MOUNTAINEERING
MEDICINE
MOUNTAINEERING SAFETY

As an alpinist who carries a long list of dead friends and partners, I approach the mountains differently than most. I go to them intending to survive, which I define as a success. A new route or the summit is a bonus.

- Mark Twight, Extreme Alpinism (1999)

**Mountaineering Accidents – Immediate Causes***

- Fall or slip on rock
- Slip on snow or ice
- Falling rock, ice or object
- Climbing unroped
- Exceeding one’s abilities
- Having inadequate equipment/clothing
- Placing no/inadequate protection
- Weather

*Accidents in North American Mountaineering, AAC

**Mountaineering Accidents – Contributing Causes***

- Climbing unroped
- Exceeding one’s abilities
- Having inadequate equipment/clothing
- Placing no/inadequate protection
- Weather

*Accidents in North American Mountaineering, AAC

**Mountaineering Accidents – Objective Hazards**

- Exposure
- High altitude
- Weather
- Dangerous landscape (unstable trail, rock or snow)

The “SPHERE OF ACCEPTABLE RISK”

**The Poor Judgment Chain**

One poor judgment increases the probability that another will follow
Each error in judgment provides false information that can lead to additional errors
As the poor judgment chain grows, the alternatives for a safe outcome decrease

**The Poor Judgment Chain -- Clues**

- Failure to meet planned targets
- Preoccupation with one aspect of a trek
- Violating the sphere of acceptable risk
- Unresolved discrepancies
- Gut feeling that something is wrong
The Poor Judgment Chain – Breaking It

Recognize your own poor judgment
Check for stress
- low stress . . . complacency
- moderate stress . . . good decisions
- high stress . . . panic
Be alert for groups of poor judgments
Review an original poor judgment as soon as the poor judgment chain has been broken

Master Warning Panel

Gut
Senses
Brain

Planning and Preparation – Two Deep

Trek leader
- responsible for party welfare
- orchestrates the evacuation
First-aid leader
- assumes leadership of first-aid scenario in the field

The Seven Steps in Accident Response

Take charge of the situation
Approach the patient safely
Perform emergency rescue and urgent first aid
Protect the patient
Check for other injuries
Make a plan
Carry out the plan

Step 1: Take Charge of the Situation

Establish leadership roles
Survey the accident scene
Triage

Step 2: Approach the Patient Safely

Do not endanger uninjured party members
Designate a lookout
**Step 3: Perform Emergency Rescue and Urgent First Aid**

The first-aid leader should move a patient *only* if one of two conditions exist:
- the rescuer is in imminent danger
- the patient is in danger of further harm

Absent one of these two conditions, *do not move the patient*

Note patient's body position
- neck injury
- back injury

Check level of consciousness

Check **ABCD** indicators
- Airway
- Breathing
- Circulation
- Deadly bleeding

**Step 4: Protect the Patient**

Counter the environment (heat, cold, rain, etc.)
Maintain adequate breathing and circulation
Limit shock
Provide psychological support

Symptoms of Shock
- nausea
- thirst
- weakness
- fear/restlessness
- sweating
- shortness of breath

Signs of Shock
- pulse rapid but weak
- breathing rapid and shallow
- skin cool and clammy
- lips and nail beds blue
- restlessness
- face pale
- eyes dull
- pupils dilated
- unresponsiveness (a late sign)

**Step 5: Check for Other Injuries**

Deformity compared with another body part
Discoloration or bruising
Bleeding or loss of other fluids
Swelling
Pain or tenderness
Limited range of motion
Guarding of a particular body part
Step 6: Make a Plan

The first-aid leader makes a plan for further first aid for the patient
The trek leader makes a plan for the evacuation of the patient
The trek leader makes a plan for the rest of the party

Step 7: Carry Out the Plan

Bivouac the party
First aid to the patient
Two of the party's strongest and most competent go for help

Mountain Maladies

High altitude conditions
Cold-related conditions
Heat-related conditions
UV radiation related conditions
Lightning-caused injuries
Backcountry wounds
Gastrointestinal disorders
Blisters
Injuries (head, neck, back, extremities)

Adaptation to Altitude: Early Changes

Increased respiratory rate
Increased heart rate
Fluid shifts

Adaptation to Altitude: Delayed Changes

Increased red blood cell production
Increased 2,3-diphosphoglycerate production
Increased number of capillaries

Altitude Illness: Definition of Terms

“AMS” -- Acute Mountain Sickness
“HAPE” -- High-altitude Pulmonary Edema
“HACE” -- High-altitude Cerebral Edema

Five Factors that Affect the Incidence and Severity of Altitude Illness

Rate of ascent - the faster you climb, the greater your risk.
Altitude attained (especially sleeping altitude) - the higher you sleep, the greater the risk.
Level of exertion - hard exertion, without rest or hydration, increases the risk.
Hydration and diet - high fat, high protein diets and dehydration increase the risk.
Inherent physiological susceptibility - some people are more likely to become ill and we don’t know why.
**Signs and Symptoms**

Headache
Malaise
Loss of appetite
Nausea and vomiting
Peripheral edema
Disturbed sleep
Cyanosis
Ataxia

**Treatment**

Hydrate
Rest (light exercise okay)
Use pain medication for headache
Avoid sedatives
Descend if symptoms worsen or signs of HAPE or HACE develop

**High Altitude Pulmonary Edema – Signs and Symptoms**

Hydrate
Rest (light exercise okay)
Use pain medication for headache
Avoid sedatives
Descend if symptoms worsen or signs of HAPE or HACE develop

**Treatment**

Descend at least 2,000-3,000 feet until symptoms abate

**High Altitude Cerebral Edema – Signs and Symptoms**

Signs of acute mountain sickness
Changes in level of consciousness
Ataxia
Severe lassitude
Headache
Nausea and vomiting
Vision disturbances
Paralysis
Seizures
Hallucinations
Cyanosis

**Treatment**

DESCEND, DESCEND, DESCEND!!!!
**Acclimatization**

Ascend slowly  
Climb high, sleep low  
High-carbohydrate diet  
Hydrate

**Mechanisms of Heat Generation**

Resting Metabolism  
Exercise  
Shivering

**Mechanisms of Heat Loss**

Conduction  
Convection  
Radiation  
Evaporation

**Signs and Symptoms of Hypothermia**

Mental deterioration in decision-making ability  
Slow and improper response to cold  
Apathy, lethargy  
Increased complaints, decreased group cooperation  
Slurred speech, disorientation progressing to incoherence and irrationality and possible unconsciousness  
Shivering  
Loss of fine motor ability progressing to stumbling, clumsiness, and falling  
Muscle stiffness and inability to move (in severe cases)

**Assessment of Hypothermia**

Conscious  
Shivering  
Able to walk  
Alert (altered mental status possible)  
Altered mental status  
No shivering  
Unable to walk

**Backcountry Warming Techniques**

Remove the patient from the cold environment  
Dry the patient and dress him or her in dry clothing  
Insulate the head and neck  
Feed and hydrate the patient  
Place patient in sleeping bag  
Place insulated hot water bottles on the torso, hands, and feet  
Use fires as heat sources  
Feed, hydrate, and rotate the warmers  
Be persistent; warming takes time
Treatment of Hypothermia – Mild to Moderate Above 90°F (32°C)

Prevent further heat loss
Remove from cold
Dry
Insulate
Actively warm
Sleeping bag
Heat sources
Hydrate, hot drinks
Food for fuel; feed the shivering

Treatment of Hypothermia – Severe Below 90°F (32°C)

Evacuate to hospital for warming
Dry, insulate
Prevent further heat loss (apply heat)
ABC’s
Handle gently

Frostbite – First Degree or Superficial

AKA “frostnip”
Initially, skin turns red
Over several days, the dead skin peels
Injury is similar to that of sunburn

Frostbite – Second Degree or Partial-Thickness

Externally, appears as a white, mottled or gray area
Feels hard on the surface, soft and resilient below
Blisters appear within 24 hours after warming

Frostbite – Third Degree or Deep

Full thickness involving underlying soft tissues and muscle
Entire frozen area feels hard
External appearance similar to partial thickness frostbite
Blood-filled blisters or no blisters at all

Causes of Frostbite

Low temperatures
Wind chill
Moisture
Poor insulation
Contact with supercooled metal or gasoline
Interference with circulation of blood
Cramped position
Tight clothing (gaiters, wristwatches, etc.)
Local pressure
Tight fitting or laced boots
Dehydration
**Treatment of Frostbite**

Delay warming until it can be done once and done well
Rapidly warm in warm water
Water should be between 100° and 108°F (38° and 42°C)
Completely immerse the frozen tissue
Use a large basin
Thaw completely
Ibuprofen is helpful for pain

**Treatment of Frostbite – Post Thaw**

Protect the thawed tissue from trauma
Elevate to reduce swelling
Place pads between toes and fingers
Avoid constricting the extremity
Prevent a second freezing

**Immersion Foot – Signs and Symptoms**

Cold, mottled extremity
Foot feels wooden, numb; pins and needles
When warmed, foot becomes red, dry, and painful with bounding pulses

**Immersion Foot – Prevention**

Rotate socks as needed to keep feet dry
Check feet daily
Sleep with feet warm and dry

**Immersion Foot – Treatment**

Remove feet from the cold, wet environment
Air dry
Avoid constricting the extremity
Protect feet from trauma
Elevate feet to reduce the swelling

**Heat Related Conditions – Dehydration**

Water loss occurs through sweating, respiration, urination and defecation
Variables are body conditioning and the environment
Drink 1 to 1½ cups of fluids q 20-30 minutes while underway

**Heat Related Conditions – Heat Cramps**

Avoid dehydration and electrolyte imbalance
Rest
Massage and slow-stretch the affected muscles
Heat Related Conditions – Heat Exhaustion (the milder one)

- Faintness
- Cool and clammy skin
- Weakness
- Nausea
- Rapid pulse
- Treatment as per shock

Heat Related Conditions – Heat Exhaustion (the milder one)

- Core temperature 105°F or higher
- Altered mental state
- Rapid, full pulse
- Headache
- Weakness
- Flushed, hot and dry skin

Heat Stroke – Treatment

- Rapid cooling of head and body. . . shade, splash water, pack in snow
- Stop rapid cooling at 102°F
- Treat for shock

Sunburn

- Proper clothing
- Hat
- Sunglasses
- Sunscreen . . . appropriate SPF rating

Snowblindness

“Sunburn of the cornea”
- Signs and symptoms set in 6 to 12 hours following radiation exposure
- Caused by radiation reflected off snow or Sierra granite

Snowblindness – Signs and Symptoms

- Dry, sandy-feeling eyes
- Foreign body sensation
- Light-sensitivity
- Red, teary and painful eyes later

Snowblindness -- Treatment

- Remove contact lenses
- Cover eyes with sterile dressings and padding. . .eye shield
- Spontaneous recovery in 1 to 2 days
Snowblindness -- Prevention
Sunglasses with proper lenses
Side shields
Emergency goggles can be fashioned out of duct tape by cutting narrow, horizontal slits for each eye

Lightning-Caused Injuries – Lightning Strikes
Direct strike
Splash strike
Contact injury
Step voltage
Blunt trauma
St. Elmo’s Fire

Lightning-Caused Injuries – Spectrum
Cardiac arrest
Burns
  • superficial
  • internal
Internal injuries

Lightning-Caused Injuries – Treatment
Access ABC
Treat for shock
Transport to hospital ASAP

Backcountry Wound Care -- Abrasions
Syringe irrigation with diluted Povidone-Iodine
Dry surrounding skin with gauge
Antibiotic ointment
Gauze/Tegaderm dressing. . .use Benzoin

Backcountry Wound Care – Non-Gusher Lacerations
Syringe irrigation with diluted Povidone-Iodine
Dry with gauze
Steri-Strip. . .use Benzoin
Gauze/Tegaderm dressing. . .use Benzoin

Backcountry Wound Care -- Gusher Lacerations
Hold absorbent gauze over the cut and elevate above the heart. . .20 minutes
Wrap with elastic bandage. . .a few hours
Remove dressing and clean surrounding skin with Povidone-Iodine
Dry with gauze
Steri-Strip. . .use Benzoin
Gauze/Tegaderm dressing. . .use Benzoin
Gastrointestinal Disorders – Nausea and Vomiting Etiology

Acute Mountain Sickness
High Altitude Cerebral Edema
Head injury
Metabolic disorders (Diabetes)
Infection
Ulcers/appendicitis

Gastrointestinal Disorders -- Nausea and Vomiting Treatment

Usually self-limited in minor disorders
Treat the suspected underlying cause
Airway protection for suspected brain injury

Gastrointestinal Disorders – Non-Invasive - AKA

- “traveler’s diarrhea”
- “turista”
- “Montezuma’s revenge”
- “Aztec two step”
- “Delhi belly”
- “green apple quick step”

Gastrointestinal Disorders -- Non-Invasive Diarrhea Etiology

Change in food, water or surroundings
Fecal-oral contamination
Animal waste

Gastrointestinal Disorders -- Non-Invasive Diarrhea Treatment

Usually self-limited
Fluid and electrolyte replacement
Bismuth subsalicylate (Pepto-Bismol®)
Loperamide (Immodium®)

Gastrointestinal Disorders – Giardiasis – Giardia lamblia

Etiology…fecal contamination of water
Symptoms…abdominal distention/diarrhea
Prevention…water purification
Treatment…metronidazole (Flagyl®)

Blisters – Skin Structure

Epidermis
Basement Membrane Zone (BMZ)
Dermis
**Blisters – Etiology**

Heat  
Cold  
Moisture  
Friction  
Infection

**Blisters – Prevention**

Toughen up the skin  
Smooth areas of roughened skin  
Apply tape, Moleskin, Molefoam, etc. to problem areas  
Pick socks that fit  
Buy the right footwear  
Break in your footwear  
Keep your feet dry  
Wear Teva’s in camp

**Blisters – with Moleskin, Molefoam and Tape**

Start with clean skin  
Apply Tincture of Benzoin  
Apply Moleskin or Molefoam  
Cover with hospital-grade or duct tape

**Blisters – Treatment**

Leave the blister closed if:  
- 0.5 cm or less diameter  
- in a warm, moist area (between the toes)  
- it is blood-filled  
Open the blister if:  
- over 0.5 cm in diameter  
- in an area likely to increase in size (ball of foot or heel)  
- infected

**Blisters – Treatment for Closed Blister**

Clean and dry blister  
Cut Moleskin or Second Skin donut  
Position donut around blister  
Cover with tape

**Blisters – Treatment for Blisters to be Drained**

Puncture blister  
Remove the fluid  
Apply Tincture of Benzoin to edges  
Apply bandage
Head, Neck, Back and Extremity Injuries – Head Injury Indicators

For all head injuries, you must assume that there is a cervical spine injury until proven otherwise, and vice versa.
- Disorientation, confusion or unconsciousness
- Blood or clear fluid drainage from nose or ear
- Unequal pupil size
- Slow or fluctuating pulse
- Fluctuations in respiratory rate

Mountaineering First Aid Kit – General Considerations

- Group size
- Trek duration
- Potential hazards of the route
- Distance/time to professional medical assistance

Mountaineering First Aid Kit – Basics

- Manual
- Basic bandages/tape
- Basic blister materials
- Basic drugs/lotions/topical antimicrobials
- Basic tools
- Miscellaneous items

Mountaineering First Aid Kit – Extras

- Bulky bandages/gauze/Ace® bandage
- Sam splint
- Wound irrigation system
- Dental kit
- Additional drugs/lotions/topical antimicrobials

Mountaineering First Aid Kit – Dr. Crockett

DR. CROCKETT’S EXPEDITION FIRST AID KIT FOR LONG-TERM BOY SCOUT SIERRA TREKS
DR. CROCKETT’S BLISTER KIT
WWW.CHINOOKMED.COM
DR. CROCKETT’S EXPEDITION FIRST AID KIT
FOR LONG-TERM BOY SCOUT SIERRA TREKS *

INFORMATION

- Backcountry First Aid and Extended Care, Third Edition, Buck Tilton, M.D. (1)
- Accident Report Form (2)
- Pencil (1)
- Labels (10)

INSTRUMENTS AND HARDWARE

- Nitrile Examination Gloves (6)
- Bandage Scissors (1)
- Uncle Bill’s Tweezers® (1)
- Forceps, Stainless Steel (1)
- Hemostat, Stainless Steel (1)
- Pro Tick Remedy® Tick Lifter, (1)
- Needle (2)
- Razor Blade (2)
- Wound Irrigation Syringe (1)
- Oral Thermometer (1)
- Hypothermia Thermometer (1)
- Safety Pin (8)
- Cotton Swab (12)
- Zip-Top Plastic Bag (4)
- Kwik-Kold™ Instant Ice-Pack Kit-Size (1)
- CPR Microshield (1)
- Magnifying Loupe (1)

BANDAGING

- Gauze Pad, 4x4 in. (12)
- Gauze Pad, 2x2 in. (12)
- Sterile Kling™ Fluff Sponges (4)
- Kling™ Conforming Bandage, 4 in. (4)
- Kling™ Conforming Bandage, 2 in. (4)
- ACET™ Elastic Bandage, 4 in. (1)
- Tegaderm™ 10x12 cm (4) †
- Tegaderm™ 6x7 cm (12) †
- Coverlet™ Adhesive Bandage, 2x4 ½ in. (4) †
- Coverlet™ Adhesive Bandage, 1x3 in. (12) †
- Band-Aid (20)
- Butterfly Bandage (4)
- Fingertip Bandage (4)
- Knuckle Bandage (4)
- Sterile Telfa™ Pad (6)
- Hospital Grade Adhesive Tape, 2 in. (1)
- Hospital Grade Adhesive Tape, 1 in. (1)
- Duct Tape Roll, Kit-Size (1)
- Steri-Strips, ½ in. (4)
- Eye Pad (2)

SPLINTING

- SAM Splint (1)
- SAM Finger Splint (2)
- Triangular Bandage, 40 in. (1)

WOUND CARE, CLEANSERS AND TOPICAL ANTIBACTERIAL MEDICATIONS

- Alcohol Prep Pad (10)
- Povidone-Iodine U.S.P. Prep Pad (10)
- Povidone-Iodine Solution U.S.P., 1 oz. Plastic Bottle (1)
- Triple Antibiotic Ointment, 1 oz. Tube (1)
- Tincture of Benzoin, 1 oz. Plastic Bottle (1)
- Waterjel® Burn Jel Packet, ½ oz. (2)
- Cortaid® Hydrocortisone Cream, 1%, 2 oz. Tube (1)

MEDICATIONS

- Aspirin
- Acetaminophen (Tylenol®)
- Ibuprofen (Motrin®)
- Diphenhydramine (Benedryl®)
- Vicks DayQuil® Liqui Caps
- Vicks NyQuil® Liqui Caps
- Sucrèts® Throat Lozenges
- Loperamide (Imodium®)
- Pepto-Bismol®
- Alka-Seltzer®
- Electrolyte Replacement Packet (2)
DR. CROCKETT’S BLISTER KIT
FOR LONG-TERM BOY SCOUT
SIERRA TREKS *

☐ MOLESKIN™ 3X4 IN. (3)
☐ MOLEFOAM™ 3X4 IN. (2)
☐ SPENCO® 2ND SKIN DRESSING Kit (1)
☐ HOSPITAL GRADE Cloth Tape, 2 in. (1)
☐ TINCTURE OF BENZOIN 1 oz. Tube (1)
☐ ALCOHOL Prep Pad (10)
☐ POVIDONE-IODINE U.S.P. Prep Pad (10)
☐ TRIPLE ANTIBIOTIC Ointment, 1 oz. (10)
☐ COTTON Swab (10)
☐ NEEDLE (2)
☐ PORON DONUTS (4)

* THESE KITS ARE DESIGNED FOR A GROUP OF
15 SCOUTS AND LEADERS, AND ARE
INTENDED AS A SUPPLEMENT TO THE
SMALLER FIRST-AID KITS CARRIED BY
INDIVIDUALS.

† TEGERDM™ AND COVERLET™ ARE
INTERCHANGEABLE, USE ONE OR THE OTHER