multi-victime avalanche accidents

Human factors

a four years experience

G. Zen-Ruffinen - R. Richard – P. Fauchere
Air-Glaciers / Maison du Sauvetage
Sion
### Mass-casualty accidents in mountains

**ICAR medcom form 2015**

<table>
<thead>
<tr>
<th>type of accident</th>
<th>country CH</th>
<th>year</th>
<th>total N°casualities</th>
<th>dead</th>
<th>severely injured</th>
<th>injured</th>
<th>problems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>winter</strong></td>
<td>Valsorey</td>
<td>26.03.2011</td>
<td>11 caught 10 burried</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>residual danger</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>too many helicopters</td>
</tr>
<tr>
<td></td>
<td>Ayer Barneuza</td>
<td>01.04.2011</td>
<td>7 caught 4 burried</td>
<td>3</td>
<td>0</td>
<td>?</td>
<td>lack of medical material (AED)</td>
</tr>
<tr>
<td></td>
<td>Bec Etagnes</td>
<td>13.02.2013</td>
<td>6 caught</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>pediatric victims</td>
</tr>
<tr>
<td></td>
<td>Masserey</td>
<td>05.01.2014</td>
<td>6 caught 4 burried</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>psychological adversity medical material</td>
</tr>
<tr>
<td></td>
<td>Pte Ronde</td>
<td>09.01.2014</td>
<td>6 caught 1 burried</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>meteo-logistic no beacon=40 rescuers terrestrial</td>
</tr>
<tr>
<td>summer !!</td>
<td>Pte Mourti</td>
<td>19.07.2014</td>
<td>6 caught 3 burried</td>
<td>2</td>
<td>1</td>
<td></td>
<td>unexpected no beacon</td>
</tr>
<tr>
<td></td>
<td>Col des Mines</td>
<td>29.01.2015</td>
<td>5 caught 1 burried</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>meteo no beacon relational diff</td>
</tr>
<tr>
<td></td>
<td>Pigne d’Arolla</td>
<td>27.03.2015</td>
<td>6 caught 4 burried</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>meteo accu LUCAS</td>
</tr>
<tr>
<td></td>
<td>Pte Tsavolyre</td>
<td>12.04.2015</td>
<td>4 caught 3 burried</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gd St.Bernard</td>
<td>21.04.2015</td>
<td>6 caught 4 burried</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>meteo access</td>
</tr>
</tbody>
</table>
**Valsorey 26.03.2011**

### Repartition victimes

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Description</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>13h50</td>
<td>Sitting – stunned, Petzl evac.</td>
<td>GSC 15</td>
</tr>
<tr>
<td>2</td>
<td>13h58</td>
<td>Partial buried (head) Petzl evac.</td>
<td>GSC 15</td>
</tr>
<tr>
<td>3</td>
<td>14h01</td>
<td>Ensevel complet (pied visible) Petzl evac.</td>
<td>GSC 12</td>
</tr>
<tr>
<td>4</td>
<td>14h07</td>
<td>Ensevel complet, Combi-carrier evac.</td>
<td>GSC 12</td>
</tr>
<tr>
<td>5</td>
<td>14h10</td>
<td>Ensevel complet, Combi-carrier evac.</td>
<td>GSC 15</td>
</tr>
<tr>
<td>6</td>
<td>14h20</td>
<td>Ensevel complet, Combi-carrier evac.</td>
<td>GSC 15</td>
</tr>
<tr>
<td>7</td>
<td>14h30</td>
<td>Ensevel complet, Combi-carrier evac.</td>
<td>GSC 5</td>
</tr>
<tr>
<td>8</td>
<td>14h44</td>
<td>Ensevel complet, Naca 7</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>14h46</td>
<td>Ensevel complet, Naca 7</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>14h49</td>
<td>Ensevel complet, Naca 7</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Non retrouvée</td>
<td>18.05.2011</td>
</tr>
</tbody>
</table>

**Image:** Map of the area with marked locations and rescue sites.
Masserey 05.01.2014

14h58
ACR VAS + MCE
AED: VFIB: 5 def
ACLS: io, A, C...
Asyst, Trspt 55'
ROSC 8’ ED

15h25
ACR VAS +
AED: AESP
ACLS: intub, io,
V.jug.ext
Thorcostomy bilat
VFIB: 4 defib,
Adr, Cordarone..
AESP
Trsp Martigny
K+ no, T° no
Echo dcd ED

15h09
ACR VAS +
4 insuff
MCE unique
Trspt
ROSC 8’ ED

15h25
ACR VAS +
AZ: intub-
Autopuls
Dcd ED

Alarm 14h46

All 4 ACR transported

2 cardiac rythme o/site
- VFIB / AESP

2 ROSC at ED after 8’

2 ad ICU

2 organ donors...
Mourtì 19.07.2014
Grande noria > 35 min
Inconsc VAS +
Descendu à ski...
ACR VAS + MCE
Trsp sledge-B3-
PMA:intub-Lukas-
Hosp K+15

«Toute» petite noria

ACR VAS + MCE-
Fastrack
Trsp sledge-B3-
PMA:intub-Lukas-
Hosp K+15

ACR VAS + MCE-
Hosp K+4-6 / CEC

(transport B3 + PMA: intubation et transport à Lukas, hospitalisation à niveau K+15)

Drame

Les avalanches ont déjà tué 25 personnes depuis le début de l’hiver

Montagne

Grande noria > 35 min
Inconsc VAS +
Descendu à ski...
ACR VAS + MCE
Trsp sledge-B3-
PMA:intub-Lukas-
Hosp K+15

ACR VAS + MCE-
Fastrack
Trsp sledge-B3-
PMA:intub-Lukas-
Hosp K+15

ACR VAS + MCE-
Hosp K+4-6 / CEC

(transport B3 + PMA: intubation et transport à Lukas, hospitalisation à niveau K+15)
multi-victime avalanche accidents

a four years experience

human factors !!

time is pressing
multi-victim = several severe patients in one single intervention
logistical challenge
why human factors?
training
... you can anticipate everything...
Human Factors

Victim

- level of experience
- level of material
- risk behavior..
HF: dispatch center 911-112-144

- lack of avalanche accidents knowledge
- no daily business = supplemental stress
- difficult localisation
- difficult communication
- lot of rescue services (guide-heli-dog-..)
- time is brain...
HF : rescue service

- intern « dispatch-center »
- lack of avalanche accidents knowledge
- no daily business = supplemental stress
- difficult communication
- lot of team members (guide-heli-dog-..)
- time is brain...
- there are other missions on-going
- anticipation : number of helicopters
  - fuel
HF: rescuers HF « by victim »

- psychological state of the implicated
- age of victims
- personal acquaintance rescuers-victim
- victim’s equipment (beacon-AirBag...)
- burrial time (rapid access vs terrestrial...)
- stress of dispatch center repercussion
HF : rescue team pilot

- type of helicopter
- weather conditions
- difficult localisation
- difficult access

- experience of rescue team
- number of helicopters :
- number of rescuers :
- number of rotations :
- type of rotations: sling, winch, dogs..

- victim’s number and medical conditions
HF: rescue team guide

- weather conditions
- avalanche localisation
- difficult access
- residual risk: recco flight
- comprehension of mechanism: witness inquiry
- cumulation of functions: multi-tasking management, technical, medical...

- communication: rescue channel
- experience of rescue team:
- localisation: beacon, Recco, dog
- extraction: technical, medical

- number and type of rescuers: management
- type of intervention: sling, winch,
- anticipation: night mission?

- every avalanche has its own dynamic (vs highway MVA)
HF : rescue team medical

• access to the site : personal mountain experience, terrestrial, sling,

• access to the victime :
  • localisation phase
  • extraction phase
  • rapid access to head

• lack of equipment :
  • hostile environnement for BLS-ACLS
  • inadequacy of equipment : wind-cold-insufficient number

• unclear victims conditions :
  • patent airways, time, T°?
  • health conditions: either severe (REA=1doc+AED/pat) or minime

• anticipation: dispatch to hospital, no direct communication, via dispatch center
HF : task specialists

• task specialists :
  • dog handler
  • ski-patroller
  • mountain rescuers :
    • mountain guides, probers

• task specialists :
  • non-professionnel
  • not experienced
  • rare occasions to be dispatched
multi-victim avalanche level of performance

<table>
<thead>
<tr>
<th>Levels of performance</th>
<th>Latency [sec]</th>
<th>Example Emergency medicine</th>
<th>Example Mountain rescue</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skills-level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with training</td>
<td>≥ 0.06</td>
<td>Installation of an i.v. line</td>
<td>Using the winch hook</td>
</tr>
<tr>
<td>without training</td>
<td>~ 0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rules-level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with briefing</td>
<td>~ 2</td>
<td>Expected resuscitation in the ED</td>
<td>Radio communication</td>
</tr>
<tr>
<td>without briefing</td>
<td>~ 15</td>
<td>Unexpected resuscitation in the field</td>
<td>Assess the avalanche risk</td>
</tr>
<tr>
<td><strong>Knowledge-level</strong></td>
<td>&gt; 45</td>
<td>Gascow Coma Scale</td>
<td>Looking for the right route</td>
</tr>
</tbody>
</table>
HF in multivictim avalanche (1)

- MVA stratégies highway vs avalanche:
  - in 5 y never engaged MVA-container
  - professional (routine, organized) vs non-professional (rare, no pre-established hierarchy, relationship between diff groupes)

- time is life

- geography
  - acces
  - localisation
  - extrication: small noria by helicopters

- technique saves life:
  - technical kits are ready,
  - confidence in technical skills = garant of success?
HF in multivictim avalanche (2)

• ACLS comes second:
  • 1 medical kits/patient not ready
doc, AED, ACLS, carrier, 1+-Autopuls

• communication
  • diff channels between type of rescuers
  • helicopters: number, diff compagnies, language
  • via dispatch center, not directly

• multi tasking management:

• ... we can not anticipate everything ...

... but we have to deal with it...