Be informed about high altitude

This document is intended to be informative and educational in nature and should not at all be construed as an alternative to expert medical advice. It does not attempt to replace the advice of a certified medical practitioner, particularly one with knowledge of high altitude illnesses. Before embarking on any prolonged trip (more than one day) to altitudes in excess of 5,000 feet, you should consult your physician regarding specific medical conditions before taking any medications. He is the only person who can advice you on whether you are capable of journeying into high altitudes and can provide you with medication if felt necessary or advice you against undertaking the journey. At high altitudes you are living life on the edge and onset of acute mountain sickness can result in fatalities if not diagnosed promptly.

In the middle of the Himalayas, medical help is always too far away and one needs to be prepared - always - to deal with any emergency medical situation that may arise. It is said that untrained people and non practitioners of the medical profession should not attempt to give treatment beyond basic first aid. This essentially means, literally, that first aid should be administered in order to sustain life and to prevent the situation from deteriorating further till such time as professional medical help can be available.

What is High Altitude?

Altitude is the elevation above mean sea level and is defined as High (8,000 to 12,000 feet), Very High (12,000 to 18,000 feet) and Extremely High (18,000+ feet). Since few people have been to such altitudes, it is almost impossible to predict who may be adversely affected. There are no specific factors such as age, sex or physical condition that predisposes a person to altitude sickness. Some people get it and some people don't while some are more susceptible than others. Most people can go up to altitudes with minimal or no effect, others are affected at 8,000 feet. If you have not been to high altitudes before, it is important to be cautious. If you have been at high altitudes before without problems, you can *probably* return to that altitude as long as you are properly acclimatised.

High altitude is any height about 5,000 feet above mean sea level. But, in medical terms it is defined and based on alterations in human physiology. For example, from 5,000 feet to the summit of Mt Everest, there are different altitude levels with different reactions occurring as you climb higher. We are a species that lives predominantly at low altitudes. Our bodies are equipped to survive under normal atmospheric pressure of 760mm of mercury, with an oxygen concentration of 21%. With increasing altitude, even though the concentration of oxygen remains the same at 21%, the atmospheric pressure decreases and with this the partial pressure of oxygen falls. This means that the number of oxygen molecules per breath is reduced and this reduces the amount of oxygen available to the blood and tissues in the body. At the summit of Mt Everest, it is one third of sea level pressure. For people at such altitudes, the lack of oxygen may cause illness that is potentially life threatening.

What causes altitude sickness?

There are three main types of high altitude illness:
- Acute mountain sickness,
- High altitude pulmonary edema (HAPE), which affects the lungs, and
- High altitude cerebral edema (HACE), which affects the brain.

These illnesses can be serious, but they can also be prevented. Certain physiological changes occur in every person who goes to altitude: hyperventilation (breathing fast), shortness of breath during exertion, increased urination, changed breathing pattern, waking up frequently at night, weird dreams, etc.

As one ascends, atmospheric pressure decreases and every breath contains fewer and fewer molecules of oxygen. One must work harder to obtain oxygen by breathing faster. This is particularly noticeable with exertion. Being out of breath with exertion is normal, as long as the sensation of shortness of breath resolves rapidly with rest. As the amount of oxygen in the lungs decreases, the blood becomes less and less efficient at acquiring and transporting oxygen. Thus no matter how fast one breathes, attaining normal blood levels of oxygen becomes difficult.

Dramatic changes take place in the body's chemistry and fluid balance during acclimatisation. The osmotic center, which detects the concentration of the blood, gets reset to a more concentrated level. 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. It is normal at altitude to be urinating several times per night. If you are not, you may be dehydrated, or you may not be acclimatising well.

Persistent hyperventilation results in an over-reduction in the level of carbon dioxide in the blood. The presence of carbon dioxide is the key signal to the brain that it is time to breathe. As long as you are awake it isn't much trouble to remember to breathe, but at night, an odd breathing pattern develops due to a prolonged argument between these two respiratory centers in the brain. Periodic breathing consists of cycles of normal breathing, breath-holding, and accelerated breathing. The breath-holding may last up to 10-15 seconds. This is not co-related with altitude sickness. It may improve slightly with acclimatisation, but does not usually resolve until descent.

How do I know if I'm getting high altitude illness?

Some of the first signs of high-altitude illness are headache, lightheadedness, weakness, trouble sleeping and an upset stomach. If you have these symptoms, stop going up to a higher altitude or go back down to a lower altitude until your symptoms go away. More severe symptoms include difficulty in breathing even at resting, coughing, confusion and the inability to walk in a straight line. If you get these symptoms, go to a lower altitude right away and get help.

What should I do if I get high altitude illness?

The best treatment for high altitude illness is to go down to a lower altitude right away. But if you only have mild symptoms, you may be able to stay at that altitude and let your body adjust - don't exercise at all, just rest until you feel better.

If you have severe symptoms, go down 1,500 to 2,000 feet right away to see if your symptoms get better. Keep going down until your symptoms go away completely.

Don't ignore high altitude illness. People can die if they don't recognise the signs or if they do not believe that their illness is caused by the altitude. When you have signs of high altitude illness, don't go to a higher altitude until you feel better and your symptoms have gone away completely.

What is acclimatisation?

Acclimatisation is the process of inducing physiological changes to allow the body to function with greater acceptance of the low oxygen levels in the atmosphere. At sea level our blood is 98% saturated with oxygen and this decreases to 89% at 10,000 feet and reaches as low as 40% on the summit of Everest. The heart pumps faster and blood pressure rises. Red blood cell production increases, resulting in an increased haemoglobin concentration, which is required to pick up oxygen and transport it around the body. The initial adjustment towards acclimatisation is an increase in the frequency and depth of breathing. These mechanisms are to ensure increased oxygen delivery.

At medium altitudes (8,000 to 12,000 feet) oxygen saturation remains around 90% but altitude illness is possible. At higher altitudes (12,000 to 18,000 feet) oxygen saturation falls below 90%, altitude illness is common and acclimatisation is necessary. Acclimatisation in adults is possible up to about 18,000 feet but above this elevation there is a fine balance between adjustment to altitude and deterioration. Above 18,000 feet is the Vertical Limit, the Death Zone, above which no acclimatisation occurs and prolonged exposure is incompatible with survival and can lead to fatalities!

The major cause of altitude illnesses is going too high too fast. Given time, your body can adapt to the decrease in oxygen molecules at a specific altitude. This process is known as acclimatisation and generally takes one to three days at that altitude. For example, if you reach 10,000 feet and spend several days at that altitude, your body acclimatises to 10,000 feet. If you climb to 12,000 feet, your body has to acclimatise once again. A number of changes take place in the body to allow it to operate with decreased oxygen:

- The depth of respiration increases.
- Pressure in pulmonary arteries is increased, forcing blood into portions of the lung that are normally not used during sea level breathing.
- The body produces more red blood cells to carry oxygen.
- The body produces more of a particular enzyme that facilitates the release of oxygen from hemoglobin to the body tissues.

What is Acute Mountain Sickness (AMS)?

In higher altitudes, every person should be aware of Acute Mountain Sickness (AMS) otherwise commonly known as altitude sickness or mountain sickness. Primarily, this is caused due to the lack of acclimatisation, which is brought about by climbing to higher altitudes too fast. Experience shows that acclimatisation halts should be with every increase of 2,000 to 4,000 feet altitude with the night halt no more than 1,000 feet higher than the previous night.

At elevations between 8,000 feet and 15,000 feet, about 20% to 90% of those who are not adapted to high altitude will experience symptoms of AMS. Approximately half the people who walk to altitudes above

12,000 feet develop AMS, while almost three fourths of those who fly to altitudes of 12,000 feet or more are affected. Anyone, regardless of sex, age and fitness, venturing to higher altitudes can develop AMS. Young, strong and healthy people may be completely overcome.

As mentioned previously, there is an increase in breathing frequency when one is exposed to lower oxygen environment. This natural response is known as the hypoxic ventilatory response (HVR) and there is some evidence to suggest that people with a low HVR are more liable to develop AMS. However, the well-known mountaineers Messner and Habeler, who were the first ever to climb Everest without bottled oxygen, both had low HVRs and yet were not susceptible to AMS. Recent experiments show that subjects with a lower oxygen saturation develop AMS. It has also been found that anxious individuals are more likely to develop AMS. This makes it difficult to determine if you will suffer from AMS or not.

AMS is a benign, self-limiting illness. Its symptoms, in decreasing order of frequency, include headache, insomnia, anorexia, nausea, vomiting, disturbed consciousness and unusual fatigue. They appear gradually 12 to 24 hours after arrival at altitude and begin to decrease in severity by the third day. The number of symptoms as well as their severity, rapidity of onset, time course and durations vary among individuals. The symptoms of AMS are warning symptoms and should never be ignored. If ignored, the condition may worsen to severe AMS affecting balance and muscle coordination. Other signs include breathlessness with almost any activity. The person also becomes angry, irritable or incomprehensible. The treatment is simply ... rest … at a lower altitude from where the symptoms develop.

Denial is extremely common. Many people with obvious AMS, discount their headache as sinus. Some who have walked for eight hours uphill believe their lack of appetite to be normal. People who are on the ‘trip of a lifetime’ have a great deal invested emotionally in remaining well enough to achieve their goal. Many people fear being left behind or holding up the group, while others have a strong sense of group identity that it is common for them to hide (or at least not reveal) their symptoms, until they become so ill that it is unmistakable.

Dehydration is a common cause of non-AMS headaches and there are many other potential causes as well. You can perform a diagnostic/therapeutic trial by having someone with a headache drink a liter of fluid and take a mild pain-reliever (aspirin, paracetamol, ibuprofen). If the headache goes away completely, it’s not likely to be AMS.

The rule in avoiding AMS is a graded ascent, not going too high or too fast, allowing time for acclimatisation to occur. Although this is common knowledge, many factors such a limited time, weather conditions, the increase in high altitude roads and rapid ascents cause this basic rule to be ignored or forgotten. Careful planning to incorporate regular rest days and to avoid rapid ascents usually obviates the need for the use of drugs.

The drug Diamox has been in use for many years as preventative medication for high altitude sickness. It stimulates an increase in breathing, thus helping to maintain oxygenation and aiding acclimatisation. Many dose regimes have been effective with the most common being 250mg twice daily starting at least 24 hours before ascent above 7,500 feet. However, there are possible side effects that include tingling of the lips and fingertips, blurring of vision and alteration of taste. Dexamethasone is a steroid drug that is also used to prevent AMS, although it is not as popular as Diamox and does not aid acclimatisation. The recommended dose for adults is 4mg every six to eight hours and should be taken at least 24 hours prior to ascent. Short term use of dexamethasone is relatively free of side-effects, although it is usually associated with a euphoric feeling that may mask the symptoms of HAPE and HACE.

Most people with mild AMS get better with no treatment at all. People with moderate or severe symptoms should see a doctor. Things that help:

- Before your trip, maintain a good work/rest cycle, avoiding excessive work hours and last minute packing.
- Avoid alcohol, sleeping pills or narcotics, they may decrease ventilation, intensify hypoxemia and make symptoms worse.
- Drink plenty of fluids.
- Eat high-carbohydrate foods (rice, pasta, cereal) while avoiding fatty stuff.
- Avoid heavy exercise, mild exercise is okay.
- Diamox (acetazolamide) taken twice a day helps prevent and treat AMS. It also helps you breath deeper and faster. This allows you to get more oxygen. Diamox is especially helpful with insomnia.
- Home oxygen will relieve symptoms. Home oxygen is safe, cheap and easy to use. It can be used at night when symptoms are worse and off and on during the day as symptoms dictate.

Many people tend to ignore some of the milder symptoms, thinking that they will pass and ascend to higher altitudes. This can have detrimental effects, so if there is ever any doubt, appropriate treatment should be administered and further ascent should be avoided at all costs. Mild AMS can be treated with rest to facilitate acclimatisation. Mild and severe AMS sufferers can use drugs such as aspirin and ibuprofen to alleviate high altitude headache.

Supplementary oxygen and treatment in a portable hyperbaric chamber are effective in relieving symptoms and are very useful where descent is not possible. After about 1 to 2 hours in the bag, a person's body chemistry will reset to the lower altitude.

At altitude, it is very important to *listen* to your body. If you are planning a high altitude trip, do take the necessary precautions. It cannot be over emphasised that descent remains the most important and only definitive treatment for all forms of altitude illness. This descent should be to an altitude lower than where symptoms began. But remember that the best preventive method is to avoid a rapid ascent.

What is High Altitude Cerebral Edema (HACE)?

AMS is a spectrum of illness, from mild to life-threatening. On the life-threatening end of the spectrum is a severe swelling known as High Altitude Cerebral Edema (HACE) when the brain swells and ceases to function properly. HACE has been known to occur as low as 10,000 feet above sea level. The higher the elevation, the more severe HACE can become. Symptoms include ataxia or loss of balance and muscle coordination. The person's mental functioning decreases rapidly and severe headaches, nausea and vomiting are experienced. Hallucinations or stroke-like symptoms follow and speech becomes slurred. Coma and death may rapidly follow unless the person can immediately be evacuated to a lower altitude. HACE, once present, can progress rapidly, and can be fatal in a matter of a few hours. Persons with this illness are often confused and may not recognise that they are ill. There may be confusion, changes in behaviour or lethargy. However, it is probably easier to recognise a characteristic loss of coordination that is called ataxia. This is a staggering walk that is like the walk of an intoxicated person.

Do a straight line walk, on level ground, without a backpack and without big heavy boots. 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. If it is a struggle to stay on the line, or cannot stay on it or fall down, the test is failed and HACE should be presumed.

The treatment is *immediate* descent. This is of the utmost urgency, and cannot wait 'until morning' (unfortunately, HACE often strikes at night). Delay may be fatal. The moment this is recognised is the moment to start organising flashlights, helpers, porters, whatever is necessary to get this person down at least to the last elevation at which they woke up in the morning with no symptoms of AMS.

Bearing in mind that the vast majority of cases of HACE occur in persons who ascend with symptoms of AMS, this is likely to be the elevation the person slept at two nights previous. If you are uncertain, 2,500 to 3,000 feet descent is a good starting point.

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.

What is High Altitude Pulmonary Edema (HAPE)?

HAPE results from fluid buildup in the lungs. The fluid in the lungs prevents effective oxygen exchange. As the condition becomes more severe, the level of oxygen in the bloodstream decreases and this can lead to cyanosis, impaired cerebral function and death. Symptoms include shortness of breath even at rest, tightness in the chest, marked fatigue, a feeling of impending suffocation at night, weakness and a persistent productive cough bringing up white, watery or frothy fluid. Confusion and irrational behavior are signs that insufficient oxygen is reaching the brain. One of the methods for testing yourself for HAPE is to check your recovery time after exertion. If your heart and breathing rates normally slow down in 'x' seconds after exercise, but at altitude your recovery time is much greater, it may mean fluid is building up in the lungs. In cases of HAPE, immediate descent is a necessary lifesaving measure (2,000 to 4,000 feet) and then evacuation to a medical facility for treatment.

HAPE is a condition that rarely occurs below 8,000 feet altitude. Signs and symptoms of HAPE include any of the following:

- Extreme fatigue
- Breathlessness at rest
- Cough, possibly productive of frothy or pink sputum
- Gurgling or rattling breaths
- Chest tightness, fullness or congestion
- Blue or grey lips or fingernails

People at high altitudes occasionally experience flu-like symptoms, which go away at lower heights. This is actually HAPE, in which a build-up of fluids occurs in the lungs. This leads to a feeling of severe fatigue. Pulmonary edema is a result of greatly increased blood flow through the lungs, as the body tries to obtain the maximum amount of oxygen from the air. The heart increases the flow by increasing the pressure, causing leakage from the blood vessels into the air sacs of the lungs. Pulmonary edema usually takes a few days to develop. Symptoms include extreme difficulty in breathing, a very rapid heart and breathing rate and extreme exhaustion with any exertion. *In severe cases, death can occur in minutes unless the person can be evacuated immediately to lower altitudes.*

Descent is of the utmost urgency and delay may be fatal. The same rules apply for how far as well, to the last elevation where the victim felt well upon awakening. While HACE descent is complicated by confusion and staggering on the part of the victim, HAPE descent is complicated by extreme fatigue and possibly also due to confusion (due to inability to get enough oxygen to the brain).

HAPE resolves rapidly with descent and one or two days of rest at a lower elevation may be adequate for complete recovery.

How does cold weather affect the heart?

Many people are not conditioned to the physical stress of outdoor activities and do not know the dangers of being outdoors in cold weather. Enthusiasts who do not take certain precautions, can suffer accidental hypothermia when the body temperature falls below normal. It occurs when your body cannot produce enough energy to keep the internal body temperature warm enough. It can kill you. Heart failure causes most deaths in hypothermia. Symptoms include lack of coordination, mental confusion, slowed reactions, shivering and sleepiness.

Children, the elderly and those with heart disease are at special risk. As people age, their ability to maintain a normal internal body temperature often decreases and they seem to be relatively insensitive to moderately cold conditions and can become hypothermic without knowing they are in danger. People with coronary heart disease often suffer chest pain or discomfort when they're in cold weather. Some studies suggest that harsh winter weather may increase a person's risk of heart attack due to overexertion.

Besides cold temperatures, high winds, snow and rain also can steal body heat. Wind is especially dangerous, because it removes the layer of heated air from around your body. At 0°C in a 15kmph wind, the cooling effect is equal to calm air at -15°C. Similarly, dampness causes the body to lose heat faster than it would at the same temperature in drier conditions.

To keep warm, wear layers of clothing. This traps air between layers, forming a protective insulation. Also, wear a hat or scarf, as much of your body heat can be lost through your head. And ears are especially prone to frostbite. Keep your hands and feet warm, too, as they tend to lose heat rapidly.

Do not drink alcohol before going outdoors or when outside. Alcohol gives an initial feeling of warmth, but this is caused by expanding blood vessels in the skin. Heat is then drawn away from the body's vital organs.

Is it safe to go to a high altitude if I have a chronic heart or lung disease?

It might be safe. The answer depends on the type of illness you have and its severity. Most people with chronic illnesses, such as heart or lung disease, can safely spend time at a high altitude if their disease is under control. People with coronary artery disease, mild emphysema or high blood pressure are not at greater risk than people without these diseases. They also do not risk making their disease worse by travelling to a high altitude. Being overweight does not increase the risk of getting high altitude illness.

But some diseases make going to a high altitude very dangerous. People with sickle cell anemia should not go to a high altitude. A high altitude is also dangerous for people with severe lung disease, such as chronic obstructive pulmonary disease (COPD) or severe emphysema and for people with severe heart disease. If you have a chronic disease, ask your doctor if it is safe for you to travel to a high altitude.

Is going to a high altitude dangerous during pregnancy?

There isn't much information about the risk of high altitude illness during pregnancy, so it is hard to say if going to a high altitude is safe for pregnant women. Some experts recommend that pregnant women not travel to an altitude above 8,000 feet. If you are pregnant, ask your doctor for advice before you travel to a high altitude.

What about children and high altitudes?

It is usually safe for children to go to high altitudes, but they are more likely to get high altitude illness because their bodies have a hard time adjusting to the low oxygen level. A child may not be able to recognise the symptoms of high altitude illness, so parents and other adults must carefully watch for any signs of high altitude illness in children.

What is Hyperbaric Treatment?

Hyperbaric bags have revolutionised field treatment of high altitude illnesses. The bag is basically a sealed chamber with a pump. The person is placed inside the bag and it is inflated. Pumping the bag full of air effectively increases the concentration of oxygen molecules and therefore simulates a descent to lower altitude. In as little as 10 minutes the bag can create an atmosphere that corresponds to that at 3,000 to 5,000 feet lower. After 1 to 2 hours in the bag, the person's body chemistry will have reset to the lower altitude. This lasts for up to 12 hours outside of the bag, which should be enough time to walk them down to a lower altitude and allow for further acclimatisation.

Several portable hyperbaric chambers are now available, and are very helpful in treating severe forms of altitude illness. They all are all similar to the extent that they are air-impermeable bags that completely enclose the patient and are inflated to a significant pressure above ambient atmospheric simulating a descent. This can be demonstrated with an altimeter inside the bag.

Typical treatment protocols are to put the patient into the bag, pump it up and keep the patient at pressure for one hour. At the end of the hour, the patient is removed from the bag and re-assessed. Additional cycles of descent and re-assessment are continued as needed until either the patient is clinically improved enough to not need further hyperbaric treatment, or is able to descend. Experience has shown that HAPE and HACE typically require 2 to 4 hours and 4 to 6 hours of hyperbaric treatment respectively.

Patients with severe HAPE may not tolerate lying flat; this problem is readily addressed by putting the bag on a rigid surface and propping one end up. However, it is so much easier for these patients to breathe inside the bag once it is pressurised, that this maneuver is usually not necessary.

Remember to put a sleeping bag in with the patient - it can get very cold lying motionless for an hour at high altitude. Conversely, if you are outside in the sun, remember to shade the hyperbaric bag, as the sun is intense at altitude and will cook the patient.

What is Hypothermia?

Hypothermia is dangerously low body temperature, below 35°C. People who are most likely to experience hypothermia include those who are very old or very young, chronically ill, especially with heart or circulation problems, malnourished, overly tired or are under the influence of alcohol or drugs.

Hypothermia occurs when more heat is lost than the body can generate. It is usually caused by extended exposure to the cold. Common causes include being outside without enough protective clothing in the winter, falling overboard from a boat into cold water, wearing wet clothing for an extended period of time in windy or very cold weather, heavy exertion, not drinking enough fluids or not eating enough in cold weather.

The symptoms usually begin slowly. As people develop hypothermia, their abilities to think and move are often lost slowly. They may even be unaware that they need medical treatment. Someone with hypothermia is likely to have frostbite as well.

The symptoms include drowsiness, weakness and loss of coordination, pale and cold skin, confusion, uncontrollable shivering (although, at extremely low body temperatures, shivering may stop), slowed breathing or pulse.

If not treated promptly, lethargy, cardiac arrest, shock and coma can set in. Hypothermia can be fatal.

If the person is unconscious, check the airway, breathing and circulation. If necessary, begin rescue breathing or CPR. If the victim is breathing at a rate of less than 6 breaths per minute, begin rescue breathing.

Take the person inside to an area at room temperature and cover him or her with warm blankets. If going indoors is not possible, get the person out of the wind and use a blanket to provide insulation from the cold ground. Cover the person's head and neck to help retain body heat.

Once inside, remove any wet or constricting clothes and replace them with dry clothing.

Warm the person. If necessary, use your own body heat to aid the warming. Apply warm compresses to the neck, chest wall and groin. If the person is alert and can easily swallow, give warm, sweetened fluids (nonalcoholic) to aid in the warming process.

- Do not assume that someone found lying motionless in the cold is already dead.
- Do not use direct heat (such as hot water, a heating pad or a heat lamp) to warm the person.
- Do not give the person alcohol!

Before you spend time outside in the cold, do not drink alcohol or smoke. Drink plenty of fluid and get adequate food and rest.

Wear proper clothing in cold temperatures to protect your body. These include mittens (not gloves), wind-proof, water-resistant, many-layered clothing, two pairs of socks (cotton next to skin, then wool), scarf and hat that cover the ears (to avoid major heat loss through the top of your head), avoid things that can contribute to hypothermia like extremely cold temperature, specially with high winds, wet clothes, tight clothing or boots, cramped positions, fatigue, smoking and alcohol.

If caught in a severe snowstorm, find shelter as quickly as possible.

What are Chillblains?

A chilblain is a small, red swelling on the skin which can be very itchy and gradually becomes very painful. Chilblains usually occur on the smaller toes but can occur on the finger, face and nose. They occur due to abnormal reaction of the body to cold.

A chilblain will usually appear as a red, swollen lesion. They can dry out leaving cracks in the skin, exposing the skin to infection. The lesion becomes increasingly painful and itchy. Patients may suffer from a burning sensation on their feet. In extreme cases the surface of the skin breaks and infection develops.

A chilblain is an abnormal reaction to cold. Elderly people with a poor circulation are at a greater risk. Young adults are also at risk. If the skin is chilled and then followed by too rapid warming such as a gas fire, a chilblain may develop. Damp living conditions can also be a contributing factor. The sudden onset of very cold water on the skin can also lead to a chilblain.

Keep legs and body warm, especially if you have poor circulation. Leg warmers and thick woolen socks may be of benefit. Don't scratch them.

What is Frostbite?

Frostbite occurs when skin tissue and blood vessels are damaged from exposure to temperatures below 0°C. It most commonly affects the toes, fingers, earlobes, chin, cheeks and nose, body parts which are often left uncovered in cold temperatures. Frostbite can occur gradually or rapidly. The speed with which the process progresses depends upon how cold or windy the temperature conditions are and the duration of exposure to those conditions. A person with frostbite on the extremities may also be subject to hypothermia (lowered body temperature). Check for hypothermia and treat those symptoms first. Frostbite is distinguishable by the hard, pale, and cold quality of the skin that has been exposed to the cold for a length of time. The area is likely to lack sensitivity to touch, although there may be an aching pain. As the area thaws, the flesh becomes red and very painful.

Frostbite has three stages of progression:

Frostnip: In this stage, the individual experiences a pins and needles sensation with the skin turning very white and soft. No blistering occurs. This stage produces no permanent damage and may be reversed by soaking in warm water or breathing warm breath on the affected area.

Superficial Frostbite: In this stage, blistering may occur. The skin feels numb, waxy and frozen. Ice crystals form in the skin cells and the rest of the skin remains flexible.

Deep Frostbite: This is the most serious stage of frostbite. In this stage, blood vessels, muscles, tendons, nerves and bone may be frozen. This stage can lead to permanent damage, blood clots and gangrene, in severe cases. No feeling is experienced in the affected area and there is usually no blistering. Serious infection and loss of limbs frequently occurs after frostbite reaches this stage. However, even with deep frostbite, some frozen limbs may be saved if medical attention is obtained as soon as possible.

Frostbite risk can be reduced by wearing several layers of clothing when in extremely cold conditions since the air pockets between the layers will help to retain warmth, limiting the use of alcohol and tobacco as alcohol causes the blood to cool quickly and tobacco inhibits circulation to extremities, avoiding going outdoors during extremely cold weather, when outside, by shielding the face and other body parts from the cold wind and temperatures by wearing protective clothing, scarves, earmuffs, gloves, etc, by wearing waterproof skin moisturiser on exposed areas, by not spending extended periods in extreme temperatures when exhausted, intoxicated, wet or under the influence of certain drugs.

If, after being in extremely cold conditions, any of the following are experienced, seek emergency care.

- skin swelling
- loss of limb function and absence of pain
- drastic skin color changes
- blisters
- slurred speech
- memory loss

If the patient cannot be transported to a hospital immediately, the following re-warming techniques may help until reaching an emergency facility:

- Bring patient indoors as soon as possible.
- Remove any constricting jewelry and wet clothing.
- Look for signs of hypothermia.
- Apply warm towels or immerse the area in *circulating lukewarm water* for twenty to thirty minutes. Hot water should not be used and the area should not be rubbed in any way. Severe burning pain, swelling, and color changes may occur during warming. Warming is complete when the skin is soft and sensation returns.
- Do not use direct dry heat (such as a radiator, campfire, heating pad, or hair dryer) to thaw the frostbitten areas. Direct heat can burn the tissues that are already damaged.
- Do not rub or massage the affected area.
- If blisters are present, leave them intact.
- Do not hold the affected area near fire since the area may be burned due to the reduced feeling in the area.
- Offer the patient warm coffee or tea to replace lost fluids, but never alcohol.
- Keep the affected area raised
- Move thawed areas as little as possible.
- Re-freezing of thawed extremities can cause more severe damage. Prevent re-freezing by wrapping the thawed areas and keeping the victim warm. If re-freezing can not be guaranteed, it may be better to delay the initial re-warming process until a warm, safe location is reached.
- Apply dry, sterile dressing to the frostbitten areas. Put dressings between frostbitten fingers or toes to keep them separated.

After re-warming, a superficial frostbite will redden and become painful as circulation resumes in the area. Blisters are likely to form within 24 hours. A deep frostbite injury will remain hard, cool to the touch and may turn blue. Blisters may form and the area can turn black. Skin surrounding the affected area may become swollen and remain swollen for over a month. If gangrene develops, amputation may become necessary.

While a frostbite injury is healing, do the following:

- Avoid infection by leaving any blisters intact.
- Watch for signs of infection such as redness, swelling, fever, oozing pus, and red streaks on skin.
- Take all prescribed medications.
- Do not expose the affected area to cold temperatures until cleared to do so by a physician.

What is Snow Blindness?

When in the high reaches of the mountains, the warm and moist breathing air will escape upwards and sometimes clog up your goggles. Your choice will then be to continue blindfolded or remove the glasses. You might choose to pull your glasses a bit out from your face, allowing the warm air to pass them. The suns rays will now be able to burn your eyes at the unprotected sides.

If the weather is overcast you might be tempted to remove the glasses altogether. Yet the rays are just as harmful when cloudy, and the following morning you'll be sorry.

Exposure to ultraviolet radiation from the sun can lead to a sunburn of the cornea (clear surface of the eye). This occurs when proper precautions are not used at high altitudes, where a greater amount of unfiltered (by the atmosphere) ultraviolet radiation is present; the exposure may be compounded by reflection from the snow. The intensity of ultraviolet energy increases by a factor of 4% to 6% for every 1,000-foot increase in altitude above sea level. Snow reflects 85% of ultraviolet B (UVB, the culprit wavelengths that cause snow blindness); dry sand reflects 17%, while grass or sandy turf reflects 2.5%. Water may reflect 10% to 30% of ultraviolet B, depending upon the time of day and location.

The cornea absorbs ultraviolet radiation below 300 nanometers, which includes a fair portion of UVB. Radiation of wavelengths longer than 300 nanometers is transmitted to the lens and, over time, can cause cataracts.

High exposure to UVB can cause a corneal burn within one hour, although symptoms may not become apparent for six to twelve hours. Symptoms include excessive tearing, pain, redness, swollen eyelids, pain when looking at light, headache, a gritty sensation in the eyes and decreased vision. Similar symptoms occur when the surface of the eye is physically scratched (corneal abrasion).

Treatment consists of patching the eye closed after instilling a few drops of ophthalmic antibiotic solution because the surface of the cornea will regenerate spontaneously in 24 to 48 hours. It is important to check the eye first for a foreign body. After patching, the eye must be rechecked in 24 hours. If the eye appears infected with pus, then it should be left unpatched; administer a topical antibiotic solution three to four times a day, and have the victim wear sunglasses. Pain medicine should be used as appropriate. If both eyes are involved, then only the more severely affected eye should be patched.

What is Sunburn?

Everybody seems to like sunny weather. Sunlight is a source of natural light and energy. It is good for our general health, has healing properties and produces a feel good factor. Although sunbathing may be enjoyable it must always be remembered that excessive exposure to the sun's rays is a health hazard due to the harmful effects of ultraviolet radiation on the skin.

The sun emits two kinds of ultraviolet rays. **UV-A** penetrates deep into the skin and can trigger allergies and cause premature ageing and wrinkling while **UV-B** affects the upper layers of the skin and triggers the production of melanin which causes tanning. Too much causes burning, freckling and thickening of the skin. And skin cancers.

They are both present when the sun shines and can penetrate through cloud. Sun damage can also occur when sunlight is 'reflected' from water, sand or snow.

Sunburn often affects skiers, climbers and trekkers at high altitude where the intensity of the light increases by stealth. The higher the altitude,the more concentrated the sun's UV rays.

The sun's rays can also penetrate through water and are effectively magnified. In shallow water the rays can reflect off a sandy bottom. Being underwater can therefore be deceptive due to the cooling effect of the water.

Sunburn when it occurs is a major cause of distress to travellers and can have long-term effects including skin cancer and premature skin ageing. Over exposure to the sun can also dehydrate the skin.

Research confirms that the higher the altitude, the quicker a person will develop sunburn. In fact, the risk gets greater faster with increasing altitude.

UV-B levels at 8,500 feet is approximately 60% higher than at sea level. The intensity of the UV-B exposure suggests that a person having an average complexion, with unprotected skin, would burn after only six minutes of sun exposure on a clear day at noon at 11,000 feet above sea level. The same person would develop sunburn after 25 minutes of noontime exposure at sea level or 14 minutes of unprotected noontime exposure on a beach close to the equator.

A person's exposure to ultraviolet light, especially UV-B light, is one of the key factors in the development of skin cancer. It is vital that people recognise the increase in UV exposure at higher altitudes and take extra precautions to prevent sunburn.

Research suggests an approximate 8-10% increase in ultraviolet intensity for each 1,000 feet of elevation. UV-B intensity decreases as light moving toward the Earth is scattered, reflected and/or absorbed. The higher the altitude, the more intense the UV-B light exposure can damage unprotected skin.

With the increased exposure to UV-B, the expected annual non-melanoma skin cancer rate for year-round residents at 8,500 feet is estimated to be approximately 115 percent greater than those living at sea level at the same latitude. Melanoma rates can also be expected to be higher at increasing altitudes.

The American Academy of Dermatology recommends that everyone wear protective clothing, avoid the strongest mid-day sun and wear sunscreen daily. This triad of protective measures is increasingly important as a skin cancer prevention measure in high altitude areas.

Though UV-B levels are less during cloudy days, they are not absent, so don't get lulled into a false sense of security if you don't see the sun during a day on the slopes! The fact that only the face is exposed to the sun does not necessarily reduce your risk of skin cancer. Indeed, some of the most dangerous forms of skin cancer are often found in areas of the body that actually get less sun.

The harmful effects of UV-A and UV-B rays are cumulative, so take protective measures even if you are outside for only a short time each day.

A tan is actually a symptom of damage to the skin, the idea of a healthy appearance is actually a fallacy. The fact that you have a tan does not protect you from the harmful rays of the sun, but it will help protect against getting a sunburn.

Southern climates closer to the equator may be even more dangerous, given the amount of skin exposed and the longer daylight hours. Be sure to cover up whenever possible (e.g. brimmed hats and UVB protective clothing).

General precautions to avoid sunburn are obvious - avoid the midday sun, wear a broad brimmed hat, long sleeved shirts and sunglasses, never lie in the sun to dry off after swimming, the skin will burn in a matter of minutes, if you at high altitude wear a hat with a neck cover and sunglasses with nose shields and blinker side pieces and wear cotton fabrics next to the skin, they are cooler. Avoid loose weave fabrics that allow penetration of the sun's rays.

If you have sunburn or are with someone with sunburn

- Get the person out of the sun
- Cool the skin where possible with cold running water, a cold shower or immersion in a cool to luke warm bath
- Avoid direct pressure to the burnt area
- Give pain killers
- Apply calamine lotion

What is Wind chill?

Perhaps the most crucial weather element is temperature which is a good indicator of body comfort. The ideal air temperature is 27°C. Temperature gradually decreases at higher altitudes on an average by around 1.7°C for every 1,000 feet increase in elevation up to about the summit of Mt Everest.

Wind, which is air in motion, is another important weather element. Winds are caused by pressure gradients, the difference in pressure between two locations. Air moves from an area of high pressure towards an area of low pressure. The greater the pressure gradient, the faster the wind. Sea breezes form when cool high pressure air flows from the water to the the low pressure area created by warm air over land. On a clear hot summer day, the sea breeze will begin mid morning and can blow inland upto 16kms at wind speeds of 16-24 kmph. In the evening, the process is reversed. An offshore land breeze blows at a more gentle speed, usually about half the speed of the daytime onshore wind.

A somewhat similar situation occurs in the mountains and valleys. During the daytime, the valley floor and sides and the air above them warm up considerably. The air is less dense than the colder air higher up so it rises along the slopes creating a valley wind. In the summer, the southern slopes receive more sun and heat up more which result in valley winds that are stronger than their north slope cousins. At night the process is reversed and downside mountain winds result from the cold air above the mountain tops draining down into the valley.

Winds are also affected by such factors as large area pressure differences and by day-night effects. The sun produces maximum wind speeds while at night winds near the ground are usually weak or absent. Wind speed is also influenced by how rough the ground is. Over smooth surfaces the wind speed increases very rapidly and reaches a peak speed at a height of about 500ft. Over rough terrain, the wind speed increases gradually with increasing altitude and does not reach its peak until about 1,500ft.

Wind and temperature have a bearing on our comfort. To indicate how a combination of these elements affect the weather, we need to understand the wind chill factor.

The wind chill factor is the cooling effect on the body of any combination of wind and temperature. It accounts for the rate at which our exposed skin loses heat under different wind-temperature conditions. In a wind of 32kmph, -4°C will feel like -19°C. This effect is called wind chill, the measure of cold one feels regardless of the temperature. Chill increases as the temperature drops and winds get stronger, up to about 72kmph beyond which there is little increase. Thus at 12°C, increase the wind from 0 to 8kmph reduces temperature by 2°C but a change in wind speed from 64 to 72kmph it reduces only 0.5°C.

The wind may not always be caused naturally. For example, someone motorbiking into the wind may receive quite a chill. If one is moving into the wind, the speed of travel is added to the speed of wind. Thus, if the wind is blowing at 16kmph and one’s speed is 24kmph into the wind, the actual air movement against the body is 40kmph. At -9°C this air speed gives a wind chill equivalent of -30°C. This is easily cold enough for exposed parts of the body to sustain frostbite.