

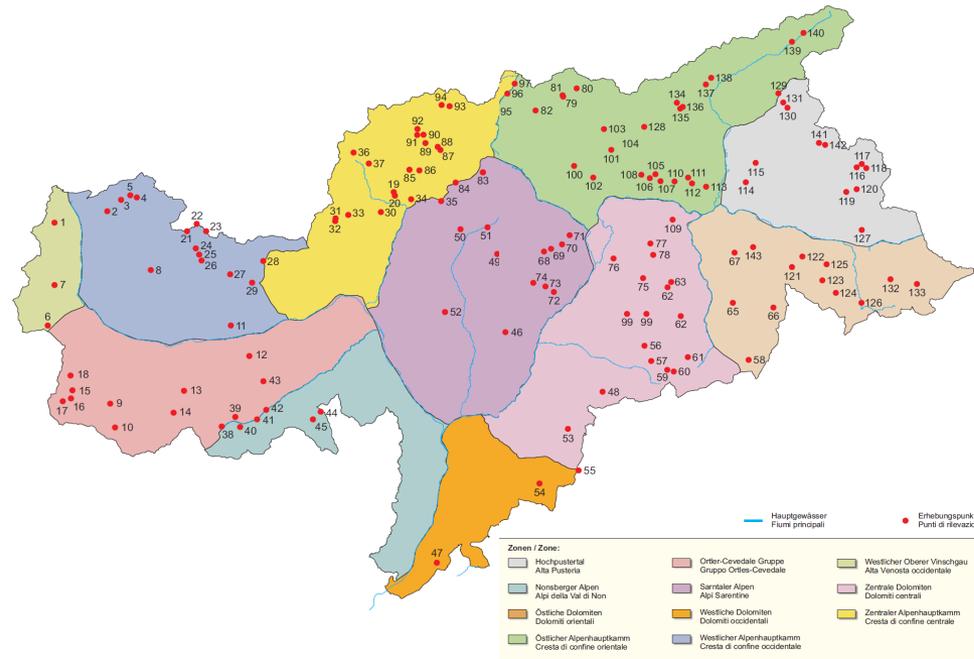
The avalanche accident

Recent news and ILCOR guidelines 2010



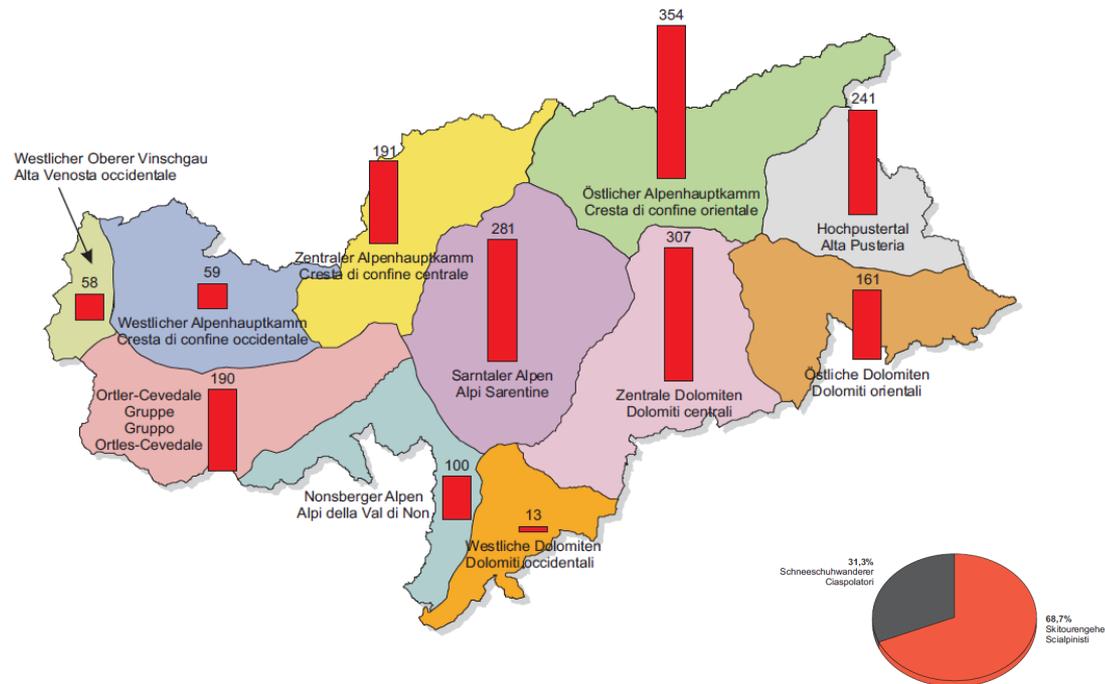
**Hermann Brugger,
2nd HEMS Course
Sulden/Solda, November 16th, 2010**

How dangerous is backcountry skiing? First census of backcountry skiers



**143 checkpoints in South Tyrol
21st february 2010**

How dangerous is backcountry skiing? First census of backcountry skiers



1955 groups
6010 backcountry skiers and snowshoers

Patterns of death from avalanche Canada 1984-2005

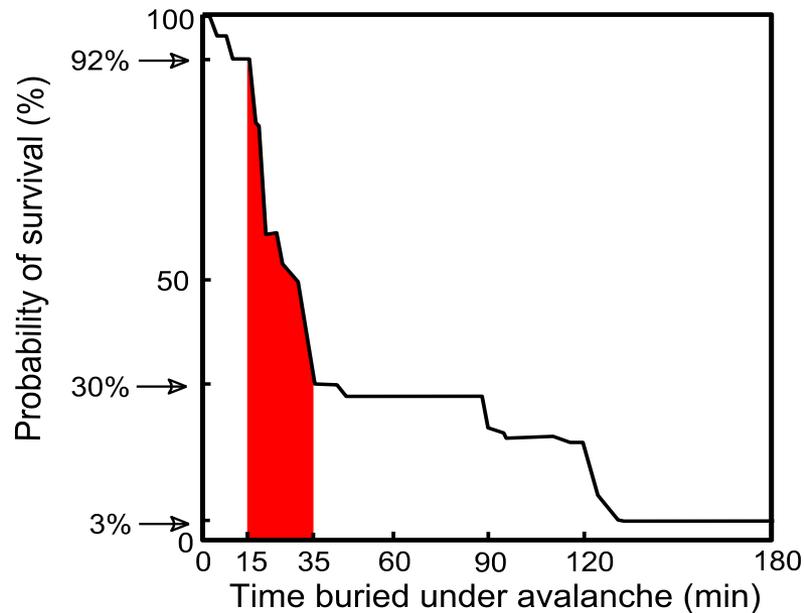


Table 1: Cause of death as determined by autopsy or external examination for 204 avalanche fatalities in western Canada

Immediate cause of death	No. (%) of deaths				
	Autopsy		External examination*		All deaths*
Asphyxia	92	(79)	62	(71)	154 (75)
Trauma	25	(21)	23	(26)	48 (24)
Hypothermia	0	(0)	2	(2)	2 (1)
Total	117	(100)	87	(100)	204 (100)

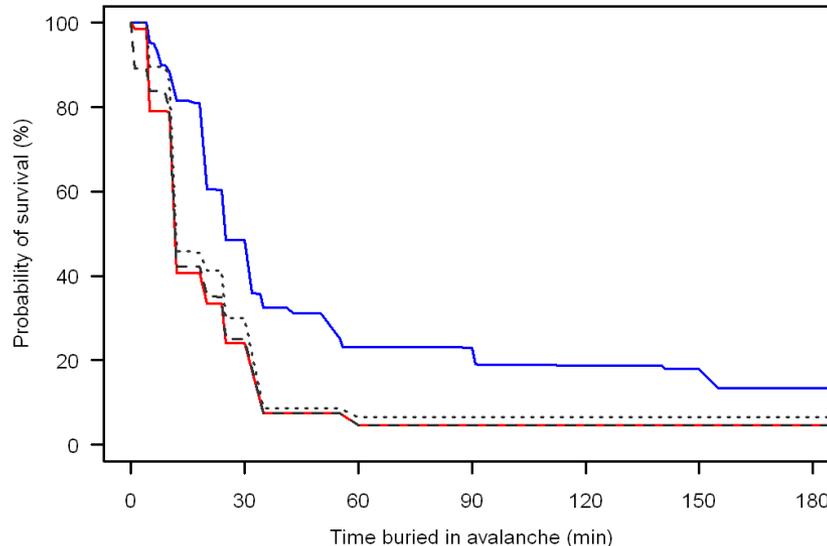
*No significant difference in the distribution of causes of death between autopsy and external examination (2-tailed Pearson χ^2 test, $p = 0.17$).

Avalanche survival chances Switzerland 1984-1998



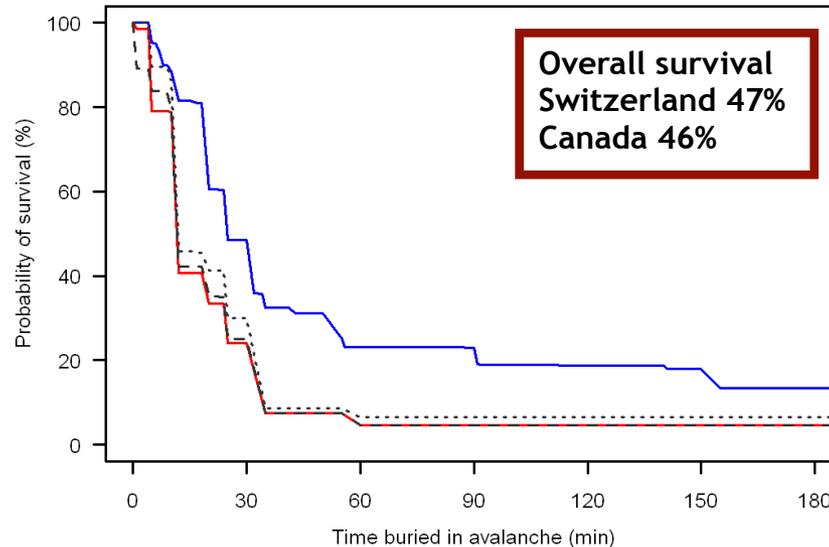
Falk M et al Nature 1994. Brugger H et al Resuscitation 2001

Avalanche survival patterns Canada vs Switzerland



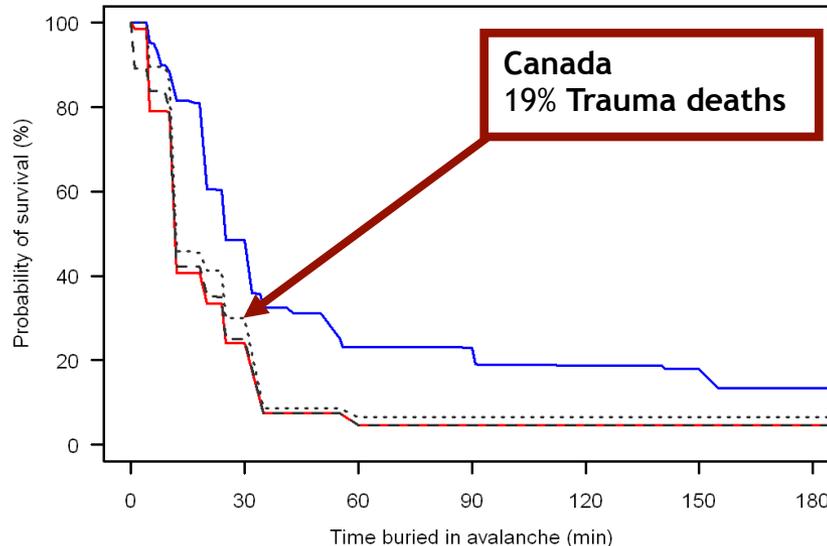
Comparison of survival curves. Swiss survival curve (blue; n=946) and Canadian survival curve (red; n=301). The black dotted survival curve is based on the Canadian dataset without trauma fatalities (n=255). The black dashed survival curve is calculated with the Canadian dataset where the extraction times for severe trauma fatalities was replaced with an estimated time of death of 1 minute after burial (n=301).

Avalanche survival patterns Canada vs Switzerland



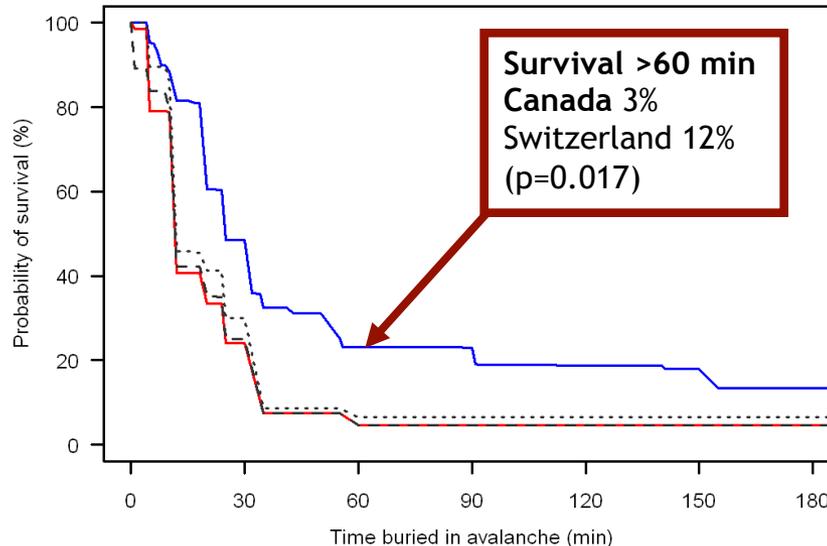
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Avalanche survival patterns Canada vs Switzerland



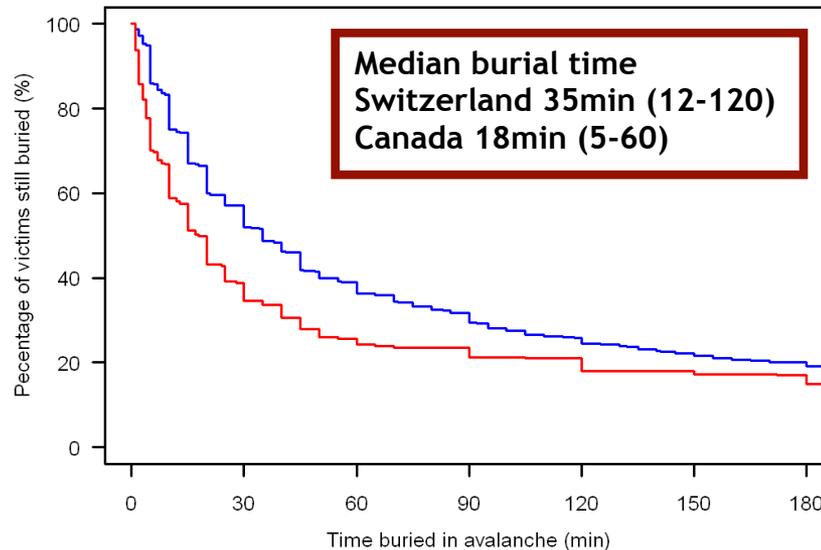
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Avalanche survival patterns Canada vs Switzerland



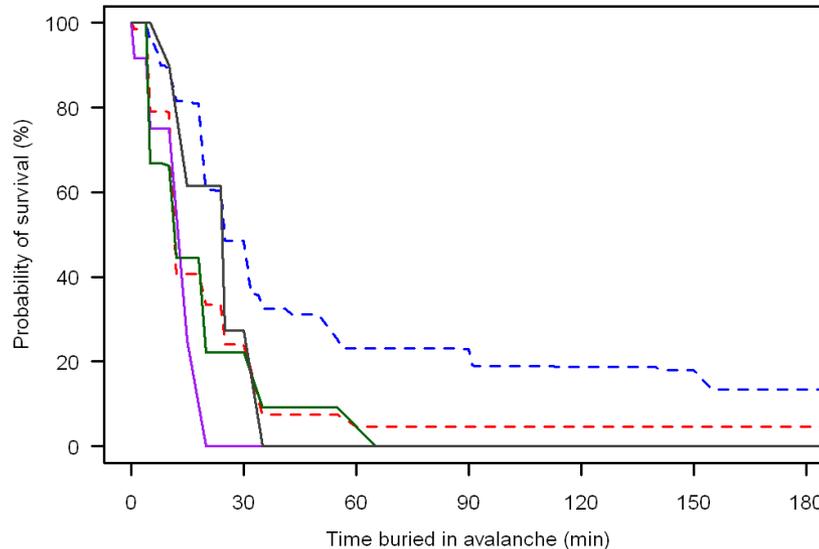
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Avalanche survival patterns Canada vs Switzerland



Kaplan-Meier curves of extrication times. Kaplan-Meier curve for extrication times in Swiss (blue; n=946) and Canadian (red; n=301) datasets.

Avalanche survival patterns Canada vs Switzerland



Canadian survival curves in relation to snow climate zones. Survival curves for maritime (purple, n=36), transitional (green, n=132), and continental (grey, n=101) datasets. General Swiss (blue) and Canadian (red) survival curves are included for reference as dashed lines.

Avalanche survival patterns Canada vs Switzerland

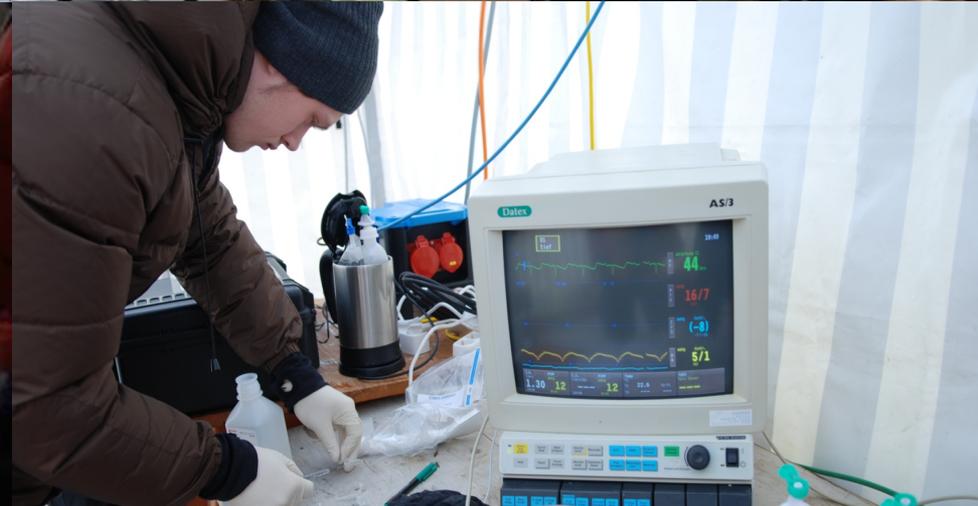


Factors determining poorer survival beyond 60 minutes in Canada

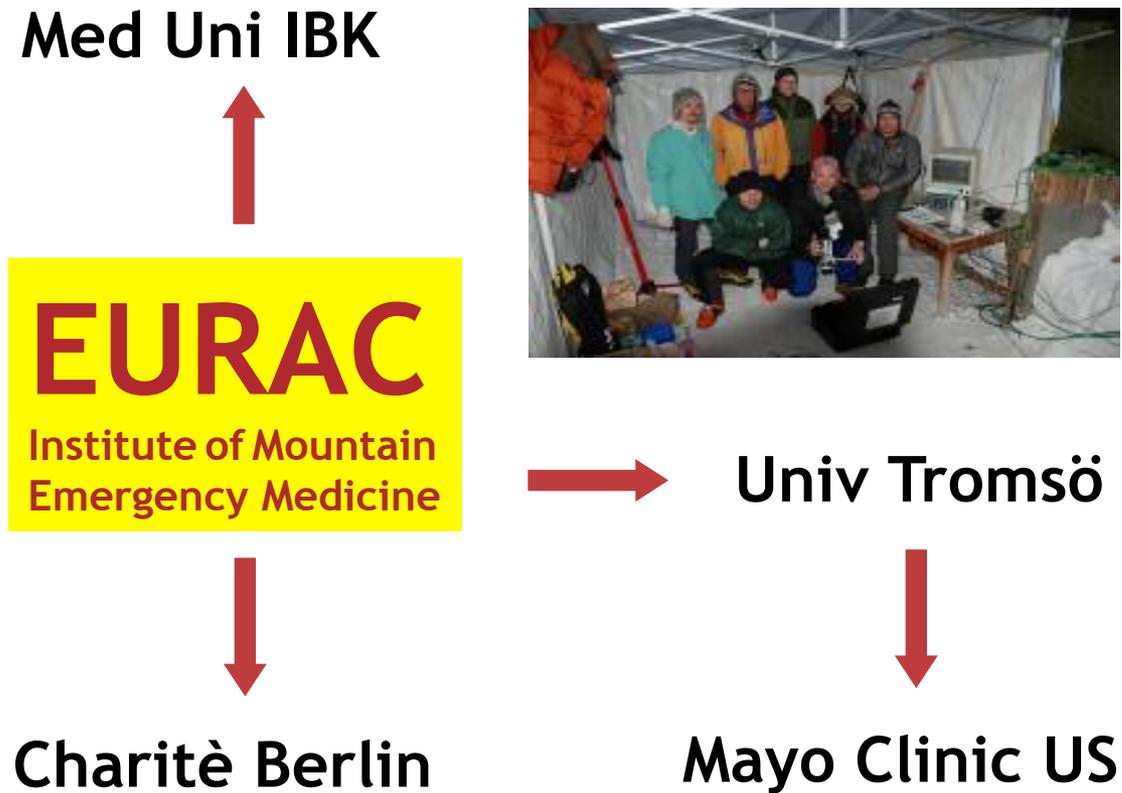
- 1. Delay of organized rescue**
- 2. Limited medical support upon extrication and during transport**
- 3. Higher snow density**



Vent (A) 2010: The Triple H Study



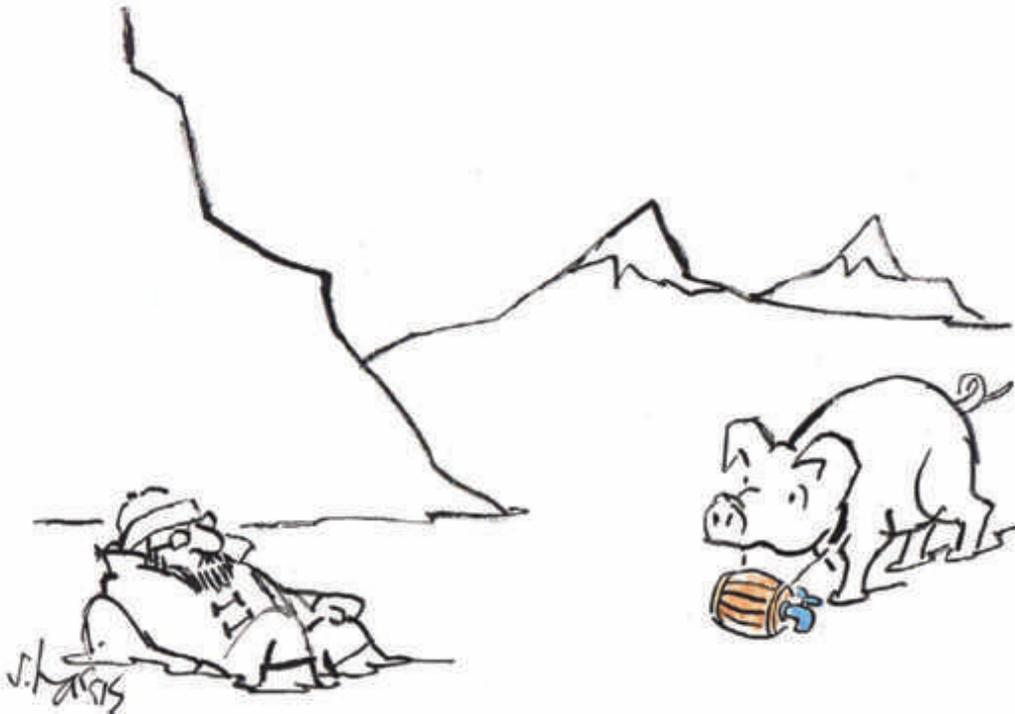
Triple H Study



Triple H Study



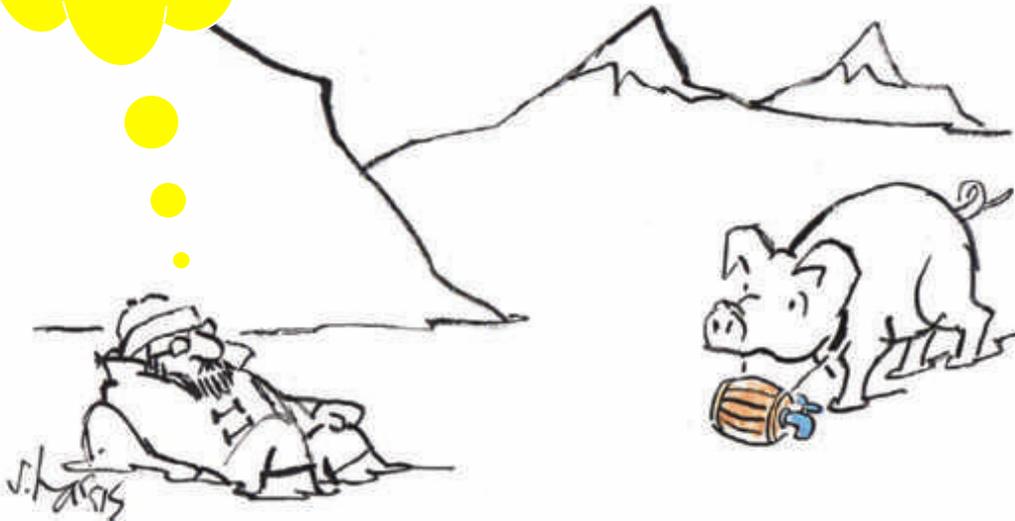
Triple H Study



Outcry stopped approved pig study of avalanche survival
Hermann Brugger EURAC Institute of Mountain Emergency Medicine, Bolzano, Italy
 e-mail: hermann.brugger@eurac.edu
Peter Paal Department of Anesthesiology and Critical Care Medicine, University Hospital Innsbruck, Austria
Markus Falk Inova Q Inc., Brunico, Italy

Triple H Study

**Oops..
EURAC
scientist!**



Outcry stopped approved pig study of avalanche survival
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e-mail: hermann.brugger@eurac.edu
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Triple H Study

MEDICINE AND THE MEDIA

Animal rights activists bury avalanche study

Why did a research study into the effects of hypothermia on avalanche survival hit central European headlines earlier this year and spark 35 000 protest emails? **Peter Paal and colleagues** report



On 14 January this year in Vent in the Austrian Tyrol we were forced to call off an approved avalanche burial study involving anaesthetised piglets on the fourth of the 10 planned days of the study. We had no choice but to shut down the study because of overwhelming negative and sensational media coverage, closely followed by massive criticism and protests from animal rights activists and a few politicians.¹ Local people involved in the project had withdrawn their support, fearing repercussions for tourism, the economic mainstay of the valley. Headlines in Austrian, German, and Italian news media were along the lines of “Pigs buried alive in snow,” suggesting that animal cruelty had occurred. More than 200 newspapers worldwide, and national as well as international television and radio stations, reported on the avalanche project.

Avalanche survival is only partly understood. About 70% of completely buried avalanche victims have a traumatic death or die from asphyxia,^{2,3} and survival for more than 15–35

In a multipurpose building an operating theatre was set up where the piglets were anaesthetised but still spontaneously breathing. They were protected from the cold, and endotracheal tubes and systemic arterial and pulmonary arterial lines were inserted. The piglets were then taken to the avalanche burial site and, after baseline measurements were taken, were placed in an artificially created air pocket and buried to a depth of 1 m in snow. While they were buried, haemodynamic function, body core temperature, and blood gas measurements were taken. To analyse hypothermia induced myocardial dysfunction, heart biopsies took place after the animals had died.⁷ Furthermore, a novel non-invasive temperature sensor to measure body core temperature was tested in the field.⁸

The study was approved by the Austrian Federal Ministry of Science and Research and was supervised on site by a ministry representative. However, the European Union directive 86/609/EC and respective Austrian laws regulating animal

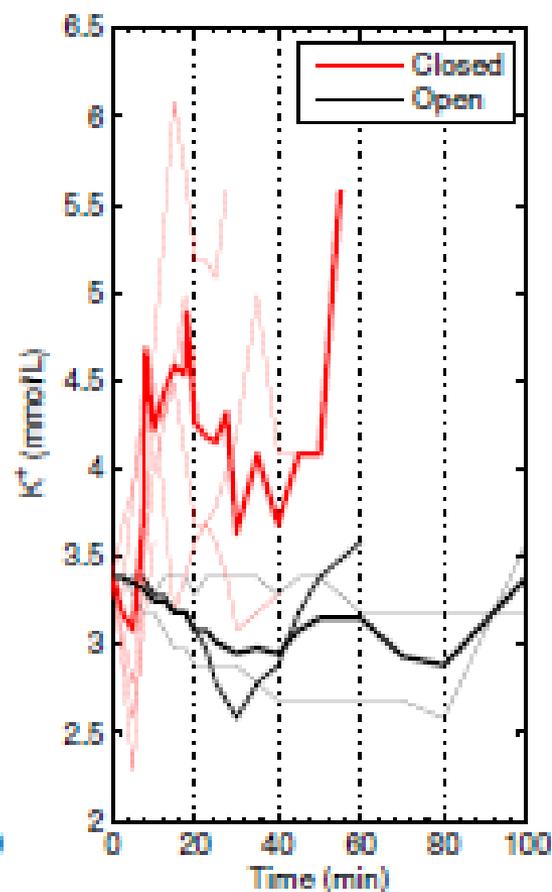
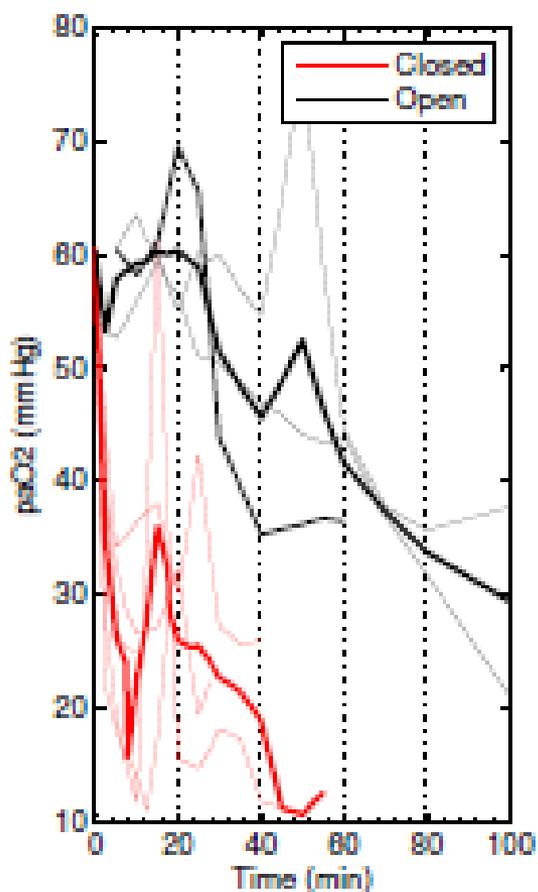
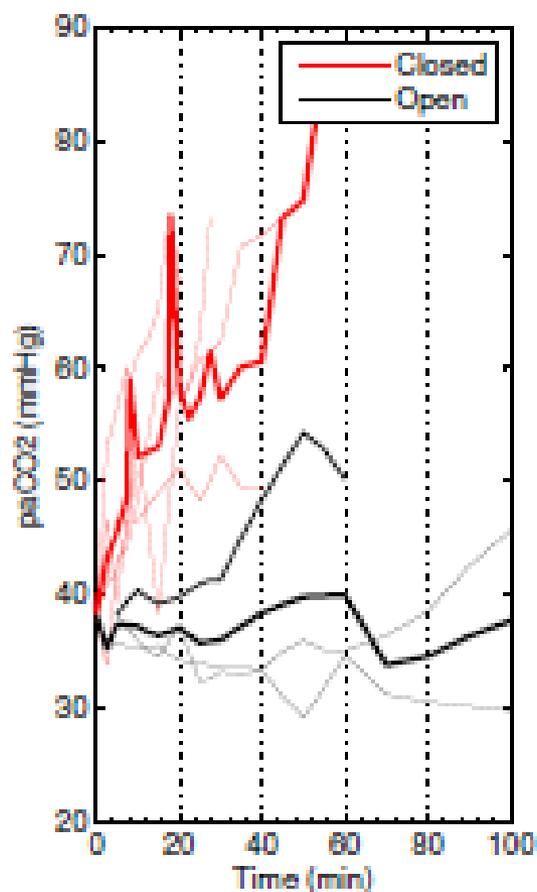
supporting local people received more than 35 000 protest emails, and there were several threats of violence and death, including one bomb threat. Consequently we had to suspend the study. In addition, the study team and the former Austrian minister of science, who is now the European commissioner for regional policy, were sued by animal rights activists for animal cruelty and murder. These complaints have since been dismissed by the state attorney.

If the media publish misinformation and the public subsequently becomes enraged, isn't this our own fault? Winning the “war” on animal testing, as stated by the former UK science minister Paul Drayson,¹⁰ should be the scientist's duty. Thus initiatives to inform the public, such as the UK based Pro-Test group,¹¹ which campaigns in favour of animal testing, are essential. Unfortunately equivalents in continental Europe seem to be lacking.

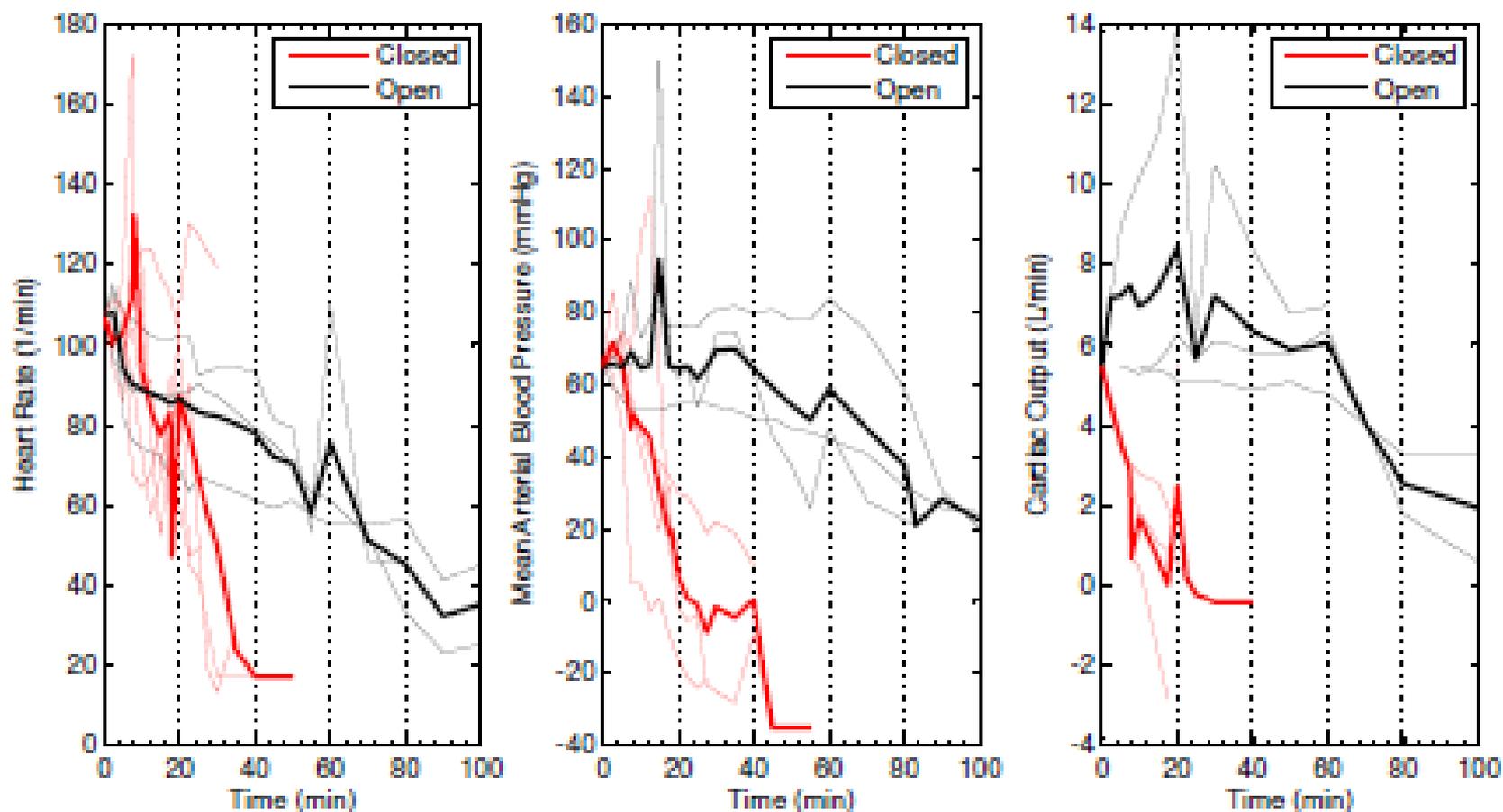
What are the wider implications for biomedical research if sensational reporting animal rights



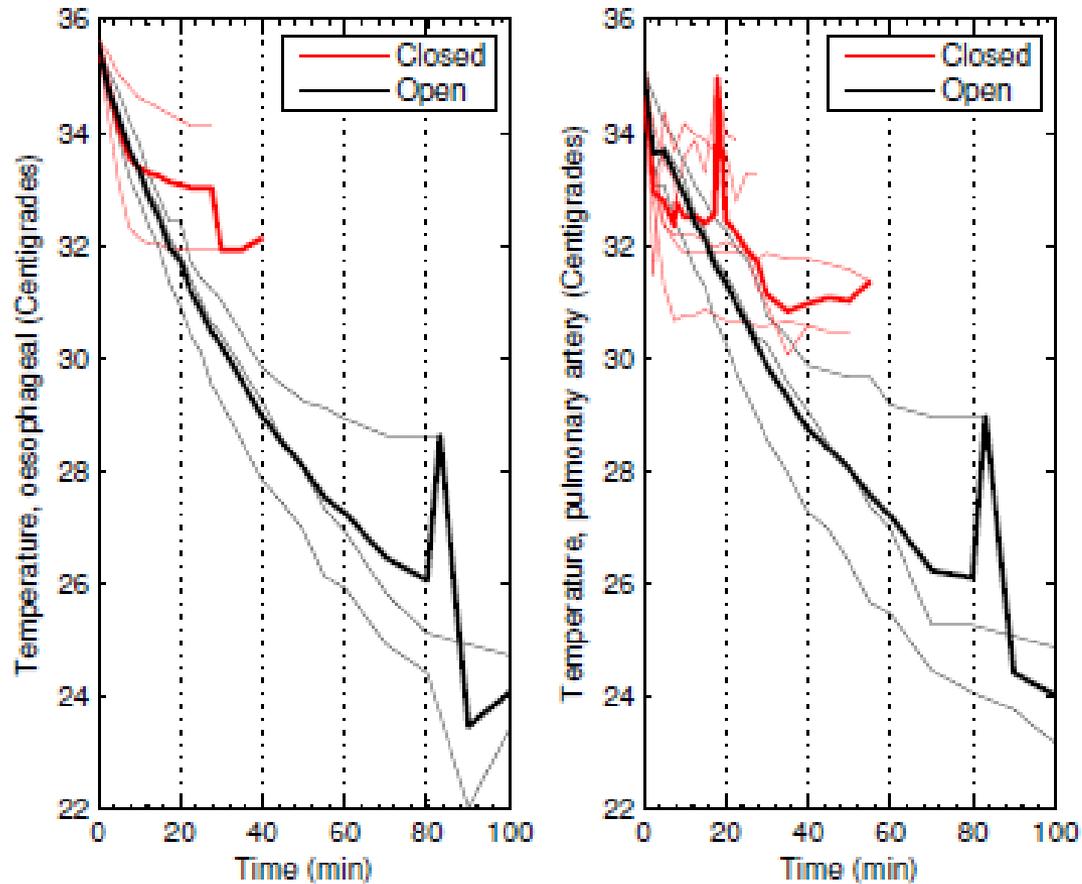
Triple H Study



Triple H Study



Triple H Study

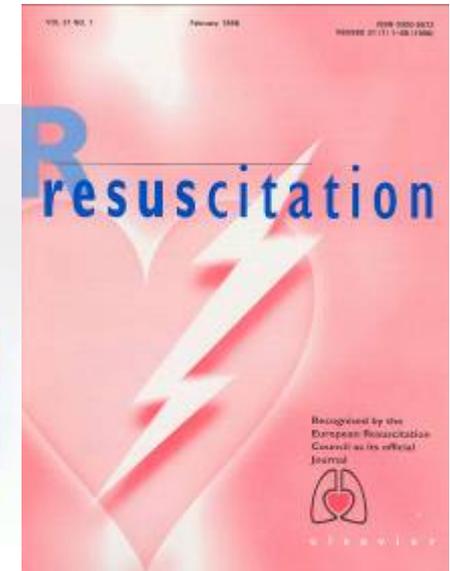


Triple H Study

Our case series supports the hypotheses that

- a) acute hypothermia does occur and may protect avalanche victims from death during burial if oxygen support is sufficient, and**
- b) serum potassium is confirmed to be a prognostic marker for survival.**

AHA & ERC CoSTR Guidelines ILCOR 2010



Proposed Treatment Recommendations

ILCOR 2010 Worksheet ALS-SC-078A & B

- In avalanche victims found in cardiac arrest *after 35 minutes of burial, the presence of a patent airway should prompt BLS and ALS resuscitation and advanced rewarming measures, such as Cardiopulmonary Bypass or ECMO (when available)*, if indicated and when other factors do not suggest an un-survivable injury.



Proposed Treatment Recommendations **ILCOR 2010 Worksheet ALS-SC-078A & B**

- Avalanche victims found in cardiac arrest and *without a patent airway after more than 35 minutes of burial may not benefit from aggressive resuscitation.*



Proposed Treatment Recommendations *ILCOR 2010 Worksheet ALS-SC-078A & B*

... no hypothermic avalanche victims with a patent airway is dead until rewarmed and dead.



European Resuscitation Council Article of the month June 2010



European Resuscitation Council

Free Article of the Month

The June Free Article of the Month is:
[Prognostic factors in avalanche resuscitation: A systematic review.](#)
(Jeff Boyd, Hermann Brugger, Michael Shuster)



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Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Review

Prognostic factors in avalanche resuscitation: A systematic review[☆]

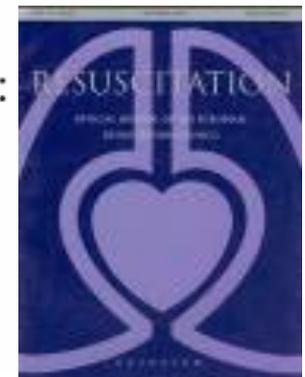
Jeff Boyd^{a,b,*}, Hermann Brugger^{c,d}, Michael Shuster^a

^a Department of Emergency Medicine, Mineral Springs Hospital, Banff, AB, Canada

^b International Federation of Mountain Guides, Banff, Alberta, Canada

^c EURAC Institute of Mountain Emergency Medicine, Bozen/Bolzano, Italy

^d Innsbruck Medical University, Innsbruck, Austria



Proposed Treatment Recommendations *ILCOR 2010 Worksheet ALS-SC-078A & B*

Serum potassium levels of

<7 mmol/L predictive for survival

7-8 mmol/L predictive for ROSC

8-12 mmol/L predictive for death in adults

>12 mmol/L predictive for death



ERC resuscitation guidelines 2010

Soar J, Perkins GD, Abbas G, Alfonzo A, Barelli A, Bierens J, Brugger H, Deakin C, Dunning J, Georgiou M, Handley AJ, Lockett DJ, Paal P, Sandroni C, Thies KC, Zideman DA, Nolan JP. European Resuscitation Council Guidelines for Resuscitation 2010 Section 8. Cardiac arrest in special circumstances: Electrolyte abnormalities, poisoning, drowning, accidental hypothermia, hyperthermia, asthma, anaphylaxis, cardiac surgery, trauma, pregnancy, electrocution. **Resuscitation 2010;81:1410**

Avalanche victims are not likely to survive

when they are:

- buried >35 min and in cardiac arrest with an obstructed airway on extrication;
- buried initially and in cardiac arrest with an obstructed airway on extrication, and an initial core temperature of <32°;
- buried initially and in cardiac arrest on extrication with an initial serum potassium of >12 mmol.

Full resuscitative measures, including extracorporeal re-warming, when available, are indicated for all other avalanche victims without evidence of an unsurvivable injury.



AHA resuscitation guidelines 2010

Morrison LJ, Deakin CD, Morley PT, Callaway CW, Kerber RE, Kronick SL, Lavonas EJ, Link MS, Neumar RW, Otto CW, Parr M, Shuster M, Sunde K, Peberdy MA, Tang W, Vanden Hoek TL, Böttiger BW, Drajer S, Lim SH, Nolan JP, ILCOR resuscitation guidelines writing group. *Circulation* 2010;**122**:359-360.

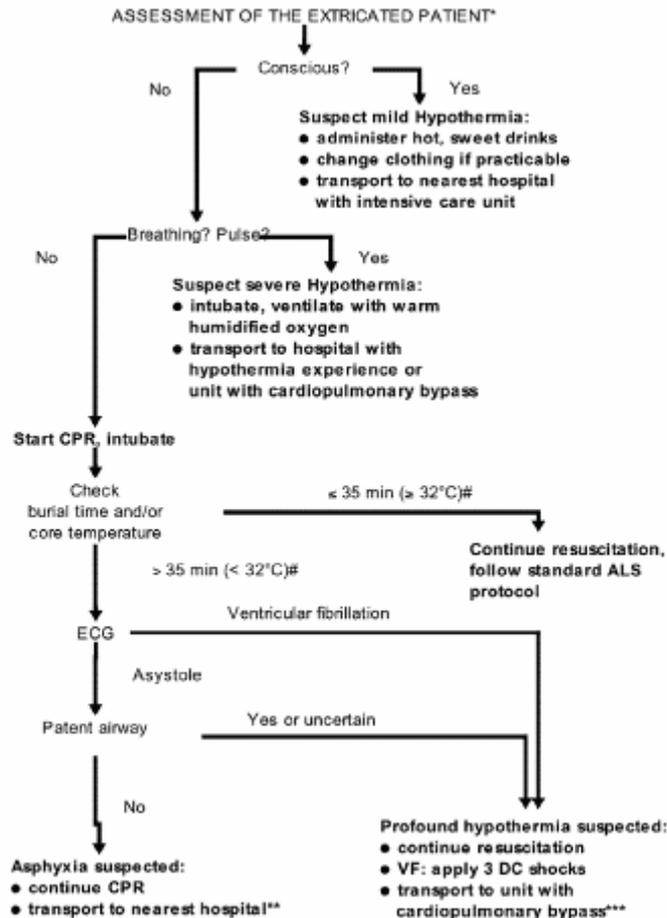
Avalanche victims are not likely to survive when they are

- Buried >35 minutes and in cardiac arrest with an obstructed airway on extrication.
- Buried initially and in cardiac arrest with an obstructed airway on extrication, and an initial core temperature of <32°C.
- Buried initially and in cardiac arrest on extrication with an initial serum potassium of >8 mmol/L or more.

Full resuscitative measures, including extracorporeal rewarming, when available, are indicated for all other avalanche victims without evidence of an unsurvivable injury.



On-site treatment of avalanche victims ICAR MEDCOM recommendations 2011



Case Report



44y male healthy skier

255 min (3:15h) complete burial

60 cm burial depth

Patent airway & air pocket

No pulse no breathing

No visible injuries

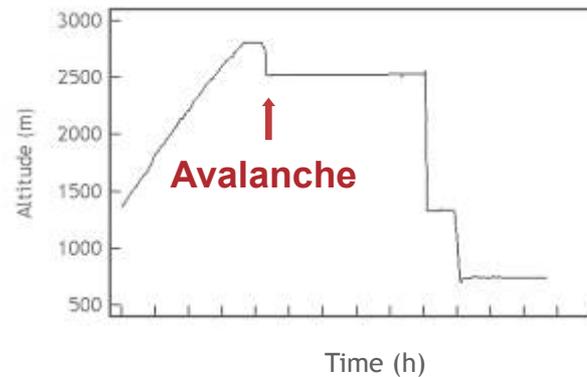
No temperature measurement

No ECG

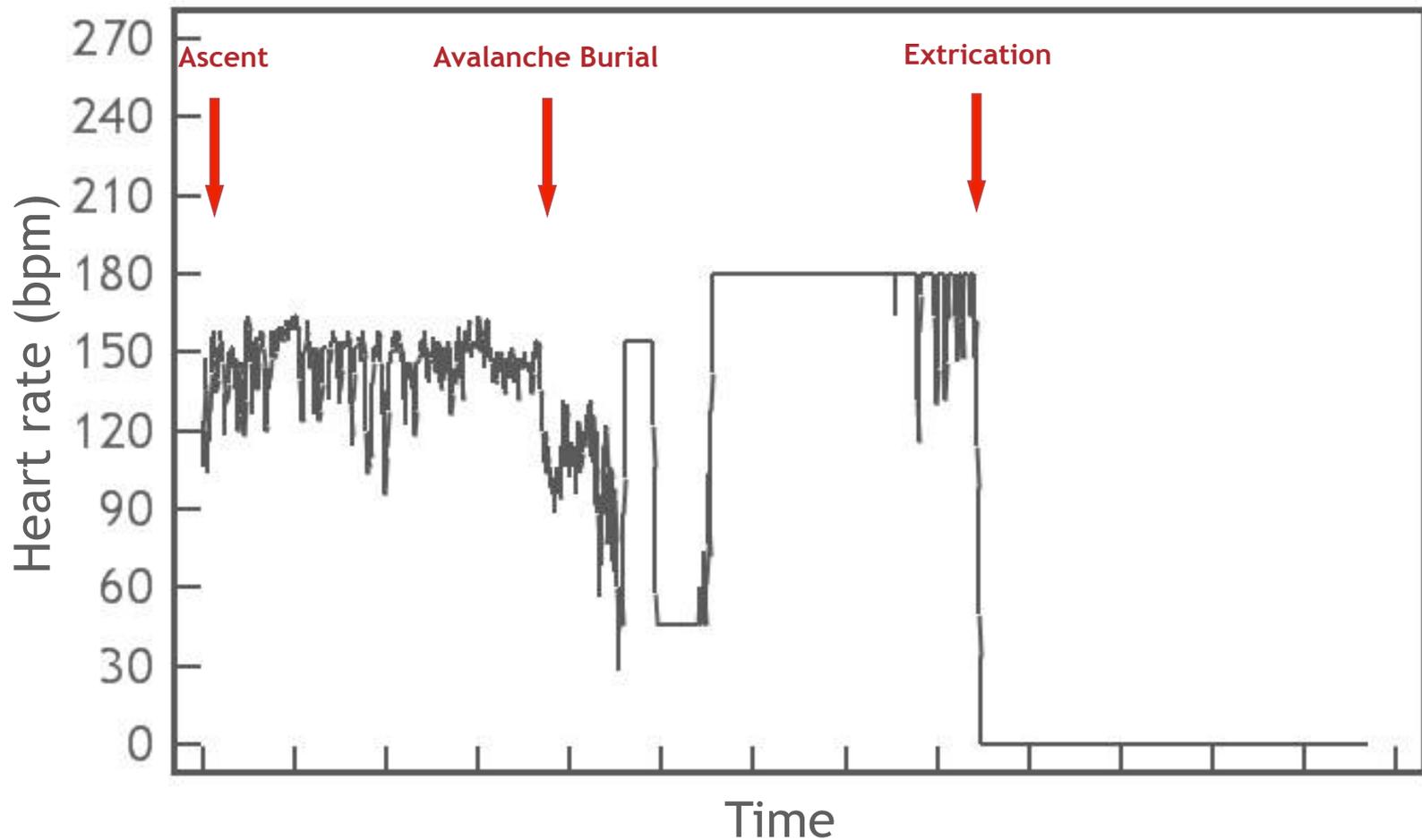
Declared dead on site

Case Report

Found the day after:
 Multifunction sport watch
 Wireless chest belt
 Continuous monitoring of
 altitude, temp, heart rate etc



Case Report





11/11



Thank you for your attention

