

Pearls in Wilderness Medicine

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Introduction

- General discussion of wilderness medicine as a medical subspecialty (13 slides)
- 14 wilderness medicine pearls you probably won't learn in an EM residency (46 slides)
- And, in case you get bored, 57 pictures

What is Wilderness Medicine?

- Wilderness-An unsettled, uncultivated region left in its natural condition
- Medicine- the science of preventing, diagnosing, or curing disease
- Wilderness Medicine- the practice of medicine where definitive care is more than one hour away, and often days to weeks away. The practice of wilderness medicine is defined by difficult patient access, limited equipment, and environmental extremes.

Wilderness



Not Wilderness



Semi-wilderness



Why Wilderness Medicine?

- Intentional
- Recreation, Adventure, Beauty, Ruggedness
 - Most distant from medical care
 - Increases chance of adverse outcome
- Outdoor activities increasing in popularity
 - Hike, ski, run rivers, scuba dive, climb, bike
 - Injuries and illnesses are common
 - Some pathology unique to outdoors

Why Wilderness

Medicine?

- Large numbers of participants, with decreasing wilderness experience
- Pre-existing medical conditions
- More zeal than preparation and fitness
- Responsibility for medical care lies with participants
- Healthcare professional (especially an emergency doc) who frequents the backcountry WILL encounter medical problems and WILL be depended upon as an authority

Why Wilderness

Medicine?

- Traditional medical training useful (especially EM) but knowledge of unique wilderness maladies are generally outside the scope of daily clinical practice (high altitude, frostbite, snake bite, lightning strikes etc.)
- WM skills also useful in disasters
- Incorporates search and rescue, EMS, psychology and group dynamics, EM, preventative med, and especially improvisation
- Generally requires providers to divert attention away from medical care

Why Wilderness Medicine?

- Lack of typical medical equipment (stethoscope, monitor, blood pressure cuff, sterile supplies, gurneys, backboards etc.)
- Limited space and weight for supplies
- Must apply medical judgment to unique situations
 - Sprained ankle example

Wilderness Medicine Organizations

- Wilderness Medical Society
 - Founded 1983 by 3 docs in CA, now in SLC
 - Wilderness Medicine Magazine (layperson)
 - Wilderness and Environment Magazine (PR)
 - Annual Conference
 - Quadrennial World Congress
 - F.A.W.M. requires 70 hour course, 30 hours exper.
- ACEP-Wilderness Medicine Section
- EM Fellowships-Stanford, Utah, Harvard, Fresno

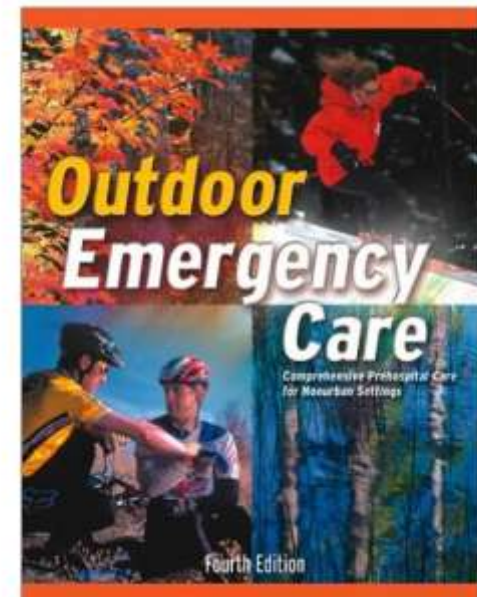
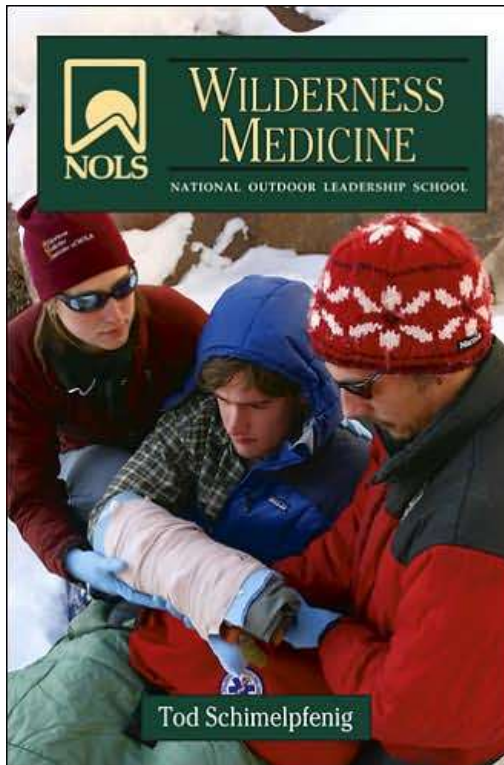
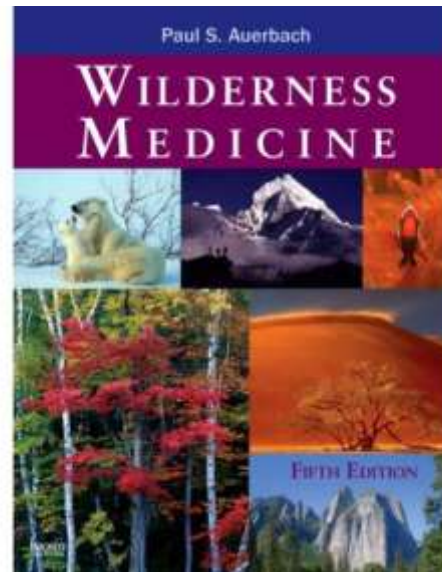
Wilderness Medicine

Organizations

- National Ski Patrol-Outdoor Emergency Care
 - 80 hour course, developed in the late 80s
- National Outdoor Leadership School
 - Wilderness First Responder (80 hours, or 5 day upgrade for medical personnel)
 - Wilderness EMT (month long)
- Wilderness Medical Associates
 - Commercial, designed for wilderness professionals, Outward Bound in 1978
 - Wilderness Advanced Life Support (39 hrs, \$975), EMT-I through MD
- Wilderness Life Support Institute
 - Academic, Found in 1997 at U of Utah by Auerbach/Ingebretson
 - Advanced Wilderness Life Support (25 hrs, \$575), Paramedic through MD and students
- Others-SOLO, Aerie Backcountry Medicine, Remote Medical International

Wilderness Medicine Organizations

Textbooks



#1- Avalanche

Survival

- What kills the victims?
 - University Hospital of Innsbruck
 - 96-05, 105 victims with 49 injuries, 36 deaths
 - 2 deaths due to cervical spine injury
 - 34 deaths due to asphyxiation
 - 0 due to hypothermia
- 100-150 deaths per year in N.A. and Europe, and increasing



#1- Avalanche

Survival

- Can reach 100 mph in ~ 10 seconds
- Usually triggered by victim or someone in his party
- 30-45 degree, treeless slopes, recent melting, recent snowfall, and high winds (leeward side)
- Factors in survival
 - 1) Time buried in snow
 - (90% if <15 minutes)
 - 2) Depth of burial



#1- Avalanche Survival

- Safety

- Call the hotline
- Never travel above another party member
- Avoid terrain traps
- One person at a time
- Red flags
 - Cracking, sinking
- Releasable bindings
- Personal protective equipment
 - Helmet, Beacon, Avalung



#1- Avalanche Survival

- Survival
 - Head for the side
 - Get the skis and poles off
 - Pack may protect spine
 - Swim to the surface as it moves
 - Stay upright
 - As snow slows, clear air pocket
 - Insert avalung mouthpiece



#1- Avalanche Survival

- Rescue

- Watch CAREFULLY until slide stops
 - Mentally note last location with FIXED landmarks
- Extreme caution
- Turn transceivers to receive
- Start at point of last sighting
- Work downhill/switchbacks
- Leave surface clues
- Max signal at low sensitivity
- Probe and dig (fast!), CPR prn
- If multiple victims, switch off



N.Y. man survives Utah avalanche

By [Laura Hancock](#)

Deseret News staff writer

Published: Tuesday, Jan. 7, 2003 12:50 p.m. MST

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Paul Hansen, buried 5 feet under snow that was as hard and solid as concrete, was gasping for air.

He couldn't move his arms to dig his way out or create a larger air pocket to continue breathing. Seconds before he passed out he remembered his life insurance policy would take care of his wife of 35 years.

"I was prepared to die in that avalanche, really," said Hansen, 58, a financial consultant in Saratoga Springs, N.Y.

About 10 minutes later Hansen was rescued. He's grateful to four other backcountry skiers who saw him swallowed by the massive slide, located him with avalanche beacons and dug him out. In a bed at LDS Hospital Monday evening, Hansen said he saw the avalanche coming. Earlier that day he was skiing in Big Cottonwood Canyon's Cardiff Fork, about 10,000 feet in elevation. He finished an 11,000 feet vertical run. "I could start to see it go," he said.

Hansen tried to turn off the slope but was unable. He then tried to stay on top of the avalanche, but when he flew off a small hill, he felt the snow topple him.

Other backcountry skiers saw him disappear. They pinpointed his avalanche beacon with their own beacons within about five minutes and had uncovered his face within another five minutes, said David Hughes, a former Salt Lake resident who is now a Grand Rapids, Mich., emergency room doctor.

#2-Approach taught in WM Courses

- 1) Scene safety
 - Bystanders
 - Physical safety
 - (fire, avalanche, rockfall, high angle, moving water etc)
 - Environment (Cold weather, hot weather, precipitation, harsh weather, surface)
 - Disease transmission
 - Scenes change
- 2) Approach from the side, in line with patient, keep patient in view
- 3) Stabilize C-spine, identify self, ask for permission to treat, identify patient
- 4) Primary and Secondary survey



#3-Diamox for Prevention of AMS

- Does it work?
 - High Alt Med Biol. 2003 Spring;4(1):45-52.
 - 197 Everest Trekkers, survey + pulse ox
 - 125 BID, 79% survey response rate
 - 25% of placebo got AMS, 12% of Diamox
 - NNT 8
 - 10% of placebo got more severe mountain sickness (“Lake Louise 5”) vs 0% of Diamox
 - Also statistically significant decrease in headaches and increase in pulse ox

#3-Diamox for Prevention of AMS

- What dose?
 - PACE Trial (Prophylactic Acetazolamide dosage Comparison for Efficacy)
 - High Alt Med Biol. 2006 Spring;7(1):17-27.
 - 222 non-native Nepal Trekkers, 3440 M to 4928 M
 - 375 BID vs 125 BID vs Placebo
 - Pulse ox: 82.8, 82.9, 80.7
 - Incidence of AMS: 24%, 21%, 51%
 - Also, more paresthesias in 375 group ($p < 0.02$)

#4-The “Tight fit” Hypothesis

- Who gets cerebral edema?
 - Neurosurgery. 2008 Nov;63(5):970-4; discussion 974-5
 - Data collected in 1985 and recently found
 - Part 1- IRB Nightmare
 - 3 Subjects with direct ICP measurement at altitude
 - All had normal ICP at rest. The one with AMS had dramatic increase even with minimal exertion
 - Unlikely to ever be repeated
 - Part 2- Ventricle size inversely correlated with AMS
 - 10 subjects, all had CT, then went to altitude and recorded headache score



#6-Wilderness Med and the Law

- Affirmative Obligation to Help
 - Europe, Quebec, Minnesota, Rhode Island, Vermont
 - A person at...an emergency who knows that another person is exposed to or has suffered grave physical harm shall, to the extent that the person can do so without danger...to self or others, give reasonable assistance to the exposed person...

#6-Wilderness Med and the Law

- Limitation of Liability
 - Good Samaritan Laws-All 50 states most of Canada
 - A person who renders emergency care...is not liable for any civil damages as a result of any act or omission...
 - 5 Principles
 - 1) Person rendering care must not have caused injury
 - 2) Must act “in good faith”
 - 3) Must be provided gratuitously
 - 4) Must not commit gross negligence (careful with abandonment)
 - 5) Must not have preexisting duty to care for patient

#6-Wilderness Med and the Law

- Tort Law
 - Duty to Provide Care at the Standard of Care
 - Failure to Perform the duty
 - Loss or injury
 - Causation



#7-Stingray Envenomation

- Protein Venom
 - Causes necrosis
- Heat-soak vs heat packs
 - 30-90 minutes
- Anesthetic vs analgesics
- Careful removal
- Abx-Quinolones, Doxy,
Bactrim



#7-Stingray Envenomation



- Most injuries to limbs
- Columbia sees ~2000 injuries/year
 - Over 5 year period, had 8 deaths and 23 amputations
- Observe wound injuries for necrosis
- Trunk injuries need to be evacuated and worked up!
- 12 year old boy struck in chest, initially asymptomatic until necrosis caused ventricular rupture

#8 “Is there a physician on board?”

- What’s in an airline medical kit?
 - AED
 - BP cuff and stethoscope
 - Three sizes of oral airways, ambu bag
 - Latex gloves, CPR masks
 - Syringes, needles, IV administration kit with connectors
 - Dextrose, Epi, diphenhydramine, nitroglycerin, ASA, atropine, inhaled bronchodilator, lidocaine, Non-narcotic analgesics
 - May also find laryngoscope, ET tubes, glucometer/strips



#9 Bears



- **Anchorage girl recovering from bear mauling**
- Dan Joling/The Associated Press
- Published Monday, June 30, 2008

- ANCHORAGE -- A 14-year-old girl mauled by a bear as she rode in a 24-hour mountain bike race was on a city trail known to be regularly patrolled by grizzlies.
- Strong winds that made it hard to hear, the early hour and salmon in a nearby stream made the location even more dangerous.
- "Even black bears have better sense than to walk that trail," said biologist Rick Sinnott of the Alaska Department of Fish and Game. "They're as afraid of brown bears as we are."
- City officials on Monday asked residents not to use the trail but said it would be impossible to enforce a closure because of its remote location.
- Warning signs were posted at 20 trailheads that lead to the attack location. The signs urge people to find alternate routes, said Jeff Dillon, Anchorage's parks director.
- The injured girl, whose name has not been released, suffered head, neck, leg and torso wounds, including damage to a lung, early Sunday morning. She underwent emergency surgery and was scheduled for more Monday, said Anchorage Fire Department spokeswoman Cleo Hill. Her parents have asked that no further information, including her name, be released.
- The race was in Far North Bicentennial Park, which borders on the 773-square mile Chugach State Park. The race was moved from the city's west side because of construction. About 60 riders were entered, making circles on an 8.6-mile loop of trails.
- The bear attacked the teenager in the 13th hour of the 24-hour mountain bike race. She was able to retrieve her cell phone from her pocket and call 911 at 1:40 a.m. Dispatchers heard someone with extreme difficulty breathing. The girl mumbled "bear" and the line went dead, Hill said.
- Dispatchers called the number back. Another rider heard the phone ringing, stopped to investigate and spotted the teen off the trail.

#9 Bears



• **Bear mauling survivor recalls attack in Gates of the Arctic park**

By [Tim Mowry](#)

Published Saturday, August 30, 2008

FAIRBANKS — The grizzly bear that attacked Jo Ann Staples inside her tent at a remote camping spot in the Brooks Range on Thursday morning hit her “like a ton of bricks,” the 61-year-old Kentucky woman said.

“I was just sitting in my tent on the sleeping bag and packing my pack,” Staples said from her hospital bed at Fairbanks Memorial Hospital on Friday, a day after the violent attack that left her with what she described as a “mangled” right arm and an ear that doctors “put back together.”

“I didn’t hear anything,” she said. “It was like a ton of bricks coming in on me.”

Staples was with six other women at the end of a week-long camping/hiking trip on the Okokmilaga River in Gates of the Arctic National Park and Preserve, about 250 miles north of Fairbanks. She was packing up to leave for a flight out when the bear attacked about 6:30 a.m.

“It tried to drag me out of the tent,” Staples said. “When (the bear) started dragging me, I started screaming for Anne and the other ladies.”

Guide Anne Dellenbaugh and an assistant guide awoke to Staples’ screams, said Gates of the Arctic superintendent Greg Dudgeon, who spoke with Staples and Dellenbaugh at the hospital on Friday. At first, Dellenbaugh, who could not be reached for comment, thought one of the other ladies may have been having a nightmare, but she quickly realized it was a bear attack, Dudgeon said. Dellenbaugh and the other woman, whose name was not known, ran at the bear yelling.

“They came running at the tent, and the bear had its head in the tent,” Dudgeon said. “That got it’s attention, and it left (Staples) alone and came toward the other two women.”

The women had pepper spray, but they shot it into the ground, not at the bear, Dudgeon said.

“The sound of the aerosol spray and the odor was enough for the bear to turn and amble slowly away.”

The women continued to bang on pots and yell at the bear until it retreated, Dudgeon said.... There were two nurses in the group who administered first aid following the attack, and the women used a satellite phone to call Coyote Air in Coldfoot, the air taxi that had flown them into the area.

Staples was “pretty well bandaged up” by the time pilot Dirk Nickisch arrived to pick her up about 9 a.m., about two hours after the attack.....

The women had a shotgun with them but there was no time to find or use it, the pilot said.

#8 Bears



- **Mauling victim kept garbage on porch**
- Daily News wire and staff
- Published: April 23rd, 2008 11:53 AM
- KENAI -- A jogger was mauled by a brown bear on the Kenai Peninsula in what state officials are calling the first mauling of 2008.
- The mauling is being blamed on improperly stored garbage.
- Larry Lewis, a wildlife technician who investigated the mauling for the Division of Wildlife Conservation, said he found several large buckets of garbage on the victim's porch, about 150 yards from where the mauling occurred.
- The 43-year-old victim, who has not been identified, was charged by a sow with two cubs when he left his home early Tuesday. The man ran but the bear quickly caught him, biting his buttocks, the back of his head and his chest. The victim was able get home under his own power.
- He underwent surgery at a local hospital.
- In addition to the garbage and presence of cubs, Lewis said, the victim's rapid movement likely triggered the bear's chase instinct. Experts suggest people in such situations play dead once a bear makes contact.
- Lewis said the man also had an old chicken coop in his yard and a rabbit hutch. Penned livestock also attract bears

#8 Bears

- **When Bears Attack: What to do if you meet bear in the wild**

- ABC4.com

Last Update: 7/06/2007 11:30 am

- Michael Dunn of Utah's Olympus Cove also knows about terrible chains of events unleashed by entering bear country unprepared. A morning jog in the Grand Tetons changed his life forever.

Dunn remembers, "This was a beautiful summer morning in 1994. I was not making noise, was not with any one else, was not doing the things you're supposed to when all of a sudden I hear what sounds like a big boulder breaking loose and crashing through the trees. When I heard that sound, I knew I was in immediate trouble. The hairs just stood up on the back of my neck and I knew even before seeing it, something was really, really wrong. You just can't believe it. You cannot believe there is a full grown bear that is charging you. I saw the bear at a distance of about forty yards. It was already at full speed. I had about two or three seconds to see this bear come straight at me and plow into me and just proceed to claw and bite and maul and do what bears do. I think maybe people understand bears are ferocious, but they're so agile. They're quick. I'm a pretty average adult male and this bear just did, whatever he wanted. I realized what I had to do was play dead. That's what I did and that's what ultimately saved my life."

#9 Bears



- Brown Bears (Grizzly, Coastal, Kodiak)
 - 220-1500 lbs, 6-9 ft tall, runs 40 mph
 - Russia, Alaska, Canada, Rockies
 - 50 Deaths from 1990-2003
 - Sudden unexpected close encounter
 - Prevent by making noise and avoiding berries, streams (especially loud), and carcasses
 - Stand ground, be submissive
 - Shotgun with slugs (only load lethal rounds)
 - Bear spray

#9 Bears



- Black Bears

- 250-600 lbs, 5-7 ft tall
- Runs 30 mph
- 41 of 50 states
- 52 Deaths from 1990-2003
- Generally only attacked if threatened, cornered, or wounded
- Yell, throw things, act aggressively
- Fetal position, Firearm, Bear Spray

#9 Bears



- Polar Bears

- 330-1500 lbs, 6-10 ft tall
- Swims 6 mph, carnivorous diet, hunts humans
- Arctic Ocean and surrounding seas
- 5 Deaths from 1990-2003
- Attacks almost always fatal
- Avoid garbage
- Defend yourself



#9 Bears

- 2003
- Northern Canada



#10 Ten Ways to Die in Australia



- 1) Chironex Fleckeri (Box Jellyfish)
 - Vinegar, CPR (arrest < 3 minutes),
 - Antivenom
- 2) Irukandji Jellyfish
 - 30 minutes until severe sx
 - Can cause arrest, poorly understood pathophys
 - Vinegar, Magnesium, Analgesics
- 3) Salt Water Crocodile
 - Up to 23 feet, 3000 lbs
 - 1-2 deaths/year, attacks usually fatal, ambush



#10 Ten Ways to Die in Australia

- 4) Blue-ringed Octopus
 - Size of golf ball
 - Neurotoxin, no antidote
 - Rescue Breathing
- 5) Flamboyant Cuttlefish
 - 6 cm long, similar neurotoxin
- 6) Barrier Reef Cone Shell
 - Fits in palm, similar neurotoxin



#9 Ten Ways to Die in Australia



- 7) Scorpion Fish

- Neurotoxin-paralyzes cardiac and skeletal muscle
- Very heat labile
- Usually not fatal



- 8) Sharks

- 15 species including Great White, Bull, and Tiger
- 60 deaths in last 50 years (1.2/year vs 1.8/year with hymenoptera)
- 15 attacks per year with 1 or 2 fatalities

#9 Ten Ways to Die in Australia

Australia Facing Shark 'Plague' After Three Attacks in Two Days

By Gemma Daley

Jan. 13 2008 (Bloomberg) -- Australia is in the middle of a shark "plague" and beachgoers have been told to swim in groups after three attacks in two days and increased sightings in aerial surveys. [Surfwatch](#) Australia, which conducts daily observation flights across beaches on the east coast, is seeing twice the number of hammerhead, bull and white pointer sharks than five years ago, managing director Michael Brown said.

An abundance of nutrient rich waters, following storms three years ago, has boosted the volume of bait fish near the coast, increasing the number of sharks in the midst of a "feeding frenzy," Brown said. A 25-year-old man was attacked yesterday while snorkeling about 100 kilometers (62 miles) south of Sydney. On Jan. 11, a 13-year-old girl was bitten by a 5-meter shark off the coast of Tasmania state and a 31-year-old male was assailed off the New South Wales north coast.

#10 Ten Ways to Die in Australia



• 9) Spiders

• Funnel Web

- Near Sydney, most bites non-lethal
- Antivenom available
- 10% experience a loss of consciousness
- Neurotoxin, pulmonary edema, rhabdo

• Red Back

- Very common in Australia, black-widow like
- No deaths since development of antivenom in 1956

• White Tail

- More rare
- Local ulceration



#10 Ten Ways to Die in Australia

- 10) Snakes
 - Most venomous snakes (lowest murine LD50 in mg/kg)
 - Inland Taipan (0.01)
 - Eastern Brown snake (0.041)
 - Coastal Taipan (0.064)
 - Mainland Tiger Snake (0.118)
 - Peninsula Tiger Snake (0.099)
 - Western Tiger Snake (0.124)
 - Beaked Sea Snake (0.173)
 - Chappell Island Tiger snake (0.271)
 - Common Death Adder (0.338)
 - Gwardar (0.338)
 - + 26 other venomous Australian snakes
 - All have an antivenin
 - 41 Deaths since 1980 in Australia



#11 Water Purification

- What do you need to avoid?
 - **Bacteria**-E. Coli, Shigella, Campylobacter, Salmonella, Yersinia, Aeromonas, Vibrio
 - **Viral**-Hep A, Hep E, Norwalk
 - **Protozoa**-Giardia, Entamoeba, Cryptosporidia, Cyclospora, Blastocystis, Acanthamoebae, Isospora, Naegleria
 - **Helminths**-Ascarias, Taenia, Trichuris, Strongyloides, Diphylobothrium

#11 Water Purification

- Methods

- Heat

- Pro-Kills everything
 - Cons-Time and energy intensive, warm

Pathogen	Time to Thermal Death
Giardia, Entamoeba	2-3 min at 60 C
Cryptosporidium	2 min at 65 C
Enteric viruses	Seconds at 80-100 C
Bacteria	Seconds at 100 C
Hepatitis A	1 min at 92 C

- Remember water boils at 90 C at 10,000 ft

#11 Water Purification



- Methods
 - Chemical
 - Pros-lightweight, little effort, cheap
 - Cons-Wait to drink, doesn't kill helminths, bad taste, cannot use iodine >1-2 months (thyroid issues)
 - Iodine tablets, 1-2 per Liter (more in cold, contaminated water)
 - Use ascorbic acid or powdered drink mix to improve taste
 - 5% bleach, 2 drops per liter

#11 Water Purification

- Methods
 - Filtration
 - Pros- Essentially unlimited amount, only human energy required, tastes good, don't have to wait for water to cool
 - Cons- Expensive, heavy, requires effort, can break/clog, doesn't kill viruses



#11 Water Purification

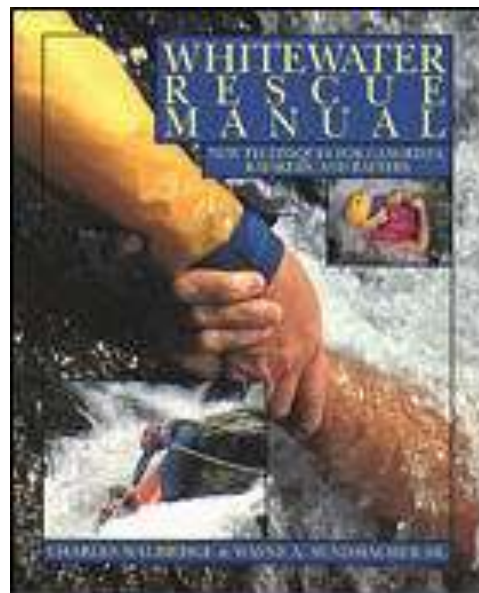
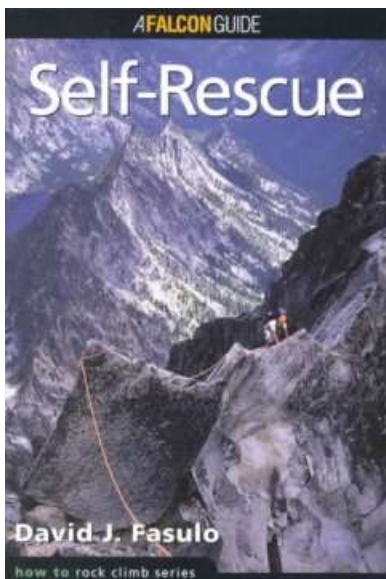
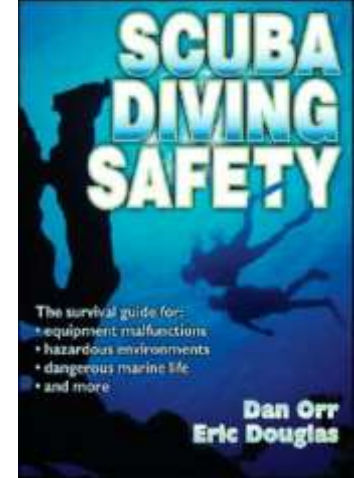
Pathogen	Heat	Filtration	Chemical
Bacteria	+	+	++
Viruses	+	-	+
Protozoa and cysts	++	++	+
Helminths and oocytes	++	++	-

- Other Methods
 - UV light -requires too much energy and weight
 - Chlorine dioxide (AquaMira)-still somewhat unproven, but promising. Better tasting, kills crypto



#12 Specialized Rescue Skills

- Scuba: PADI, Rescue Diver Course
- Climbing: Self-rescue courses
- River-running: Swiftwater rescue course
- Backcountry Skiing- Avalanche rescue course



#13 Assembling your medical kit

- Each trip requires a different kit
 - Adapt to weight and space limitations
 - Adapt to participants
 - Consider length of trip
 - Target likely pathology and environment
- Assemble it yourself
- Make a large “car kit” and assemble smaller kits from its contents
- Prescriptions can be written by your doctor, a colleague or “to the trip”
- Scheduled drugs
- Don’t forget to rotate drugs

#13 Assembling your medical kit

- Consider the following:
- SAM splints
- Lots of Tape
- Band-aids, Moleskin, and LOTS of bandaging material (common stuff is common)
- Suturing material (straight needle)/steri-strips/glue
- Scalpel (abscesses, subungual hematomas)
- Small knife (make bandages from clothing)
- Rescue plan (cell phone, radio, sat phone)
- Gloves

#13 Assembling your medical kit

- Tweezers
- Safety pins
- Syringes/Needles
- Iodine wipes
- Stapler
- Ace wrap
- Ambu bag/mask (especially whitewater trips)
- Survival blanket, saw, insect repellent, sunscreen

#13 Assembling your medical kit

- Medications
 - Epi-Pen
 - Benadryl
 - Antibiotics
 - Cipro
 - Flagyl
 - Augmentin
 - Anti-fungal cream
 - Antibiotic ointment
 - Antibiotic eyedrops
 - (doubles as otic)
 - Tylenol/motrin
 - Percocet
 - Meclizine
 - Zofran
 - Dental Wax
 - Marcaine
 - Imodium
 - Prednisone
 - Dulcolax

#14 Assembling a rope litter

- What do you need?
 - 60 feet of rope (easy if you're climbing, boating etc)
 - Tarp
 - Sleeping pad
 - Sleeping bag
 - SAM splint for C-collar prn
 - Something hard for backboard prn (oars ?)
 - 1-8 people to carry it

Questions?

