NEED FOR HELICOPTER EMERGENCY MEDICAL SERVICES (HEMS) IN RURAL BRITISH COLUMBIA

by

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ABSTRACT

Currently, there is no dedicated helicopter emergency medical service (HEMS) in Northern British Columbia (BC). Injuries to workers in BC result in the loss of more economically productive years than heart disease and cancer combined and cost nearly $2.8 billion per year. Nearly three quarters of all people who die of trauma-related conditions in Northern BC do so before they can be brought to a hospital; 82% in Northwestern BC, compared to 12% in Metro Vancouver (Cameron 2007; McKenna 2013). Minimizing the time from injury to optimal trauma care through the utilization of HEMS has been adopted as an essential component of emergency care infrastructures globally.

The purpose of this paper is to examine the opportunities, challenges and needs of a dedicated helicopter emergency medical system to service the remote regions of Northern BC.
## TABLE OF CONTENTS

<p>| Approval                                         | ii |
| Abstract                                         | iii |
| Table of contents                                | iv |
| List of Tables                                   | vi |
| List of Figures                                  | vii |
| Abbreviations                                   | viii |
| Acknowledgements                                 | x |
| Chapter I Introduction                           | 1 |
| Chapter II Literature Review                     | 7 |
| Section 2.1 Need for HEMS Services in Northern British Columbia | 7 |
| Section 2.2 Brief History of HEMS in Canada and World-wide | 8 |
| Section 2.3 Review of Literature on HEMS Services in BC    | 11 |
| Section 2.4 Existing Emergency Medical Service Model | 20 |
| Section 2.5 Debate on Delivery Modes             | 22 |
| Section 2.6 Helicopter Emergency Medical Services Analysis of Challenges | 28 |
| Chapter III Methodology                          | 31 |
| Section 3.1 Limitations of the Study             | 32 |
| Chapter IV Ground VS Helicopter Emergency Management Services – Substitutes or Complements? | 33 |
| Section 4.1 Rescue Management and Activity Cycle | 33 |
| Section 4.2 Cost of Delivery of Ground Verses Helicopter EMS | 35 |
| Section 4.3 Conclusions                          | 38 |
| Chapter V Concluding Observations                | 39 |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1</td>
<td>Challenges</td>
<td>43</td>
</tr>
<tr>
<td>5.2</td>
<td>Recommendations</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Bibliography</td>
<td>47</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 2.1  Injuries and Fatalities in Canada by Location 16
Table 4.1  Typical SAR Operation effort and resource management hierarchy 33
Table 4.2  Annual Cost of Operating Ground Vs. Helicopter EMS 1991 (US$s) 36
Table 4.3  Cost Per Patient in Ground and Helicopter EMS 1991 (US$s) 37
**LIST OF FIGURES**

<p>| Figure 2.1 | British Columbia Health Authorities | 11 |
| Figure 2.2 | Current Provincial Trauma Centres | 13 |
| Figure 2.3 | One Hour Trauma Catchment in Canada | 14 |
| Figure 2.4 | One Hour Trauma Catchment of BC | 15 |
| Figure 2.5 | BC Coroners Service Number of Deaths &amp; Death Rates | 17 |
| Figure 2.6 | BC Coroners Motor Vehicle Incident Deaths &amp; Death Rate by Region | 17 |
| Figure 2.7 | Emergency Communication Process | 20 |
| Figure 2.8 | Ground Emergency Medical Service | 24 |
| Figure 2.9 | Helicopter Emergency Medical Service | 24 |
| Figure 2.10 | BC Autolaunch Response Area | 27 |
| Figure 2.11 | Helicopter accidents by event phase of flight, 2003-2012 | 29 |
| Figure 4.1 | Typical SAR operation effort and resource management hierarchy | 33 |
| Figure 5.1 | One Hour Helicopter Catchment Area from Prince George | 45 |</p>
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACP</td>
<td>Advanced Care Paramedics</td>
</tr>
<tr>
<td>BC</td>
<td>British Columbia</td>
</tr>
<tr>
<td>BCAS</td>
<td>British Columbia Ambulance Service</td>
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<tr>
<td>BCEHS</td>
<td>British Columbia Emergency Health Services</td>
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<tr>
<td>BCLP</td>
<td>British Columbia Liberal Party</td>
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<tr>
<td>BLS</td>
<td>Basic Life Support</td>
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<tr>
<td>CCP</td>
<td>Critical Care Paramedics</td>
</tr>
<tr>
<td>CFR</td>
<td>Crash Fatality Rates</td>
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<tr>
<td>EHSC</td>
<td>Emergency Health Services Commission</td>
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<tr>
<td>EMA</td>
<td>Emergency Medical Assistant</td>
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<td>EMR</td>
<td>Emergency Medical Responders</td>
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<td>EHS</td>
<td>Emergency Health Services</td>
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<td>EMS</td>
<td>Emergency Medical Services</td>
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<tr>
<td>EVS</td>
<td>Enhanced Vision Systems</td>
</tr>
<tr>
<td>GEMS</td>
<td>Ground Emergency Medical Service</td>
</tr>
<tr>
<td>HEMS</td>
<td>Helicopter Emergency Medical Services</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>ISS</td>
<td>Injury Severity Score</td>
</tr>
<tr>
<td>NVIS</td>
<td>Night Vision Imaging Systems</td>
</tr>
<tr>
<td>NVG</td>
<td>Night Vision Goggles</td>
</tr>
<tr>
<td>PCP</td>
<td>Primary Care Paramedics</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>---------</td>
<td>--------------------------------------------------</td>
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<tr>
<td>SAR</td>
<td>Search and Rescue</td>
</tr>
<tr>
<td>SOPs</td>
<td>Standard Operating Procedures</td>
</tr>
<tr>
<td>STARS</td>
<td>Shock Trauma Air Rescue Service</td>
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<tr>
<td>UNBC</td>
<td>University of Northern British Columbia</td>
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<tr>
<td>UNBCH</td>
<td>University of Northern British Columbia Hospital</td>
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<tr>
<td>WorkSafeBC</td>
<td>Worker’s Compensation Board of British Columbia</td>
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ACKNOWLEDGEMENT

I owe a special thanks to Dr. Ajit Dayanandan for his unwavering support as my senior academic supervisor and for his genuine desire to help me succeed throughout this endeavour. Further thanks to the University of Northern British Columbia Master of Business Administration faculty; your insights, wisdom and candor are souvenirs I will value always as I go forward in life. Thanks to those special people in my life and my family for always encouraging me and for enduring this process of graduate school through all the peaks and valleys. Finally, my sincere gratitude to our Father in heaven for His most precious gift, to our Lord Jesus for His love, truth and grace, and the Holy Spirit for His faithful guidance during this project. Giving me health, strength and perseverance to continue and finish.
CHAPTER I

INTRODUCTION

In most of the developed countries including Canada, majority of public land is available for public use. Residents and visitors generally participate in some type of outdoor activity like hiking, backpacking, biking, water rafting, canyoneering etc. With these opportunities comes the risk of injury and illness and may require search and rescue (SAR) or emergency medical services (EMS). Every year, thousands of outdoor recreational users are stranded in remote areas or encounter injuries that are hard to reach by foot or vehicle. Similarly, natural disasters like earthquake, tsunami create a need for SARs. The trauma that affects the victims is often grave and physical and is the leading cause of disability, morbidity and death world-wide. The health care expenditure associated with such events in Canada and around the world is enormous (Danielson 2009; Fleet et al. 2013). Approximately 200,000 Canadians are hospitalized due to acute injury each year, and Canadians spend $19.8 billion annually in direct and indirect costs as a result of injury (Simons et al. 2010; Syed et al. 2010; British Columbia Ministry of Health 2013). The public expectation of safe and successful responses has reached extraordinary heights in recent years. In the modern world, the clamor for rescue services assumes greater importance given the fact that substantial segment of the population is litigious and distrustful of authority.
The need for SAR and EMS is grave in remote places like Northern British Columbia (BC). Nearly three quarters of deaths in Northern BC do so before they are brought to a hospital. In Northern BC, 82% die before hospital care can be provided compared with 12% in Metro Vancouver (Cameron 2007; McKenna 2013). These statistics are substantially higher when other time-sensitive events such as substance overdose, heart attack, or drowning are included. Obstacles to current trauma care in Northern BC are numerous. During the pre-hospital phase these include limited 911 and cell phone coverage, remote highways, delayed responses of Emergency Medical Services (EMS) due to distance and personnel that are usually volunteers and need to assemble (Cameron 2007). The primary method of EMS transport is ground, often over long distances, to a non-trauma medical facility. Personnel in the hospital phase are not provided with clear directions for bypass protocols that further delay medical treatments. Also, the absences of a designated trauma centre or a structured system of trauma care both increase the probability of unfavorable outcomes for patients and their families.

There are well-defined discoveries that pre-hospital delays are primarily responsible for excess mortality in Northern BC. Delays in discovering an incident, EMS response times, and transport inevitably result in a disproportionate number of on-scene deaths and short times to death (Shepherd et al. 2008). Simons et al. (2010) identified limitations in the Northern BC trauma infrastructure as the need for functional local no-refusal policies, centralized and coordinated trauma capabilities intra-region with or without a designated trauma center, and access to in-region trauma related continued professional development. Within intraregional referrals obstacles
such as ineffective no-refusal policies, no Advance Life Support (ALS) transfer capability, limited Basic Life Support (BLS) helicopter transfer capability, inconsistent and disparate surgical service and no “go to” trauma centre or trauma service (Judge 2007).

In Northern BC a tertiary referral is often impacted by limited local airport competences, especially in cases where patients are transported at night, inadequate resources to deal with unpredictable weather conditions and lengthy aeromedical response times. Prior studies demonstrate that the timing of advanced interventions from the time of incident to pre-hospital care, and the time to definitive hospital trauma care are considered to be the foremost factors determining patient outcomes and play a critical role in the duration of recovery time (Petrie et al. 2007; Danielson 2009; Ringburg et al. 2009; Sullivent, Faul, and Wald 2011).

Helicopter Emergency Medical Service (HEMS) has become globally accepted as a term to describe the use of helicopters for the transport of trauma or critically ill patients to the nearest acute care facility. Today HEMS is an essential element in the multifaceted assembly of urgent emergency care, serving as an integrator and the bond between incongruent entities of the health care system (Judge 2007). Vesterbacka and Eriksson (2001) and Tomazin et al. (2012) state that HEMS will shorten transportation times for critically ill simply because helicopters are capable of travelling at higher speeds over longer distances, minimizing the difficulties that remoteness or difficult terrain pose to ground travel. Patients can be reached by helicopter on average three to five times faster in urban areas than ground-based ambulances and hours faster in

---

1 Tertiary referral is when a patient needs to be transferred to a facility that offers the highly specialized medical care they require. High risk new born care (neonatology), organ transplantation, burn units and neurosurgery are primary examples.
many cases, in rural use (H.E.R.O.S 2013). The use of HEMS can improve survival outcome compared to emergency ground transportation especially in regard to BC’s large landmass and diverse terrain (Koury et al. 1998; Frankema et al. 2004; Brown et al. 2010; Galvagno et al. 2013). Northern BC itself is twice the size of the United Kingdom and 500,000 square kilometers, plus covers more than half the landmass of the total BC province (Simons et al. 2010). The majority of this area has little to no critical infrastructure, communications or emergency services (Bowering 2005) thus making northern BC a prime candidate for HEMS.

The Insurance Corporation of British Columbia (ICBC) reported 3,430 people were injured in motor vehicle accidents in Northern BC in 2012. In the same 2012 report, ICBC’s results compare motor vehicle fatalities between rural and urban areas, one in every 25 motor vehicle incidents in rural areas compared to one in every 136 in urban areas. Contributing factors are reported to include, higher rates of speed on rural highways, increased interface with commercial vehicles, emergency response times, distance to hospitals, poor climate conditions, alcohol or drugs, poor vehicle condition, driver fatigue and wildlife.

Worker’s Compensation Board of British Columbia (WorkSafeBC) reported that in 2012, 149 workers died and 144,000 were injured on the job, costing 2.9 million days of lost productivity. WorkSafeBC did not have the information technology (IT) capabilities to produce the numbers specifically for the Northern region because their data is non-standardized and makes data analysis and comparisons difficult or impossible.
The evolution of trauma systems has closely paralleled local population and geographic considerations. In BC, where access to high-level trauma care can be limited by geographic remoteness, an inclusive trauma system has developed in which an integrated network of local hospitals (level III and IV trauma centers) provides early trauma care and triage, which is the process of determining the priority of patients treatments based on the severity of their condition, to level I centers for definitive care as needed. In contrast, many areas of Ontario, where population density is high and transport distances are relatively short, much of the population has direct, early access to level I trauma centers. This type of access, where there is less reliance on a network of trauma hospitals for early and definitive care is common with exclusive trauma systems. For populations in these regions, investment in pre-hospital care may provide more benefit than the creation of new centers. The nearest trauma center to the communities of Northern BC is the University Hospital of Northern British Columbia, a designated Level III trauma centre serving the entire Northern half of the province².

Among the critical infrastructure for SAR and EMS, HEMS is a critical component. Helicopter emergency medical services is a public good and is the vehicle of choice for many SAR operations compared with traditional methods such as walk-outs and litter carryout's becoming a thing of the past. The main aim of the present

² As defined by the Accreditation Guidelines of the Trauma Association of Canada a Level III Trauma centre is required in jurisdictions without timely access to Level I or Level II centres and typically exist in smaller urban or rural communities. A Level III Trauma centre has a central role in providing trauma care in the local community for both adult and pediatric trauma. Level III centres will be expected to transfer major traumas that require more advanced medical services. Most of the population of Northern BC is six to eight hours driving time to Prince George’s Level III trauma centre and the only Level I trauma services is in the lower mainland which requires ALS aeromedical tertiary transport to travel there.
study is to undertake a systematic study of the role of HEMS in SAR and EMS in Northern BC. The central question raised in this investigation is whether the present trauma and trauma mortality rates in Northern BC and the associated patient-centered benefits substantiate the utilization of a dedicated HEMS.

This study is organized into five chapters. Chapter II provides a literature review on HEMS; Chapter III discusses the methodology used in this study; Chapter IV compares ground EMS verses HEMS; Chapter V has concluding observations with policy and practice recommendations.
CHAPTER II
LITERATURE REVIEW

This chapter briefly reviews the literature on HEMS. The chapter is organized as follows; Section 1 provides the rationale for HEMS in Northern BC. Section 2 deals with a review of literature on HEMS. Section 3 reviews the existing delivery model of emergency medical services in Northern BC. Section 4 deals with the debate on delivery modes; ground verses air emergency medical services and section 5 discusses the challenges of HEMS in the context of Northern BC.

2.1: Need for HEMS Services in Northern British Columbia

British Columbia has some of the most remote worksites, towns and highways and is known for its rugged and diverse topography. Such challenging geography compounds the problems for emergency medical systems. Currently in BC, there exists an essential air ambulance service (fixed and rotary-wing) under the direction of the British Columbia Ambulance Service (BCAS). British Columbia Ambulance Service works on a request-availability basis. Supplementing BC’s service is the contractor Helijet which operates with BCAS paramedics on board. Currently, four helicopter emergency medical stations service 4.6 million residents and the 15 million tourists that visit BC annually (My Destination BC 2013). From their annual budget of $317 million, the air ambulance component has an operating budget of $33 million (Emergency and Health Service Commission 2012; Lang n.d.). Recently, BCAS has come under scrutiny and adverse comments by the provincial Auditor General due to
their inability to demonstrate the quality, timeliness and safety of their patient care. This is largely due to a lack of a performance-based approach to managing its air ambulance services (Office of the Auditor General of BC 2013).

2.2: Brief History of HEMS in Canada and World-wide:

Helicopter emergency medical service is a comprehensive term covering the use of medically equipped air transportation to move patients to designated healthcare facilities. Highly trained personnel provide broad pre-hospital emergency and critical care to patients during aeromedical evacuations or rescue operations.

The first documented medevac by helicopter occurred during the Second World War by the US Army Air Forces (April 1944). The helicopter had its largest impact during the Korean War (1950-1953), where casualties were delivered from the front-line to battlefield medical units and later transported patients from these units to hospital ships off-shore. The use of helicopters has become a foremost component in the modern trauma care system. England, Switzerland, France, Germany, Austria, Italy, Scandinavia, South Africa, Japan and Germany all have very successful versions of helicopter-based EMS. The benefits of HEMS have been well documented (McVey, Petrie, and Tallon 1997; Frankema et al. 2004; Taylor et al. 2010; Mommsen et al. 2012; Taylor et al. 2012; Weerheijm et al. 2012) London Air Ambulance’s analysis of over 14,000 patients demonstrated that trauma infrastructures systems using doctor-led advanced medical care reduce the death rate in severe trauma by 30 to 40% (Bøtker, Bakke, and Christensen 2009).

The concept of the “golden hour” was first coined by the late Dr. R Adams Cowley during the Vietnam War (1965). The understanding was that the quicker a
critically injured soldier was transported to an adequately equipped medical Centre, the greater the chance of survival. A patient who was delivered to trauma surgeons by helicopters within that first sixty minutes, “the golden hour”, had the greatest chance of surviving (Cowley et al. 1979; Lerner and Moscati 2001).

Emergency Medical Services in Canada are the responsibility of the provinces. Each has its own delivery models. In 1977 an air ambulance program was implemented in Toronto, and featured a paramedic-based system of care. The system, operated by the Ontario Ministry of Health, began with a single rotor-wing aircraft. In 2005, the Ontario government announced the appointment of Ornge (formerly the Ontario Air Ambulance Services Co.) to co-ordinate Ontario’s air ambulance system. Ornge, a non-profit body is responsible for all air ambulance operations; contracting of flight service providers, medical oversight of all air paramedics, air dispatch and authorizing air and land ambulance transfers. Ornge has 12 dedicated bases and access to more than 22 bases throughout Ontario. The majority of Ornge’s nearly $184 million operating expenses are ministry funded (Ernst & Young Global Limited 2013).

In Alberta, STARS (Shock Trauma Air Rescue Service), a non-profit foundation, operates its own medical helicopters that are staffed with two pilots, a critical-care nurse and a critical-care paramedic, all employed by STARS. An emergency physician trained in pre-hospital care and transportation is also available by telephone for every emergency response and travels in the helicopter when medically necessary. STARS has service agreements with the Alberta, Saskatchewan and Manitoba governments, operating a total of six bases with total operating expenses per base approximately $10 million a year. The Alberta government provides only 20% of
the cost for the Alberta bases, with the non-profit agency making up the rest through sponsorships and fundraising (STARS Air Ambulance 2014). STARS is compensated $10 million dollars per year by the province of Manitoba to operate a helicopter EMS program out of a Winnipeg base. The provincial of Saskatchewan is investing approximately $10 million dollars annually. The balance of the funds come from STARS fundraising efforts, including contributions from the community and corporate sector.

The province of Nova Scotia operates a single-helicopter air ambulance service out of Halifax. It is operated by Canadian Helicopters with paramedics from Nova Scotia Emergency Health Services (EHS). Nova Scotia EHS also provides service to Prince Edward Island and New Brunswick under mutual-aid agreements. The program is fully funded by the province’s Department of Health and Wellness. Nova Scotia EHS budget was $108 million. Approximately 80% is for paramedic, nurse, physician and other health professionals salaries. The remaining 20% covers operational costs.

While Newfoundland has no dedicated helicopter air-ambulance system, the province operates a fleet of four helicopters that can be used for air-ambulance service on an as needed or emergency basis.

Quebec has no government-mandated helicopter air-ambulance service only ad hoc services operated by AirMédic air ambulance which is a private, membership-based company independent from the public health-care system. AirMédic operates from seven bases in Quebec to airlift members in need of urgent hospital care. AirMédic is not funded by the Quebec government. Annual individual coverage starts
at $120 and family memberships are $250. Members also include remote lodges, the Quebec Major Junior Hockey League and La Capitale General Insurance, which provides its clients with coverage. Services are free of charge for its members and it business model is structured similar to Swiss Air-Rescue Rega in Switzerland, which has operated since 1952 (Dixon 2014; Owen 2014).

2.3: Review of Literature on Helicopter Emergency Medical Services in BC

British Columbia is divided into five geographical Health Authorities: Vancouver Island, Vancouver Coastal, Fraser, Interior and Northern (see figure 2.1). The Fraser Health Authority estimates lost productivity, long-term care and rehabilitation of trauma related injuries costs British Columbians nearly $2.8 billion per year.

Figure 2.1: British Columbia Health Authorities

Source http://www.health.gov.bc.ca/socsec/provmap.html
Injuries to workers result in the loss of more economically productive years than heart disease and cancer combined. A primary challenge for the Northern Health Authority is their ability to provide timely or consistent health services to the residents of the north due to staff recruitment and retention issues.

As Fleet et al. (2013) points out, “With health care costs increasing and physician and staff harder to recruit, rural communities might expect further attempts to centralize hospital services which reduces access to emergency departments”. It is further argued that current legislation may be ineffective in protecting rural citizens from service cuts because poor access to comprehensive emergency care in rural areas is unchallenged and almost accepted as the standard.

The only trauma center to the communities of Northern BC (shown in Figure 2.2) is the University Hospital of Northern British Columbia, a designated Level III trauma centre serving the entire Northern half of the province. As defined by the Accreditation Guidelines of the Trauma Association of Canada a Level III Trauma centre is required in jurisdictions without timely access to Level I or Level II centres and typically exist in smaller urban or rural communities. A Level III Trauma centre has a central role in providing trauma care in the local community for both adult and pediatric trauma. Level III centres will be expected to transfer major traumas that require more advanced medical services. Most of the population of Northern BC is six to eight hours driving time to Prince George’s Level III trauma centre. The only Level I trauma service is in the lower mainland and requires ALS aeromedical tertiary transport to travel there.
Due to current pre-hospital times in Northern BC, time-to-death currently prevents any realistic chance for severely injured patients to survive long enough to access the appropriate level of hospital care. Figure 2.3 shows almost 25% of the population in BC well outside the catchment of the “Golden Hour” and Figure 2.4 is a closer examination at the populations within the Golden Hour catchment in BC.
Figure 2.3: One Hour Trauma Catchment in Canada

<table>
<thead>
<tr>
<th>Total Population</th>
<th>Population outside 1 Hour Catchment</th>
<th>Population inside 1 Hour Catchment</th>
</tr>
</thead>
<tbody>
<tr>
<td>31612897</td>
<td>7115050 (22.5%)</td>
<td>24497847 (77.5%)</td>
</tr>
</tbody>
</table>

Source: www.sfu.ca/gis/schuurman/cv/PDF/accesstotraumasytems.pdf
Injury time-to-death statistics are inconsistently reported and shared between different authorities and services in BC according to the data collected by Simons et al. (2010). This data indicates the majority of trauma death take place within a shorter time period in Northern BC then in other regions. Health Canada and Northern Health Authority statistics (see Table 2.1) show greater injury and injury mortality rates in
rural areas than urban communities. Northern BC is mainly large, sparsely populated regions (Simons et al. 2010).

Table 2.1: Injuries and Fatalities in Canada by Location

<table>
<thead>
<tr>
<th>Location</th>
<th>Fatal</th>
<th>Personal Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>805</td>
<td>109,405</td>
</tr>
<tr>
<td><strong>Rural</strong></td>
<td><strong>1,599</strong></td>
<td><strong>40,206</strong></td>
</tr>
<tr>
<td>Not stated</td>
<td>29</td>
<td>2,224</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,433</strong></td>
<td><strong>151,835</strong></td>
</tr>
</tbody>
</table>

1 Urban includes: (a) metropolitan roads and streets and other urban areas or, (b) a speed limit at a collision site of 60 km/h or less.

2 Rural includes: (a) primary or secondary highways, as well as local roads, or (b) a speed limit at the collision site exceeding 60 km/h.


Higher injury rates in rural or remote communities are often attributed to higher motor vehicle crash rates, higher suicide rates and higher occupational injury rates (Peek-Asa et al. 2004). The 2010 BC Coroner’s Annual Report states that over 2200 people die of unnatural causes. The statistics presented in Figure 2.5 show that Northern BC has a significantly higher death rate than both the Metro and Fraser Valley. This is evident in 77% of fatalities from motor vehicle incidents occurring at the roadside compared to approximately 50% in other BC jurisdictions (Esposito and Sanddal 1995; Grossman and Hart 1995; Gonzalez et al. 2007). Various studies emphasize that if an individual’s condition or injury occurred at or very near an appropriate medical facility, those people, in many cases, would have likely survived (Danielson 2009; Simons et al. 2010; Galvagno et al. 2013). Prolonged discovery times, delays in getting to a hospital or trauma care unit and the lower level of care during transport, directly contributes to the premature deaths of patients.
The BC Coroners report also states that the motor vehicle incident death rates per 100,000 people was the highest in Northern BC with a rate of 23.9, as shown in figure 2.6.

Great distances and limited resources make local access to needed services difficult in rural areas of Northern BC. Rural citizens show higher rates of
unemployment, lower median household income, and lower percentage of high school and college graduates. The population is typically older and has higher rates of chronic disease than the urban population, associated with poorer health putting them at an increased risk for trauma and trauma death compared to urban counterparts (Fleet et al. 2013).

As of 2007 Northern BC saw 592 emergency medical events per every 10,000 individuals (Cameron 2007). The rising number of emergency calls relating to medical situations has resulted in a growing demand of more efficient EMS. There are various entities involved in BC’s pre-hospital emergency care (Cameron 2007). An important component in the chain of survival, are those individuals, called first responders, who arrive or are at the scene of an accident and can help save lives by providing basic first aid, such as CPR and defibrillation, while paramedics are en-route to the scene. First responders are a necessary segment of pre-hospital care.

There are currently six levels of Emergency Medical Assistant (EMA) licences in British Columbia, each level of licence building upon the skills of the one level below it. As of December 2012, there were a total of 13,476 valid EMA licenses in BC. 7,937 are licensed first responders such as firefighters and police officers. 1,271 Emergency Medical Responders (EMR) are the first licence level allowed to transport patients and typically employed in rural and remote areas of the province. There are 3,798 Primary Care Paramedics (PCP) which is the most common level of paramedic working in British Columbia in both rural and urban settings. These first three levels comprise the paramedic population across the province. There are 356 Advanced Care Paramedics (ACP) that work in major centres like Vancouver, Victoria, Nanaimo and
Advanced Care Paramedics provide advanced life support, including advanced cardiac care. 73 Critical Care Paramedics (CCP) provide critical care transport (including air transport) throughout the province (BC Ministry of Health 2012). In the case of infant trauma or critical illness there are 41 specialized Infant Transport Team licenses for approximately 87,537 infants ages zero to one (B.C. Stats 2013). By comparison, Alberta has more than 2,000 Advance Care paramedics servicing one million fewer residents, 300,000 square kilometers less territory and a much less-challenging topography (Government of Alberta 2014).

Multiple reports indicate that the supply of EMAs is on a decline in Canada which is contributing to the staffing challenges facing BC. The main causes to shortages of EMAs in urban and rural municipalities are competition between provinces, demographic composition and low graduating numbers (Hague 2005; Curren 2007).

BC Emergency Health Services (BCEHS), formerly the Emergency and Health Services Commission (EHSC), is responsible for three operating entities, BCAS, the BC (TSBC) and the BC Patient Transfer Network. BC Emergency Health Services is responsible for coordination of all inter-facility patient transfers. The Trauma Services B.C. (TSBC) is dedicated to ensuring all British Columbians have access to a high performing, comprehensive, integrated and inclusive provincial trauma system.

BC Emergency Health Services recognizes that there is a very complex structure for service delivery among all first responders and presently there is no entity responsible for overseeing the coordination between services. In an effort to ensure
pre-hospital emergency care in BC the BCEHS continues to seek applicants to fill service gaps (Cameron 2007).

2.4: Existing Emergency Medical Service Model

Emergency Medical Services communications start as soon as an individual dials. In BC once a 911 call is received by a Public Safety Answering Point that identifies the urgency of the call and make decisions on whether an ambulance, fire or police needs to be dispatched. In Northern BC this is a function of the Prince George Royal Mounted Canadian Police (RCMP) Operational Communication Centre (OCC). This centre services Peace River Regional District; and Regional District of Fraser-Fort George, which coordinates the provision of 9-1-1 services to: Cariboo Regional District, the Regional District of Bulkley-Nechako and the Regional District of Kitimat-Stikine. The communication process is illustrated in Figure 2.7.

Figure 2.7: Emergency Communications Process

When a call for help is placed to 911 and received by an Emergency Medical Call-Taker, a medical priority call assessment begins where an Emergency Medical Dispatcher uses an internationally recognized Medical Priority Dispatch System to
quickly assess the severity of the patient’s condition and deploys the appropriate resources to an accident site.

The two primary methods of transport for trauma patients currently used in BC are by ground or air and two staffing methods of response from BCAS, Basic Life Support (BLS) and Advanced Life Support (ALS). The BCAS’s ground units may respond with lights and sirens activated or without. Some calls of a very lower acuity and may be put in a queue until an appropriate ambulance resource is available. High acuity calls dispatch a ambulance unit with lights and sirens.

As part of the pre-hospital emergency care response, First Responders such as area fire departments, working under the direction of the BCAS, may provide ‘on scene’ first aid and basic life support prior to the arrival of BCAS. On arrival, BCAS assumes patient responsibility. Once at the scene the paramedics triage, treat, stabilize and transport patients to the closest trauma receiving centre (Institute Of Medicine 2007). In the southern regions of BC the BCAS HEMS protocol is most commonly activated when patients are experiencing critical trauma injuries and are greater than twenty minutes driving time by ground ambulance.

In Northern BC, trauma patients are subject to being transported by ground over long distances up to 10 hours because HEMS is not available thus reducing the chance of survival (Oppe and De Charro 2001; Shepherd et al. 2008; Hesselfeldt et al. 2013). Research has shown that an estimated thirteen extra patients with major trauma could survive each year if attended by a helicopter (Nicholl et al. 1995; Thomas et al. 2002; Brown et al. 2010; Hankins 2010; Hameed et al. 2010; Sullivan, Faul, & Wald 2011; Hesselfeldt et al. 2013).
2.5: Debate on Delivery Modes

Numerous studies found significant differences between the two systems. Most important amongst the findings were improved survival rates and travel times to advance medical treatments among patients transported by HEMS (Gearhart, Wuerz, and Localio 1997; Frankema et al. 2004; Mitchell, Tallon, and Sealy 2007; Momsen et al. 2012). Sullivent, Faul, & Wald (2011) found as much as 39% decrease in the odds of mortality in adults transported by HEMS compared with ground ambulance and saving as much as one to 12 lives per 100 uses of HEMS. Weerheijm et al. (2012) pointed out that the average absolute time benefit for ground ambulance was 7 minutes compared to a time benefit of 31 minutes by HEMS. Strong emphasized was made that the time benefit over ground ambulance can be lost when inadequate landing facilities force distant landing. Weerheijm et al. (2012) identified for optimization of helicopter transport times to specialized trauma centres, heliports near the emergency department are essential. Brown et al. (2012) and de Jongh et al. (2012) have reported increased scrutiny around safety issues and overutilization of HEMS. McVey, Petrie, and Tallon (1997) examined two groups of trauma patients that were appropriate for HEMS, one group was flown and the other was transported by ground (because HEMS was not available). Their findings indicated that 5.61 more lives per 100 patients were saved in the group transported by air. Additionally, Sullivent, Faul, and Wald (2011) analyzed 2007 data from the National Trauma Data bank and found that the odds of death were 26% higher in patients transported by ground. Some studies revealed that ground ambulance services benefit from not being limited by weather and climate conditions in contrasted to HEMS. It has been estimated that HEMS misses 20% to 25% of their
calls compared to 5% for ground ambulance (Bruhn et al. 1993) due to severe weather conditions. For distances less than 50 kilometers ground transportation was faster in optimum conditions (Shepherd et al. 2008).

Utilizing HEMS to decrease the time to advance medical treatment (see Figure 2.8 and 2.9 for comparison) is increasingly accepted in North America (Danielson 2009). However the difference between HEMS in Canada and the United States is significant. Due to a fiercely competitive American environment, the number of dedicated HEMS in the United States has roughly doubled every 10 years, to approximately 638 dedicated HEMS compared with Canada’s 20 dedicated HEMS (Jones 2009). Canadian HEMS services operate under largely revenue-hour neutral contracts based on a larger monthly fees and smaller hourly rates. In the United States HEMS is a $2.5 billion dollar annual business that operates largely as a pay for service fee structure. The inherent danger in this business model is the appeal to fly in less than optimal conditions.

Helicopter emergency medical transport in BC is available in the Lower Mainland and Kamloops. Prince Rupert has a single basic life support helicopter for inter-facility transfers and transfers to and from the local airport. The Prince Rupert location can not cover the entire region and the lack of a local destination trauma level I or II centre disqualifies its use in accident/injury scene responses (Simons et al. 2010).
Figure 2.8: Ground Emergency Medical Service
Example service to McBride, BC

Receipt of Call → Mobilization of Ambulance → Mobilization of Ambulance
   ↓                           ↓                           ↓
   Arrival on Scene           Travel Time                Mobilization of Ambulance
   ↓                           1 to 1.5 hours one way*    Within 1 to 3 minutes
   Delivery of Pre-Hospital Aid to Patients

Liaison with Hospital on Appropriate Treatment for Patient
   ↓
   Delivery of Patients to Hospital

Response Time 1 hours 33 minutes

Service Time Minimum total time 3 hours and 6 minutes

* Allocated time reflects optimum weather and road conditions

Figure 2.9: Helicopter Emergency Medical Service
Example service to McBride, BC

Receipt of Call → Mobilization of Helicopter Ambulance → Mobilization of Helicopter Ambulance
   ↓                           ↓                           ↓
   Arrival on Scene           Travel Time                Mobilization of Helicopter Ambulance
   ↓                           30 minutes*                   Within 1 to 3 minutes
   Delivery of Pre-Hospital Aid to Patients

Liaison with Hospital on Appropriate Treatment for Patient
   ↓
   Delivery of Patients to Hospital

Response Time 35 minutes

Service Time Minimum total time 1 hour and 10 minutes

* Allocated time reflects optimum weather and road conditions
The most important factor in determining cost effectiveness of HEMS is the rate of survival (Gearhart, Wuerz, & Localio, 1997; Svenson, O’Connor, & Lindsay, 2006; Svenson et al. 2006) followed by shorting of the time between accident scene and tertiary care (Weerheijm et al. 2012; Lukovits et al. 2013). Additionally important advantages include the aerial view of an accident/injury scene that only a helicopter provides and the ability to access a site where geographical and topographical impediments prevent ground access (Sullivent, Faul, and Wald 2011). Another notable benefit of HEMS that is not fully realized in BC is that dedicated HEMS crews can provide a higher level of care than ground ambulance crews. For example the STARS organization has a crew complement of two pilots, three medically certified individuals; a flight paramedic and a flight nurse active in major hospital intensive care unit or emergency department. Additionally, a physician specialized in emergency medicine and other specialized physicians (e.g., neurosurgeons, cardiologists, neonatal and pediatric intensive care unit team) have assisted on the flights when the clinical condition required their expertise (Powell et al. 1997). In contrast to positive findings with HEMS, others have shown no such improvements. The result is continued scrutiny of HEMS. However studies were of varying sizes and different methods were used to determine if more patients survived when transported by helicopter than by ground ambulances. Patients transported by helicopter or ground emergency medical services had varying numbers and types of procedures en route to the trauma centre (Sollid et al. 2010, Sullivent et al. 2011, de Jongh et al. 2012). The results from reviewed works showed multiple gaps in their methodologies and potential for over
simplifying injury variables. This further supports an ongoing need for diligent reporting, which is imperative for transparency.

Operational HEMS and ground emergency medical service (GEMS) transport together are seen as a way to counter some of the problems and risks associated with specific emergency situations, as when the incident scene does not have a suitable area nearby for a helicopter to safely land. In this case, a ground ambulance provides initial response at the scene and then transports the patient to the closest landing zone where the patient is transferred to an air ambulance. Additionally if the ground ambulance and the air ambulance meet at the injury scene, then joint coverage may be more advantageous both in terms of shorter out-of-hospital time and higher medical care at the injury scene.

A strategy called Autolaunch (shown in Figure 2.10) in BC has been used in the southwest corner of BC since July 1, 2004 and serves the lower mainland and Vancouver Island. This service is for high-risk emergency, the BCAS simultaneously dispatches both a ground ambulance and helicopter ambulance based on information provided from the scene by 911 callers. This compares to the more traditional method of waiting for ground ambulance paramedics to arrive and assess the patient’s condition.
Autolaunch streamlines the triage process by having pre-designated trauma centres that are obliged to accept inbound trauma patients. Therefore Autolaunch approach is able to reduce the elapsed time from patient injury to arrival at definitive care. With the exception of the East Kootenay region, all other areas in the province currently receive air medical services through a request by ground ambulance crews after their arrival on-scene; their requests are subject to the resources, either BCAS or otherwise, available at the time.
2.6: Helicopter Emergency Medical Services Analysis of Challenges

The number of emergency medical helicopters has increased dramatically worldwide. Safety concerns and stresses on resources have continued to cause revaluations of the use of HEMS. Beyond issues of safety are those of improper use and possibly overutilization or triage (Bledsoe et al. 2006; Greene 2009; Sullivent, Faul, and Wald 2011; Janssen and Burns 2013; C. B. Taylor et al. 2013).

Over-triage occurs when the HEMS is dispatched but subsequently cancelled by ground EMS because the patient(s) suffered only minor injuries. It also occurs when HEMS transports a patient with an low acuity or is called to transport a patient who was discharged from the hospital during the last forty eight hours. Reducing over-triage of patients with minor injuries would improve HEMS cost-effectiveness.

A number of helicopter fatal and non-fatal crashes have occurred in Canada in 2012. The Transportation Safety Board of Canada reported that there were forty helicopter accidents (private, commercial and military) yielding a 9% increase from the five-year average of thirty-seven. Seven of those accidents were fatal, with nine causalities. Over the past ten years, the highest proportion of helicopter accidents occurred during air transport operations at 39%, 14% pleasure/travel and 8% training. As shown in figure 7, the greatest numbers of helicopter accidents were associated with landings at 33% and 30% during maneuvering phases of flight, followed by 21% en route and 16% occurring during approach phases (Government of Canada 2012).

In May 2013, an Ontario’s HEMS Ornge helicopter crashed 850 meters from the airport, resulting in the death of all four crewmembers. It was believed the crew lost visual reference with the ground because of darkness. Had the helicopter been
outfitted with Night Vision Imaging Systems (NVIS) such as Night Vision Goggles (NVG) or Enhanced Vision Systems (EVS), this tragedy might have been averted. These technologies, which are growing in popularity can provide increased safety.

With so few Helicopter emergency medical accidents historically in Canada, published studies on German HEMS operations, accident rates and risk factors have been used to measure fatality risks. A total of ninety-nine helicopter emergency medical accidents were identified, dating from September 1970 to December 2009. In nineteen accidents at least one occupant was fatally injured. There were 63 accidents that occurred without any injuries, eight occurred with minor injuries to the occupants, and nine with major injuries. Accidents were graded according to the FIA Score. A four point score using three different parameters; F = fire; I = Instrument meteorological conditions, A = Away from airport to calculate the risk of fatalities after aviation crashes (Hinkelbein et al. 2012). Calculation of the FIA score does not require sophisticated formula and therefore, may be suitable for daily practice in Emergency Medical Service call centers. In addition, the gravity of the crash and

**Figure 2.11:** Helicopter accidents by event phase of flight, 2003-2012

fatalities can be estimated. Furthermore, models to predict injury gravity have been
described for general aviation accidents, as well FIA Score can predict fatalities
precisely in HEMS accidents and is easy to use. Thus, the FIA Score is a valuable tool
in BC HEMS accidents and in EMS calls centres to predict survival after a crash.
CHAPTER III

METHODOLOGY

This chapter describes the research methodology used in this study.

The methodology for studying the relevance and impact of SAR and HEMS has generally followed four broad approaches. The first approach consists of studies which examine data on emergency management system (EMS) and the role of HEMS in EMS over a certain period (Heggie et al. 2008). The second group of studies looks at the effectiveness of HEMS comparing clinical indicators between pre-hospital setting and arrival at the emergency department (ED). The indicators examined at these points (at the scene and on arrival at the emergency department) include patient age, Injury Severity Score and Revised Trauma Score (Matsumoto et al. 2006). The third group of studies examine the relative effectiveness of ground versus helicopter EMS (Rhodes et al. 1986; Schiller et al. 1988; Cunningham et al. 1997; Lerner et al. 1999; Wills et al. 2000). The fourth group of studies examine the relative cost effectiveness of ground versus helicopter based EMS (Bruhn et al. 1993; Nicholl et al. 1995; Gearhart et al. 1997; Taylor et al. 2012; Delgado et al. 2013). We adopt the latter (third and fourth) approach in our investigation. The author has substantial operational and policy experience in the HEMS industry. Based on the existing literature and operational evidence of SAR and HEMS in Northern British Columbia, the author tested the existing hypothesis (especially related to cost and benefits) using ethnographic research methods widely used in anthropology, marketing, human
resources, organizational behavior etc. In this endeavor, the author conducted open-ended repeated interviews with experts, practitioners and stakeholders in this field to derive informed conclusions. These conclusions could be considered similar to those derived under Delphi method.

3.1: Limitations of the Study

This study used HEMS, EMS, and trauma documentation as the main sources of information. Unfortunately, these sources did not include specific information regarding time to discovery or capture data on victims that succumbed before help arrived. The reviewed literature predominantly focuses on medical outcomes limiting the scope of its relevance to Northern BC unique situation. In addition, there is a disconnect between data sources within the overall health infrastructure that accounts for inconsistencies in data and the probable absence of relevant data. Archival data sets may have suffered from missing, incomplete, or compromised data. This can take the form of insufficient sample size, the absence of information on important variables that were not included in the original data collection, or the reliance on flawed or out of date measures.

Regrettably the BC Trauma Registry does not review those individuals who die prior to arriving at the hospital. Even though the BC Coroners Office does captures some of this information they only investigates those incidents that are sudden and suspicious. In 2010, there were 31,428 deaths in British Columbia, 7,825 of which were reported to the BC Coroners. The significant flaw is that there is no formal partnership or exchange of data between these two organizations.
CHAPTER IV

GROUND VS HELICOPTER EMERGENCY MANAGEMENT SERVICES - SUBSTITUTES OR COMPLEMENTS?

The task of coordinating a rescue operation demands effective selection of tools and personnel. Among the toolkit, the choice between ground and helicopter rescue models is controversial. This chapter attempts a discussion on the relative merits of ground and helicopter based rescue missions. The chapter is organized as follows: Section 1 discusses the rescue management and activity cycle. Section 2 compares the cost and effectiveness of ground-based EMS vs helicopter-based EMS. Section 3 summarizes the conclusions.

4.1: Rescue Management and Activity Cycle

The resource and information flow in an organized rescue infrastructure can be represented in Figure 1.

Table 4.1 - Typical search and rescue operation effort and resource management hierarchy.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Observation and Analysis</td>
</tr>
<tr>
<td>2.</td>
<td>Task/Need Identification</td>
</tr>
<tr>
<td>3.</td>
<td>Resource Availability Check</td>
</tr>
<tr>
<td>4.</td>
<td>Resource Request</td>
</tr>
<tr>
<td>5.</td>
<td>Operation Execution</td>
</tr>
</tbody>
</table>

Source: Chatterjee and Matsuno (2005) p.842.

1. Observation and Analysis:

This involves observation and acquisition of relevant information to estimate and evaluate the degree of damage and typically involve the following steps:
(i) Analyzing the characteristics of the situation;
(ii) Estimating the basic functionalities required to access the intended region;
(iii) Estimating the available time for any operation taking into consideration the elapsed time.
(iv) Estimating the degree of risk to the rescue personnel and equipment from the situation.

2. Task identification:

Task identification involves what, when, where, why and how to do an operation. In other words, this activity involves identification of specific needs (target of a rescue operation). The task could be to look for any trapped person or mapping a region or delivering food or drugs to an already located victim etc. The composition and expertise of the team to put together directly depends on the goal of the activity.

If the incident happens in less populated and remote areas where there are few developed roadways and limited services available, one cannot use ground-based ambulance systems. These access roads are often temporary trails or narrow gravel roadways. Hence the choice narrows down to helicopter or fixed wing aircraft, landing at temporary heliports or remote airstrips with landing surfaces varying from asphalt and concrete to grass and gravel.

3. Resource availability check:

Once the task is specified, the rescue personnel on site may take stock of the immediate availability of usable equipment which may be necessary to perform the task. In the case of rescue missions in less populated and remote locations, the resources required is the Rotary Air Ambulance system. These remote operations and
the travel conditions to access them present a variety of risks to the workers, residents, wildlife and environment.

4. Resource request:
In cases that the target task requires additional equipment, the situation and requirements are conveyed to higher-level facilities which are likely to act as a warehouse of necessary resources.

5. Operation Execution:

For site level rescue team, this is the actual search and rescue task execution phase.

4.2: Cost of Delivery of Ground Versus Helicopter EMS

In Northern BC transporting a patient to definitive care, usually requires transport with multiple ambulances through numerous community hospitals. Prior research has shown that HEMS is economically justifiable for trauma (Gearhart, Wuerz, and Localio 1997; Bruhn, Williams, and Aghababian 1993; C. Taylor et al. 2012). On the other hand, other studies have reported findings which show HEMS to be more expensive (Nicholl et al. 1995; Delgado et al. 2013). Although, there are no publicly available information about the relative costs in recent years, the study by Jarrett Bruhn from the Department of Economic at Clark University in Worcester Massachusetts offered a relative comparison of costs of ground vs. air ambulance models (Bruhn, Williams, and Aghababian 1993). Table 3.1 reports the annual operating cost of ground and helicopter ambulance system for 1991 which is also valid in the present environment (after adjusting for inflation).
### Table 4.2: Annual Cost of Operating Ground Vs. Helicopter EMS - 1991.
(in US$$s)

<table>
<thead>
<tr>
<th>Operating Category</th>
<th>Ground (6 vehicles)</th>
<th>Helicopter (1 vehicle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office utilities, base</td>
<td>39,600</td>
<td>39,600</td>
</tr>
<tr>
<td>Office rent and utilities, other sites</td>
<td>assumed donated</td>
<td>none needed</td>
</tr>
<tr>
<td>Medical supplies, new</td>
<td>240,000</td>
<td>40,000</td>
</tr>
<tr>
<td>Medical supplies, disposable</td>
<td>12,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Non-medical supplies</td>
<td>33,500</td>
<td>5,600</td>
</tr>
<tr>
<td>Maintenance</td>
<td>72,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Unexpected costs</td>
<td>18,000</td>
<td>18,000</td>
</tr>
<tr>
<td>Insurance</td>
<td>28,800</td>
<td>Included in lease</td>
</tr>
<tr>
<td>Vehicle fuel</td>
<td>24,500</td>
<td>92,300</td>
</tr>
<tr>
<td>Training (centralized)</td>
<td>6,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Vehicle lease</td>
<td>45,600</td>
<td>975,000</td>
</tr>
<tr>
<td>Total operating costs</td>
<td>520,000</td>
<td>1,197,500</td>
</tr>
</tbody>
</table>

#### Staff Costs Salary and Benefits

<table>
<thead>
<tr>
<th>Role</th>
<th>Ground Annual Cost</th>
<th>Helicopter Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurses (5 full-time equivalent [FTE] per vehicle)</td>
<td>1,290,000</td>
<td>215,000</td>
</tr>
<tr>
<td>Paramedics (5 FTE per vehicle)</td>
<td>984,000</td>
<td>164,000</td>
</tr>
<tr>
<td>Driver/Pilot (5 FTE per vehicle)</td>
<td>900,000</td>
<td>included in lease</td>
</tr>
<tr>
<td>Clinical operations director</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Medical director</td>
<td>25,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Office staff (part time)</td>
<td>35,000</td>
<td>35,000</td>
</tr>
<tr>
<td><strong>Total staff cost</strong></td>
<td>3,284,000</td>
<td>489,800</td>
</tr>
</tbody>
</table>

#### Total Annual Cost

<table>
<thead>
<tr>
<th>Ground Annual Cost</th>
<th>Helicopter Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,804,000</td>
<td>1,686,500</td>
</tr>
</tbody>
</table>

Source: True costs of air medical vs. ground ambulance systems. Air Medical Journal 1993

Analysis based on Table 3.1 shows the annual cost of operating a ground-based ambulatory care is nearly 2.3 times that of helicopter-EMS. The cost per patient of ground-EMS is also nearly twice that helicopter-EMS. Secondly, the fundamental basis for helicopter-EMS is the fact that it can confront any adverse locations not hospitable to ground-EMS with greater relative speed (to ground-based EMS). It provides improved patient outcomes or expedites the transfer of patients that cannot be
transported by any other means. Thirdly, the likelihood of saving a life (major benefit of helicopter-EMS) is greater in helicopter-EMS than in ground EMS.

Table 4.3: Cost Per Patient in Ground and Helicopter EMS- 1991 (in US $s)

<table>
<thead>
<tr>
<th>Category</th>
<th>Ground</th>
<th>Helicopter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total annual requests</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Missed due to weather</td>
<td>50</td>
<td>250</td>
</tr>
<tr>
<td>Missed due to being in use</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Missed due to maintenance</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Total annual missions completes</td>
<td>850</td>
<td>600</td>
</tr>
<tr>
<td>Annual System cost ($)</td>
<td>3,804,000</td>
<td>1,686,500</td>
</tr>
<tr>
<td>Cost per completed mission ($)</td>
<td>4,475</td>
<td>2,811</td>
</tr>
</tbody>
</table>

Source: True costs of air medical vs. ground ambulance systems. Air Medical journal 1993

In recent years studies concluded that the annual cost of HEMS ranged from $115,777 to $3,023,568 and a per patient transport cost of $2,214 to $15,849 (P. Gearhart, Wuerz, and Localio 1997; Taylor et al. 2010). There were studies that looked at the cost effectiveness ratios per year of life saved showed benefits ranging $2500 to $10,548 (Silbergleit and Scott 2003; Bardach, Olson, and Elkins 2004; Mitchell, Tallon, and Sealy 2007). Studies by Kurola and Wangel (2002) and Taylor et al. (2009) suggests that per life saving or beneficial mission was worth € 28,444 or 91,478 ($ USD). Delgado et al (2013) suggests that even if HEMS costs $10,000 more per transport than ground transport, as it might in rural areas with low flight volume, it would cost less than $100,000 per quality-adjusted life-year if mortality reductions of more than 25% could be achieved.

3 The quality-adjusted life year or quality-adjusted life-year (QALY) is a measure of disease burden, including both the quality and the quantity of life lived. It is used in assessing the value for money of a medical intervention. The QALY is based on the number of years of life that would be added by the intervention. Each year in perfect health is assigned the value of 1.0 down to a value of 0.0 for being dead. If the extra years would not be lived in full health, for example if the patient would lose a limb, or be blind or have to use a wheelchair, then the extra life-years are given a value between 0 and 1 to account for this.
4.3: Conclusions:

Helicopter emergency transport services are not costly when compared to similar services provided by ground. The cost and effectiveness of HEMS are well documented in research and applied literature. Despite, the general perception that it is more expensive than ground transport, a number of studies found HEMS to be cost-effective. Given these results and the effectiveness of operation execution of HEMS, there is an apparent case for use of HEMS. HEMS and Ground EMS are not substitutes for each other. Rather they are complements and their relative use depends on where the incident occurs and what is the gravity of the situation. The capital expenditure component of HEMS can be fully public or private or public-private. Decisions on ownership of capital assets are secondary to the debate.
CHAPTER V
CONCLUDING OBSERVATIONS

In most of the developed countries like Canada, residents and visitors generally participate in some type of outdoor activity like hiking, backpacking, biking, water rafting, canyoneering etc. With these opportunities comes the risk of injury and illness and may require search and rescue (SAR) or emergency medical system (EMS). The trauma that affects the victims is often grave and physical and is the leading cause of disability, morbidity and death in Canada and world-wide. Approximately 200,000 Canadians are hospitalized every year due to acute injury. The need for SAR and EMS is relevant in remote places like Northern BC. Nearly three-quarters of deaths in Northern BC occurs before victims are brought to a hospital; in Northern BC, 82% of injured die before hospital care can be provided as compared with 12% in Metro Vancouver. The public expectation of safe and successful responses has reached extraordinary heights in recent years. In the modern world, the clamor for rescue services assumes greater importance given the fact that substantial segment of the population is litigious and distrustful of authority. The societal response to disasters begin with the initial-post event rescue and relief operations (SAR and EMS). This is followed by recovery, reconstruction, mitigation and these are collectively known as the emergency response cycle.

Trauma should be recognized as a disease process that requires a multidisciplinary team response. The medical services and trauma care infrastructures must then also be relevant to the needs of the north. The contemplation of dedicated
HEMS exposes a range of claimed ‘benefits’ and ‘disadvantages’ from other authorities that may be relevant in Northern BC context. Northern BC is in a unique situation considering medical services, trauma care and HEMS. This study recognizes the unique characteristics and needs of rural and remote areas and the relevance of the HEMS and trauma infrastructures to people at risk.

The University of Northern British Columbia Hospital (UNBCH) is an accredited Level III Trauma centre, the only one in the north. It has an emergency department staffed entirely with CCFP-EM physicians⁴. It also has trauma surgeons who can manage all intraabdominal trauma, most thoracic trauma and emergency neurosurgical trauma in the form of rapidly expanding epidural and subdural bleeds. Once the immediate threat is minimized and the patient stabilized, they can then be transferred to a neurosurgical centre (Level I trauma centre) in Vancouver or Edmonton.

Additional UNBCH has two trauma surgeons who worked for the military in the Afghanistan campaign and two vascular surgeons who can manage vascular injuries and emergency bleeds. There is a trauma team leader on call 24 hours a day to deal with all major traumas that might arise. All burn victims can be managed in their initial stages at UNBC Hospital and then transferred to Vancouver General Hospital.

Treatable life threatening injuries like ruptured spleen or epidural bleed that requires definitive treatment within two to four hours, can not be managed in smaller centres, in the north. However if a patient has a chance to be brought to UNBCH for high level emergency management to diminish or eliminate the risk of

⁴ This designation means that the physician presently holds Certification in Family Medicine and Certificate in Special Competence in Emergency Medicine from the College of Family Physicians of Canada.
death or permanent disability it should be provided. Canada has recognized the right of each resident to equal access to medical care but in the realm of trauma not all residents are equally helped. British Columbians view basic health care as a fundamental right. For more than a quarter of all British Columbians, appropriate treatment after injury will be, at best, unpredictable and, at worst, unavailable, resulting in death and disability. Trauma is predictable. It happened yesterday, it is happening today, and it will happen tomorrow.

Fortunately, proven solutions are available. The development of dedicated HEMS in Northern BC should be completely integrated and must ‘evolve’ from, and complement, existing services for pre-hospital emergency care such as Ministry of Health, BCAS, the BC First Nations Health Authority and policing services. The case of HEMS is based on two reasons: first is the rapid transport of the patients to the definitive care centre. Second is the immediate life support usually provided by the helicopter crews. The system is presently built on a two-tiered response. The initial responders are ground-based crews. The helicopter crews are second responders. The decision to activate the helicopter system depends on the nature of the event, accessibility of first responders to the event site, the gravity of the situation etc.

There are a number of key elements required including; regulatory compliance, development and certification of landing sites; development and implementation of education awareness programs; recruitment and training of properly skilled staff and the procurement of helicopter. The formation of proper
affiliations between the pre-hospital emergency care services and the hospital services will be essential. Standard Operating Procedures (SOPs) are developed internally that covers all aspects of safe operations and compliance of all regulations. These SOPs must be developed in partnership with BCAS. Various stakeholder arrangements would need to be established, including hospital resourcing and staffing arrangements, funding and payment agreements, hospital protocols, clinical and operational auditing functions and ‘memorandum of understanding’ with various other agencies, particularly those in the emergency medical service sector (Booz/Allen/Hamilton 2004).

Any decision to introduce dedicated HEMS in Northern BC would involve significant capital investment and annual operating costs; due to the need to provide landing sites and other supporting infrastructure to ensure effective service. One dedicated HEMS would involve up to six million in capital investment and incur annual operating costs of four million dollars. Of this additional annual operating cost, two-thirds to three-quarters would be associated directly with helicopter operations (including a base for the aircraft and operational crew) and the remainder associated with medical staff salaries and asset management. Key considerations in assessing the most appropriate location for a dedicated HEMS will include the quality, depth and breadth of medical skills, resources and services available for the treatment of ‘incoming’ critically ill and or severely injured patients.

Policy changes introduced by the British Columbia Liberal Party (BCLP) have sought to empower corporate actors through deregulation, and institutionalizing the separation of corporate resources and local or community-based economies in the
province. These reforms have established multiple liberties for major corporate players in the resource economy (Young and Matthews 2007). This fact makes investing in local communities’ increasingly strategic for major corporate players and presents an economical avenue for fostering community relationships.

Corporations throughout Canada like PotashCorp in Saskatchewan, who understand the value of deep roots in communities and have invested $27 million dollars towards providing HEMS to small communities. PotashCorp President and CEO, Bill Doyle, remarked that safety and improving the quality of life where they live and work are high priorities for companies (Potash Corporation of Saskatchewan Inc. 2011).

The benefits of a dedicated HEMS for corporations are added safety net for employees and their families, reduced WorkSafeBC premiums and reduced insurance premiums and payouts. Additional benefits are a reduction in deaths and the number and severity of disabilities caused by trauma. Further benefits are an increase in the number of productive working years through reduction of death and disability and a decrease in the costs associated with initial treatment and continued rehabilitation of trauma victims. Local communities, municipalities, provincial and federal government agencies would all have a reduced burden of supporting disabled trauma victims. Communities and local care facilities would gain the benefits of increased availability of additional highly skilled emergency medical personnel through a dedicated HEMS.

5.1: Challenges

The HEMS’ single biggest challenge in Northern British Columbia’s single biggest challenge will be the establishment of partnerships and support by all levels of
government. Secondary to support, will be the integration of a new system into the current BC medical system, as current regulatory regimes are restrictive to new entrants. When considering the high costs and potential risks associated with HEMS, strict dispatch criteria and protocols will need to be established with the purpose of identifying those who would benefit the most, while preventing excessive over utilization. The aging population, earlier discharges from hospitals, and lack of skilled medical resources in the north increase the demand for emergency services such as HEMS.

5.2: Recommendations

Change is inevitable, more and more people will be converging on the North as employment and investment opportunity develop. Demographic shifts, expanding resource’s exploration, development of transportation infrastructures, and population growth all point to an evolving Northern region.

The operations plan for HEMS is complex and substantial in scope due to the nature of the service. Helicopter emergency medical service operations require many levels of regulatory compliance, oversight and partnerships which include the blending of corporate cultures. The first and highest priority for the operations plan is to ensure that all aspects of safety are considered and all safety considerations are implemented and practiced within the culture of HEMS. The safety of patients and staff must always be the number one priority for HEMS. The second objective is to achieve results that are meaningful for patients, ensuring that the actions have a positive impact on patient care. Northern British Columbians need to know that emergency care will be there when they need it without delay. For the vast majority of people, being involved in a
trauma injury or being critically ill is fortunately a rare occurrence. People need to have confidence that their problem will be quickly identified by appropriately qualified staff and, if treatment or hospitalization is needed, that this will be delivered quickly and to a high standard.

When it comes to trauma and the critically ill, time is truly a life and death matter. Figure 5.1 is a visual representation of the estimated distance a helicopter will travel within 15 minutes, 30 minutes, 45 minutes and 60 minutes after it takes off from Prince George.

Figure 5.1: One Hour Helicopter Catchment Area from Prince George

Distance & Response time calculated using Technical Data for a Bell 429 Helicopter and an estimated dispatch time of three minutes.

Source: www.nbcHEROS.org
After decades of HEMS debates, BC still lacks a comprehensive strategy that recognizes the complexity of trauma care issues in the north and the tradeoffs involved. Everyone has the right to quality medical care wherever he or she may live or travel. The North of BC needs an unquestioned, competent and high caliber life saving transport for critical ill and injured patients, which can only be developed by the creation of an independent and dedicated helicopter emergency medical service.
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