

Embracing the wild

Conceptualizing wilderness medicine in Canada

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Several hundred metres from the summit of a remote peak in the Northern Rockies 2 climbers feverishly moved toward their goal. The younger climber, who was leading the charge, heard his friend yell. He shot a quick look over his shoulder in time to see the older climber hitting a shallow outcrop below, then braced himself for a vigorous pull on the rope around his waist. The “okay” signal did not come and panic froze the young climber’s body. Looking down again, he could see the other climber lying twisted on the outcrop and unresponsive. After a few minutes passed, the man on the outcrop returned to a foggy consciousness, before being jolted into full sensation by a piercing pain in his right leg. The young climber’s panic eased a little; however, he was not sure of the severity of his companion’s injury. After a few minutes’ discussion, the 2 climbers agreed to use their satellite phone to contact Parks Canada for help.

For many, these climbers’ predicament epitomizes the wilderness medicine (WM) case. However, the scope and complexity of wilderness medicine contexts are greater than this scenario suggests. Wilderness medicine encounters occur in settings where definitive treatment is not possible and where challenges of time and distance are compounded by inadequate resources, severe weather, or natural hazards. Health care professionals’ responses must adapt to reflect the circumstances and can range from modified standard practice to inspired improvisation. Wilderness medical care is delivered daily throughout Canada, and in recent years groups have been working to recognize and formalize the principles and practices unique to its demanding environments. Their efforts are leading to research and care guidelines¹⁻⁴ that improve upon ad hoc solutions.

Canadian primary care physicians who incorporate emergency medicine, global health and humanitarian medicine, or working with underserved populations (such as First Nations people or remote communities) into their practices will find that the growing WM field offers valuable and readily transferable knowledge and skills. In turn, the generalist training of family medicine makes such practitioners well suited to tackling the challenges that arise in WM. Wilderness medicine training can allow primary care physicians to feel confident working in diverse circumstances, with or without abundant resources at hand.

from urban resources, frequently in austere settings. It addresses the unique conditions of wilderness environments, such as high altitude or extremes of temperature, and their physiologic and pathophysiologic effects. Wilderness medicine has grown to encompass a broader range of settings, not just those traditionally thought of as wilderness. Wilderness medicine can therefore be described as the practice of medicine in settings with any of the following: 1) extreme or uncontrolled environmental conditions; 2) absent, inadequate, or otherwise scant resources; and 3) substantial time delay in transport to or arrival of definitive care.^{5,6} Under this definition, WM scenarios would include challenges like those health care professionals face working in remote medical outposts in the Northwest Territories or during disasters such as the wildfire that swept through Slave Lake, Alta, in May 2011.

To appreciate this definition, one needs to examine the 3 key elements of wilderness medicine, as each element creates increased risk to either the patient or the first responder (or both):

- *Environment* refers to how natural elements and human factors affect patient physiology to cause a medical problem, make a developing problem worse, or make a pre-existing problem unstable. Examples of natural factors include meteorological, aquatic, or terrestrial extremes, while human factors include, but are not limited to, remote communities, expeditions, and armed-conflict zones.
- *Resources* refers not only to the difficulties of working in a limited-resource setting but also to the need to determine which resources are most functional in specific, unique circumstances. In difficult settings, the ideal treatments dictated by standards of care might not be deemed practical once the necessary equipment’s weight, size, functionality, availability, and appropriateness⁷ have been considered. Inherent to this concept is a strong emphasis on improvisation.⁸
- *Time* refers to delayed access to definitive medical care, which occurs owing to distance, logistics, or hazards.⁷

This definition of WM does not depend on any particular setting or circumstance. Instead, it extends the scope of WM far beyond a typical wilderness setting, applying whenever any of these 3 features influences care.

Emerging field

Definition. The field of wilderness medicine grew out of the need to provide care to persons who were far

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Unique competencies. The scope and variety of WM takes it beyond any single field; although it overlaps closely with family medicine, it also shares elements with emergency medicine, sports and exercise medicine, trauma surgery, orthopedics, public health, travel medicine, and veterinary medicine.⁸ The wilderness medicine practitioner (WMP), who could be from any health care profession, must integrate the science and art of these diverse disciplines in order to optimize patient care. Furthermore, circumstances might require a WMP to reach beyond his or her traditional medical role and draw upon skills typically assigned to paramedics, nurses, or other health care professionals.⁹ These skills include triaging, formulating a diagnosis and treatment plan in the field, starting intravenous infusions, administering medication, and transport and evacuation, to name a few. Finally, owing to the unconventional settings in which WMPs find themselves, they need expertise in survival, navigation, search and rescue, and incident command systems^{6,10} (Figure 1). Ultimately, the WMP maintains competencies that create a unique practice of medicine.

Relevance to the Canadian health care system

Clinical practice perspective. Diverse practitioners in Canada deliver WM. They include providers living and working in remote environments—physicians and nurses in rural or remote communities or medical outposts, and paramedics working in rural environments

where transport times are measured in hours, if not days. There are dedicated organizations whose practices are largely wilderness-based: the military, the coast guard, and search and rescue groups. For these WMPs, the typical treatment goals used in conventional medical settings are reframed within a WM context. Consider the standard management of an open tibial plateau fracture, which is open reduction and internal fixation, antibiotics, venous thrombosis prophylaxis, and continuing wound care. These interventions would not be realistic if this injury occurred in a resource-poor or remote location. Evacuation to a hospital would be the ultimate goal, but the initial approach would be fracture stabilization, basic wound care, pain management, and prevention of complications while rescue or evacuation efforts were under way. Sometimes, actions that are reflexive in resource-abundant settings, such as withholding oral intake in anticipation of surgery, are impractical in a remote environment.¹¹ In austere circumstances, maintaining patient and rescuer safety with adequate food, fluids, and shelter takes priority. Resourceful WMPs are able to balance medical necessity with the vagaries of the environment, the resources available, and the urgency of treatment when developing a unique management plan. The capacity to do so requires knowledge of how the patient could be affected by the environment, as well as the training and equipment to modify standard treatments as required.

Demographic perspective. According to the Kirby Report,¹² approximately 95% of Canada's territory is rural, with 30% of the population living in rural or remote areas. A substantial proportion of medical encounters in rural areas would fall into the WM category.¹³ To date, there are few statistics on illnesses and injuries occurring in remote locations. Untapped data sources already exist in Canada, including the Canadian Forces and many other federal and provincial organizations, and additional efforts are needed to examine and publicize these records. A single Canadian epidemiologic study¹⁴ examining morbidity and mortality in mountain rescue incidents in national parks showed that musculoskeletal injuries accounted for most medical issues. The same study indicated that WM settings also experience the typical array of medical conditions seen in urban emergency departments. While we are not aware of any relevant published Canadian studies, American data show that baby boomers, older adults, and younger people alike enjoy adventure activity. As such, there are changes in the risk factors and medical concern profiles of those engaging in outdoor adventure. "Diabetic hikers, post-coronary bypass surgery mountain bikers, and osteoporotic river rafters are now common in recreational areas."¹⁵ Given the number of people living in rural or remote settings, as well as the trends in population demographics, there is a growing need

Figure 1. Wilderness medicine comprises a unique body of knowledge from a wide cross-section of competencies



for health care provision beyond the confines of urban medical facilities.

The Canadian public would also benefit from WM knowledge creation and transfer. For instance, is standard first aid or cardiopulmonary resuscitation training appropriate for persons residing in rural or remote communities, especially as this style of training depends on the support of urban emergency medical services and medical infrastructure?¹¹ Is there a more appropriate model for these communities? We speculate that there are practices and criterion standards that might need to be reevaluated using a WM lens in order to optimize their effectiveness and relevance in resource-poor or remote settings.

Basic medical research perspective. Wilderness medicine offers the opportunity to explore ways in which the environment affects the human condition. **Table 1**¹⁻⁴ displays examples of biomedical research conducted in Canada that have clinical relevance to WM. Beyond its obvious application to those engaging in recreation or work in extreme environments, WM research also has relevance in other areas of medicine (eg, pulmonology and critical care). Future WM research within Canada is limited only by imagination. Important areas for investigation include cold and heat exposure; infectious diseases and animal encounters related to changing environmental conditions (eg, West Nile virus, Lyme disease, invasive venomous species); the physiology of endurance sports; and management of special needs and conditions (eg, diabetes, cystic fibrosis, cancer) far from routine care or in extreme environments.

The way forward

The current state of WM in Canada ranges from practice dictated by necessity, to scattered instances of formal training, research, and focused practice. While WM is not a recognized field in this country, the discipline is undergoing a process of formalization. A scientifically established WM knowledge base is growing, and evidence-informed standards of care are evolving.

Although the WM field is still emerging in Canada, the process of developing WM has been under way in the United States for decades. Numerous WM education opportunities are available in the United States, including core rotations or electives in medical school, residency curricula, fellowship programs,^{9,15} and accredited continuing medical education (CME).⁹ The Wilderness Medical Society, a Utah-based organization, is viewed as the leading international professional body, and has made great strides in fostering the growth of WM. The Wilderness Medical Society promotes WM by awarding research grants; developing CME programs; producing the first peer-reviewed scientific WM journal (*Wilderness & Environmental Medicine*); creating multiple educational lecture series; publishing its *Practice Guidelines for Wilderness Emergency Care*¹⁶; and forming the Academy of Wilderness Medicine. Canadian WM education opportunities are not as plentiful and diverse but are growing in number. Currently, medical students, residents, and those already in practice have access to several didactic and clinical experiences across the country (**Table 2**).^{17,18}


Table 1. Canadian research relevant to wilderness medicine

RESEARCH AREA	STUDIES' RESULTS
Hypothermia treatment¹ Prehospital torso-warming modalities for severe hypothermia: a comparative study using a human model	"In non-shivering subjects, external heat application was effective in attenuating core temperature afterdrop and facilitating safe core rewarming. ... The modalities studied appear sufficiently practical and portable for pre-hospital use."
Hyperthermia treatment² Cooling hyperthermic firefighters by immersing forearms and hands in 10°C and 20°C water	"Distal limb immersion in cool water is simple, [practical,] reduces heat strain, and may increase work performance in a hot, humid environment. With 20°C water, forearms should be immersed with the hands to be effective. At lower water temperatures, forearm and/or hand immersion will be effective, although [increasing surface area for heat transfer with] forearm immersion will [be advantageous]."
Altitude-induced cerebral and pulmonary edema³ Effects of acetazolamide on ventilatory, cerebrovascular, and pulmonary vascular responses to hypoxia	"Acetazolamide has benefit in alleviating ... hypoxia-induced pulmonary vasoconstriction and increased pulmonary artery pressures and as such may be a valuable means to prevent or treat high-altitude pulmonary edema [and noncardiogenic pulmonary hypertension]."
Avalanche-induced trauma and asphyxiation⁴ Comparison of avalanche survival patterns in Canada and Switzerland	"Observed differences in avalanche survival curves between the Canadian and Swiss samples were associated with the prevalence of trauma and differences in snow climate. Although avoidance of avalanches remains paramount for survival, the earlier onset of asphyxia, especially in maritime snow climates, emphasizes the importance of prompt extrication, ideally within 10 minutes. Protective devices [helmets, avalanche air bags or transceivers] against trauma and better clinical skills in organized rescue may further improve survival."

Table 2. Wilderness medical training in Canada

PROVIDER	TRAINING OFFERED
Society of Rural Physicians of Canada	Rural and remote medicine course www.srpc.ca/rr2013
Wilderness Medical Associates International	Wilderness medicine elective www.wildmed.ca/wilderness-medical-courses/medical-professionals/wilderness-medical-elective.php
Canadian Society of Mountain Medicine	Canadian Diploma in Mountain Medicine www.mountainmedicine-canada.org/page-default.html
Canadian Space Agency	Aerospace medicine elective
Simon Fraser University, Environmental Medicine and Physiology Unit	Hyperbaric medicine training www.sfu.ca/empu/training
Simon Fraser University, Environmental Medicine and Physiology Unit	Research opportunities www.sfu.ca/empu/about
University of Calgary, Mountain Medicine and High Altitude Physiology program	Research opportunities www.ucalgary.ca/mmhap
University of Manitoba, Laboratory for Exercise and Environmental Medicine	Research opportunities www.umanitoba.ca/faculties/kinrec/research/lab_offices/exercise_environment
Search and rescue organizations ¹⁷	Search and rescue training
STARS Critical Care and Transport Medicine Academy	Fundamentals of critical care transport medicine www.stars.ca/what-we-do/education-training/stars-academy.html
Data from Curran-Sills. ¹⁸	

Conclusion

Wilderness medicine would undoubtedly benefit from wider recognition and attention within the Canadian health care system. There are individuals and small groups trying to nurture the growth of WM. Formal links between the medical community and organizations already engaged in WM will promote education and encourage development of evidence-informed practice recommendations. Robust educational experiences (medical school electives, fellowships, and accredited CME) are vital if we hope to attract sharp, adventure-some minds to this field and to continue to cultivate its development. Fostering research interest will lead to clinically relevant recommendations and allow Canadian investigators to continue to contribute to the international body of WM knowledge. As WM continues to grow, Canadians are in an enviable position, if inspired to action. Collectively, we have the opportunity to steer the scientific development of WM in ways relevant to policy, education, and practice. 

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Competing interests

None declared

References

- Hultzer MV, Xu X, Marrao C, Bristow G, Chochinov A, Giesbrecht GG. Pre-hospital torso-warming modalities for severe hypothermia: a comparative study using a human model. *Can J Emerg Med* 2005;7(6):378-86.

- Giesbrecht GG, Jamieson C, Cahill F. Cooling hyperthermic firefighters by immersing forearms and hands in 10 degrees C and 20 degrees C water. *Aviat Space Environ Med* 2007;78(6):561-7.
- Teppema LJ, Balanos GM, Steinback CD, Brown AD, Foster GE, Duff HJ, et al. Effects of acetazolamide on ventilatory, cerebrovascular, and pulmonary vascular responses to hypoxia. *Am J Respir Crit Care Med* 2007;175(3):277-81. Epub 2006 Nov 9.
- Haegeli P, Falk M, Brugger H, Etter HJ, Boyd J. Comparison of avalanche survival patterns in Canada and Switzerland. *CMAJ* 2011;183(7):789-95. Epub 2011 Mar 21.
- Bowman WD. The development and current status of wilderness prehospital emergency care in the United States. *J Wilderness Med* 1990;1(2):93-102.
- Russell MF. Wilderness emergency medical services systems. *Emerg Med Clin North Am* 2004;22(2):561-73, x-xi.
- Wilderness Medical Associates Canada [website]. "Frequently Asked Questions" and "Courses." Haliburton, ON: WMA-Canada; 2007. Available from: www.wildmed.ca. Accessed 2013 Apr 8.
- Sholl JM, Curcio EP 3rd. An introduction to wilderness medicine. *Emerg Med Clin North Am* 2004;22(2):265-79, vii.
- Morton PM, Marshall JP. Wilderness medicine education for the physician. *Emerg Med Clin North Am* 2004;22(2):539-59, x.
- Morton PM, Kummerfeldt P. Wilderness survival. *Emerg Med Clin North Am* 2004;22(2):475-509, ix-x.
- Bowman WD. Perspectives on being a wilderness physician: is wilderness medicine more than a special body of knowledge? *Wilderness Environ Med* 2001;12(3):165-7.
- Kirby MJL, LeBreton M; Standing Senate Committee on Social Affairs, Science and Technology. Chapter 10, rural health. In: *Volume two: current trends and future challenges. The health of Canadians—the federal role. Interim report*. Ottawa, ON: Standing Senate Committee on Social Affairs, Science and Technology, Parliament of Canada; 2002.
- Curran-Sills G. Rural medicine goes wild. *Can J Rural Med* 2011;16(4):139-40.
- Wild FJ. Epidemiology of mountain search and rescue operations in Banff, Yoho, and Kootenay National Parks, 2003-06. *Wilderness Environ Med* 2008;19(4):245-51.
- Lemery J, Tedeschi C, Miner T. Wilderness medicine education in the city: a new paradigm. *Wilderness Environ Med* 2008;19(3):206-9.
- Forgey WW. *Wilderness Medical Society: practice guidelines for wilderness emergency care*. 5th ed. Guilford, CT: Falcon Guides; 2006.
- Search and Rescue Volunteer Association of Canada [website]. *Links*. Paradise, NL: SARVAC; 2011. Available from: www.sarvac.ca/Links/tabid/186/language/en-US/Default.aspx. Accessed 2013 Apr 8.
- Curran-Sills G. Wilderness medicine opportunities in Canada do exist. *Can J Emerg Med*. In press.