

# A review of wilderness patient transport: a British Columbian perspective

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## Abstract

British Columbia is a mountainous province known for wilderness adventure. In British Columbia, transport of patients injured in the wilderness is conducted by a network of agencies including British Columbia Emergency Health Services (BCEHS), the Canadian Armed Forces, and 83 volunteer Search and Rescue teams. This narrative review examines select topics in order to provide allied health professionals with an understanding of resources in British Columbia and how they compare to jurisdictions elsewhere to identify areas for improvement.

The mode of transport is based on the patient's condition and factors at the scene, making it important for both air and ground resources to work together smoothly to provide the greatest benefit to the patient. Often both ground and air resources are involved on a single rescue. Transport time is heavily dependent upon the distance from the site of dispatch to the patient, the environment, and the patient's condition. Methods of helicopter rescue in British Columbia include landing, winch rescue (raising the patient to a hovering helicopter), and Helicopter External Transport Systems. The combination of these three methods in British Columbia is similar to the combination in the United Kingdom. Qualification of transport personnel varies between resources, with some ground rescuers only required to hold first aid, while EHS helicopters in British Columbia are staffed by critical care paramedics who perform just as well as physicians on helicopters in other jurisdictions.

Overall, British Columbia's system of wilderness transport is similar to that seen in other jurisdictions, but the field would benefit from a more robust body of research.

## Introduction

British Columbia is a mountainous province that markets itself as a destination for wilderness adventure.<sup>1</sup> In British Columbia, patients injured in the wilderness are transported by a network of agencies working together. British Columbia Emergency Health Services (BCEHS) is formally responsible for prehospital care and transport throughout the province.<sup>2</sup> However, BCEHS may collaborate with other organizations that, for wilderness transport, include the Canadian Armed Forces (CAF) 442 Transport and Rescue Squadron,<sup>3</sup> and the 83 volunteer Search and Rescue (SAR) teams throughout the province.<sup>4</sup> Each organization in this network contributes unique abilities to the wilderness transport capacity in British Columbia. This narrative review examines select topics relevant to wilderness transport and relates them to current practice in British Columbia. We hope to provide allied health professionals with an understanding of the available resources and how they compare to jurisdictions elsewhere, and to identify areas for improvement.

## Mode of Transport

The International Commission for Alpine Rescue (ICAR) guidelines specify three general indications for choosing helicopter over ground transport: the patient's medical condition, conditions at the scene (terrain, weather, *etc.*), and moving bulk equipment.<sup>5</sup> Accordingly, a study of 309 helicopter transports from Swiss Alpine Club huts found that medical severity accounted for about one-third of missions, and remote location was responsible for the rest.<sup>6</sup> In a review of rescues from Banff National Parks, helicopters were used in 64% of transfers due to the remote wilderness locations and the technical nature of the terrain.<sup>7</sup>

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The rate of helicopter use seen in 1088 rescues recorded by the Alpine Club of Canada was 37.4%, whereas ground transport was involved in 87.1% and was the exclusive method in 49.7%.<sup>8</sup> Notable here is that even when the initial response is by helicopter, ground crews may still be required to assist in the rescue and the patient may still be transported by ground, reinforcing the importance of British Columbia's volunteer SAR teams and their ground rescue capabilities.<sup>9,10</sup>

While studies have demonstrated a survival benefit to transporting non-wilderness trauma patients by helicopter rather than ground ambulance, few studies have examined the benefit during wilderness transport, where the distances are often long and resources limited.<sup>11</sup> A retrospective analysis of 1018 skiers and snowboarders who suffered a traumatic brain injury compared the effect of helicopter versus ground transport on survival: transport via helicopter conferred a survival benefit that the authors attributed to the ability to quickly travel the large distances from remote ski areas to receiving facilities.<sup>12</sup> Here in British Columbia, where neurosurgical resources are concentrated in the southern one-sixth of the province geographically, this speed-over-distance benefit has the potential to be particularly valuable.<sup>13</sup> However, this must be balanced against the risks inherent to helicopters. For instance, helicopter accidents that occur during wilderness transport have twice the fatality rate of accidents during general civilian flight.<sup>14</sup>

## Transport Time

ICAR guidelines and others highlight the impact that delays in transport from wilderness locations can have on patients.<sup>5,15</sup> With long distances and a sparsely distributed population, the most relevant benchmark for helicopter response times in British Columbia may come from a Norwegian study that recorded average dispatch-to-take-off (activation) times of nine minutes and total response times averaging 47 minutes.<sup>16,17</sup> In Central and Western Europe, total response time was found to be more closely correlated with flight time than with activation time, suggesting the location of resources is

the more important factor.<sup>18</sup>

The complexity of a patient's injuries, together with terrain and environment, can also increase the time to hospital, as illustrated in a study from Austria showing that 18% of major trauma patients took more than two hours to reach a hospital from wilderness environments.<sup>10</sup> A Swiss study further supported patient severity as a cause of delay, with crews averaging 54 minutes on the scene with severely injured patients compared to 37 minutes with moderately injured patients.<sup>19</sup>

While no published information about wilderness response times in British Columbia was identified during this review, most dedicated Emergency Health Service (EHS) helicopters are based in the south of the province, suggesting increased response times should be expected in the vast northern wilderness.<sup>20</sup> Increased data in this area would be helpful for drawing comparisons to other jurisdictions and identifying areas for improvement, as suggested by ICAR.<sup>21</sup>

### Methods of Helicopter Rescue

There are three primary helicopter rescue techniques: landing, winch rescue, and Helicopter External Transport Systems (HETS).

Landing the helicopter to embark a patient is the simplest approach, requiring the least specialized equipment, least training, and least risk; however, its disadvantage is requiring a landing site, which may be some distance from the patient.<sup>22,23</sup> The time taken to transport the patient by ground to the landing site will therefore detract from the helicopter's benefit.

Winch rescue involves the helicopter hovering above the patient, using a winch to lower a rescuer, and then raising both the patient and the rescuer to the helicopter cabin for transport.<sup>9</sup> The capacity for winch rescue is encouraged by ICAR to facilitate rapid rescue from challenging environments; however, it comes with the greatest cost, training demand, risk of malfunction, and helicopter weight requirement.<sup>19,21</sup> Additionally, because winching is technically challenging, even winch-equipped helicopters land when possible, with two Swiss studies showing that winch rescue was required in just 8.4–9.3% of responses.<sup>19,24</sup> In the United States, a review of 214 winch rescues identified perceived danger associated with ground rescue as its primary indication, though time, distance, and the need for technical rescue are identified elsewhere.<sup>9,23</sup>

HETS involves landing away from the patient, securing a rescuer beneath the helicopter via a fixed line, flying to the patient with the rescuer suspended below, securing the patient together with the rescuer, and then returning them to the landing site for embarking onto ground transport or the helicopter cabin.<sup>23</sup> HETS has the same ability as winching to extract patients from challenging environments using smaller, more economical helicopters and less complex equipment. The drawback is that HETS requires additional landings, which takes extra time. Still, HETS has been shown to save at least 30 minutes versus ground transport in the most time-critical patients, and ICAR considers HETS to be an acceptable alternative to winch rescue where resources are limited.<sup>17,21</sup>

In British Columbia, BCEHS requires landing zones to embark patients onto its helicopters, winch rescue is conducted by the CAF, and HETS is provided by helicopters contracted through volunteer SAR teams.<sup>20,25,26</sup> This arrangement is similar to that in the United Kingdom, where only SAR helicopters have winch and HETS abilities while EHS helicopters must land to embark patients.<sup>23</sup> In Victoria, Australia, however, the state's five EHS helicopters are all equipped

with winches, allowing one service to carry out the full spectrum of helicopter wilderness transport.<sup>27</sup> As this approach offers the advantage of pairing the greatest rescue capabilities with the greatest medical skillset in a single rescue resource, it may be beneficial to explore the inclusion of winch rescue capabilities on EHS helicopters in British Columbia.

### Qualification of Transport Personnel

The skill of wilderness transport personnel has been identified as a critical factor in patient outcomes.<sup>28</sup> For ground transport, B.C. government guidelines mandate all SAR personnel remain current in a seven-hour first aid course and suggest each field rescue group have one member with a 16-hour first aid course.<sup>29</sup> When transport times exceed 20 minutes, at least one member must have 70 hours of first aid training or more. The make-up of SAR teams in British Columbia is heterogeneous, and many teams have paramedic or physician members.<sup>21</sup> These requirements and general team makeup are consistent with observations in a survey of SAR teams in the intermountain west region of the United States, where 66% were trained to a first aid/CPR level, 17% as Emergency Medical Responders (EMR), and 17% above EMR.<sup>30</sup> In the extreme wilderness environment of Denali National Park in Alaska, however, physicians, mid-level providers, paramedics, emergency medical technicians, and nurses care for 90% of all patients seen by the National Parks Service, whereas only 10% are cared for exclusively by a lower level provider.<sup>31</sup> No published sources were identified that described a similar targeting of high-level resources to extreme environments in British Columbia, and this may represent an opportunity to improve care for those at the greatest risk of injury.

In North America, rescue helicopters are typically staffed by paramedics, whereas elsewhere, it is common to include a physician.<sup>32</sup> In Australia, the Greater Sydney Area Helicopter Emergency Medical Services (GSAHEMS) utilizes a physician-paramedic team. A study of 120 missions by GSAHEMS found physician-only interventions were carried out on 40% of patients, an outcome they felt justified the provision of physicians on helicopters.<sup>33</sup> However, the only observed physician-only interventions outside the scope of practice of Critical Care Paramedics (CCPs) in British Columbia were a fascia iliaca block and a tube thoracostomy, with B.C. CCPs limited to needle thoracostomies.<sup>34</sup> Two other studies from Austria and Switzerland have also examined the procedures carried out by physicians on helicopters. Similarly, tube thoracostomy and peripheral nerve blocks were the only interventions performed in these studies, which were outside the scope of practice of B.C. CCPs.<sup>10,24,34</sup> In Victoria, Australia, Intensive Care Flight Paramedics have a scope of practice similar to B.C. CCPs. In a study of 125 helicopter winch rescues carried out by Intensive Care Flight Paramedics, the most common procedures were analgesia, vascular access, and antiemetic administration. The only advanced procedures required were two thoracostomies. These findings suggest that the scope of practice for CCPs is sufficient.<sup>27</sup> When the performance of physicians and paramedics were directly compared, no difference in survival was found between patients attended to by a physician and those attended to by a paramedic during rural Australian helicopter transport.<sup>35</sup> Thus, the current practice of staffing EHS helicopters in British Columbia with paramedics rather than physicians seems to be supported by the literature.

**Conclusion**

Transporting patients injured in the wilderness is an essential part of pre-hospital care in British Columbia, a province known for its abundant outdoor activities. For those likely to care for patients transported from wilderness locations, this review draws attention to the variation in transport times depending on the resources involved and the location of the event, which should be considered when planning resuscitation. It also highlights the diversity of qualifications amongst wilderness rescue personnel in British Columbia and illustrates that the use of paramedics rather than physicians on EHS helicopters does not suggest inferior care. This review has illustrated that the components making up British Columbia’s wilderness transport network function similarly to those in other jurisdictions, but that there are also opportunities for improvement. In particular, the expansion of winch rescue capabilities in this province would decrease the time to care for patients injured in the wilderness, and further study and publication of response and transport times would allow more meaningful comparison to other jurisdictions.

**Table 1** | Public wilderness transport resources based in British Columbia. BCEHS, B.C. Emergency Health Services. CAF, Canadian Armed Forces. SAR, Search And Rescue. HETS, Helicopter External Transport Systems.

Agency	Resources	Qualifications
BCEHS	Two wheel drive ambulances: 482 Four wheel drive ambulances: 9 Sikorsky S76 helicopters: 3 Bell 412 helicopter Private helicopters hired as needed	<b>Licensed as one of:</b> Emergency Medical Responder Primary Care Paramedic Advanced Care Paramedic Critical Care Paramedic
CAF	<b>CH-149 helicopters</b> Equipped with winch	<b>SAR Tech, encompassing:</b> Primary Care Paramedic Arctic rescue Parachuting Diving Mountaineering
SAR	<b>Diverse land vehicles</b> Four wheel drive vehicles All terrain vehicles Snowmobiles <b>Diverse water craft</b> Boats Jet skis Hovercraft <b>Private helicopters hired as needed</b> Equipped with HETS	<b>Required training:</b> Ground SAR course First aid (7 hours) <b>Additional training:</b> Rope rescue Swift water rescue First aid (16 hours) First aid (70 hours) <b>Members may have further medical and rescue training</b>

**Conflict of interest**

The authors have declared no conflict of interest.

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