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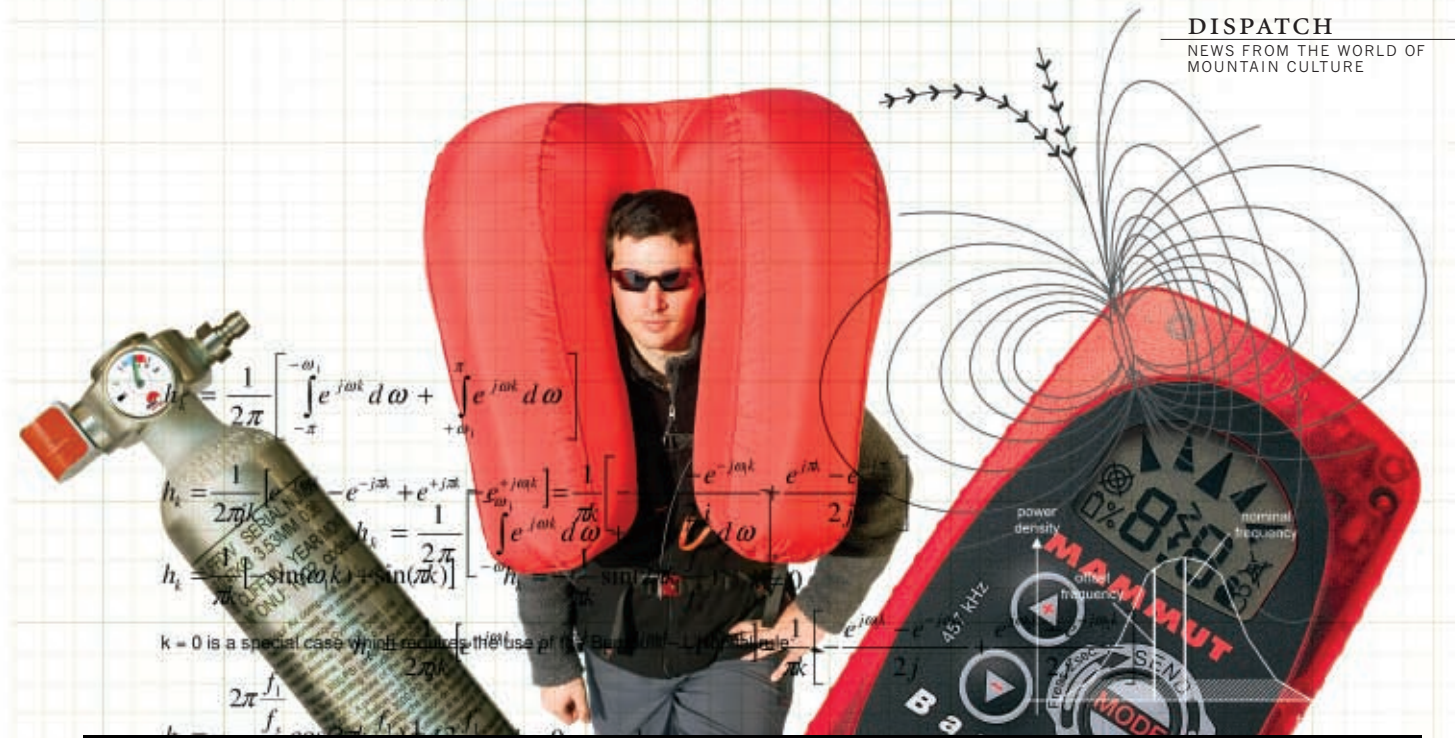
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Science for Survival

As more people venture into the backcountry every winter, it's no surprise the outdoor gear industry has followed suit with a veritable slide of new avalanche rescue products. We take a look at the facts, the stats and the abilities of technology designed to save lives

By Thomas Chalmers



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“BUHWHOOOM!”

The ground lurches underfoot. Your stomach flip-flops. The snow surface spiderwebs around you, hissing and crumbling. You try and point it the hell outta here, but your legs are swept away and the mountainscape disappears into a pummeling, powder-clouded tumult of snow and holy shit. The avalanche is sluicing you down into an ugly vortex of accident statistics.

According to various studies of avalanche accidents in Canada and abroad, you have between a 75 to 85 per cent probability of survival. The outcome depends on many factors: how much trauma is inflicted on your nasty ride down, whether or not you get completely buried, the time of burial, and your ability to breathe while awaiting rescue. If you are a fully equipped mountain warrior, girded in the latest and greatest of personal avalanche rescue gear, take some comfort in having stacked these variables — and the final outcome — in your favour.

Fatal Avalanche Accidents

According to the Canadian Avalanche Centre (CAC), our national organization for public avalanche awareness (www.avalanche.ca) there were 144 avalanche fatalities in Canada between 1999 and 2009: snowmobilers were 38 per cent of these, backcountry and out-of-bounds skiers and snowboarders 37 per cent, guided helicopter and snowcat sliders 9 per cent, and other recreation 13 per cent. Last winter, 2008-2009, marked a historic shift in the Canadian avalanche demographic, when only one backcountry skier was killed. Disturbingly, there were still a total of 26 avalanche deaths, almost double the previous decade's average of about 15 deaths per year. Nineteen of these were snowmobilers, around double the number killed in the worst season previously known.

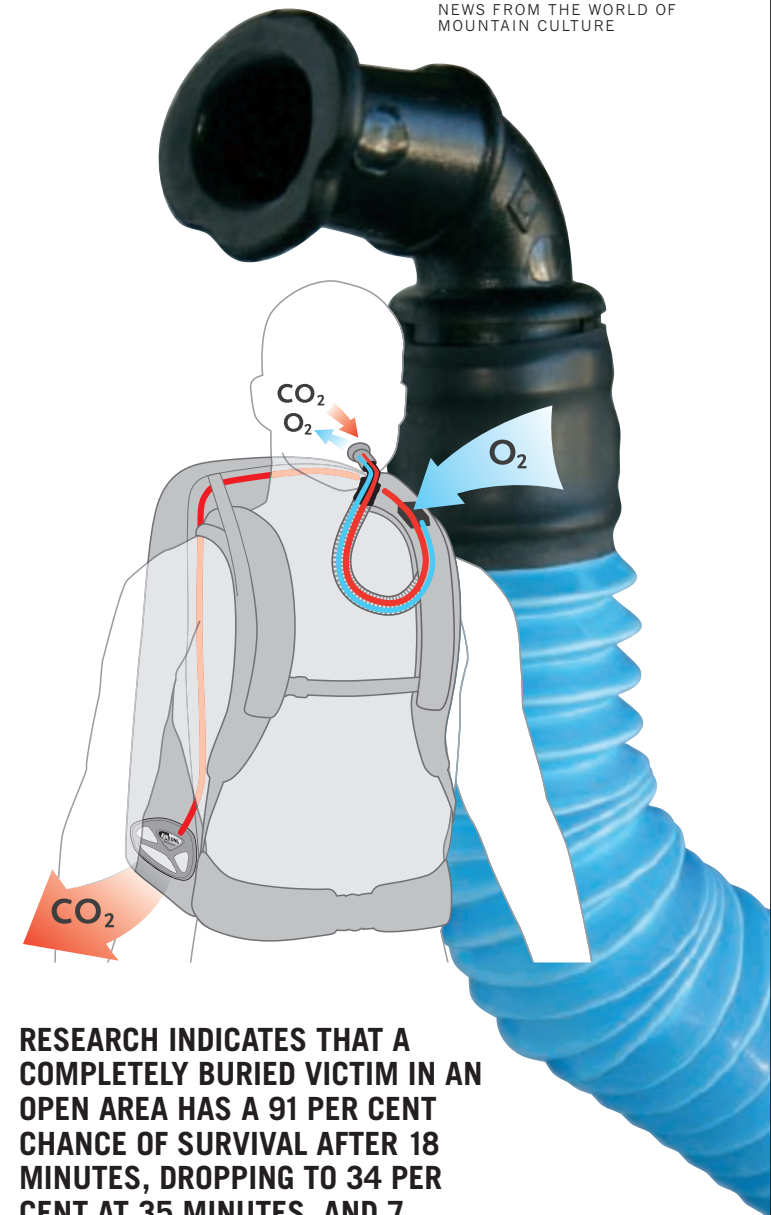
The major cause of death by avalanche worldwide is asphyxia, killing 75 per cent of Canadian victims by oxygen deprivation and under-snow suffocation. Research indicates that a completely buried victim in an open area has a 91 per cent chance of survival after 18 minutes, dropping to 34 per cent at 35 minutes, and 7 per cent at 130 minutes. A personal, avalanche-specific rescue device helps prevent being killed by reducing the depth of burial (an airbag balloon system) or the time of burial (a transceiver locating beacon), or increasing your ability to breathe once buried (an Avalung).

The next leading cause of avalanche deaths is traumatic injury, mostly incurred through collision with trees or rocks in a flowing avalanche. In a study published by the Canadian Medical Association, head injury accounts for 42 per cent of these trauma deaths, so a helmet may also be considered as personal avalanche safety gear. The incidence of traumatic avalanche death varies dramatically by region, from about 6 per cent in Europe, to 24 per cent in Canada, because most backcountry usage in Europe is on open alpine slopes, while Canadians typically shred a mix of open and forested terrain. Trauma only accounts for 9 per cent of Canadian snowmobile fatalities, reflecting our sledders' preference for open terrain similar to the European backcountry.

Personal Avalanche Rescue Devices

In the forgotten pre-history of personal electronics, hardy pipe-smoking, leather-booted telewhackers trailed a long red string behind the klister-smear tracks of their wooden skis. If caught by an avalanche, a rescuer could conceivably unravel metres of looped and twisted string from rock-hard avalanche debris to locate the victim, but that simply took too much time.

By the 1960s, the outdoor gear market was revolutionized by the introduction of the avalanche transceiver, freeing Grandma's knitting basket from pilfering. If both victim and rescuer are equipped,



RESEARCH INDICATES THAT A COMPLETELY BURIED VICTIM IN AN OPEN AREA HAS A 91 PER CENT CHANCE OF SURVIVAL AFTER 18 MINUTES, DROPPING TO 34 PER CENT AT 35 MINUTES, AND 7 PER CENT AT 130 MINUTES.

Top: Black Diamond's Avalung allows buried avalanche victims to breathe longer. Bottom: Ortovox's new S1





LIKE GROWNUP WATER WINGS, THE AVALANCHE AIRBAG'S BUOYANCY KEEPS A RIDER CAUGHT IN A FLOWING AVALANCHE CLOSE TO THE SURFACE, DECREASING THE LIKELIHOOD OF SUBMERSION AND BURIAL.



The backcountry industry has seen a recent spike in new inflatable avalanche flotation devices. Top: The new Avi Vest in field testing. Bottom: A diagram showing how the Snowpulse avalanche airbag prevents burial.



these wearable radio beacons can both transmit and receive a standard signal for tracking buried mountain adventurers. Forty years later, a transceiver, shovel, and probe are viewed as standard backcountry gear. Many types of transceivers now exist, from original analog beeps and lights (around \$250) to souped-up digital signal computing and display (about \$300 to \$600).

The game changed again in the 1990s, when backpacks with ripcorded avalanche airbags came to Europe. When caught by an avalanche, the wearer yanks a shoulder strap-mounted release toggle, and the bag is instantly deployed and inflated by a compressed gas canister. Like grownup water wings, the avalanche airbag's buoyancy keeps a rider caught in a flowing avalanche close to the surface, decreasing the likelihood of submersion and burial. Several brands of airbag backpack systems are now available in North America, starting at about \$900. According to airbag distributor Chuck Gorton of Avalanche Safety Solutions in Golden, British Columbia, yearly Canadian sales are growing extensively, especially among snowmobilers. Several commercial British Columbia backcountry helicopter and cat skiing operations are early adopters, outfitting both their guides and guests with in-house airbag fleets, and ski retailers are now jumping on the bandwagon in most mountain towns.

Soon after, Black Diamond Equipment's exclusive Avalung came along. This snorkel-like breathing tube is connected to a protected intake chamber strapped around the body outside the jacket, creating a bigger effective air pocket than that around the wearer's face. Valves exhaust spent air away from this source of precious fresh. From sledders to ski guides, many Canadians now wear Avalungs, available as a stand-alone over-the-shoulder strap unit, for about \$120, or as an integrated part of a special backpack, for \$160 and up.

Rescue Device Survival Studies and Statistics

An important study of European accident data, published by the International Commission for Alpine Rescue (ICAR), shows that wearing a transceiver significantly reduces the average burial time of a completely covered victim from 125 minutes to 25 minutes, increasing the odds of survival by 74 per cent. Provided, of course, that an avalanche probe and shovel are used in conjunction with the transceiver to provide an effectively complete rescue device. Newer-model digital transceivers claim to simplify the search process and speed up the recovery of multiple buried victims, which is supported by some research under experimental conditions. However, the technological effectiveness in actual accidents is contentious among industry experts, especially between different brands and technologies. More importantly, only a debatably low percentage of avalanche incidents involve multiple burials, and it is argued these may be handled reliably with any familiar beacon, basic single-victim search technique, and some practice.

The ICAR study indicates that avalanche airbags also increase survival considerably, by 91 per cent. Notably, 20 per cent of the airbag-wearing survivors in that study had balloons that did not deploy, due to malfunction or user error. Applying these results to skiing and snowboarding in Canada is a bit sticky because forested terrain and therefore trauma weigh in more heavily, though asphyxia is still the number one killer. The expert consensus is that snowmobilers, choosing mostly open terrain, compare best to the European results. Other Canadian user groups would likely benefit from airbags, but their risk reduction has yet to be quantified. Accordingly, the Canadian Avalanche Centre advocates avalanche balloon systems for backcountry recreation, especially among

mountain snowmobile enthusiasts. CAC Operations Manager John Kelly states, "Avalanche airbags for sledders are almost a no-brainer, given the comparison to European statistics, a user demographic characterized by higher disposable income to spend on their chosen activity, and generally less experience and training in backcountry travel than the typical skier or snowboarder."

When examining the Avalung, the American Medical Association reported on a study of the blood-oxygen content of voluntarily buried victims. The 10 minute acceptable burial time got a major boost to 58 minutes with an Avalung. Though other experiments corroborate this significant extension of survivable burial time, ICAR maintains there is not yet enough incident data for Avalung's statistical validation as a personal risk-reduction device.

Discussion

Since each type of personal avalanche rescue device works differently to reduce the chance of death, building a quiver of them does indeed pad the layers of safety, but the possibility can never be eliminated. The odds do not add up on a one-to-one basis (i.e. transceiver 74 per cent plus airbag 91 per cent does not necessarily create a 165 per cent increase in survival probability).

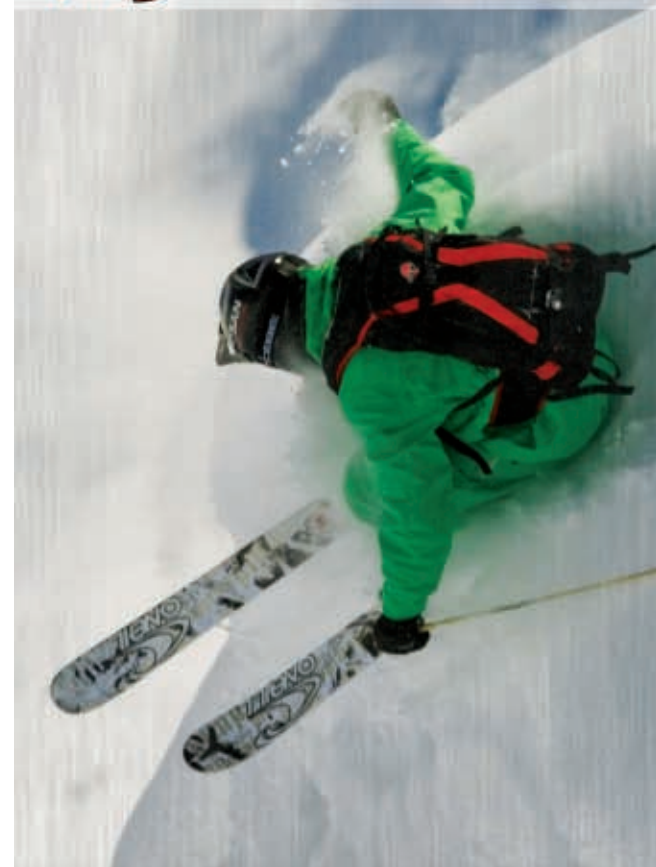
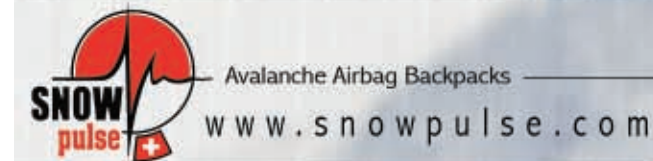
Avalanche transceivers contain delicate electronics, require battery upkeep, and only become a factor once burial is complete and all parties are equipped. Airbags are mechanically complex and create additional pack weight but actively prevent being buried, and some even provide protection against head and neck trauma. Avalungs only factor in once burial is complete but are relatively cheap and mechanically simple. Transceivers are turned on preventatively before entering avalanche terrain, but users need some training and practice. Both airbags and Avalungs must be activated by the avalanche victim at the right time and under intense duress, but need less training.

A full slate of personal avalanche rescue equipment, excluding the essential shovel and probe, runs up a bill in excess of \$1,300. This slaps on 50 to 100 per cent additional cost when gearing up for backcountry skiing or snowboarding, and an extra 10 to 20 per cent on top of a decent mountain sled.

All this information means that picking just one piece of personal avalanche rescue gear over another is not a simple matter. Canada still remains a testing ground for both new avalanche technology and winter backcountry recreation as a whole, so the experts are wrestling to understand the evolving scope of avalanche burial and death. Ilya Storm, manager of public avalanche forecasting at the CAC, emphasizes the challenge of collecting timely data: "Incident reporting from the backcountry-travelling public is crucial to not only the assessment of avalanche rescue equipment," Storm explains, "but more importantly, to the creation of better avalanche forecasts, decision-making tools and targeted communications. The best personal risk management is a pre-trip plan that matches objectives to terrain and conditions."

In the meantime, while you catch up on the latest public avalanche forecast, Grandma can whip up a nice wooly red toque for you to wear while practicing small-party avalanche rescue technique, or perhaps seeking pow through good backcountry travel decisions. In the end, brains have the best chance of saving your life. Thankfully, they're free.

Currently immersed in sustainable lifestyle engineering and passive solar home design, Thomas Chalmers slides between mountains and sea. Check out his other stories in this issue, page 73 and 112.



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