Avalanche

OHSU Wilderness Medicine CME conference
September 2020
Lindsey Fell
OHSU MS3 student
Agenda

• What is an Avalanche?
• Complications of burial
• Avalanche Prevention
• If caught in an avalanche
• Avalanche Rescue
• Avalanche Resuscitation
• Discussion
• Q&A
What is an avalanche?

“a large mass of snow, ice, earth, rock, or other material in swift motion down a mountainside.”
Anatomy of an Avalanche
Recipe for an Avalanche

Weather — Trigger — Terrain — Snowpack
Terrain

• “Steep enough to slide, flat enough to hold snow”
  • 35-45 degrees
• Additional considerations:
  • CONVEX shape
  • Underlying rock bands
  • Cornices
  • Terrain Traps
Snowpack

- Slab
- Weak Layer
- Bed Surface
Weather

Precipitation
- Type: Rain or snow?
- Rate: Heavy or light?
- Amount: 6 or more inches?

Wind
- Wind
- Speed: 10-50 mph
- Direction: leeward, windward
- How long?

Temperature
- Temperature
- Warming fast?
- Greater than 32 degrees?
- Is the sun out?
Avalanche Types

- Loose
- Dry Slab
- Wet Slab
Complications of Avalanche Burial

- Hypothermia
- Asphyxia
- Trauma
- Hypothermia
Asphyxia

Considerations:
- Air pocket
- Physical Blockage
- Ice Masks
- Oxygen deprivation
- Weight of snow on chest
Trauma

- ~ 25% in North America and Europe
- North American > Europe
- Head, c-spine, trunk, extremities
Hypothermia

- Less common
- Core temp best measurement
- Complications
  - Coagulopathies
  - Cardiac arrhythmias
- Afterdrop
Avalanche Prevention

- Education
  - Formal classes
  - Community events
  - Academic research
- Public Safety
  - Department of Transportation
  - Avalanche Information Centers
  - Ski area/resort avalanche departments
- Avoidance
  - Terrain, weather, snowpack trifecta
# North American Avalanche Danger Scale

<table>
<thead>
<tr>
<th>Danger Level</th>
<th>Travel Advice</th>
<th>Likelihood of Avalanches</th>
<th>Avalanche Size and Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5 Extreme</strong></td>
<td>Avoid all avalanche terrain.</td>
<td>Natural and human-triggered avalanches certain.</td>
<td>Large to very large avalanches in many areas.</td>
</tr>
<tr>
<td><strong>4 High</strong></td>
<td>Very dangerous avalanche conditions. Travel in avalanche terrain not recommended.</td>
<td>Natural avalanches likely; human-triggered avalanches very likely.</td>
<td>Large avalanches in many areas; or very large avalanches in specific areas.</td>
</tr>
<tr>
<td><strong>3 Considerable</strong></td>
<td>Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.</td>
<td>Natural avalanches possible; human-triggered avalanches likely.</td>
<td>Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.</td>
</tr>
<tr>
<td><strong>2 Moderate</strong></td>
<td>Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.</td>
<td>Natural avalanches unlikely; human-triggered avalanches possible.</td>
<td>Small avalanches in specific areas; or large avalanches in specific areas; or very large avalanches in isolated areas.</td>
</tr>
<tr>
<td><strong>1 Low</strong></td>
<td>Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.</td>
<td>Natural and human-triggered avalanches unlikely.</td>
<td>Small avalanches in isolated areas or extreme terrain.</td>
</tr>
</tbody>
</table>

Safe backcountry travel requires training and experience. You control your own risk by choosing where, when and how you travel.

### North American Public Avalanche Danger Scale

Avalanche danger is determined by the likelihood, size and distribution of avalanches.

- **5 Extreme**
- **4 High**
- **3 Considerable**
- **2 Moderate**
- **1 Low**
- No Rating

**Map:**
- Seattle
- Portland
- Spokane
- Vancouver
- Everett
- Olympia
- Yakima
- Portland
- Beverly
- Salem
- Oneonta
- Bellingham

Watch for signs of unstable snow such as recent avalanches, cracking in the snow, and audible collapsing. Avoid traveling on or under similar slopes.
If you trigger an avalanche...

• Attempt to get off the slab
• Avoid being buried
• Minimize trauma to self
• Avoid asphyxia
Goals of Avalanche Rescue

• locate/uncover victims
• provide medical treatment and evacuation
• provide support for prolonged operations
Avalanche Rescue

- Scene Safety
- Surface Search
- Transceiver Search
- Pinpoint/probe Search
- Strategic Shoveling
- Medical Care
- Evacuation
Partner Rescue Skills

**Beacon Searching 101**
There are three phases in a rescue beacon search: the signal phase, the coarse search and the fine search. It is important to practice these techniques to become effective in your team.

1. **Signal Search**
   - **Positional Search:** Signal beacon is placed in the center of a circle 3m in diameter, facing each other in a 90-degree angle.
   - **Oscillation:** Signal beacon is placed in the center of a circle 3m in diameter, facing each other in a 90-degree angle.

2. **Coarse Search**
   - **Parallax:** Signal beacon is placed in the center of a circle 3m in diameter, facing each other in a 90-degree angle.
   - **Distance:** Signal beacon is placed in the center of a circle 3m in diameter, facing each other in a 90-degree angle.

3. **Fine Search**
   - **Parallel:** Signal beacon is placed in the center of a circle 3m in diameter, facing each other in a 90-degree angle.
   - **Angle:** Signal beacon is placed in the center of a circle 3m in diameter, facing each other in a 90-degree angle.

**Probing 101**
Avalanche probes are essential in rescuing your team. A probe is always buried in the snowpack. A probe is best used in conjunction with an avalanche beacon.

- **Reconnaissance:** Probing should be done using a 1:10 scale model of the avalanche site. The probe should be inserted into the avalanche site and the probe should be inserted into the avalanche site. The probe should be inserted into the avalanche site and the probe should be inserted into the avalanche site.

- **Surface Probing:** Probing should be done using a 1:10 scale model of the avalanche site. The probe should be inserted into the avalanche site and the probe should be inserted into the avalanche site.

**Shoveling 101**
How to excavate an avalanche victim

1. **Single Rescuer**
   - **Shovel:** Shovel is used to excavate the avalanche victim. The shovel should be inserted into the avalanche site and the shovel should be inserted into the avalanche site.
   - **Avalanche Safety:** Shovel is used to excavate the avalanche victim. The shovel should be inserted into the avalanche site and the shovel should be inserted into the avalanche site.

2. **Multiple Rescuers**
   - **Shoveling:** Shoveling is used to excavate the avalanche victim. The shovel should be inserted into the avalanche site and the shovel should be inserted into the avalanche site.
   - **Safety:** Shoveling is used to excavate the avalanche victim. The shovel should be inserted into the avalanche site and the shovel should be inserted into the avalanche site.
Professional Rescue Organizations
Avalanche Resuscitation Considerations:

- Triage
- Data gathering
- Prognosis

**Time of avalanche:** ____% ____%

**Face exposure:** ____%

**Burial time:**
- ≤ 60 min (<30°C)
- >60 min (>30°C)

**Core temperature:**
- ≥ 30°C at extraction
- <30°C at extraction

**Follow standard ALS guidelines:**
- STOP$%
- or go to appropriate medical facility%

**ALS Provider:**
- Yes
- No

**Face exposure:**
- No
- Yes

**Core temperature:**
- ≥ 30°C
- <30°C

**Transport or multiple casualties:**
- Yes
- No

**ECLS FACILITY:**
- Yes
- No

**ALS Provider Name:**

Follow standard ALS guidelines$ STOP$%

or go to appropriate medical facility$%
Avalanche Resuscitation - Initial Considerations...

- Full burial, uninjured
  - Pulmonary edema
  - Hypothermia – long burial with patent airway
- Trauma
  - Exacerbated hypothermia
  - Treat head, spinal, long bone fractures according to accepted practice
  - Manage C-spine with validated guidelines
- What resources will you need?
Cardiac arrest

- Initiating
- Defibrillation
- ALS
- Mechanical chest compressions
- Delayed/Intermittent
- Withholding/terminating
Hypothermia

- Suspect moderate-severe in cold, unconscious patient
- Long burial with patent airway
- Rewarm with minimally-invasive methods if severe
- Transport to ECLS
- Afterdrop accelerated
Serum Potassium

• Rewarming eligibility
• Strong survival predictor
• Can override factors that would normally terminate resuscitation
• Cutoff values changing
• 2019: 7.0 mmol/L cutoff
Definitive Care

- Cardiac arrest with severe hypothermia → ECLS
- Trauma patients → trauma center
Concluding Remarks

- Good judgment
- Limited data
- Future research:
  - Helmets
  - Avalanche Airbags
  - Trauma prevention
  - Transceiver technology
  - Medical advances
References


Thanks!