posture and appearance of awareness
	86º - 82ºF	Muscle rigidity, semiconscious, stupor, loss of awareness of others, pulse and respiration rate decrease, possible heart fibrillation
	82º - 78ºF	Unconscious, heart beat and respiration erratic, pulse may not be palpable
	78º - 75ºF	Pulmonary oedema, cardiac and respiratory failure, death. Death may occur before this temperature is reached.

HYPOTHERMIA

"A decrease in the core body temperature to a level at which normal muscular and cerebral functions are impaired."

Conditions Leading to Hypothermia

- Cold temperatures
- Improper clothing and equipment
- Wetness
- Fatigue, exhaustion
- Dehydration
- Poor food intake
- No knowledge of hypothermia
- Alcohol intake - causes vasodilation leading to increased heat loss

Signs and Symptoms of Hypothermia

Watch for the "Umbles" - stumbles, mumbles, fumbles, and grumbles which show changes in motor coordination and levels of consciousness

Mild Hypothermia - core temperature 98.6-96 degrees F

- Shivering - not under voluntary control
- Can't do complex motor functions, can still walk & talk
- Vasoconstriction to periphery

Moderate Hypothermia - core temperature 95-93 degrees F

- Dazed consciousness
- Loss of fine motor coordination - particularly in hands
- Slurred speech
- Violent shivering
- Irrational behaviour - paradoxical undressing
- "I don't care attitude"

Severe Hypothermia - core temperature 92-86 degrees and below (immediately life threatening)

- Shivering occurs in waves, violent then pause, pauses get longer until shivering finally ceases
- Person falls to the ground, can't walk, curls up into a fetal position to conserve heat
- Muscle rigidity develops - because peripheral blood flow is reduced and due to lactic acid and CO_2 build-up in the muscles
- Skin is pale
- Pupils dilate
- Pulse rate decreases
- At 90 degrees the body tries to move into hibernation, shutting down all peripheral blood flow and reducing breathing rate and heart rate.
- At 86 degrees the body is in a state of "metabolic freeze." The person looks dead but is still alive.

Death from Hypothermia

- Breathing becomes erratic and very shallow
- Semi-conscious
- Cardiac arrythmias develop, any sudden shock may set off Ventricular Fibrillation
- Heart stops, death

How to assess if someone is Hypothermic

- If shivering can be stopped voluntarily = mild hypothermia
- Ask the person a question that requires higher reasoning in the brain (count backwards from 100 by 9's). If the person is hypothermic, they won't be able to do it
- If shivering cannot be stopped voluntarily = moderate - severe hypothermia
- If you can't get a radial pulse at the wrist it indicates a core temp below 90 - 86 degrees
- The person may be curled up in a fetal position. Try to open their arm up from the fetal position, if it curls back up, the person is alive. Dead muscles won't contract only live muscles.

Treating Hypothermia

The basic principles of re-warming a hypothermic victim are to conserve the heat they have and replace the body fuel they are burning up to generate that heat. If a person is shivering, they have the ability to re-warm themselves at a rate of 2 degrees C per hour.

Mild - Moderate Hypothermia

Reduce Heat Loss

- Additional layers of clothing
- Dry clothing
- Increased physical activity
- Shelter

Add Fuel & Fluids

It is essential to keep a hypothermic person adequately hydrated and fueled.

Food types:

- Carbohydrates - quickly released into blood stream for sudden brief heat surge - these are the best to use for quick energy intake especially for mild cases of hypothermia
- Proteins - slowly released - heat given off over a longer period
- Fats - slowly released but are good because they release heat over a long period, however, it takes more energy to break fats down into glucose - also takes more water to break down fats leading to increased fluid loss

Food intake

- Hot liquids - calories plus heat source
- Sugars

Things to avoid

- Alcohol - a vasodilator - increases peripheral heat loss
- Caffeine - a diuretic - causes water loss increasing dehydration
- Tobacco/nicotine - a vasoconstrictor, increases risk of frostbite

Add Heat

- Fire or other external heat source
- Body to body contact

Severe Hypothermia

Reduce Heat Loss

- **Hypothermia Wrap**: The idea is to provide a shell of total insulation for the patient. No matter how cold, patients can still internally re-warm themselves much more efficiently than any external re-warming. Make sure the patient is dry. Use multiple sleeping bags, wool blankets, wool clothing, Include an aluminium "space" blanket to help prevent radiant heat loss.

Add Fuel & Fluids

Warm Sugar Water - for people in severe hypothermia, the stomach has shut down and will not digest solid food but can absorb water and sugars. Give a dilute mixture of warm water with sugar

every 15 mins. Dilute Jelly works best since it is part sugar and part protein. This is absorbed directly into the blood stream providing the necessary calories to allow the person to re-warm themselves.

- **Urination** - A full bladder results in body heat being used to keep urine warm rather than vital organs. Once the person has urinated, body heat will be used to maintain the temperature of vital organs.

Add Heat

Heat can be applied to transfer heat to major arteries - at the neck for the carotid, at the armpits for the brachial, at the groin for the femoral, at the palms of the hands for the arterial arch.

- Chemical heat packs provides 110 degrees F for 6-10 hours
- Hot water bottles, towels, compresses
- For a severely hypothermic person, rescue breathing can increase oxygen and provide internal heat

Afterdrop

The core temperature can actually decrease during re-warming. This is caused by peripheral vessels in the arms and legs dilating if they are re-warmed. This dilation sends this cold, stagnate blood from the periphery to the core further decreasing core temperature which can lead to death. Afterdrop can best be avoided by not re-warming the periphery. Re-warm the core only. Do not expose a severely hypothermic victim to extremes of heat.

CPR & Hypothermia

When a person is in severe hypothermia they may demonstrate all the accepted clinical signs of death:

- Cold
- Blue skin
- Fixed and dilated pupils
- No discernable pulse
- No discernable breathing
- Comatose & unresponsive to any stimuli
- Rigid muscles

But they still may be alive in a "metabolic freezer" and can be revived. Your job is to re-warm the person and do CPR if indicated. A hypothermic victim is never cold and dead only warm and dead.

Make sure you do a complete assessment of heart rate before beginning CPR. Instituting CPR at this point may lead to life-threatening arrythmias. Check the carotid pulse for a longer time period to ascertain if there is a slow heartbeat. Be sure the pulse is absent before beginning CPR. You will need to continue to do CPR as you re-warm the person.

In addition, blowing warm air into the persons lungs may assist in internal re-warming.

Cold Injuries

Tissue temperature in cold weather is regulated by two factors, the external temperature and the internal heat flow. All cold injuries described below are intimately connected with the degree of peripheral circulation. As peripheral circulation is reduced to prevent heat loss to the core these conditions are more likely to occur.

Factors influencing cold injuries

- Low ambient temperature
- Wind chill - increases rate of freezing dramatically
- Moisture - wet skin freezes at a higher temp than dry
- Insulation

- Contact with metal
- Exposed skin
- Vasodilation
- Vasoconstriction
- Previous cold injuries
- Constricting garments
- Local pressure
- Cramped position
- Body type
- Dehydration
- Women do better in cold than men (greater subcutaneous body fat)
- Caloric intake
- Alcohol
- Caffeine, nicotine

When a hand or foot is cooled to 59 degrees F, vasoconstriction and minimal blood flow occur. If cooling continues to 50 degrees, vasoconstriction is interrupted by periods of vasodilation with an increase in blood and heat flow. This response recurs in 5-10 minute cycles to provide some protection from cold. Prolonged, repeated exposure increases this response and offers some degree of acclimatization.

As tissue begins to freeze, ice crystals are formed within the cells. As intracellular fluids freeze, extracellular fluid enters the cell and there is an increase in the levels of extracellular salts due to the water transfer. Cells may rupture due to the increased water and/or from tearing by the ice crystals. Do not rub tissue; it causes cell tearing from the ice crystals. As the ice melts there is an influx of salts into the tissue further damaging the cell membranes. Cell destruction results in tissue death and loss of tissue. Tissue can't freeze if the temperature is above 32 degrees F. It has to be below 28 degrees F because of the salt content in body fluids. Distal areas of the body and areas with a high surface to volume ratio are the most susceptible (e.g. ears, nose, fingers and toes).

- Surface frostbite generally involves destruction of skin layers resulting in blistering and minor tissue loss.
- Deep frostbite can involve muscle and bone

	Cold Response	Mild Frostnip	Superficial Frostbite	Deep Frostbite
Sensation	Painful	May have sensation	Numb	Numb
Feels	Normal	Normal	Soft	Hard
Colour	Red	White	White	White

Cold Response

- Circulation is reduced to the area to prevent heat loss
- The area may be pale, cold
- It may have sensation or be numb

Frostnip

- Freezing of top layers of skin tissue
- It is generally reversible
- White, waxy skin, top layer feels hard, rubbery but deeper tissue is still soft
- Numbness
- Most typically seen on cheeks, earlobes, fingers, and toes

Treatment

- Re-warm the area gently, generally by blowing warm air on it or placing the area against a warm body part
- Do not rub the area - this can damage the effected tissue by having ice crystals tear the cell

Frostbite

- Skin is white and "wooden" feeling all the way through
- Superficial frostbite includes all layers of skin
- Numbness
- Deep frostbite can include freezing of muscle and/or bone, it is very difficult to re-warm the appendage without some damage occurring

Treatment

- Superficial frostbite may be rewarmed as frostnip if only a small area is involved
- If deep frostbite, use the rewarming technique

Rewarming of Frostbite

- Rewarming is accomplished by immersion of the effected part into a water bath of 105-110 degrees F. No hotter or additional damage will result. This is the temperature which is warm to your skin. Place the appendage in the water and continue to monitor the water temperature. This temperature will drop so that additional warm water will need to be added to maintain the 105-110 degrees. Do not add this warm water directly to the injury. The water will need to be circulated fairly constantly to maintain even temperature. The effected appendage should be immersed for 25-40 minutes. Thawing is complete when the part is pliable and colour and sensation has returned. Once the area is re-warmed, there can be significant pain. Discontinue the warm water bath when thawing is complete.
- Do not use dry heat to re-warm. It cannot be effectively maintained at 105-110 degrees and can cause burns further damaging the tissues.
- Once re-warming is complete the injured area should be wrapped in sterile gauze and protected from movement and further cold.
- Once a body part has been re-warmed it cannot be used for anything. Also it is essential that the part can be kept from refreezing. Refreezing after re-warming causes extensive tissue damage and may result in loss of tissue. If you cannot guarantee that the tissue will stay warm, do not re-warm it. Once the tissue is frozen the major harm has been done. Keeping it frozen will not cause significant additional damage.

Special Considerations for Frostbite

- If the person is hypothermic and frostbitten, the first concern is core re-warming. Do not re-warm the frostbitten areas until the core temp approaches 96 degrees.
- No alcohol or smoking

Immersion Foot

Immersion foot (trench foot) is a process similar to chillblains. It is caused by prolonged exposure of the feet to cool, wet conditions. This can occur at temperatures as high as 60 degrees F if the feet are constantly wet. Wet feet lose heat 25x faster than dry, therefore the body uses vasoconstriction to shut down peripheral circulation in the foot to prevent heat loss. Skin tissue begins to die because of lack of oxygen and nutrients and due to build up of toxic products. The skin is initially reddened with numbness, tingling pain, and itching then becomes pale and mottled and finally dark purple, grey or blue. The effected tissue generally dies. In severe cases Immersion foot can involve the toes, heels, or the entire foot. If circulation is impaired for > 6 hours there will be permanent damage to tissue. If circulation is impaired for > 24 hours the victim may lose the entire

foot. Immersion Foot causes permanent damage to the circulatory system making the person more prone to cold related injuries in that area.

Treatment and Prevention of Immersion foot

- Includes careful washing and drying of the feet, gentle re-warming and slight elevation. Since the tissue is not frozen as in severe frostbite it is more susceptible to damage by walking on it. Pain and itching are common complaints. Give Ibuprofen or other pain medication.
- Keep feet dry by wearing appropriate footwear. Check your feet regularly to see if they are wet. If your feet get wet, stop and dry your feet and put on dry socks. Periodic air drying will also help. Change socks at least once a day and do not sleep with wet socks. Foot powder can help.

Chillblains

- Caused by repeated exposure of bare skin to temperatures below 60 degrees
- Redness and itching of the effected area
- Particularly found on cheeks and ears, fingers and toes
- Women and young children are the most susceptible
- The cold exposure causes damage to the peripheral capillary beds, this damage is permanent and the redness and itching will return with exposure

Snowblindness

- Sunburn of the eyes
- Prevention by wearing good sunglasses with side shields or goggles

Symptoms

- Occur 8-12 hours after exposure
- Eyes feel dry and irritated, then feel as if they are full of sand, moving or blinking becomes extremely painful, exposure to light hurts the eyes, eyelids may swell, eye redness, and excessive tearing

Treatment

- Cold compresses and dark environment
- Do not rub eyes

FIRST AID KIT LIST:

INJECTABLES

1 x Ceftriaxone inj and wfi
Adrenaline
5 x Lignocaine 2 % inj
1 x Mycil powder

PAIN RELIEF

50 x Paracetamol 500mg
10 x Tramadol 50mg caps
46 x Ibuprofen 400mg tabs
16 x Aspirin 300mg tabs

DIGESTIVE
60 x Metronidazole 400mg tabs
20 x Ciprofloxacin 250mg tabs
50x Cefixime 200 mg Tab
50xOfloxacin +Ornidazole tabs
20xAmoxycillin +Cloxacillin caps

SKIN
1 x Clotrimazole cream
1 x Fucidin cream
1xMomatason scream

EYES & EARS
5 x Sterile eye wash
1 x Gentisone eye/ear drops
1xDexona Eye drops

DIARRHOEA AND VOMITTING
20 x Electrolyte sachets
30 x Loperamide 2mg
20 x Senna
42 x Prochlorperazine 5mg
15 x Ranitidine 150mg

Antihistaminics

30 x Cetirizine 10mg

28 x Chlorpheniramine 4mg

Detachable Needle Pack
5x Syringes 10ml, 5ml, 2ml
5x Needles 21g. 23g, 25g
10 sterets/swabs
100 x cotton buds
2 x eye pads
2 x Sterile Gloves (pairs)
1 x Sterile dressing pack

2x venflon
3x stitch cutter
3x suture
1x forceps
1x needle holder
3x scalpel s

1x Aneroid sphygmomanometer

1x Stethoscope

DRESSINGS & PLASTERS

4x Samsplint 36inch
1x Hand sanitizer 500ml
1x Videne antiseptic solution 500ml
6x Safety pins
10x Lancets
14x Non adherent wound pad 5cmx5
1x wound closure strip 3mm x 75mm
1x waterproof dressing 1metre
1x fabric dressing 1 meter
20x assorted plasters
2x Crepe bandage 10cm/4.5m
2x Crepe bandage 7.5cm x4m
1x OP Airwaysize 3
1x OP Airwaysize 4
1x cotton wool 25g
10x gauze swabs 7.5cmx7.5cm
1x tweezers
1x scissors
1x thermometer
20x disposable vinyl gloves (pairs)
10x paraffin gauze dressing 5cm/5cm
15 x non adherent wound pad 10 cm/10cm
2x Hydrocolloid pad 10cmx10cm

CLEANING
1x Iodine tincture
100 x sterets (swabs)
10 x streets tisept 25ml

DRESSINGS
2x wound dressing (medium)
2x wound dressing (large)

2x triangular bandage 95cmsidesx134cm base
3x Set IV Fluid

Personal Medical Kit:

Co-Amoxiclav 375 mg
Diorolyte
Loperamide 2mg
Ciprofloxacin 500mg
Fucidin cream 15g
Chloraphenimine 4mg
Levonelle Morning after pillsx2

Malerone 250 / 100 mg
Chloramphenicol Eye Ointment 4g