HQCA
Health Quality Council of Alberta

April 2011

Review of the Safety Implications for Patients Requiring Medevac Services to and from the Edmonton International Airport

As Requested by the Minister of Alberta Health and Wellness and in Accordance with Section 13 of the *Health Quality Council of Alberta Regulation* 130/2006 under the *Regional Health Authorities Act*

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EXECUTIVE SUMMARY

On October 20, 2010 the Minister of Health and Wellness, following a request by the Premier, directed the Health Quality Council of Alberta (HQCA) to conduct an assessment of the patient safety issues to be addressed if or when medevac services are relocated to the Edmonton International Airport. This assessment was conducted in accordance with Section 13 of the *Health Quality Council of Alberta Regulation* 130/2006 under the *Regional Health Authorities Act.*

To perform this assessment, the HQCA established a review team charged with conducting a prospective safety analysis and developing recommendations to mitigate patient safety-related problems that might exist during transportation of medevac patients into and from the Edmonton International Airport. Although the review team initially focused on patients with time-sensitive conditions (or 'Red Priority' patients), a decision was made to also consider patients with time-dependent conditions (or 'Yellow Priority' patients). The decision to close the Edmonton City Centre Airport was out of the scope established for the review.

Accountability for the review was with John Cowell MSc MD CCFP FRCPC (Executive Sponsor and Chief Executive Officer, HQCA). Jay Ramotar, Deputy Minister of Alberta Health and Wellness was the lead and key Ministry contact. The HQCA Review Team members consisted of Charlene Blair BScPharm RPh PBDM (Project Lead, HQCA), Herman Borkent BSc MD CCFP, Jan Davies MSc MD FRCPC, Carmella Duchscherer RRT BHS(RT) MPA, Rinda LaBranche RN BEd MEd (Patient Safety Lead, HQCA) and Kim Trufyn MT (Program Assistant, HQCA).

Using the *Systematic Systems Analysis - the Alberta Approach to Patient Safety Reviews*, the HQCA Review Team focused on how relocating medevac services from the Edmonton City Centre Airport, including the transportation of medevac patients to and from the Edmonton International Airport, would be affected. As part of the methodology, the following activities were conducted:

- A review of previous reports about medevac transportation into the Edmonton City Centre Airport.
- A systematic search of the literature.
- Surveys sent to identified stakeholders.
- A review of documents from key stakeholders.
- Interviews with key stakeholders.
- A Proactive Risk Assessment (modified Healthcare Failure Mode and Effects Analysis®).
- Observation of the medevac work environment at the two Edmonton airports.
- Collection of data from other provinces/territories and one U.S. city.

During the review, the team sought the knowledge and opinions of a wide range of individuals from Alberta, other provinces/territories and one U.S. city. Several concerns were identified related to the safety of medevac patients and suggestions for improvements and recommendations were elicited.

On August 3, 2010 one of two runways at the Edmonton City Centre Airport was closed, based on an order from the City of Edmonton. The runway that closed had instrument landing system capabilities that could accommodate medevac flights during low ceilings or reduced visibility due to fog, rain or blowing snow. Since then, an increased number of medevac flights have been diverted from the Edmonton City Centre Airport to the Edmonton International Airport due to weather and runway limitations.

The relocation of medevac services from the Edmonton City Centre Airport to the Edmonton International Airport results in a longer journey for patients who are brought to a tertiary care facility in Edmonton. The main patient safety concern is that an increase in journey time for critically-ill medevac patients could have a negative effect on their well-being. While there are specific groups of patients for

whom an increased journey duration represents an increased threat to their well-being, it is difficult to determine the magnitude of this effect.

Additionally, the effect of the increased journey time extends beyond the patient who is in transit. Other patients waiting for emergency air transportation are affected, as are those who require transportation by air to leave an Edmonton hospital and return home. Thus, the current partial closure of the Edmonton City Centre Airport is already having an effect on the medevac system.

Since August 2010, both Alberta Health Services and Edmonton Regional Airports Authority have made changes to their structures and processes in an attempt to mitigate the problem posed by the closure of one runway at the Edmonton City Centre Airport. These two organizations are to be commended for these changes and for their willingness to consider various options. However, not all necessary structures and processes have been established at the Edmonton International Airport to mitigate potential patient safety concerns related to this relocation.

RECOMMENDATIONS:

To support and guide the transition of medevac services from the Edmonton City Centre Airport to the Edmonton International Airport, the following recommendations are made:

1. A Transition Advisory Committee be struck to facilitate information sharing and to advise on key decisions. Representation on this committee should include individuals from Transport Canada, NAV CANADA, Alberta Health and Wellness, Alberta Health Services, the medical community, fixed wing and rotary wing providers (both air and medical crews), the Edmonton Regional Airports Authority and a member of the public. As well, correspondence and consultation with Alberta Finance, Alberta Transportation, British Columbia, City of Edmonton, Northwest Territories, Saskatchewan and Yukon should occur.

To minimize transfer time for patients transported to Edmonton International Airport and from Edmonton International Airport to treatment facilities in Edmonton, as well as the medical crew returning from the treatment facility back to the airport, it is recommended that:

2. Until a new dedicated Medevac facility is in place, the Edmonton International Airport provide a dedicated area for medevac flights, which should include parking for medevac aircraft and ambulances, power, refueling and other services.

3. Traffic patterns be studied and an optimal ambulance route established from the Edmonton International Airport to tertiary care facilities.

4. An evaluation be conducted on the impact of traffic lights on transport times and changes implemented to minimize this impact. Changes could include installing an Optacom device/system to allow ambulances to change traffic lights to green or synchronizing traffic lights on the main routes from the Edmonton International Airport to tertiary care facilities.

5. All ambulances be equipped with a Global Positioning System so alternate routes can be determined when traffic is problematic.

6. The current process of how medical crews return to the airport from the tertiary care centre be improved. This could include timely transfer of care from the medevac crew to the tertiary care facility, providing taxi-cab drivers with greater financial incentive to take staff to the Edmonton International Airport or using Alberta Health Services transportation.

7. Arriving and departing medevac flights be given priority for landing, taxi and take-off.

In the future, additional building and infrastructure will be necessary at the Edmonton International Airport to support expanded medevac services. Therefore, it is recommended that:

8. A new facility dedicated to medevac aircraft and ground facilities be built at the Edmonton International Airport. This should include space to accommodate:
   - the transfer of patients from air to ground ambulance that is out of the elements
   - crew facilities to allow uninterrupted rest periods for flight crews
   - storage of necessary equipment

9. The new facility/air ambulance hangar be located away from the general commercial traffic.

10. Additional road infrastructure, such as an on/off ramp from the new facility that will provide faster access to north-bound Queen Elizabeth II or a dedicated emergency lane on Queen Elizabeth II, be built.

Regardless of where medevac services are located within the Edmonton area, there are a number of additional changes that can be made to improve medevac services in Edmonton and province-wide. Therefore, it is recommended that:

11. A standardized and agreed upon coding system is implemented for classifying and prioritizing patient transports, along with standardized use of the term 'medevac'.

12. The mandatory use of RAAPID (Referral, Access, Advice, Placement, Information and Destination) for all patient transports and the Red Referral process for all critically-ill patient transports originating within and outside Alberta be adopted.

13. Ground ambulances that transport patients between the Edmonton International Airport and Edmonton hospitals are staffed with a second healthcare provider to provide care during ground transportation of unstable or critically-ill patients.

14. Equipment is standardized across the various ground and air ambulance providers (including fixed wing and rotary wing).

15. Medical personnel who transport patients in ground ambulance, rotary or fixed wing aircraft are cross trained in all modes of transport.

16. Once equipment is standardized and personnel are trained, rotary wing transportation between the Edmonton International Airport and the tertiary care facility be used when it is deemed that this mode of transport will result in substantial time savings (e.g., extreme traffic/road conditions that would result in unacceptable delays using ground transportation).

While some of the recommendations in this report are directly related to the increase in transfer time from the Edmonton International Airport to a tertiary care hospital in Edmonton, there may be additional opportunities to decrease the overall duration of a patient's journey. Other factors, such as pre-transport care, may also affect what happens to a patient. Therefore, it is recommended that:

17. An evaluation of the entire process of the transfer of medevac patients, with application of quality improvement techniques, should be conducted to identify:
    - opportunities to reduce times spent before air ambulance transportation
    - improved and/or new ways of providing care, such as assessment of services available in hospitals outside and within Edmonton

Although the HQCA review was tasked with assessing and inquiring into the patient safety implications of relocating medevac services to the Edmonton International Airport, the review team also identified additional concerns that could arise if the Edmonton International Airport is the only airport in the Edmonton area for medevac flights. Prior to take-off, all flights are required to create a flight plan that includes determination of an alternate airport. When the Edmonton City Centre Airport is closed, the Edmonton International Airport will be the primary destination and the closest instrument landing system airport located in Calgary will likely be the alternate. If medevac flights are not able to land at the Edmonton International Airport and must go on to Calgary, several patient safety concerns arise. Certain services are available only in Edmonton hospitals and critically-ill patients who require those services would not receive timely care (i.e., neonatal extra-corporeal membrane oxygenation, major neonatal cardiac surgery, major organ transplants and hyperbarics). In addition, patients being sent to Edmonton should have a physician and a hospital bed identified in Edmonton. If they are re-routed, finding another bed and physician in the alternate city adds to the complexity of the situation and requires further and last minute coordination.

For flights that originate a long distance from Edmonton, designating the Edmonton International Airport as the primary destination and Calgary as the alternate airport could result in a mandatory fuel stop. This means longer transport times for these patients. Refueling requires that patients be off-loaded from and reloaded onto the aircraft. Patients are exposed to inclement weather/ temperatures and are at increased risk of inadvertent medical line and tube dislodgement. For some flights, such as those originating from Whitehorse, Yukon, it might be beneficial to fly directly to Calgary. Diversions to Calgary could result in capacity issues at both the Calgary airport and tertiary care facilities. Because of these identified concerns, it is recommended that:

18. Another airport be considered as a back up within the Edmonton area with instrument landing system capabilities that can accommodate medevac flights.

CONCLUSION:

In July 2009, the City of Edmonton decided to implement a phased closure to the Edmonton City Centre Airport (ECCA). On August 3, 2010, based on an order from the City of Edmonton, one of two runways at the ECCA was closed. The runway that closed had instrument landing capabilities that could accommodate medevac flights during low ceilings or reduced visibility. This closure has resulted in an increased number of medevac flights being diverted from the ECCA to the Edmonton International Airport.

The HQCA review has identified patient safety issues and associated recommendations due to the partial closure of the ECCA that need to be addressed. In addition to these concerns, the review includes recommendations that should be addressed prior to the full closure of the ECCA.

PROJECT OVERVIEW

INTRODUCTION

The provision of medical care in Alberta, and across Canada, is based on the principle that "all residents have reasonable access to medically necessary hospital and physician services.[1] However, approximately 20% percent of Albertans and other Canadians live in rural rather than urban areas.[2] Some of these rural areas are geographically isolated from major medical centres, which may make it difficult for individuals to gain access to care on a time-critical basis, for example, for trauma or complicated obstetrics. In addition, not all health services can be offered in all locations, for example, diagnostic services such as magnetic resonance imaging (MRI) or surgical treatment of cardiac disease.

Improved access to both time-critical care and specialized diagnostic and treatment services has been achieved through the use of ground and air ambulance based services, with the latter including fixed wing and rotary wing aircraft. For those patients requiring urgent or emergency care, this process is known as 'Medevac', as shorthand for 'medical evacuation'.

Starting in the 1930s and 1940s, patients from the northern part of Alberta, as well as northeastern British Columbia, Nunavut, Northwest Territories, Yukon and northern Saskatchewan have been flown from their home centres to Edmonton, with the aircraft landing at the Edmonton City Centre Airport. Patients from the southern part of Alberta, southeastern British Columbia, and southern Saskatchewan have been flown to Calgary, landing at the Calgary International Airport. The announcement by the Edmonton City Council in July 2009 of the planned closure of the Edmonton City Centre Airport was to change the process for patients being transported to Edmonton by air for medical treatment.

PURPOSE

On October 20, 2010 the Minister of Health and Wellness requested that the Health Quality Council of Alberta conduct an assessment of the patient safety issues to be addressed if or when medevac services are relocated to the Edmonton International Airport.

OBJECTIVES

To achieve this purpose, Health Quality Council of Alberta established a review team charged with conducting a prospective safety analysis and developing recommendations to mitigate patient safety concerns that might exist during transportation of medevac patients into and from the Edmonton International Airport. A final report detailing the findings and recommendations was to be submitted by April 30, 2011.

SCOPE

The scope of this review was to focus on those critically-ill ('Red Priority') patients, who require time-sensitive care. The review was not to examine the decision to close the Edmonton City Centre Airport.

Although the HQCA Review Team initially focused on patients with time-sensitive conditions (or 'Red Priority' patients), a decision was made to also consider patients with time-dependent conditions (or 'Yellow Priority' patients). As with any coding scheme, the large variability in patients' condition often makes precise coding difficult. In addition, because of the possibility of a patient with a time-dependent ('Yellow') condition deteriorating to a time-sensitive ('Red') state during transportation, it was thought important to consider these additional patients.

PROJECT GOVERNANCE

This review was conducted in accordance with Section 13 of the *Health Quality Council of Alberta Regulation* 130/2006 under the *Regional Health Authorities Act*. This review was not undertaken by the Quality Assurance Committee of the HQCA.

Accountability for the review was with John Cowell MSc MD CCFP FRCPC (Executive Sponsor and Chief Executive Officer, HQCA). Jay Ramotar, Deputy Minister of Alberta Health and Wellness was the lead and key Ministry contact. The HQCA Review Team members consisted of Charlene Blair BScPharm RPh PBDM (Project Lead, HQCA), Herman Borkent BSc MD CCFP, Jan Davies MSc MD FRCPC, Carmella Duchscherer RRT BHS(RT) MPA, Rinda LaBranche RN BEd MEd (Patient Safety Lead, HQCA) and Kim Trufyn MT (Program Assistant, HQCA).

METHODOLOGY

This review was conducted using the *Systematic Systems Analysis: the Alberta Approach to Patient Safety Reviews.*[3] This methodology has three steps:

- Gather Information
- Conduct an Analysis
- Develop Recommendations

GATHER INFORMATION

Information was gathered from a number of sources. These included:

1. Previous reports about medevac transportation into the Edmonton City Centre Airport

   Three reports were reviewed:
   - Institute of Health Economics. *IHE Report: Air Ambulance with Advanced Life Support.* February 2008.[4]
   - Fitch and Associates. *City Centre Airport Closure Impact Study*. Edmonton: Alberta Health and Wellness Emergency Services Branch, March 25, 2009.[5]
   - Towers, D. L. *Report to the City of Edmonton, Medevac Transport*. Edmonton, 2009.[6]

2. A systematic search of the literature

   This literature search was conducted by a qualified medical librarian, using the same search terms as employed in the IHE Report (2008), but with time limits of 2007 to 2011. Results of the search were evaluated by the HQCA Review Team and selected articles were then reviewed (see Appendix I).

3. Surveys were sent to stakeholders to develop a better understanding of patient safety issues and the plan for the provision of medevac services at the Edmonton International Airport.

   The survey included three open-ended questions:
   - What do you think are the safety hazards or areas of concern with relocating Medevac services from the Edmonton City Centre Airport (ECCA) to the Edmonton International Airport (EIA)?
   - Please specify why you think they are hazards/concerns.
   - What would you suggest to minimize these hazards/concerns or their effect on patient safety?

   Thirty-three surveys were sent out and 11 were returned (for a response rate of 32%).

4. Documents from key stakeholders

   Several documents were received from key stakeholders such as advocacy groups, aviation, government (municipal, provincial, other provinces/territories and federal) and healthcare. These documents provided both factual information and opinion.

5. Interviews

   Interviews were conducted in person and by telephone. Participants were asked the same three open-ended questions as in the survey and then asked more specific questions about the entire healthcare system as related to medevac services (i.e., with respect to patients, personnel, equipment/environment, organizations and regulatory agencies). A total of 36 interviews were requested and 35 were completed (for a response rate of 97%). Individuals from advocacy groups,

Alberta Health Services (AHS), other provincial and territorial health authorities, physicians, and air and medical crews from fixed wing and rotary wing operators participated in the interviews. A phone interview with HealthONE AIRLIFE in Denver Colorado was also completed to gather information on their current medevac system because previous reports[5, 6] made reference to Denver's air ambulance program.

6. Proactive Risk Assessment (PRA)

A PRA was undertaken to examine the steps in the numerous and variable processes when transferring medevac patients into and from the Edmonton International Airport to treatment facilities in Edmonton. The PRA methodology employed was a modification of the Healthcare Failure Mode and Effects Analysis® (HFMEA) tool, which can be applied to determine the effect of a problem or "failure" on each step and on the system under examination.[7] The PRA was used to identify the critical points that could arise during a medevac patient transfer.

The PRA was held in Edmonton, Alberta on February 8 - 9, 2011. Individuals invited were directly or indirectly involved with medevac services, were knowledgeable about standards and protocols for medevac services at ECCA and EIA, and/or were involved in the planning of the relocation of medevac services from ECCA. These individuals included representatives from:

- Alberta Health and Wellness
- Alberta Health Services
  - Emergency Medical Services, Dispatch, Interfacility Transport, Provincial Air Ambulance
- Edmonton Regional Airports Authority
- Fixed Wing and Rotary Wing Operators
  - Pilot
  - Paramedic
- Healthcare Providers
  - Nurse Practitioner
  - Rural Physician
- HQCA Review Team

The PRA was led by two facilitators who currently work for the United States Department of Veterans Affairs, National Centre for Patient Safety. On February 7, 2011, the two facilitators met with the HQCA Review Team to establish a draft process map. During the PRA session, the facilitators led the working group through the process described in figure 1 below.

Figure 1: Proactive Risk Assessment Steps

The two-day event offered all participants the opportunity to listen to and gain an understanding of the multiple issues from both the healthcare and aviation systems, from the perspective of the patient, personnel, environment/equipment, organizations and regulatory agencies. In addition, the event also provided an occasion for individuals to meet others working in differing areas of the system and to start to discuss their common interests and concerns.

7. Observation of the medevac work environment

   Members of the HQCA Review Team toured the Edmonton City Centre Airport and the Edmonton International Airport.

8. Data from other provinces/territories

   Data from other provinces/territories were gathered about their medevac services. This information included:
   - distances from the airport to the tertiary care facilities and average journey times
   - locations and distances to an alternate receiving airport
   - the number of patients from neighbouring provinces / territories that were transported into Edmonton

9. Data on locations of Edmonton airports and tertiary care facilities

   Maps downloaded from Google were reviewed to determine locations and to calculate the distances and travel times between the airports and tertiary care facilities. The distances between primary and alternate airports were calculated using World Airport Codes.[8]

CONDUCT AN ANALYSIS

The Systematic Systems Analysis – the Alberta Approach for Patient Safety Reviews (SSA) is an analytical method used to systematically and systemically conduct a patient safety review. SSA is systematic in that a methodical approach is followed to ensure that important matters will not be left out. Taking a systemic approach helps ensure that all components of the entire healthcare system are considered and are recognized to interact, rather than only looking at one particular factor in isolation. The healthcare system can be grouped into five components: patient, personnel, environment/equipment, organization(s) and regulatory agencies.[3]

DEVELOP RECOMMENDATIONS

System-level recommendations were developed to mitigate the identified patient-safety-related issues that could occur when medevac services are moved from the Edmonton City Centre Airport to the Edmonton International Airport.

FINDINGS/ANALYSIS

The system-level findings and analysis focuses on fixed wing medevac services in the Edmonton area and specifically on two airports the Edmonton City Centre Airport (ECCA) and the Edmonton International Airport (EIA). We first present an overview of medevac services in Alberta, followed by a description of medevac services in Edmonton. Each section will be described using five components of the healthcare system: patient, personnel, equipment/ environment, organization and regulatory agencies.

MEDEVAC SERVICES IN ALBERTA

An overview

For the past several decades patients have been transported within Alberta and from remote northern communities outside Alberta by air ambulance for healthcare that they could not otherwise receive. These patients have required a spectrum of care, ranging from time-critical care to specialized diagnostic and treatment services with a fixed appointment date and time.

The term 'medevac' was first used during the Vietnam War as shorthand for 'medical evacuation', referring to those patients who required urgent or emergency care and who were transported by a medical evacuation helicopter.[9] The United States Army still refers to MEDEVAC as a "U.S. Army capability involving designated rotary wing aircraft and specially trained enlisted medical crew members."[10] In Alberta the term 'Medevac' is now often, but not consistently, used for all air ambulance and associated ground ambulance transports and not just for those patients requiring urgent or emergency care.

The medevac process is complex and involves numerous providers from different departments, organizations and regulators. (see Appendix II) Any decision to transport a patient by air is based on many factors. These include a patient requiring a "level of care" that "exceeds the capabilities" of the sending physicians and/or facility, as well as a "time-critical evaluation or intervention or for special monitoring, medication, equipment or expertise" during the journey. Lack of availability of "appropriate ground ambulance transport", the problem of "excessive distance or rugged terrain that hinders transport to a care facility", and "weather conditions" are additional factors. The weight of the patient is also a consideration.[11]

Once a decision has been made to transport a patient by air, then the choice is made regarding the most appropriate mode of transportation. In Alberta, this decision is made by the Central Communication Centre (CCC) of Emergency Medical Services, Alberta Health Services. Again there are many factors that contribute to this decision, including distance and weather. For the purpose of this report, the diagram below illustrates the steps in the medevac process after a decision has been made that a fixed wing aircraft is the most appropriate mode of transport.

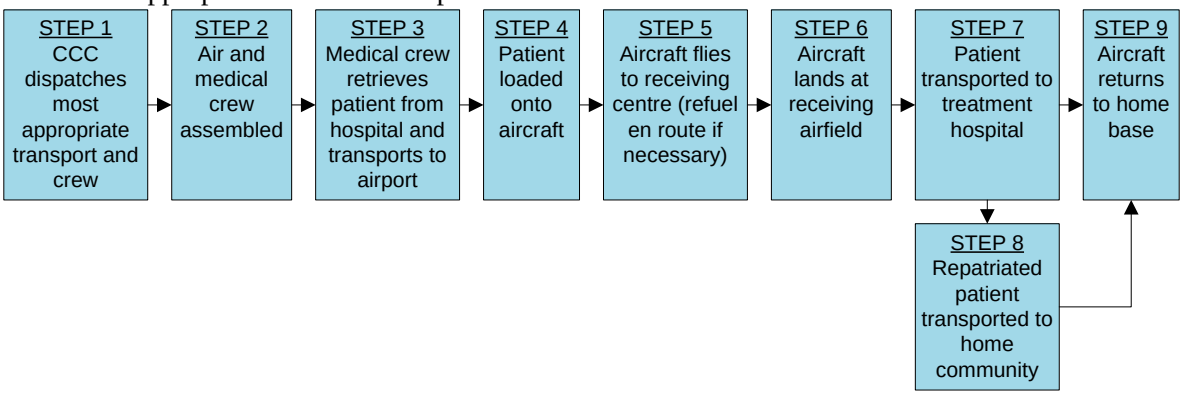

Figure 2: Steps in the Medevac Process

Using a pager, telephone or radio, the CCC notifies the flight crew from one of five companies in Alberta contracted to provide aircraft for medevac flights. The flight crew first determines if the weather at their home base and at the landing airport will permit them to fly. They also consider other factors, such as the mechanical status of aircraft and the need to refuel along the way. If the requested aircraft is unavailable, the CCC contacts the next available medevac provider. With an aircraft and flight crew available, the air medical crew is contacted. These individuals, who work for one of eight different organizations, proceed to the airport (if they are not already on base).

If the medevac provider is in the same community as the sending facility (e.g., Lac La Biche), then most likely this air medical crew will transfer the patient from the hospital to the aircraft. Otherwise, a local paramedic team may transport the patient from the local hospital to the airport, transfer the patient from the ambulance stretcher to the aircraft stretcher and hand-over care to the medevac crew. After the patient is positioned in the aircraft and all necessary equipment secured, the flight proceeds.

Some flights from far northern communities may need to stop en route to refuel. This requires coordination with a fueling truck or fuel depot and a ground ambulance. "Refueling of aircraft must not be conducted with patients or medical flight personnel on board unless the aircraft is equipped for single point pressure refueling and all applicable Transport Canada Regulations and Standards are met."[12] The patient must therefore be transferred from the aircraft into a ground ambulance, so as to be protected from inclement weather during refueling. The ambulance also provides power for necessary medical equipment.

On landing, the aircraft taxis to the assigned hangar. The patient is transferred to a ground ambulance and is then taken to one of the tertiary care facilities by the air medical crew. After the care of the patient has been transferred to a physician in the receiving hospital, the air medical crew can return to the airport. The medevac aircraft will usually return to its home base, either without a patient or with a patient who is being repatriated to his/her local hospital or home community.

Once the medevac aircraft has returned to its home base, the air medical crew restocks the plane in preparation for the next call. The flight crew attends to the mechanical and fuel requirements of the aircraft in preparation for potential back-to-back calls. Arrangements for a change of flight crew may also have to be made if the flight crew is nearing its maximum duty hours, as determined by Transport Canada.[13]

System components

Patient Factors

Types of patients

For the past three decades, healthcare providers treating patients who suffered traumatic injuries have tried to do so within what is described as the "golden hour", that is "the first hour after the onset of out-of-hospital traumatic injury".[14] Although experts suggest that "there is little evidence to directly support" the relationship between a reduction in time to definitive care and improved injury outcomes", a belief in this relationship is considered a "basic premise of trauma systems and emergency medical services".[14] Only survival from "out-of-hospital cardiac arrest" (not related to trauma) has been shown to be directly related to time, that is, the interval between the arrest and provision of defibrillation.[14, 15]

In a review from British Columbia of the transport intervals between sending and receiving hospitals, Belway and colleagues could not show an association between transport times and death in hospital.[16] Newgard and colleagues[14] conducted a large review of patients in Canada and the United States who were admitted to trauma hospitals. The authors did not find any association between time and mortality, for any of the intervals studied, including transportation to hospital.

Similarly with pediatric patients with traumatic injuries, a study from Utah suggested that "factors before arrival" (of the rotary wing transport), such as severity of the accident, might have "more of an impact" on the overall rates of death in rural areas "than transport times alone".[17] Indeed, recent publications suggest that "speed is not the priority" and that the "myth of the 'golden hour' should be refuted in pediatric medical transport.[18] Rather, the "best guiding principle of trauma management and the immediate postinjury period" should be considered to be a "golden opportunity", the aim of which should be to "ensure prompt, appropriate treatment for each and every patient".[19]

Thus, an increased time to treatment, such as that imposed by an increased length of journey time, has not been shown to be related to an increased mortality rate. However, for critically-ill or injured patients, the time between presentation and definitive treatment can be vitally important. This concept is sometimes expressed by the phrase "time is tissue".[20] Factors contributing to the total time before treatment include the patient, the healthcare providers, the ambulance system, and the hospital.[20]

For example, patients who suffer an 'ischemic stroke' (when blood flow to the brain is blocked by a blood clot), lose an estimated 1.9 million neurons (of an average of 22 billion in the front part of the brain) for each minute that a stroke is untreated.[21] The 2008 Canadian Guidelines state that all patients with an acute disabling ischemic stroke who can be treated within 4.5 hours after onset of their symptoms "should be evaluated without delay to determine their eligibility for treatment" with a drug to dissolve the clot. This medication should be given "within one hour of hospital arrival", also expressed as "door-to-needle time" of less than 60 minutes.[22] Thus, for stroke patients, "time is brain".[23]

A similar time-dependent situation exists for patients who suffer a specific type of heart attack known as STEMI or ST-segment elevation myocardial infarction. The Canadian Guidelines for STEMI treatment suggest that patients should be treated within 90 minutes of hospital admission with "primary percutaneous angioplasty" or "balloon angioplasty". Ideally, patients should have a "door to balloon" time of less than 90 minutes to minimize myocardial damage.[24]

Another aspect of patient care affected by increased transportation time is that of "unplanned events" during transport.[25] In a recent study from Ontario, Singh and colleagues reviewed both clinical and administrative data from the Ontario provincial air medical transport organization (Ornge), looking for a "critical event" during transport. Of the nearly 20,000 patients, just over 5% suffered a critical event, for example respiratory arrest. The authors were able to calculate that for "every 10 minute increase in duration of transport", there was a "2% increase in the odds of critical events".[26]

Although there is recognition that delays in transportation contribute to patients suffering complications, there are now an increasing number of studies that suggest "speed isn't everything".[18] Other factors are now being identified that can assist in improving a patient's overall condition, such as the use of telemedicine / telehealth,[27, 28] transport teams with specialized knowledge, skills, and judgment.[18, 29] Another concept is that of having a patient transported to the sending airport with an appropriate medical team to await the arrival of the air ambulance, rather than having the patient wait at the hospital.[30] However, these concepts, as well as that of reviewing the range of services provided at hospitals both outside and in Edmonton, are beyond the scope of this review.

Coding of patients' acuity

There are several different systems used by medevac air ambulance service providers to code the degree of acuity of a patient's condition and/or need for transport. Alberta Health and Wellness (AHW)[31], Alberta Health Services (AHS)[32], Alberta Shock Trauma Air Rescue Society (STARS)[33] and the Northwest Territories each use their own systems, while Saskatchewan and Yukon currently follow the Canadian Triage and Acuity Score (CTAS)[34] Coding System (see Appendix III). Before December 7, 2010, medevac providers in Alberta used a coding system developed and authorized by Alberta Health and Wellness. On December 7, 2010, Alberta Health Services (AHS) implemented a new patient coding system which AHS developed for all Emergency Medical Service (EMS) dispatches in Alberta including both ground and air transports.

Some of the significant differences among these Coding Systems are (Table 1):

- Different colours are sometimes used to describe the same level of priority.
- Different descriptions are used for the same category. The highest priority is described as *urgent, time critical* by AHW; *emergency transfer, unstable, time dependent* by AHS; *red* by STARS; *resuscitation* by CTAS and *critical, emergent, urgent and referred care* by Medic North Medevac.[35]
- A category may have more than one purpose. For example, since December 2010, AHS has used its second highest level, "Yellow", to classify a patient suffering from a "condition (illness or injury) that is potentially threatening to life or limb" and also to classify a patient who is being returned home when the "Demand Driven Protocol/Overcapacity Plan is triggered."
- Different numbers of categories are used, ranging from two to five in the various systems.

Patient Acuity Coding Systems					
CATEGORIES	**AHW** (ended December 7, 2010)	**AHS**	**STARS**	**CTAS**	**Medic North**
	Priority: Red *Time Critical*	**Red** *Emergency*	**Red**	**Level I** *Resuscitation*	**Critical** *Unstable* *Transport immediately*
	Priority: Yellow *Urgent, Non time-critical*	**Yellow** *Urgent* *Transports Triggered by Demand Driven Protocol/Overcapacity Plan*	**Yellow** *May be medically judged to be red*	**Level II** *Emergent*	**Emergent** *Transport as soon as possible*
	Priority: Blue *Scheduled*	**Green** *Routine*		**Level III** *Urgent*	**Urgent** *Transport within 24 hours*
	Priority: Green *Non-Urgent*	**Blue** *Scheduled*		**Level IV** *Less Urgent*	**Referred Care** *Scheduled transport*
	Priority: White *Returning Patients*			**Level V** *Non Urgent*	

Table 1:Different coding systems used to classify the acuity of a patient's condition and/or need for treatment. [31-35]

> **ISSUE:** The existence of multiple coding systems can lead to confusion and errors in assigning priorities for the transportation and treatment of patients, particularly when patients arrive from outside Alberta and when the care of patients is handed from one team to another. The tracking of information about patients is also made more difficult, thus reducing the possibility of gathering complete and adequate data for analysis and improvement of the system.

Personnel Factors

Medevac transports require qualified and skilled medical and air crew. In order to provide medevac services in Alberta, requirements must be met as outlined in a service provider contract.

For fixed-wing medical crew, there must be a minimum of two qualified attendants on each air ambulance flight. At least one attendant must be a qualified Emergency Medical Technologist-Paramedic or a Physician and the second attendant must be qualified at least as an Emergency Technician-Ambulance or as a Registered Nurse.

The rotary wing medical crew consists of a critical care flight nurse and a critical care paramedic trained to work in Emergency/Intensive Care Unit/Coronary Care Unit and out of hospital environments. A referral emergency physician joins the flight crew on approximately 20 to 25% of patient transports.[36]

All fixed-wing and rotary-wing flights must have two pilots who meet specific criteria about qualifications and experience, such as instrument and night qualifications, and a minimum number of flying hours.[12]

Environment/Equipment Factors

Currently there are 152 airports in Alberta.[37] Which airport is used for a medevac flight is dependent on runway length, surface conditions (e.g., snow, ice, water) and visual approach capabilities.[38]

Rotary wing aircraft (helicopters) are also used for medevac operations, in part because of their ability to land 'almost anywhere', including accident scenes and on helipads adjacent to or on the rooftop of hospitals. However, there are some factors that limit where helicopters can land, such as the weight of the helicopter. The new STARS helicopter, scheduled to start flying missions later in 2011, the AgustaWestland 139 (AW 139), weighs approximately 14,500 pounds. According to the new *Canada Flight Supplement*[39] the weight restriction for the helipad at the Royal Alexandra Hospital is a maximum of 12,000 pounds and thus the new STARS helicopter will be too heavy to land at this hospital.

A review of this problem is already underway as a "Provincial Air Ambulance Committee with representation from AHS EMS, Alberta Health and Wellness, STARS, private air ambulance service providers and AHS Facilities Maintenance and Engineering has been established to make recommendations on helipads where deficiencies are identified".[40]

Air medical crews require specialized medical equipment and supplies during medevac flights to treat a wide variety of patient problems. This equipment includes monitors, IV pumps, ventilators and spinal boards. The weight and size of equipment varies and may not be appropriate for all aircraft. For example, a patient who is undergoing extra-corporeal membrane oxygenation (ECMO), which is a special modification of the heart–lung bypass machine, requires equipment that will not fit in every ambulance or aircraft.[41] A similar situation exists for patients who are morbidly obese.[42]

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However, even normal equipment can pose problems during transportation of patients. For example, a stretcher that is used in a fixed wing aircraft cannot be used in a helicopter, because the current clamping systems (to stabilize the stretcher and stop it from moving in flight) are not compatible. Also, as stated above, the stretcher used in an ambulance may not be appropriate for use in either type of aircraft. Currently in Alberta, there is no standardization for medical equipment and supplies - for ground, fixed wing, or rotary wing ambulances, nor for hospitals. Nor is there standardization with neighbouring provinces/territories.

In contrast, HealthONE AIRLIFE, which operates in Denver, Colorado, has standardized all medical equipment for its ground ambulances, Learjets and helicopters. All patients arriving by Learjet are shuttled to the receiving hospital by helicopter. This transfer occurs seamlessly as the ground ambulances, Learjet and helicopter have standardized medical equipment and all medical crew are trained in Learjet, rotary and ground transports.[44]

> **ISSUE:** Non-standardized equipment means that for a patient being transported there could be a change of equipment (e.g., monitors, IV pumps, ventilators, spinal boards and stretcher) for each transfer of care, from sending hospital to ambulance to aircraft to ground ambulance to receiving hospital. This process adds to the journey time for the patient and increases opportunities for complications. The situation becomes more problematic when a patient has a time-critical condition.

Organization Factors

Alberta Health Services

The creation of Alberta Health Services, announced on May 15, 2008, amalgamated 12 formerly separate health entities including nine geographically based health authorities into one regional health authority. This consolidation of services has resulted in many changes, such as the issuing of new AHS Medical Staff Bylaws, which came into effect on February 28, 2011 and replaced the numerous legacy medical bylaws.[45]

With a goal of improving patient care, accountability and efficiency, the responsibility for *ground* ambulance in Alberta was transferred from all the municipalities in Alberta to AHS on April 1, 2009.[46] One year later, funding and operational governance for *air* ambulance services in Alberta was transferred from Alberta Health and Wellness to AHS.

These two major transfers have meant that for the first time in Alberta, all of the core components of Emergency Medical Services (emergency response, inter-facility patient transfers, ground ambulance, air ambulance and dispatch services) have come under a single governance structure.[47] This consolidation of governance has brought an opportunity to establish new structures to support the delivery of integrated services.

AHS EMS is currently developing an integrated provincial dispatch system to ensure that the closest most appropriate EMS resource is sent to a call. An electronic Intergraph Computer Aided Dispatch system was implemented on December 7, 2010 for air ambulance dispatch. As well, AHS EMS has proposed consolidating the current thirty-five dispatch centres into three, with three main coordination centres being Northern Communication Centre (between Peace River and Grimshaw), Central Communication Centre (located in Edmonton), and Southern Communication Centre (located in Calgary).[47] As of February 2011[48], eighteen consolidations had taken place.

Another AHS initiative is the use of RAAPID (Referral, Access, Advice, Placement, Information and Destination), a provincial entity that provides a single point of contact for the coordination of seamless transitions of care, including:

- Accessing critical and/or urgent consultation with a specialist and, if necessary, facilitating transfers to a tertiary care facility.
- Arranging repatriation of a patient to his/her sending institution or closest healthcare facility within his/her community after care in a referral treatment centre.[49]

RAAPID also retains an archival copy of telephone calls. This copy is considered an official part of a patient's health record. Today, the majority of physicians and facilities in Alberta use RAAPID to coordinate the seamless transition of care for their patients.

In the fall of 2010, the 'Red Referral Process' was also implemented in Alberta.[33] This is a single point of contact for physician-to-physician referral, care and transportation of all rural 'Red' patients (with a time-dependent condition). The STARS Referral Emergency Physician is involved as the first point of contact for all rural physicians who require advice about patients needing critical care. Transportation of these patients may then be provided by ground or air ambulance (see Appendix IV).

> **ISSUE:** Physicians and facilities from other provinces and territories do not consistently use RAAPID or the Red Referral Process for patients sent to Edmonton.

As identified in the five-year business plan for AHS EMS, an Electronic Patient Care Record (ePCR) will be rolled out provincially during 2011 through 2013. The implementation of ePCR for all EMS services will support integration of the recording of all aspects of care provided by EMS, including medevac services with the patient's health record. The ePCR will also facilitate the transfer of information between care professionals and foster collection of clinical outcomes and performance data.[47]

In addition to these large infrastructure changes, AHS EMS has also undertaken changes to bylaws, policies and protocols. For example, EMS has developed a comprehensive set of Provincial Medical Control Protocols for ground EMS, which were published in December, 2010.[50] These new protocols help to ensure that EMS practitioners across Alberta provide evidence-based practices and consistent standards of care.

AHS EMS is to be commended for ongoing province-wide improvements.

Medevac providers

Currently, AHS provides air ambulance services through contracted providers of fixed wing air ambulances located at 10 bases throughout the province. These contracted providers of the aircraft work with contracted providers and AHS EMS for air medical services – the air medical crew. Table 2 details the location, type and number of aircraft and the air and medical crew of the contracted fixed wing providers.


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Fixed Wing Providers


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Location	Aircraft Company & Crew	Type of Aircraft	Number of Dedicated Medevac Aircraft	Air Medical Crew
Fort Vermilion	Nor-Alta	Fixed wing	1	Aeromedical Emergency Services
High Level	Nor-Alta	Fixed wing	1	Aeromedical Emergency Services
Peace River	Northern Air Charters Inc.	Fixed wing	2	Advanced Paramedic Ltd.
Grande Prairie	Alberta Central Airways	Fixed wing	1	Western Air Rescue
Slave Lake	Can-West	Fixed wing	1	Slave Lake EMS (AHS)
Fort McMurray	Nor-Alta	Fixed wing	1	Alberta Central Air Ambulance Ltd.
Lac La Biche	Alberta Central Airways	Fixed wing	1	Alberta Central Air Ambulance Ltd.
Edmonton	Can-West	Fixed wing	1	Alberta Central Air Ambulance Ltd.
Medicine Hat	Bar XH Air Inc	Fixed wing	2	Medicine Hat EMS (AHS)
Calgary	Bar XH Air Inc	Fixed wing	1	Calgary EMS (AHS)

Table 2: Fixed Wing Service Providers and associated Air Medical Crew in Alberta

AHS also has an agreement with STARS to provide rotary air ambulance services from bases in Calgary, Edmonton and Grande Prairie.[53]


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Rotary Wing

54

Location	Aircraft Crew	Type of Aircraft	Number of Dedicated Medevac Aircraft	Air Medical Crew
Grande Prairie	STARS	Rotary wing	1	STARS
Edmonton	STARS	Rotary wing	2*	STARS
Calgary	STARS	Rotary wing	2*	STARS

*STARS currently has 3 dedicated and 2 back-up rotary wing aircraft.

Table 3: Rotary Wing Service Providers in Alberta

Regulatory Factors

Regulatory agencies include those bodies established to govern, and through this governance, to maintain standards and help ensure safety. For medevac services, there are regulatory agencies for both the healthcare and aviation domains.

Healthcare

Alberta Health and Wellness governs healthcare in Alberta through the establishment of 30 laws and 100 schedules of regulations, rules, standards and bylaws.[55] For example, the Emergency Health Services Act is the central piece of legislation that influences ambulance services.[53]

Another important Act is the Health Professions Act (HPA). HPA regulates health professions "using a model that allows for non-exclusive, overlapping scopes of practice".[56] Under the HPA, health professions are organized into regulatory colleges, which have delegated powers and authorities for self-governance.

The Health Disciplines Act is the legislation by which paramedics are currently governed.[57]

There are four colleges that license and regulate the professionals that provide care during air ambulance transportation in Alberta:

- the Alberta College of Paramedics
- the College & Association of Registered Nurses of Alberta
- the College & Association of Respiratory Therapists of Alberta
- the College of Physicians & Surgeons of Alberta

Aviation

Canada has one of the safest and most successful civil aviation programs in the world.[58] To achieve and maintain this level of safety, Transport Canada has implemented regulations, some of which affect medevac services in Alberta. For example, Transport Canada regulations outline the limits for flight duty time and minimum rest periods. The regulations state that all flight crew shall not exceed 14 consecutive hours in any 24 hour period and an air operator shall provide air crew with a minimum rest period following a flight duty time.[13] Another important Transport Canada regulation specifies refueling practices. Neither patients nor medical flight personnel can remain on-board during refueling, unless the aircraft is equipped for single point pressure refueling and all applicable Transport Canada Regulations and Standards are met.[12]

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Medevac is defined by Transport Canada as "an expression used to request priority handling for a medical evacuation flight based on a medical emergency in the transport of patients, organ donors, organs or other urgently needed life-saving medical material. This expression is to be used on flight plans (FP) and in radiotelephone communications if a pilot determines that a priority is required."[59]

"Discretion must be practiced in the use of the term 'medevac', as it is intended only for that portion of a flight requiring a priority as dictated by the medical requirement."[61]

> **ISSUE:** The term 'medevac' is now often, but not consistently, used for all air ambulance and associated ground ambulance transports and not just for those patients requiring urgent or emergency care.

A second aviation regulatory agency that governs medevac services is NAV CANADA. This agency provides weather briefings, aeronautical information, airport advisory services, electronic navigation aids, flight information and air traffic control.[62] If a pilot registers the flight as a 'medevac', priority landing is given, which means that these flights can go to the front of the queue to land.[63] However, the repositioning flight (back to the home base) does not have the same status.

> **ISSUE:** For fixed wing carriers, any delay in repositioning will contribute to a lengthening of duty times for both air crew and medical personnel. The carrier may be unable to undertake a second medevac flight until the air crew has been able to take a period of rest as required by Transport Canada.

MEDEVAC SERVICES IN EDMONTON

Edmonton has served as an important centre providing specialized care to patients, many of whom have been transported by air from across the province and from neighbouring provinces and territories.

Table 4 provides an outline of important dates and events for medevac services in Edmonton for 1929 to 2010 (see Appendix V).

Date	Event/Finding/Result
1929	Edmonton City Centre Airport (ECCA) began as Blatchford Field, the first licensed airstrip in Canada
1930's - 1940's	Aeromedical transports were used sporadically because of a lack of other transportation for emergencies in the northern regions of Alberta
1963	Edmonton International Airport (EIA) was opened, 30 kilometers south of the city
1970's	Advent of paramedics and nurse specialty teams led to an increase in aeromedical transports
1980's	Air ambulance services, using dedicated aircraft with paramedics and Advanced Life Support (ALS) equipment, were established in towns such as Fort McMurray, Grande Prairie, High Level and Medicine Hat
1984	ALS and Basic Life Support (BLS) were defined in the Health Disciplines Act
1985	The Health Disciplines Act was amended to include Emergency Medical Technicians–Ambulance (EMT-A) and Emergency Medical Technician-Paramedics (EMT-P). The Minister of Health stated that ambulances were a municipality responsibility and the government would not impose standards and funding
1985	Shock Trauma Air Rescue Society (STARS) was established as a result of medical community concerns that Alberta had a 50 % higher death rate due to trauma when compared to other leading Canadian trauma centres
1988	Alberta's first formal contract for air ambulance providers was signed in Grande Prairie and was to provide specific aircraft, aeromedical equipment and pilots
1988	Alberta Health and Wellness (AHW) established the Air Ambulance Division to ensure that adequate and standardized air ambulance service was available throughout the province
1995	Scheduled air services were moved from the Edmonton City Centre Airport to the Edmonton International Airport, as the result of a public vote. General aviation was allowed to continue at the Edmonton City Centre Airport
August 2002	Emergency Health Services (EHS) took over the Northern Air Ambulance Dispatch (NAAD) and Southern Air Ambulance Dispatch (SAAD) and established one coordinated dispatch of air ambulances through the Provincial Flight Coordination Centre (PFCC)
June 2008-July 2009	A detailed review of the Edmonton City Centre Airport was undertaken to address historical importance, economic impact, market feasibility, medevac services and public consultation
April 2009	Ground ambulance services were transferred from the municipalities to AHS
July 2009	After 18 months of study, analysis and public input, the Edmonton City Council voted to implement a phased closure of the Edmonton City Centre Airport. A phased closure allowed Council to determine the timing of redevelopment based on market demand and to keep one runway open until the airport land was required
April 2010	Provincial air ambulance services were transitioned from AHW to AHS
August 3, 2010	Runway 16-34 at ECCA is closed

Table 4: Chronology of Important Dates and Events for Medevac Services in Edmonton, from 1929 to 2010

System components

Patient Factors

Patients from Alberta transported to Edmonton by fixed wing aircraft

For the period April 1, 2009 and March 31, 2010, 3059 patients from within Alberta were transported by fixed wing air ambulance into Edmonton. Of these, 3054 patients (99.8%) were on flights which landed at the Edmonton City Centre Airport. Of the 3059 patients, 213 were categorized as having time-sensitive conditions ('Red') and 1566 as having time-dependent conditions ('Yellow').[64] Figure 3 shows the total number of patients transported by fixed wing aircraft into Edmonton; classified according to the color coding system used by AHW (see Appendix VI).

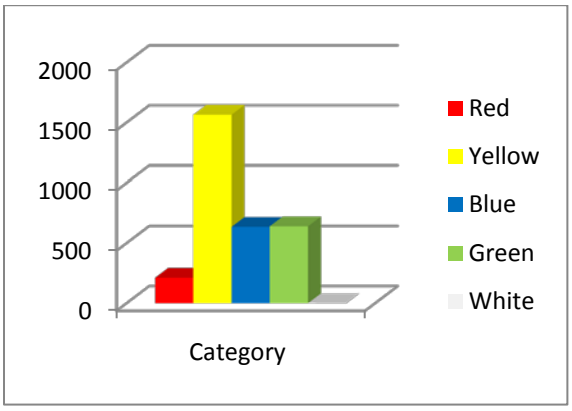
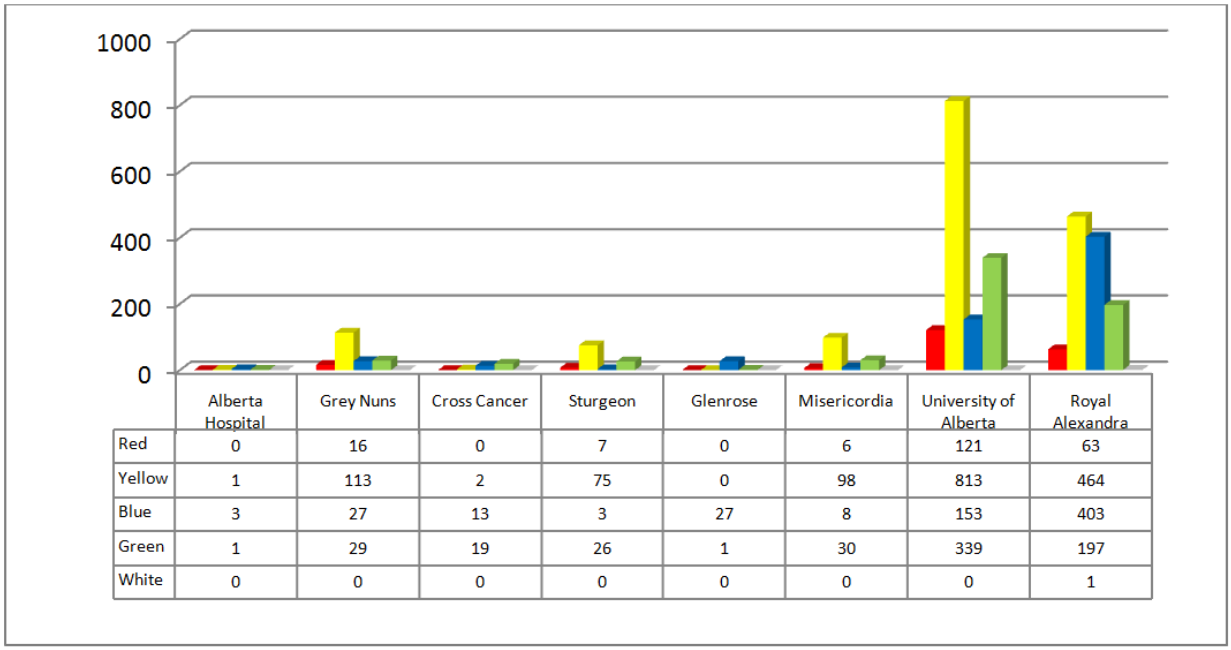


Figure 3: Alberta Fixed Wing Patient Transports into Edmonton by Priority (April 1, 2009 – March 31, 2010)

Figure 4 presents these same 3059 fixed wing transfers, but as classified by the receiving facility and by the color coding system used by AHW[65].



	Alberta Hospital	Grey Nuns	Cross Cancer	Sturgeon	Glenrose	Misericordia	University of Alberta	Royal Alexandra
Red	0	16	0	7	0	6	121	63
Yellow	1	113	2	75	0	98	813	464
Blue	3	27	13	3	27	8	153	403
Green	1	29	19	26	1	30	339	197
White	0	0	0	0	0	0	0	1

Figure 4: Alberta Fixed Wing Patient Transports into Edmonton Hospitals (April 1, 2009 – March 31, 2010)

Patients who are transported into the Edmonton region by air ambulance are taken to one of eight facilities: University of Alberta, Royal Alexandra, Grey Nuns, Misericordia, Sturgeon, Glenrose, Cross Cancer Institute or Alberta Hospital (see Appendix VII). Certain services are available only in Edmonton hospitals (i.e., neonatal extra-corporeal membrane oxygenation, major neonatal cardiac surgery, major organ transplants and hyperbarics).

Patients from out of province transported to Edmonton by fixed wing aircraft

In addition to the 3059 patients transported by fixed wing aircraft from within Alberta, another 805 patients were transported into Edmonton by air ambulance from British Columbia, Saskatchewan, Northwest Territories and Yukon. However, it is difficult to quantify the proportion of patients who were classified as 'Red' and 'Yellow' because each of these provinces and territories uses a coding system that is different to those used in Alberta.[66, 67, 68, 69]

For the same period (April 1, 2009 – March 31, 2010) British Columbia reported[69] 254 medevac flights to Edmonton (which does not represent the number of patients). The priority status was not reported for these patients. The Northwest Territories[66] sent 45 patients coded as time-dependent and 174 coded as urgent.

Figure 5 shows Saskatchewan[67] and Yukon[68] air ambulance transfers into Edmonton according to the sending facility's coding system.

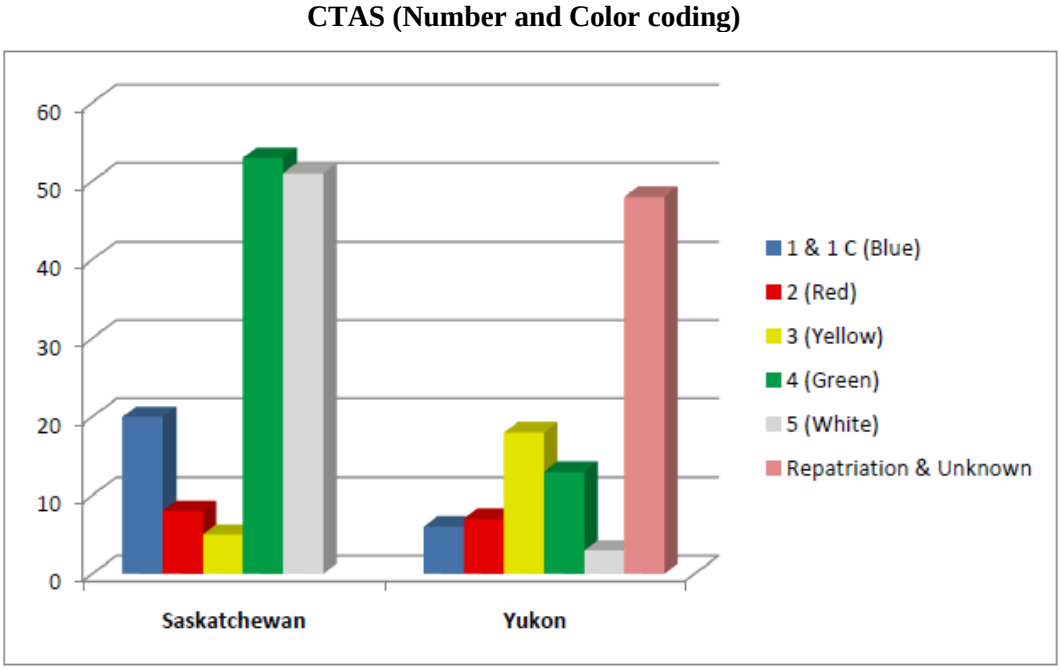


Figure 5: Saskatchewan/Yukon Patient Transports into Edmonton April 1, 2009 – March 31, 2010

Alberta rotary wing patient transports

In addition to the medevac patients flown into Edmonton by fixed wing aircraft, STARS flew 461 missions by rotary wing aircraft (helicopter) during the April 1, 2009 – March 31, 2010 time period.

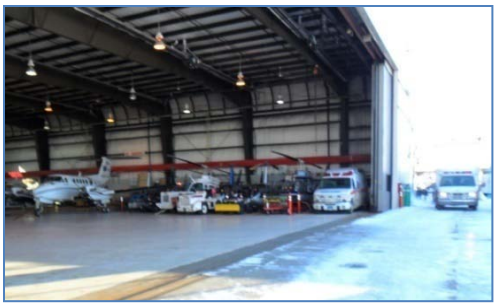
In total, more than 4300 patients were transported to Edmonton by either fixed wing or rotary wing aircraft over a one year period.

Environment/Equipment Factors

This review is centered on the two airports in the Edmonton area that are used for medevac flights. The Edmonton City Centre Airport, which has the official airport designation of CYXD, will be referred to as the 'ECCA' in this report, while the Edmonton International Airport (CYEG) will be referred to as 'EIA'.

Edmonton City Centre Airport

Originally called Blatchford Field, ECCA was renamed the Edmonton Municipal Airport (the 'Muni'), and more recently, the Edmonton City Centre Airport. Located just north of Edmonton's downtown core, ECCA is bordered by Yellowhead Trail to the north, Kingsway to the south, 121 Street to the west and the Northern Alberta Institute of Technology (NAIT) on its southeast corner.[70] In 2010 there were 66,688 aircraft movements at ECCA, none of which were regularly scheduled passenger flights.[71]



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Each paramedic provider has a ground ambulance stored in a hanger at ECCA, as required by contract with AHS. The ambulance provides ground transportation to a receiving hospital.

Edmonton International Airport

Located south of Edmonton in Leduc County on the west side of the Queen Elizabeth II highway, EIA is approximately 30 km from Edmonton's city centre. In 2010, there were 130,596 aircraft movements[71] and 6,089,099 passengers travelled through EIA.[73]

> **ISSUE:** EIA does not have a dedicated area for medevac flights including parking for aircraft and ambulances, power, refueling and other services.

Personnel Factors

For the majority of air ambulance transports, the air and medical crews deemed most appropriate and closest to the patient location are dispatched. The air and medical crews for the fixed wing providers must be readily available in order to meet the AHS contract requirements that "upon receipt of dispatch instructions, the dedicated air ambulance aircraft must be capable of being airborne within thirty (30) minutes for Priority Red and Yellow patients".[12] The goal of STARS is to lift-off within 15 minutes of being dispatched.[33]

The medical personnel who make up the neonatal, pediatric, and organ transplant teams for Northern Alberta are all based in Edmonton. These specialty teams must assemble with their equipment at an Edmonton airport to be flown from Edmonton to treat and collect the patient at the sending facility, before returning to Edmonton.

Assembling the University of Alberta Hospital and Royal Alexandra Hospital based Pediatric Intensive Care Unit (ICU)/Neonatal ICU teams and transporting them to the Edmonton International Airport for medevac flights will require more time; this may result in delays to patient treatment as well as crews not being available for extended times at their local hospital.

Organization Factors

Edmonton Regional Airports Authority

The Edmonton Regional Airports Authority is a community-based, financially independent, corporation responsible for operating and developing four airports in the Edmonton region. These airports are: Edmonton International Airport, Edmonton City Centre Airport, Villeneuve Airport and Cooking Lake Airport.[74]

Security requirements at EIA and ECCA are similar. Pilots, air ambulance medical crew and ground ambulance crew do not require security passes. Pilots are able to clear security using under their pilot's license. Medical crews on board or boarding an aircraft are under the care and control of the pilot. Ground ambulance crews are deemed emergency services and respond directly to the aircraft.[75]

Edmonton Fixed Base Operators (FBOs)

Fixed Base Operators (FBOs) provide flight planning facilities, hangar space, fueling, maintenance and rest facilities for air and medical flight crews. Currently there are two FBOs (Shell and Esso) located at ECCA and two FBOs (Shell and the Executive Flight Centre) at EIA.[76]

Regulatory Factors

There are no factors with respect to Regulatory Agencies that are specific to Edmonton and/or different from regulation in the rest of the Province of Alberta.

The land on which the Edmonton City Centre Airport is located is owned by the City of Edmonton, which then leases it to the Edmonton Regional Airport Authority to operate the airport.[77] After 18 months of study, analysis and public input, in July 2009 the City Council voted to implement a phased closure of ECCA. Council members felt that maintaining the airport was not an option because of financial and liability factors. Runway 12/30 would have required up to $10M in capital upgrades to remain operational. Other upgrades were estimated to cost nearly $35M over the next five to ten years.[78]

The runways

Up until August 3, 2010, ECCA had two runways: Runway 12/30 and Runway 16/34. All runways have two numbers, as in runway 12/30, because a runway can be used for travel in two directions and the numbers correspond with that runway's compass heading. In the case of Runway 12/30, the '12' refers to a compass heading of 120 degrees or East-South-East. The '30' refers to a compass heading of 300 degrees or West-North-West. The 'choice' of a runway, that is 12 or 30, will depend on the direction of travel chosen, which in turn depends on the direction of the prevailing winds, although there may be other factors such as Air Traffic Control requirements or noise abatement considerations.

At ECCA, Runway 16/34 had an instrument landing system (ILS).[79] (This was in contrast to the EIA, which has two runways, both of which are equipped with an ILS.) Before December 2009, the ILS equipped runway at ECCA could accommodate ceiling heights as low as 200 feet and a visibility limit of 0.25 mile. As of December 2009, Transport Canada changed the criteria for ceiling limits and the ceiling height Runway 16/34 increased from 200 ft to 492 ft. (In contrast, EIA has ceiling minimums of 200 feet and a visibility limit of 0.5 mile.)[80]

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On August 3, 2010 the ILS equipped runway (Runway 16/34) at ECCA was closed, based on an order from the City of Edmonton. This left the airport with only one runway (Runway 12/30) in operation. GPS approaches for each direction of Runway 12 /30 were developed. Because it is only equipped with a GPS landing system, the ceiling heights and visibility restrictions of Runway 12/30 are less favorable than those provided by Runway 16/34.

At ECCA, the direction of the wind often favours a landing approach on Runway 30, so that it is the runway most often used. However, landing on Runway 30 requires a ceiling of 749 feet and visibility of 2.25 miles. In bad weather with a low ceiling (below 749 feet), a pilot would need to undertake a downwind approach and land on Runway 12. If this is not possible, the airport would be considered unsuitable for landing at that time and diversion to another (alternate) airport would be required. Similarly on departure, if the winds favour Runway 12, then the pilot has to have a 1600 foot ceiling or accept a downwind take-off (or not depart at all).[82]

Since the closure of the ILS equipped runway at ECCA, the usability of the airport has been reduced (see Appendix VIII). [80]

With the closure of Runway 16/34 at ECCA, the number of diversions to the EIA has increased. In 2009 (before the closure) there were three diversions from ECCA to EIA. From August 3, 2010 to February 27, 2011, for a period of only six and a half months, there were 44 diversions to EIA. Of these 44 diversions, five flights were for patients with time-critical conditions ('Red') and 15 flights were for patients with time-dependent conditions ('Yellow').[83]

Comparison between ECCA and EIA

With the increased number of diversions of flights from ECCA to EIA, certain differences between the two airports have assumed greater importance when considering the length of time required to transfer a patient from another centre by air to Edmonton. These differences include:

- flight distance and duration to EIA
- landing approach
- wake turbulence
- length of taxi-ways
- congestion of the taxi-way, ramp and apron
- ground transportation for the patient
- road distance and duration from EIA to tertiary care facilities in Edmonton
- ground transportation for the air medical crews returning to EIA

Flight distance and duration to EIA

The additional 29 kilometres (15.6587 nautical miles) between ECCA to EIA can add a slight increase in flying time when fixed-wing aircraft are arriving from the north.[8]

Landing approach

EIA is a busier airport than ECCA (130,596 aircraft movements in 2010 versus 66,688).[71]

The volume of flights at EIA is such that the Medevac aircraft might have to join a queue before being given clearance to land. This could contribute to potential delays.

Wake turbulence

Whenever an aircraft flies it causes turbulence in the air behind it, or in its wake, hence the term 'wake turbulence'. The problem with wake turbulence is that it can destabilize another (usually smaller and lighter) aircraft, particularly on take-off and landing. At these times, when an airplane is flying at low speeds, encountering mild or moderate wake can then leave the aircraft with a smaller margin for recovery and thus the safety of the flight is threatened.

In general, the larger and heavier the fixed wing aircraft, the greater the turbulence. Greater turbulence is more likely to occur at the Edmonton International Airport than at the Edmonton City Airport because of the "heavy" aircraft traffic (those with a maximum take off mass of 136,000 kg or greater). Transport Canada requires that pilots effect a "separation" of their aircraft from a "known heavy aircraft". This separation is between two and three minutes, depending on specified criteria.[84]

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Length of taxi-ways

The runway lengths are significantly longer at EIA (~11000 ft versus ~5800 ft at ECCA).[86] The taxi-ways could be longer depending on where the aircraft lands in relation to the fixed base operator as highlighted below.

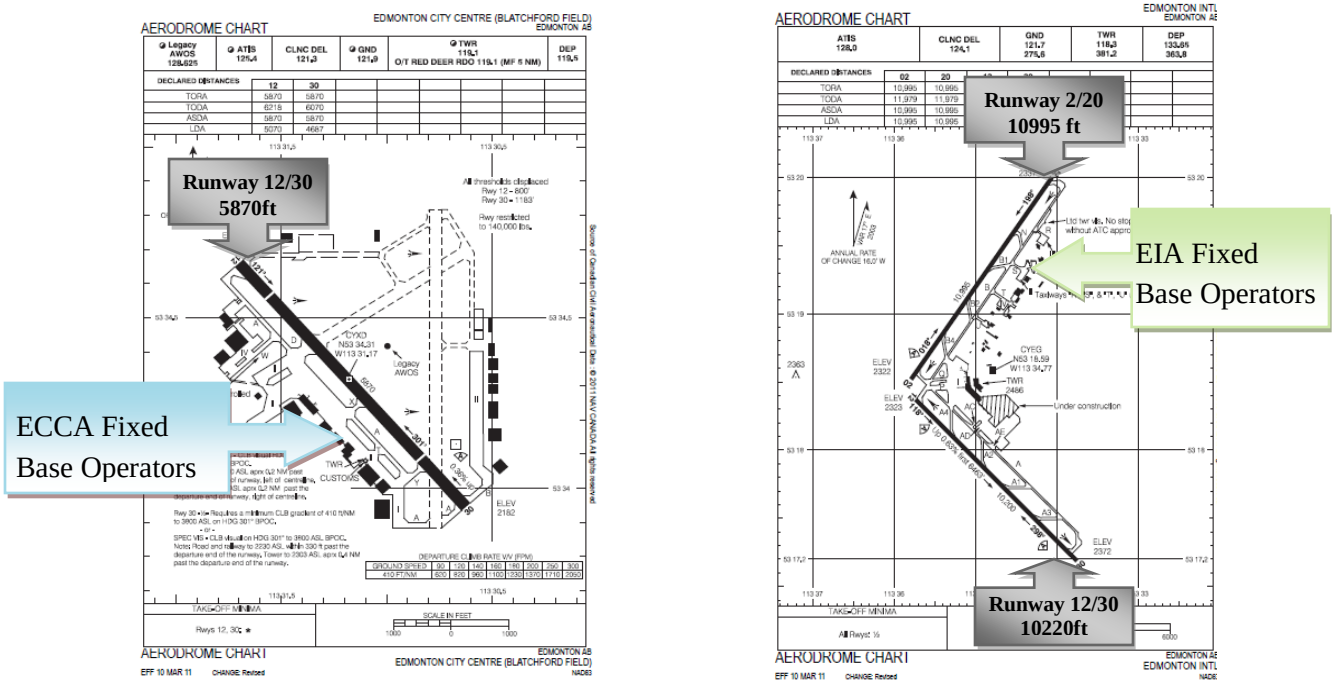


Figure 6: ECCA and EIA Aerodrome Charts[86]

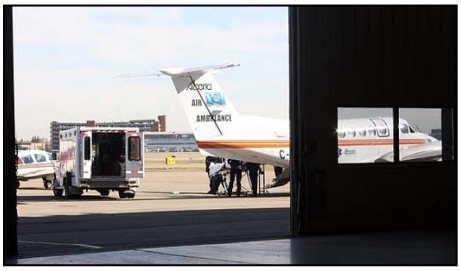
Congestion of the taxi-way, ramp and apron

Due to the higher volume of general aviation and commercial flights landings at EIA versus ECCA, congestion on the taxi-way, ramp and apron can occur. This congestion can lead to additional time delays for patient transfers, as well as potential aviation accidents.

HealthONE AIRLIFE in Denver prefers not to mix general aviation with commercial flights; therefore, their primary airport is Centennial Airport and not the Denver International Airport.

Ground transportation for the patient

Significant differences exist between EIA and ECCA in regards to ground transportation. At ECCA, each contracted operator has its own ground ambulance at the airport, which means that after landing, the medical crew will transfer the patient to their own ambulance and then transport the patient to the receiving hospital. However, at EIA each contracted operator does not have a ground ambulance based there. Depending on different situations, an ambulance is dispatched as per the algorithm below.[87]



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For flights that are scheduled to land at EIA because weather conditions prohibit landing at ECCA, the order of ambulance dispatch is from:

- Inter-Facility Transport (IFT)
- Leduc Fire/North Central EMS
- Edmonton Metro EMS
- Other Suburban EMS

In situations where the original flight plan was to land at ECCA but in-flight the aircraft was diverted to EIA, the order of ambulance dispatch is slightly different:

- Leduc Fire/North Central EMS
- Inter-Facility Transport (IFT)
- Edmonton Metro EMS
- Other Suburban EMS

For time-sensitive ("Red") priority patients landing at EIA, an AHS ambulance (without staff) is available at the Executive Flight Centre Terminal #2. This ambulance is to be used if another ambulance cannot be dispatched in time. EIA Airport Fire Department, if available, has agreed to prepare the ambulance for the medical crew and drive it to meet the inbound aircraft.

A medevac flight often has two medical crew members on-board. When the Edmonton International Airport ground ambulance or operator owned ambulances are used by the air medical crew, the EMT drives the ambulance to the receiving facility while the paramedic cares for the patient in the back of the ambulance.

> **ISSUE:** Having only one healthcare provider to provide care in the back of the ambulance between the Edmonton International Airport and the Edmonton tertiary care facility may not be adequate for critically-ill patients.

Ground transportation for the air medical crews returning to EIA

After transporting the patient to the tertiary care facility, the medical crew and their equipment must go back to the airport so they can return to their home base or be dispatched on another medevac flight with the aircraft and air crew. If they are returning to the Edmonton City Centre Airport, the medical crew can use their own ambulance. However, for return transportation to the Edmonton International Airport, the situation is more complicated. If the Edmonton International Airport ground ambulance is not used, the medical crew and their equipment are transported back to the Edmonton International Airport by taxi. Medical crews have stated that getting a taxi to go to the Edmonton International Airport with their equipment can be difficult and takes additional time.

> **ISSUE:** If a taxi is not available or is difficult to hire, the additional time delay for crew to get back to the Edmonton International Airport can reduce the availability of the crew for another mission and may lead to a duty time-out for the air crew.

Road distance and duration from EIA to tertiary care facilities in Edmonton

EIA is located further from the Edmonton area hospitals than ECCA. Table 5 presents the distances and times to each of the Edmonton area hospitals from EIA and ECCA, as well as the difference in distances and times between the two airports (see Appendix IX).

Summary of Time/Distance from ECCA and EIA to Edmonton Area Hospitals

Hospitals	ECCA		EIA		Difference to/from EIA	
	(min)	(km)	(min)	(km)	(min)	(km)
University of Alberta	13	7.1	31	28.7	**+18**	**+21.6**
Royal Alexandra	5	2.7	40	31.9	**+35**	**+29.2**
Grey Nuns	32	17.5	24	24.7	-8	**+7.2**
Misericordia	21	11.5	33	34.6	**+12**	**+23.1**
Sturgeon	17	14.3	53	53.9	**+36**	**+39.6**
Glenrose	7	3.7	39	32.7	**+32**	**+29**
Cross Cancer	13	8.8	30	28.9	**+17**	**+20.1**
Alberta Hospital	20	17.4	44	54	**+24**	**+36.6**

Table 5: Summary of Time/Distance from ECCA and EIA to Edmonton Area Hospitals

In addition to the longer distance, travel from EIA to the hospitals is on the Queen Elizabeth II highway, one of the busiest highways in Alberta.[89] Because of this increased traffic and the number of accidents, there is the possibility that patients who are being transported between EIA and Edmonton-based hospitals will experience longer journey times then described in Table 5 above.

90

> **ISSUE:** Ground travel from EIA to receiving tertiary hospitals can effect patient and medical crew safety due to increased distance, cross streets, traffic signals and traffic volume. This may be exacerbated by inclement weather and construction.

Canadian comparison: distances and times to tertiary care

Ten cities across Canada were compared to Edmonton to gain a better understanding of times and distances for medevac patient transports between primary airports and tertiary care centres (see Table 6). The estimated times are based on Google searches conducted on April 14, 2011 and the actual times may vary due to weather, road construction, accidents or other conditions (see Appendix X).

Providing medevac services from ECCA provided optimum response times with an estimated time to a tertiary care facility being five minutes (RAH) and 13 minutes (UAH). ECCA is not the only airport that provides such response times; Regina also has two tertiary care facilities within an estimated response time of 10 minutes or less.

When ECCA is closed and EIA becomes the primary airport, it will take longer than 20 minutes to travel from EIA to Edmonton's tertiary care centres. Seven of the ten cities compared to Edmonton have at least one tertiary care centre that is 11 to 20 minutes from their primary airport. Three cities have at least one tertiary care centre that is longer than 20 minutes from their primary airport.

City/Province	Airport	Hospital	Google	
			Time to Tertiary Care (min)	Distance to Tertiary Care (km)
Edmonton, AB	Edmonton City Centre Airport (YXD)	Royal Alexandra	5	2.7
		University of Alberta	13	7.1
	Edmonton International Airport (YEG)	Royal Alexandra	40	31.9
		University of Alberta	31	28.7
Vancouver, BC[91]	Vancouver International Airport (YVR)	Vancouver General Hospital	21	12.1
		BC Women's and Children's Hospital	17	9
		St. Paul's Hospital	24	13.4
Victoria, BC	Victoria International Airport (YYJ)	Victoria General Hospital	27	23.7
		Royal Jubilee Hospital	30	27.5
Kamloops, BC	Kamloops Airport (YKA)	Kamloops Royal Inland Hospital	18	11.2
Calgary, AB[92]	Calgary International Airport (YYC)	Foothills Medical Centre	18	18.9
		Peter Lougheed Centre	13	9.4
Saskatoon, SK[93]	John G. Diefenbaker International Airport (YXE)	Royal University Hospital	16	11.5
		St. Paul's Hospital	12	9.2
Regina, SK	Regina International Airport (YQR)	Regina General Hospital	10	4.9
		Pasqua Hospital	7	3.5
Winnipeg, MB[94]	Winnipeg International Airport (YWG)	Winnipeg Health Sciences Centre	14	6.7
		St. Boniface Hospital	20	11.9
Moncton, NB[95]	Moncton International Airport (YQM)	Dr. Georges-L. Dumont Regional Hospital	11	7.8
		Moncton City Hospital	14	9.7
Saint John, NB	Saint John Airport (YSJ)	Saint John Regional Hospital	23	24.7
Fredericton, NB	Fredericton International Airport (YFC)	Dr. Everett Chalmers Hospital	17	15.3

Table 6: Distances and Times to Tertiary Care in Eleven Canadian Cities

CHANGES TO EDMONTON MEDEVAC SERVICES - FUTURE

At some time in the future, the Edmonton City Centre Airport will close, leaving Edmonton with only one airport for medevac services – EIA. This change will have some specific effects on medevac flights, such as the identification of an alternate airport and the requirement for refueling en route to Edmonton. Although both these factors currently exist for all medevac flights, the effect from closure of ECCA would be magnified.

Alternate airport and refueling en route

Aircraft must identify an alternate airport when flying under Instrument Flight Rules (IFR). Currently pilots are able to use ECCA as their primary airport and EIA as their alternate. If an alternate airport is not available in the Edmonton region, then Calgary, Saskatoon or southern BC would likely become the alternate airport for medevac flights.

The additional distance to an alternate airport would significantly add to the amount of fuel required on-board.[96] As stated by Transport Canada, all flights must be planned and monitored to ensure adequate fuel quantities are available to meet the requirements outlined in the regulations. The aircraft must have enough fuel to conduct an approach and a missed approach and hold for 30 minutes at an altitude of 1,500 feet above the elevation of the identified aerodrome. The fixed wing King Air B200 aircraft that are used for medevac service often fly near their maximum take-off weight once medical crew, patients, equipment and supplies are onboard. Although these aircraft may be able to carry more fuel by volume, they cannot carry the extra weight of the fuel.[97]

With the need for an alternate airport, flights arriving from northern communities may need to stop en route for refueling. For example, a King Air B200 flying direct from Whitehorse, Yukon to EIA using Calgary, Saskatoon or southern BC as their alternate, may require a fuel stop en route. In addition to the stop, patients must be off-loaded from the aircraft during the refueling process.[31] A ground ambulance or a shelter at the airport being used to refuel may not be readily available for patient transfer. The additional time to refuel can increase total time to tertiary care.

Canadian comparison: alternate airports

With the closure of ECCA, the alternate airport for medevac flights travelling to Edmonton is 246 kilometers from the primary airport (i.e., Calgary International Airport). This distance is the furthest of all jurisdictions compared. Two other cities (Saskatoon / Regina) have an alternate airport that is greater than 200 kilometers from the primary airport; however, these two cities have identified a second alternate airport, one of which is 135 kilometers and the other 180 kilometers from the primary airport.[8]

City/Province	Primary Airport	Alternate Airport	Distance between Primary & Alternate Airports[8]	
			(kilometers)	(nautical miles)
Edmonton, AB	Edmonton City Centre Airport (YXD)	Edmonton International Airport (YEG)	29	15.6587
	Edmonton International Airport (YEG)	Calgary International Airport (YYC)	246	132.829
Vancouver, BC	Vancouver International Airport (YVR)	Abbotsford International Airport (YXX)	63	34.0172
Victoria, BC	Victoria International Airport (YYJ)	Vancouver International Airport (YVR)	63	34.0172
Kamloops, BC	*Kamloops Airport (YKA)	Kelowna Airport (YLW)	112	60.4751
Calgary, AB	Calgary International Airport (YYC)	Spring Bank (YBW)	25	13.4989
Saskatoon, SK	John G. Diefenbaker International Airport (YXE)	Regina International Airport (YQR)	239	129.049
		Prince Albert Airport (YPA)	135	72.8941
Regina, SK	Regina International Airport (YQR)	John G. Diefenbaker International Airport (YXE)	239	129.049
		*Yorkton Airport (YQV)	180	97.1922
Winnipeg, MB	Winnipeg International Airport (YWG)	*St. Andrews Airport (CYAV)	Not available: five minutes north of the City of Winnipeg[98]	
Moncton, NB	Moncton International Airport (YQM)	Saint John Airport (YSJ)	129	69.6544
Saint John, NB	Saint John Airport (YSJ)	Moncton International Airport (YQM)	129	69.6544
Fredericton, NB	Fredericton International Airport (YFC)	Moncton International Airport (YQM)	146	78.8336

Table 7: Distances from Primary Airports to Alternate Airports

*No ILS

Kilometers were converted to nautical miles. 1 kilometre = 0.539956803 nautical miles[99]; 1 nautical mile = 1.852 kilometre[100]

Previous reports[5, 6] made reference to Denver, Colorado and its air ambulance program HealthONE AIRLIFE. AIRLIFE is the Emergency Medical/Critical Care Transport Service of the HealthONE system (includes 7 of 17 hospitals in the Denver area). AIRLIFE use ground ambulances, helicopters and Learjets. The Learjets service a radius of 240 – 800 km (150 – 500 miles).

The Centennial Airport (KAPA) is AIRLIFE's primary airport and is used for general aviation. Centennial Airport has three alternate airports and all have instrument landing systems and a minimum runway length of 5700 ft. The distance between the Centennial Airport and the following alternate airports are:

- Denver International (KDEN), 36 kilometers (19.3 nautical miles NE)
- Rocky Mountain Metro (KBJC), 44 kilometers (23.8 nautical miles NW)
- City of Colorado Springs (KCOS), 86 kilometers (46.3 nautical miles S)
- Fort Collins Loveland (KFNL), 99 kilometers (53.4 nautical miles N)[44, 100]

ISSUE: If there is no alternate airport in the Edmonton region, patients may need to be diverted to other cities for treatment. As noted previously in the report, this may introduce several threats to patient safety; as well as capacity issues for airports and tertiary care centres.

The 'ripple' effect

Closure of ECCA and the transfer of all Edmonton medevac services to EIA will, in addition to the issues described above, have an effect on other aspects of care. For example, Larga is a facility in Edmonton that provides support to residents of the Northwest Territories and Nunavut when they are in the city for medical care. As noted on the Larga website: "Our mission is to supply you with the necessary support to get you back on your feet and home quickly to your family, friends, and community".[101] Larga provides a range of services, including arranging for flights as well as providing local transportation. If patients from the territories are transported to Calgary instead of Edmonton, there would be an impact on the Larga program and the patients it serves. The governments of the Northwest Territories and Nunavut would need to make a decision about whether or not to set up a similar facility in Calgary for patients and their families.

The City of Calgary would also be affected if some of the medevac flights that had previously flown into Edmonton were to land in Calgary. This could occur if medevac flights were unable to land at EIA and had to use their alternate (Calgary) or if Calgary was chosen as the primary airport. The increased traffic in Calgary could affect both aviation and healthcare system capacities. Furthermore, for flights diverted to Calgary, last minute arrangements would have to be made to assign a physician to care for the patient and find an appropriate hospital bed. This would necessitate the involvement of RAAPID South and RAAPID North in the initial discussions about the transfer of the patient.

Thus, the planned closure of ECCA will have a 'ripple' effect throughout the entire healthcare system, not only within the Province of Alberta but also in the healthcare systems of the neighboring provinces/territories, which currently send their medevac patients to Edmonton for necessary medical treatment. The closure will have wide-spread effects and much thought, planning and change will be required to mitigate the potentially deleterious effect on the safety of all patients.

RECOMMENDATIONS

During the review, the HQCA Review Team conducted surveys, interviews, a modified Proactive Risk Assessment, and a review of the literature and current documents to seek the knowledge and opinions of a wide range of individuals from Alberta, other provinces/territories and one U.S. city. Several concerns were identified related to the safety of medevac patients and suggestions for improvements and recommendations were elicited. Although the HQCA Review Team did not consider financial implications, it is recommended that all factors of quality, including affordability, be assessed prior to acceptance of the recommendations noted below.

On August 3, 2010 one of two runways at the Edmonton City Centre Airport was closed, based on an order from the City of Edmonton. The runway that closed had instrument landing system capabilities that can accommodate medevac flights during low ceilings or reduced visibility due to fog, rain or blowing snow. Since then, an increased number of medevac flights have been diverted from the Edmonton City Centre Airport to the Edmonton International Airport due to weather and runway limitations.

The relocation of medevac services from the Edmonton City Centre Airport to the Edmonton International Airport results in a longer journey for patients who are brought to a tertiary care facility in Edmonton. The main patient safety concern is that an increase in journey time for critically-ill medevac patients could have a negative effect on their well-being. While there are specific groups of patients for whom an increased journey duration represents an increased threat to their well-being, it is difficult to determine the magnitude of this effect.

Additionally, the effect of the increased journey time extends beyond the patient who is in transit. Other patients waiting for emergency air transportation are affected, as are those who require transportation by air to leave an Edmonton hospital and return home. Thus, the current partial closure of the Edmonton City Centre Airport is already having an effect on the medevac system.

Since August 2010, both Alberta Health Services and Edmonton Regional Airports Authority have made changes to their structures and processes in an attempt to mitigate the problem posed by the closure of one runway at the Edmonton City Centre Airport. These two organizations are to be commended for these changes and for their willingness to consider various options. However, not all necessary structures and processes have been established at the Edmonton International Airport to mitigate potential patient safety concerns related to this relocation.

RECOMMENDATIONS:

To support and guide the transition of medevac services from the Edmonton City Centre Airport to the Edmonton International Airport, the following recommendations are made:

1. A Transition Advisory Committee be struck to facilitate information sharing and to advise on key decisions. Representation on this committee should include individuals from Transport Canada, NAV CANADA, Alberta Health and Wellness, Alberta Health Services, the medical community, fixed wing and rotary wing providers (both air and medical crews), the Edmonton Regional Airports Authority and a member of the public. As well, correspondence and consultation with Alberta Finance, Alberta Transportation, British Columbia, City of Edmonton, Northwest Territories, Saskatchewan and Yukon should occur.

To minimize transfer time for patients transported to Edmonton International Airport and from Edmonton International Airport to treatment facilities in Edmonton, as well as the medical crew returning from the treatment facility back to the airport, it is recommended that:

2. Until a new dedicated Medevac facility is in place, the Edmonton International Airport provide a dedicated area for medevac flights, which should include parking for medevac aircraft and ambulances, power, refueling and other services.

3. Traffic patterns be studied and an optimal ambulance route established from the Edmonton International Airport to tertiary care facilities.

4. An evaluation be conducted on the impact of traffic lights on transport times and changes implemented to minimize this impact. Changes could include installing an Optacom device/system to allow ambulances to change traffic lights to green or synchronizing traffic lights on the main routes from the Edmonton International Airport to tertiary care facilities.

5. All ambulances be equipped with a Global Positioning System so alternate routes can be determined when traffic is problematic.

6. The current process of how medical crews return to the airport from the tertiary care centre be improved. This could include timely transfer of care from the medevac crew to the tertiary care facility, providing taxi-cab drivers with greater financial incentive to take staff to the Edmonton International Airport or using Alberta Health Services transportation.

7. Arriving and departing medevac flights be given priority for landing, taxi and take-off.

In the future, additional building and infrastructure will be necessary at the Edmonton International Airport to support expanded medevac services. Therefore, it is recommended that:

8. A new facility dedicated to medevac aircraft and ground facilities be built at the Edmonton International Airport. This should include space to accommodate:
   - the transfer of patients from air to ground ambulance that is out of the elements
   - crew facilities to allow uninterrupted rest periods for flight crews
   - storage of necessary equipment

9. The new facility/air ambulance hangar be located away from the general commercial traffic.

10. Additional road infrastructure, such as an on/off ramp from the new facility that will provide faster access to north-bound Queen Elizabeth II or a dedicated emergency lane on Queen Elizabeth II, be built.

Regardless of where medevac services are located within the Edmonton area, there are a number of additional changes that can be made to improve medevac services in Edmonton and province-wide. Therefore, it is recommended that:

11. A standardized and agreed upon coding system is implemented for classifying and prioritizing patient transports, along with standardized use of the term ‘medevac’.

12. The mandatory use of RAAPID (Referral, Access, Advice, Placement, Information and Destination) for all patient transports and the Red Referral process for all critically-ill patient transports originating within and outside Alberta be adopted.

13. Ground ambulances that transport patients between the Edmonton International Airport and Edmonton hospitals are staffed with a second healthcare provider to provide care during ground transportation of unstable or critically-ill patients.

14. Equipment is standardized across the various ground and air ambulance providers (including fixed wing and rotary wing).

15. Medical personnel who transport patients in ground ambulance, rotary or fixed wing aircraft are cross trained in all modes of transport.

16. Once equipment is standardized and personnel are trained, rotary wing transportation between the Edmonton International Airport and the tertiary care facility be used when it is deemed that this mode of transport will result in substantial time savings (e.g., extreme traffic/road conditions that would result in unacceptable delays using ground transportation).

While some of the recommendations in this report are directly related to the increase in transfer time from the Edmonton International Airport to a tertiary care hospital in Edmonton, there may be additional opportunities to decrease the overall duration of a patient's journey. Other factors, such as pre-transport care, may also affect what happens to a patient. Therefore, it is recommended that:

17. An evaluation of the entire process of the transfer of medevac patients, with application of quality improvement techniques, should be conducted to identify:
    - opportunities to reduce times spent before air ambulance transportation
    - improved and/or new ways of providing care, such as assessment of services available in hospitals outside and within Edmonton

Although the HQCA review was tasked with assessing and inquiring into the patient safety implications of relocating medevac services to the Edmonton International Airport, the review team also identified additional concerns that could arise if the Edmonton International Airport is the only airport in the Edmonton area for medevac flights. Prior to take-off, all flights are required to create a flight plan that includes determination of an alternate airport. When the Edmonton City Centre Airport is closed, the Edmonton International Airport will be the primary destination and the closest instrument landing system airport located in Calgary will likely be the alternate. If medevac flights are not able to land at the Edmonton International Airport and must go on to Calgary, several patient safety concerns arise. Certain services are available only in Edmonton hospitals and critically-ill patients who require those services would not receive timely care (i.e., neonatal extra-corporeal membrane oxygenation, major neonatal cardiac surgery, major organ transplants and hyperbarics). In addition, patients being sent to Edmonton should have a physician and a hospital bed identified in Edmonton. If they are re-routed, finding another bed and physician in the alternate city adds to the complexity of the situation and requires further and last minute coordination.

For flights that originate a long distance from Edmonton, designating the Edmonton International Airport as the primary destination and Calgary as the alternate airport could result in a mandatory fuel stop. This means longer transport times for these patients. Refueling requires that patients be off-loaded from and reloaded onto the aircraft. Patients are exposed to inclement weather/ temperatures and are at increased risk of inadvertent medical line and tube dislodgement. For some flights, such as those originating from Whitehorse, Yukon, it might be beneficial to fly directly to Calgary. Diversions to Calgary could result in capacity issues at both the Calgary airport and tertiary care facilities.

Because of these identified concerns, it is recommended that:

18. Another airport be considered as a back up within the Edmonton area with instrument landing system capabilities that can accommodate medevac flights.

CONCLUSION

In July 2009, the City of Edmonton decided to implement a phased closure to the Edmonton City Centre Airport (ECCA). On August 3, 2010, based on an order from the City of Edmonton, one of two runways at the ECCA was closed. The runway that closed had instrument landing capabilities that could accommodate medevac flights during low ceilings or reduced visibility. This closure has resulted in an increased number of medevac flights being diverted from the ECCA to the Edmonton International Airport.

The HQCA review has identified patient safety issues and associated recommendations due to the partial closure of the ECCA that need to be addressed. In addition to these concerns, the review includes recommendations that should be addressed prior to the full closure of the ECCA.

ACKNOWLEDGEMENTS

The HQCA thanks the individuals who were interviewed, responded to the survey, participated in the Prospective Risk Assessment, provided documentation and patiently answered our questions. Their commitment and effort to help us better understand patient safety concerns related to medevac services in Alberta was instrumental in the completion of this report.

APPENDICES

APPENDIX I: LITERATURE SEARCH METHODOLOGY

"Searches were performed as closely to the previous IHE strategy and methodology as possible. Where date limits had been used in earlier searches, limits of 2007 and later were substituted. Where it was possible to limit by more specific date, June 2007 was used.

All results from major databases, the Alberta Health and Wellness website, and library catalogues and selected results from other websites, search engines, and grey literature sources were saved to the RefWorks account set up for this project; selection was based on a generous application of inclusion criteria – where any possibility existed that the item in question might address the subjects being examined it was saved. Of the results saved, the vast majority were the results of the major databases, few of the other sources had more than a handful of results, and few of those results were selected as potentially relevant.

The resulting references were de-duplicated, erring on the side of keeping potential duplicates over deleting potentially important citations. RefWorks originally identified 1124 "close duplicates", after de-duping there were 64 "close duplicates" and 1129 kept references.

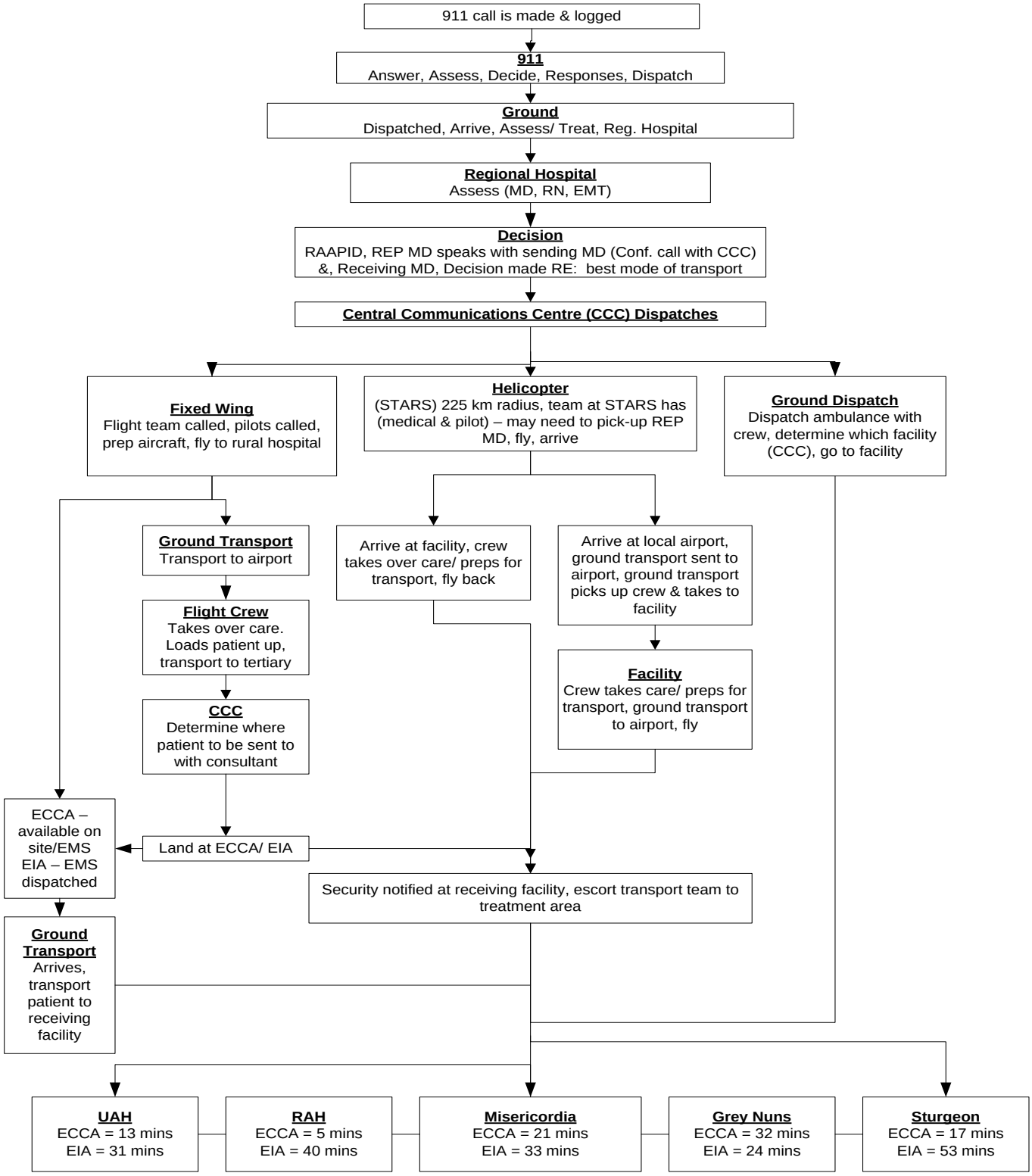
In the course of de-duping it was noted that references likely to be retained through the inclusion/exclusion process are in the minority, estimated at less than one-third."[102]

Database, Platform, and URL	Search Terms
The Cochrane Library	"rotary NEAR/2 wing* or helicopter* or heliplane* or heli-plane* or tiltrotor* or tilt NEAR/2 rotor* or eurocopter* or rotaplane* or aeromedical or air NEAR/2 ambulance* or air NEAR/2 medical or aircraft* or airline* or fixed NEAR/2 wing* or medevac or "air transport" in Title, Abstract or Keywords and transport* or transfer* or transit* in Title, Abstract or Keywords, from 2007 to 2011 ; 1 Cochrane Review; 1 "other review"; 10 Clinical Trials; 2 Economic Evaluations
PubMed http://www.ncbi.nlm.nih.gov.ezproxy.lib.ucalgary.ca/pubmed www.pubmed.gov	(rotary wing* or helicopter* or heliplane* or heli-plane* or tilt-rotor* or tilt rotor* or tiltrotor* or tilt wing* or tilt-wing* or tiltwing* or eurocopter* or rotaplane* or air-ambulance* or "aircraft"[MeSH] or aircraft* or medevac[text word] or aeromedical or airline* or fixed wing*) AND (transfer* or transport* or transit* or evacuate) AND (outcome* or criteria* or evaluat* or impact* or assess* or review*[tiab] or study[tiab] or model or models or cost or costs or protocol* or algorithm* or utili* or organisation* or organization* or patient or patients or econom* or guideline*) and (health or emergenc* or trauma or triag* or critical care or intensive care); Limits: English Language, Publication Date from 2007/06/01 to 2011/01/16; 330 Results
CRD Databases (DARE, HTA, &NHS EED) http://www.crd.york.ac.uk/crdweb/	("rotary wing*" or rotary-wing* or helicopter* or heliplane* or tilt-rotor* or tilt rotor* or tiltrotor* or "tilt wing*" or tilt-wing* or tiltwing* or eurocopter* or rotaplane* or "air ambulance*" or air-ambulance* or aeromedical or fixed wing* or "fixed wing*" or aircraft* or airline* or airplane* or medevac) or ("air medical"); Limit to Modified 2007 to 2011; 26 Documents Found; DARE 9; EED 9; HTA 8; Limit to Published 2007 to 2011; 11 Documents Found; DARE 4; EED 3
Web of Science – SCI and SSCI Licensed Resource ISI Interface	TS=("rotary wing*" or helicopter* or tilt rotor* or tiltrotor* or "tilt wing*" or tiltwing* or rotaplane* or "air ambulance*" or aeromedical or fixed wing* or "fixed wing*" or aircraft* or airline* or airplane* or medevac or "air medical"); AND TS=(transfer* or transport* or transit*); AND TS=(outcome* or evaluat* or impact* or assess* or review* or study or cost or costs or protocol* or health or emergenc* or trauma or triag* or intensive care or critical care or patient* or algorithm* or utili* or orgnisation* or organization* or econom* or guideline*); AND TS=(patient* or individual* or person* or civilian* or neonate* or child* or adult* or population or physician* or passenger* or infant*); Doc Type = All document types; Language = All languages; Databases = SCI-Expanded, SSCI; Timespan = 2007 to 2011; 418 results
CINAHL Plus with Full Text Licensed Resource	(MH "Practice Guidelines") or outcome* or criteria* or evauat* or impact* or assess* or review* or study or studies or model or models or cost or costs or protocol* or algorithm* or utili* or organization or organisation* or econom* or guideline*; AND (MH "Transfer, Discharge") or (MH "Transfer, Intrahospital") or transport* or transfer* or transit* AND; (MH "Emergencies+") or (MH "Emergency Medical Services+") or (MH "Critical Care+") or (MH "Trauma+") or trauma or critical care or intensive care or emergenc*; AND (MH "Aeromedical Transport") or (MH "Aircraft") or air ambulance* or rotary wing* or fixed wing* or helicopter* or airplane* or medevac or air medical or aircraft* Limit: July 2007 to December 2011; 213 Results
BIOSIS Previews	TS=("rotary wing*" or helicopter* or tilt rotor* or tiltrotor* or "tilt wing*" or tiltwing* or rotaplane* or "air ambulance*" or aeromedical or fixed wing* or "fixed wing*" or aircraft* or airline* or airplane* or medevac or

Database, Platform, and URL	Search Terms
	"air medical") AND TS=(transfer* or transport* or transit*) AND TS=(outcome* or evaluat* or impact* or assess* or review* or study or cost or costs or protocol* or health or emergenc* or trauma or triag* or intensive care or critical care or patient* or algorithm* or utili* or organization* or organisation* or econom* or guideline*) AND TS=(patient* or individual* or person* or civilian* or neonate* or child* or adult* or population or physician* or passenger* or infant*); DocType=All; LitType= All; Language= All; Taxa Notes= All; Databases= Biosis Previews; Timespan= to 2007 to 2011; Results = 132
EMBASE Licensed Resource (OVID Interface)	1 exp air medical transport/(1050); 2 exp HELICOPTER/(1236); 3 (rotary wing$ or fixed wing$ or air ambulance$ or medevac or aeromedical or helicopter$ or airplane$ or airline$ or air medical).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer] (8967); 4 1 or 2 or 3 (8967); 5 EMERGENCY/(24242); 6 emergency health service/(49977); 7 (emergen$ or trauma).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer] (409728); 8 critical care.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer] (18343); 9 exp intensive care/(324311); 10 -5 or 6 or 7 or 8 or 9 (707598); 11 patient transport/(15242) 12 (transfer$ or transport$ or transit$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer] (1167613); 13-11 or 12 (1167613); 14 exp practice guideline/(236791); 15 (outcome$ or criteria$ or evaluat$ or impact$ or assess$ or review$ or study or studies or model or models or cost or costs or protocol$ or algorithm$ or utili$ or organization$ or organisation$ or econom$ or guideline$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer] (12366962); 16- 14 or 15 (12370382); 17- 4 and 10 and 13 and 16 (1441); 18 limit 17 to yr="2007 - 2011" (409); 409 Results
Scopus	((TITLE-ABS-KEY("rotary wing*" OR helicopter* OR tilt rotor* OR tiltrotor* OR "tilt wing*" OR tiltwing* OR rotaplane* OR "air ambulance*" OR aeromedical OR fixed wing* OR "fixed wing*" OR aircraft* OR airline* OR airplane* OR medevac OR "air medical") AND TITLE-ABS-KEY(transfer* OR transport* OR transit*)) AND PUBYEAR AFT 2006) AND ((TITLE-ABS-KEY(emergenc* OR trauma OR triage OR "intensive care" OR "critical care") AND TITLE-ABS-KEY(outcome* OR criteria* OR evaluat* OR impact* OR assess* OR review* OR study OR studies OR model OR models OR cost OR costs OR protocol* OR algorithm* OR utili* OR organization* OR organisation* OR econom* OR guideline*)) AND PUBYEAR AFT 2006); 162 Results
NEOS (Central Alberta Library Consortium) http://www.library.ualberta.ca/	Any field "(rotary-wing$ or helicopter$ or air ambulance$ or aircraft$ or fixed wing$) and (emergen$ or trauma$)" Subject "air ambulances"; Subject "airplane ambulances"; 75 Results uploaded to RefWorks
AMICUS (National Library of Canada)	(sw air ambulances or sw airplane ambulances) and dat >2006 sw aeromedical evacuation and aw (evaluation; outcome; impact; assessment; protocol; algorithm; organization; economics; guidelines) and dat >2006; 17 results
AMA Clinical Practice Guidelines (TOP) http://www.topalbertadoctors.org/informed_practice/clinical_practice_guidelines.html	Browsed guidelines 0 relevant results
CMA Infobase http://www.cma.ca/index.php/ci_id/54316/la_id/1.htm	helicopter : 0 results; helicopters : 0 results; air ambulance : 0 results; air ambulances : 0 results; plane : 0 results; ambulance : 0 results
National Guideline Clearinghouse http://www.guideline.gov/	Air ambulance* : 9 results, 0 relevant; Helicopter* : 3 results, 0 relevant; Aeromedical : 1 result, 0 relevant; Airplane : 0 results; Aircraft : 2 results, 0 relevant
Canadian Task Force on Preventative Healthcare http://www.canadiantaskforce.ca/	Browsed the website, nothing relevant
Alberta Health and Wellness http://www.health.alberta.ca/	Air ambulance 63 results
Health Canada http://www.hc-sc.gc.ca	Air ambulance : 58 results; Medevac : 3 results Browsed list of results, 0 relevant
US Food and Drug Administration http://www.fda.gov/default.htm	Air ambulance Browsed list of results, 0 relevant
Aetna Clinical Policy Bulletins http://www.aetna.com/healt	Browsed complete alphabetical list of clinical policy bulletins. 0 relevant

Database, Platform, and URL	Search Terms
hcare-professionals/policies-guidelines/cpb_alpha.html	
BlueCross BlueShield http://www.bcbs.com/blueresources/tec/	Air ambulance : 0 results; Helicopter : 0 results; Airplane : 0 results Aircraft : 0 results
NHS Evidence Health Information Resources (formerly National Library for Health) http://www.library.nhs.uk/Default.aspx	Air ambulance 8 results; Air ambulances 0 results; Helicopter 7 results; Helicopters 0 results; Searching title and text Search limits on default: Evidence Based Reviews, Guidance, Specialist Collections All results from CRD, PubMed
KU-UC database http://kuuc.chair.ulaval.ca/english/index.php	Air ambulance 0 results; Air ambulances 0 results; Helicopter 0 results; Helicopters 0 results Aircraft 0 results
NLM Gateway http://gateway.nlm.nih.gov/gw/Cmd	Air ambulance 2167 results; Aeromedical transport, 231 results; Medevac, 17750 results; Helicopter and emergency 2830 results; Aircraft and life support 499 results; Browse results, 5 selected and loaded to RefWorks
Theses Canada Portal http://www.nlc-bnc.ca/thesescanada/	Air ambulance 5 results; Air ambulances 1 result; Aeromedical 3 results; Medevac 0 results; Helicopter 140 results; Helicopters 27 results; Aircraft and emergency 7 results; Aircraft and life support 3 results; Aircraft and trauma 0 results Aircraft and triage 0 results; Results browsed, 1 saved
ProQuest Dissertations and Theses – Full Text	((air ambulance or air ambulances or helicopter or helicopters or aircraft or medevac or aeromedical)) AND ((emergenc* or triage or trauma or life support or critical care or intensive care)); 118 results , 4 relevant results from >2006 saved
AETMIS http://www.aetmis.gouv.qc.ca	Helicopter; Helicopters; Air ambulance; 0 results
CADTH www.cadth.ca	Helicopter 1 result; Helicopters 0 results; Air ambulance 16 results; Results browsed, 1 saved
Institute for Clinical Evaluative Sciences http://www.ices.on.ca/	Helicopter; helicopters; air ambulance; results browsed, 0 relevant
Health Technology Assessment Unit at McGill http://www.mcgill.ca/tau/	Browsed list of reports 2010-2006
Medical Advisory Secretariat http://www.health.gov.on.ca/english/providers/program/mas/mas_about.html	Browsed lists of reports 2006 - present
ECRI Licensed Resource www.ecri.org	“Air ambulance*” 0 results; helicopter* 3 results; medevac 1 result; aeromedical 0 results; 0 results
Health Quality Council Saskatchewan http://www.hqc.sk.ca	helicopter 4 results, 0 relevant; “air ambulance”, 7 results, 0 relevant; medevac 0 results; aeromedical 0 results.
CCE http://www.southernhealth.org.au/page/Health_Professionals/CCE/	Browsed list of Evidence Based Clinical Guidelines, Current Evidence Reviews, Archived Evidence Reviews
NICE (UK) http://www.nice.org.uk/	Air ambulance, 128 results, 0 relevant; Helicopter; medevac aeromedical
Google www.google.ca	"air ambulance" criteria or protocol or policy or outcome or guideline; 115000 results; air ambulance site:.ca; 40100 results; Relevant results saved
Google www.ca.Google.com	"air ambulance" criteria or protocol or policy or outcome or guideline; 4920 results; air ambulance site:.ca 62900 results; Relevant results saved

APPENDIX II: MEDEVAC SERVICES PROCESS MAP



APPENDIX III: CODING OF PATIENTS' ACUITY

A number of different patient acuity coding systems are used by the various organizations that are involved with air ambulance services.

Before December 7th 2010, air ambulance patient transports were prioritized based on a coding system authorized by **Alberta Health and Wellness.**[31] Based on discussions with sending and/or receiving physicians, dispatchers assigned patient's priority category for transport according to the following five categories:

- Priority Red for time critical, unstable, "time-to-patient" or "time-to-tertiary-care" is a pre-eminent factor for patient survival
- Priority Yellow for urgent, serious but stable, "time-to-patient" or "time-to-tertiary-care" is not a factor for patient survival
- Priority Blue for scheduled assessment/diagnostic procedures in a receiving facility, "wait and returns"
- Priority Green for non-urgent need for transport
- Priority White for patients being returned to their originating facility on a return portion of a flight delivering a higher priority patient.

On December 7th 2010, **Alberta Health Services**[32] implemented a new patient coding system for EMS dispatches including ground and air transport. This system consolidates the different triaging guidelines used in the previous nine regional health authorities, air ambulances and dispatch centres. There are four categories:

- Red Emergency Transfer which is based on the Air Ambulance Red Referral System for unstable, time-dependent illness or injury that is immediately threatening to life or limb
- Yellow Transfer for illness or injury that is potentially threatening to life and/or limb, transports triaged to be higher priority over all time dependent events through the Demand Driven Protocol/over Capacity Plan, appointment or return from appointment from high priority area, non-ambulatory
- Green Routine Transfer for non-ambulatory; requires routine intervention with no immediate threat to life or limb; IV infusion with no medication; transport should not be deferred from requested/agreed upon arrival time as this could impact patient care
- Blue Scheduled Transfer for routine intervention with no immediate threat to life or limb; requiring minimal assistance; transport can be deferred from requested/agreed upon arrival time as this would have no impact on patient care.

The **Alberta Shock Trauma Air Rescue Society (STARS)**[33] Emergency Link Centre coordinates calls with the STARS Referral Emergency Physician for rural critical patients requiring critical care advice/referral using their own coding system which has two categories identified by color:

- Red/Time Dependent for an illness or injury determined by at least physician to be threatening to life or limb (compromised vital signs and/or physiologically unstable patient) and would benefit from medical intervention including transportation within six hours or less.
- Yellow may be medically judged to be RED for patients with stable vital signs but have a clinical condition that has a natural history of deterioration.

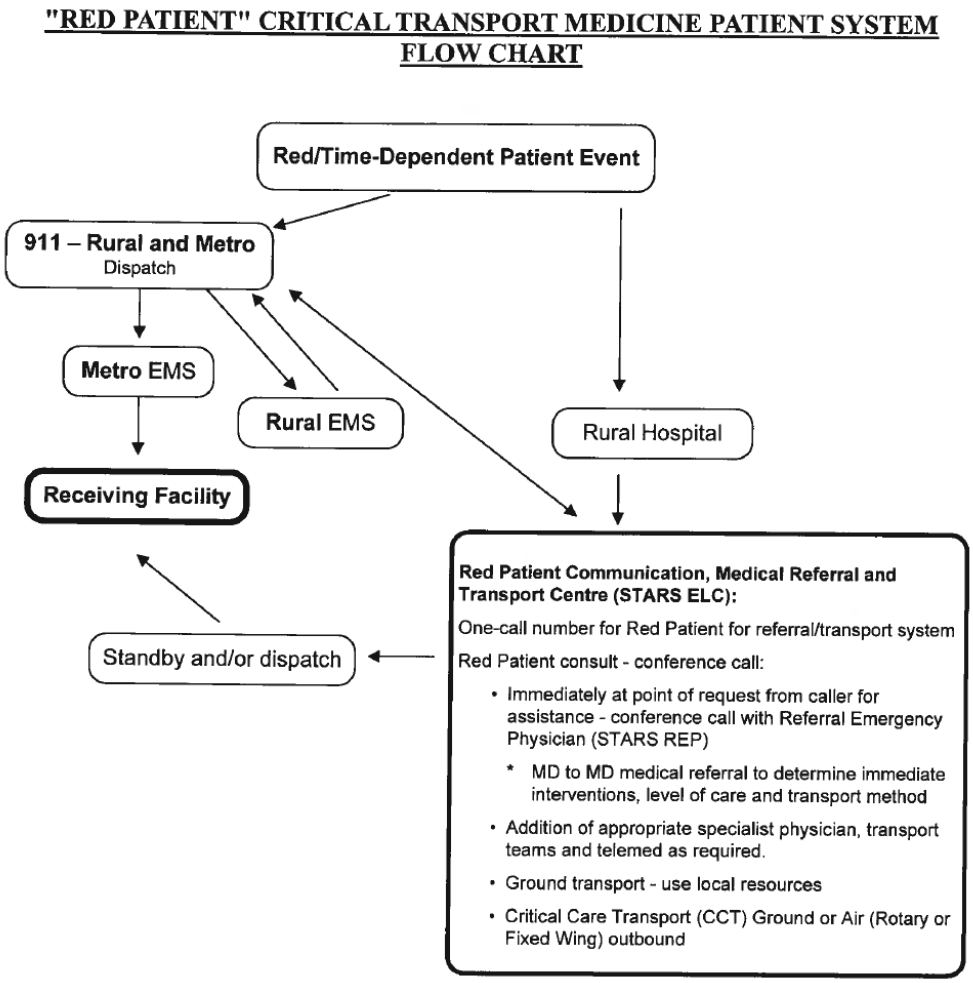
Saskatchewan[67] **and the Yukon**[68] currently follow the Canadian triage and Acuity Score (CTAS)[34] Coding System. The primary objective of CTAS is to be a triage scale that defines ideal objectives (not standards) for timely care of patients with a focus on the time to see a physician using the following five categories:

- Level 1 Blue/Resuscitation
- Level II Red/Emergent
- Level III Yellow/Urgent
- Level IV Green/Less Urgent
- Level V White/Non Urgent.

The **Northwest Territories**[35] is currently reviewing their coding system but they currently use their own system which has four categories:

- Critical (transport immediately) for critical or unstable patients with immediate threat to life or limb
- Emergent (transport as soon as possible) for acute conditions
- Urgent (transport required in 24 hours) sub-acute patients with potential threat to life or limb.
- Referred Care (scheduled transport) non-acute patients with no threat life or limb.

APPENDIX IV: "RED PATIENT" CRITICAL TRANSPORT MEDICINE PATIENT SYSTEM FLOW CHART[33]



APPENDIX V: CHRONOLOGY

Date	Event/Finding/Result	Source
1929	Edmonton City Centre Airport (ECCA) began as Blatchford Field, the first licensed airstrip in Canada.	http://www.edmonton.ca/city_government/news/12177.aspx
1930's - 1940's	Aeromedical transports were being used sporadically based on lack of other transportation for an emergency in the northern regions of Alberta.	Report: Alberta Health and Wellness - Air Ambulance Division; aeromedical Education Project - 2001
1963	Edmonton International Airport (EIA) opened 30 kilometers south of the city to provide larger runways and more space for airport buildings due to increasing air travel and size of aircraft.	http://www.edmonton.ca/city_government/news/12177.aspx
1970's	Advent of paramedics and nurse specialty teams led to an increase in aeromedical transports.	Report: Alberta Health and Wellness - Air Ambulance Division; aeromedical Education Project - 2001
1976	Recommendation for the development of the Provincial Ambulance Service for Albeta included provincewide 24 hour ground ambulance system with air evacuation support, planned, organized and coordinated at a provincial level.	EMS Medical Oversight in Alberta, presentation by Hal B. Canham MD, CCFP (EM), FCFP Provincial EMS Medical Director, Alberta Health and Wellness November 2008 http://www.mountainviewems.com/conference/speaker_presentations.htm
1979	Emergency Medicine formally recognized as a specialty.	http://www.mountainviewems.com/conference/speaker_presentations.htm
1980's	Air ambulance services using dedicated aircraft with paramedics and Advanced Life Support (ALS) equipment established in places such as Fort McMurray, Grande Prairie, High Level and Medicine Hat.	Report: Alberta Health and Wellness - Air Ambulance Division; aeromedical Education Project - 2001
1984	ALS and Basic Life Support (BLS) defined in the Health Disciplines Act	http://www.mountainviewems.com/conference/speaker_presentations.htm
1985	The Health Disciplines Act was amended to include Emergency Medical Technicians–Ambulance (EMT-A) and Emergency Medical Technician-Paramedics (EMT-P). The Minister of Health stated that ambulances were a municipality responsibility and the government would not impose standards and funding	http://www.mountainviewems.com/conference/speaker_presentations.htm
1985	Shock Trauma Air Rescue Society (STARS) is established as a result of medical community concerns that Alberta had a 50 per cent higher death rate due to trauma when compared to other leading Canadian trauma centres.	http://www.stars.ca/bins/content_page.asp?cid=2-29
1987	Recommendation that emergency medical protocols be established with the assistance of medical directors.	http://www.mountainviewems.com/conference/speaker_presentations.htm
1988	Alberta's first formal contract for an air carrier to provide specific aircraft, aeromedical equipment and pilots was signed in Grande	Report: Alberta Health and Wellness - Air Ambulance Division; aeromedical Education Project - 2001

Date	Event/Finding/Result	Source
	Prairie.	
1988	STARS receives formal recognition as an essential service when the organization is integrated into emergency planning for the Calgary Olympic Winter Games.	http://www.stars.ca/bins/content_page.asp?cid=2-29
1988	Alberta Health and Wellness (AHW) established the air ambulance division to ensure adequate and standardized air ambulance service was available throughout the province.	Report: Alberta Health and Wellness - Air Ambulance Division; aeromedical Education Project - 2001
1992	Organization of Medical Direction for EMS in Alberta	http://www.mountainviewems.com/conference/speaker_presentations.htm
1995	Scheduled air service was moved from ECCA to EIA based on a public vote. General aviation was allowed to continue at ECCA.	http://www.edmonton.ca/city_government/planning_development/redeveloping-CCA-lands-council-decision.aspx
1998	STARS receives full accreditation as a critical care provider from the Commission on Accreditation of Medical Transport Systems (CAMTS).	http://www.stars.ca/bins/content_page.asp?cid=2-29
August 2002	Emergency Health Services (EHS) took over the Northern Air Ambulance Dispatch (NAAD) and Southern Air Ambulance Dispatch (SAAD) and established one coordinated dispatch of air ambulances through the Provincial Flight Coordination Centre (PFCC).	Alberta Health and Wellness EHS Branch Air Ambulance Program Policy Manual for RFP January 2002 page 3N:\Common\Edmonton Office\Reviews\Edmonton Municipal Airport Closure Sept 2010\Documentation\AHW\Air Ambulance Program Policy Manual for RFP - January 2002.doc; Anecdotal - EMS staff
June 2008-July 2009	A detailed review of ECCA was undertaken addressing: historical importance, economic impact, market feasibility, medevac services and public consultation. People from all sides of the issue said status quo was not an option: one of the runways would have required up to $10M in capital upgrades to remain operational; other upgrades were estimated at up to $35M over the next 5-10 years; revisiting the cap on passenger traffic would have incurred significant legal liabilities.	http://www.edmonton.ca/city_government/planning_development/redeveloping-CCA-lands-council-decision.aspx http://www.edmonton.ca/city_government/planning_development/city-centre-lands-review.aspx
April 2009	Ground ambulance services were transferred from municipality to AHS.	http://www.health.alberta.ca/services/EHS.html
April 4 to June 25 2009	Public engagement opportunities including a Community Conversation Forum and online forums were held for public discussion of the existing and future land use at ECCA. Results were presented to the council's Executive Committee	http://www.edmonton.ca/city_government/news/12170.aspx

Date	Event/Finding/Result	Source
July 2009	After 18 months of study, analysis and public input, City Council voted to implement a phased closure of the City Centre Airport to determine the timing of redevelopment based on market demand, keeping the remaining runway open until the lands are required.	http://www.edmonton.ca/city_government/planning_development/redeveloping-CCA-lands-council-decision.aspx
July 8, 2009	The City of Edmonton and the Edmonton Regional Airports Authority (ERAA) resolved that there would be a partial surrender and then an eventual surrender of ECCA with an early termination of the lease.	http://www.edmonton.ca/city_government/documents/R_-_W_-_R_-_W_-_20100825121124430.pdf#xml=http://search1.edmonton.ca/texis/ThunderstoneSearchService/pdfhi.txt?query=closure+of+runway&pr=www.edmonton.ca&prox=page&rorder=750&rprox=250&rdfreq=0&rwfreq=0&rlead=750&rdepth=0&sufs=1&order=r&cq=&id=4d54fd037
April 1, 2009	15 out of 35 EMS dispatch centres were consolidated.	http://www.albertahealthservices.ca/1596.asp
April 2010	Provincial air ambulance was transitioned to AHS.	http://www.albertahealthservices.ca/209.asp
2010	STARS and AHS signed a 10 year affiliation agreement.	http://www.stars.ca/bins/content_page.asp?cid=2-29
July 2010	In an amending agreement between the City of Edmonton and the ERAA; ERAA was to close Runway 16-34 on or before August 4, 2010 establishing Runway 12-30 as the sole functioning runway.	page 2 of Amending Agreement http://www.edmonton.ca/city_government/documents/R_-_W_-_R_-_W_-_20100825121124430.pdf#xml=http://search1.edmonton.ca/texis/ThunderstoneSearchService/pdfhi.txt?query=closure+of+runway&pr=www.edmonton.ca&prox=page&rorder=750&rprox=250&rdfreq=0&rwfreq=0&rlead=750&rdepth=0&sufs=1&order=r&cq=&id=4d54fd037
August 3, 2010	Runway 16-34 at ECCA is closed.	http://corporate.flyeia.com/media_resources/media_releases_list/2010/closure_of_runway_1634_at_edmonton_city_centre_airport_begins
August 2010	A master plan design competition for external consulting teams shortlisted the top five proposals to create master plans for the 217-hectare site.	http://www.edmonton.ca/city_government/planning_development/city-centre-airport-redevelopment-master-plan-competition.aspx
March 2011	The winning team was to be selected by Council vote; their proposal is to be refined which will include public consultation, taking approximately one year to complete.	http://www.edmonton.ca/city_government/planning_development/city-centre-airport-redevelopment-master-plan-competition.aspx
2013	As per the City Centre Redevelopment website, the City's goal is to have the first shovel in the ground not later than 2013.	http://www.edmonton.ca/city_government/planning_development/city-centre-airport-redevelopment-master-plan-competition.aspx

APPENDIX VI: PATIENT TRANSPORTS

Fixed Wing

Alberta Fixed Wing Patient Transports into Edmonton April 1, 2009 – March 31, 2010						
	AHW Color Coding System					
Carrier (Alberta)	Red	Yellow	Blue	Green	White	Total # of Patients
Alberta Central Airways - Lac La Biche	52	287	59	75	0	**473**
Alberta Central Airways - Grande Prairie	31	158	161	104	0	**454**
Bar XH Air Inc. - Medicine Hat	3	9	1	5	0	**18**
Bar XH Air Inc. - Calgary (FW)	5	22	9	18	0	**54**
Air Mikisew - Fort McMurray	15	112	168	93	0	**388**
Nor Alta - High Level	7	79	33	48	0	**167**
Nor Alta - Fort Vermillion	6	38	11	27	0	**82**
Northern Air Charter - Peace River	35	288	138	124	0	**585**
Can-West - Slave Lake	17	306	44	115	0	**482**
Can-West - Edmonton	42	267	13	33	1	**356**
TOTALS	**213**	**1566**	**637**	**642**	**1**	**3059**

Out of Province Patient Transports into Edmonton April 1, 2009- March 31, 2010					
Coding	BC	SK	NWT	YK	TOTAL
CTAS Level					
1C (Blue)				6	6
1 (Blue)		20			20
2 (Red)		8		7	15
3 (Yellow)		5		18	23
4 (Green)		53		13	66
5 (White)		51		3	54
Repatriation				20	20
Time-dependent			45		45
Urgent (includes 98 for scheduled testing)			274		274
Unknown	254*			28	282
TOTALS	**254**	**137**	**319**	**95**	**805**

Rotary Wing

STARS Rotary Wing Missions April 1, 2009 – March 31, 2010													
Patient Breakdown	Patient Transports												
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Totals
Adult Trauma	13	22	20	26	29	29	20	17	14	15	5	12	222
Adult Medical	10	16	13	10	20	17	11	19	13	10	8	11	158
Pediatric Trauma	2	5	7	6	1	1	1	2	1	1	2	3	32
Pediatric Medical	1	2	2	0	2	2	1	3	2	4	1	2	22
NICU	1	2	3	2	1	2	3	2	0	1	0	1	18
OBS	0	1	2	0	2	1	0	2	0	0	0	1	9
Total # of Patients	**27**	**48**	**47**	**44**	**55**	**52**	**36**	**45**	**30**	**31**	**16**	**30**	**461**

APPENDIX VII: AHS – EDMONTON AREA EDS STRATIFICATION GUIDELINES[103]

	AHS – Edmonton Area EDs Stratification Guidelines	UAH	Stollery	RAH	GNH	MCH	SCH	NEHC	LCH	Westview	Fort Sask	Redwater	Devon
Trauma	Major Trauma (see Field Triage Guideline)	✓		✓									
	Minor Trauma (see Field Triage Guideline)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Major Burns (see Field Triage Guideline)	✓											
	Major Orthopedic Trauma	✓		✓									
	Minor Isolated Orthopedic Trauma (non-hip, non-pelvis, non-femur)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Suspect Hip/Pelvis Fracture (pain, recent hx of fall or trauma, difficulty ambulating)	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
	HIGH Suspicion of Hip/Pelvis Fracture (shortening, rotation, deformity)	✓		✓		✓							
	Obstetrical Trauma (see Field Triage Guideline)			✓									
	Isolated Ophthalmic Trauma			✓									
	Sexual Assault & SARTE (>13 years old)	✓		✓	✓	✓	✓	✓	✓		✓		
Medical	Psychiatric (Form 1 & Form 10)	✓		✓	✓	✓							
	Stroke < 4.5 hours	✓			✓								
	Stroke > 4.5 hours	✓		✓	✓	✓	✓						
	Vital Heart Response (PCI treatment)	✓		✓									
	Vital Heart Response (TNK treatment)	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
	Acute Vascular Emergency (rupture abdominal aortic aneurysm) **				✓								
	Non-ambulatory Geriatric	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
	Cardiac – ST ↑ or ST ↓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
	Organ Transplant	✓											
	Dialysis patients to their "home" facility	✓		✓	✓	✓							
Pediatric / Neonatal	Major Pediatric Trauma (see Field Triage Guideline)		✓										
	Unstable Children (<17 yrs old)		✓										
	Unstable Infant Home Delivery		✓	✓									
	Obstetrical Emergencies (non-trauma, suspected ectopic pregnancy, complications with gestation age> 20weeks) ***			✓	✓	✓	✓				✓		
	Pediatric Psychiatry (<18 yrs old)			✓									
	Pediatric Sexual Assault & SARTE (< 13 years old)		✓										
Special	Radiation Exposure *	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	Biological Exposure *	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	Biochemical Exposure *	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	Hyperbaric Oxygen Therapy					✓							

APPENDIX VIII: EDMONTON AIRPORTS APPROACH MINIMA[80]

Airport Approach Minima and Impact on Edmonton Airports Usability

Edmonton City Centre Airport (*Pre-August 3, 2010)*
(In December 2009, Transport Canada changed the criteria for determining ceiling limits As of this date, Rwy 34 ceiling increased from ~200 ft to 492ft. The data below represents limits for 492 ft and higher.)
Rwy 30 LNAV, ceiling 749ft, vis 2.25 mi Rwy 34 ILS/NDB, ceiling 492ft, vis 1.0 mi Rwy 12 LPV, ceiling 342ft, vis 0.75 mi Rwy 12 LNAV, ceiling 502ft, vis1.5 mi

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
96.77%	98.35%	97.71%	97.97%	99.09%	99.73%	99.74%	99.29%	99.55%	98.61%	98.02%	98.59%

Edmonton City Centre Airport (*Post August 3, 2010)*
Rwy 12 LPV, ceiling 342ft, vis 0.75 mi Rwy 12 LNAV, ceiling 502ft, vis 1.5 mi Rwy 30 LNAV, ceiling 749ft, vis 2.25mi

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
95.06%	97.49%	96.37%	95.96%	98.05%	99.19%	99.09%	98.84%	99.18%	97.87%	97.04%	97.35%

Edmonton International Airport
Rwy 20 LNAV, ceiling 363ft, vis 1.25mi Rwy 02 ILS, ceiling 200ft, vis 0.5 mi Rwy 12 ILS, ceiling 200ft, vis 0.5 mi Rwy 30 ILS, ceiling 202ft, vis 0.5 mi

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
99.04%	98.50%	99.32%	99.52%	99.49%	99.80%	99.73%	99.51%	99.81%	99.44%	99.32%	99.39%

Weather data from 1995 to 2010. Cross wind 15 knots or tail wind is over 5 knots

In contrast, because of weather factors STARS cancelled 206 missions out of 1252 requests between January 1-December 31, 2010.

Edmonton base STARS weather cancellations January – December 2010												
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	**Total**
18	26	7	2	14	5	3	8	9	37	17	60	**206**

APPENDIX IX: DISTANCES AND TIMES FROM ECCA AND EIA TO ALL HOSPITALS (GOOGLE)[104]

Airport	Destination	Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
Edmonton City Centre Airport	Alberta Hospital	20	17.4	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton,+AB+T5G+0W6+(Edmonton+City+Centre+(Blatchford+Field)+Airport)&daddr=Alberta+Health+Services,+17480+Fort+Road+NW,+Edmonton&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFQxvMgMdhiA--SFBY2wrxLM_ZCmh_-uSjTugUzGazd5Oe-W1rw&hl=en&mra=ls&sll=53.558048,-113.52588&sspn=0.073825,0.222301&ie=UTF8&ll=53.602692,-113.449802&spn=0.073747,0.222301&z=13
Edmonton City Centre Airport	Cross Cancer Institute	13	8.8	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=11560+University+Avenue+Northwest,+Edmonton,+AB+T6G+1Z2+(Cross+Cancer+Institute)&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFS-iMAMd66E7-SFRuV8cuQ6fMCmTEThk8SGgUzEQ_A1pVu4zSw&mra=pd&sll=53.544339,-113.527119&sspn=0.065281,0.081711&ie=UTF8&ll=53.54398,-113.537178&spn=0.065281,0.081711&z=13
Edmonton City Centre Airport	Glenrose Rehabilitation Hospital	7	3.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=Glenrose+Rehabilitation+Hospital,+Edmonton,+Alberta&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFc8-MQMdwC88-SH9bjP46xDlNA&mra=ls&sll=53.54398,-113.537178&sspn=0.065281,0.081711&ie=UTF8&z=14
Edmonton City Centre Airport	Grey Nuns Community Hospital	32	17.5	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=53.5248489,-113.4582789+to:16940+87+Ave+NW,+Edmonton,+Alberta+T5R+5Y8+(Grey+Nuns+Community+Hospital)&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFXC5MAMdmsM8-Skr-CyBfCKgUzGc-WoBT_JucQ%3BFSKlMAMdeWg6-SEHeXTyp6WbBCndUQmHPRmgUzGS_WLMUkpy2A&mra=pd&sll=53.557987,-113.528749&sspn=0.26104,0.326843&ie=UTF8&ll=53.508876,-113.436584&spn=0.261342,0.326843&z=11&via=1
Edmonton City Centre Airport	Misericordia Community Hospital	21	11.5	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=16940+-+87+Ave,+Edmonton,+AB+T5R+4H5+(Misericordia+Hospital)&hl=en&geocode=FXFt

Airport	Destination	Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
				MQMdcMs7-SEMIwaMHmu7TQ%3BFSKlMAMdeWg6-SEJ4F2ria4ggik1U8UUUCCgUzEqVhHqXNAvIw&mra=pd&sll=53.54529,-113.56724&sspn=0.130559,0.163422&ie=UTF8&ll=53.545,-113.567734&spn=0.13056,0.163422&z=12
Edmonton City Centre Airport	Royal Alexandra Hospital	5	2.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=Royal+Alexandra+Hospital,+Edmonton,+Alberta&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFeI0MQMdNiY8-SHkJb_-xp1wPA&mra=ls&sll=53.545,-113.567734&sspn=0.13056,0.163422&ie=UTF8&z=14
Edmonton City Centre Airport	Sturgeon Community Hospital	17	14.3	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=Sturgeon+Community+Hospital,+St+Albert,+Alberta+T8N+6C4&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFRe2MgMd4zU6-SkBIbeb-iWgUzGloyPEEtcTHw&mra=pd&sll=53.612996,-113.573724&sspn=0.13035,0.163422&ie=UTF8&ll=53.611451,-113.575974&spn=0.130355,0.163422&z=12
Edmonton City Centre Airport	University of Alberta Hospital	13	7.1	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=8440+112+Street,+Edmonton,+AB+T6G+2P4+(University+Of+Alberta+Hospital)&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFQKoMAMdns47-SGPP32BuRUwtQ&mra=pd&sll=53.545402,-113.521638&sspn=0.065279,0.081711&ie=UTF8&ll=53.545306,-113.517609&spn=0.065279,0.081711&z=13
Edmonton International Airport	Alberta Hospital	44	54.0	http://maps.google.ca/maps?f=d&source=s_d&saddr=Leduc+County+No.+25,+AB+(Edmonton+Airport)&daddr=Alberta+Health+Services,+17480+Fort+Road+NW,+Edmonton,+AB+t5Y+6A8&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFQxvMgMdhiA--SFBY2wrxLM_ZCmh_-uSjTugUzGazd5Oe-W1rw&hl=en&mra=ls&sll=53.309955,-113.578377&sspn=0.074257,0.222301&ie=UTF8&z=10
Edmonton International Airport	Cross Cancer Institute	30	28.9	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+International+Airport,+Edmonton,+Alberta&daddr=11560+University+Avenue+Northwest,+Edmonton,+AB+T6G+1Z2+(Cross+Cancer+Institute)&hl=en&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFS-iMAMd66E7-SFRuV8cuQ6fMCmTEThk8SGgUzEQ_A1pVu4zSw&mra=pd&sll=53.412474,-113.55474&sspn=0.261937,0.326843&ie=UTF8&ll=53.411578,-113.534088&spn=0.261942,0.326843&z=11

Airport	Destination	Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
Edmonton International Airport to	Glenrose Rehabilitation Hospital	39	32.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+International+Airport,+Edmonton,+Alberta&daddr=Glenrose+Rehabilitation+Hospital,+Edmonton,+Alberta&hl=en&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFc8-MQMdwC88-SH9bjP46xDlNA&mra=ls&sll=53.411578,-113.534088&sspn=0.261942,0.326843&ie=UTF8&ll=53.432447,-113.530655&spn=0.261813,0.326843&z=11
Edmonton International Airport	Grey Nuns Community Hospital	24	24.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Leduc+County+No.+25,+AB+(Edmonton+Airport)&daddr=Alberta+Health+Services,+17480+Fort+Road+NW,+Edmonton,+AB+t5Y+6A8&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFQxvMgMdhiA--SFBY2wrxLM_ZCmh_-uSjTugUzGazd5Oe-W1rw&hl=en&mra=ls&sll=53.309955,-113.578377&sspn=0.074257,0.222301&ie=UTF8&z=10
Edmonton International Airport	Misericordia Community Hospital	33	34.6	http://maps.google.ca/maps?f=d&source=s_d&saddr=YEG:+Edmonton+International+Airport,+Edmonton+Alberta+T5J+2T2&daddr=16940+-+87+Ave,+Edmonton,+AB+T5R+4H5+(Misericordia+Hospital)&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFSKlMAMdeWg6-SEJ4F2ria4ggik1U8UUUCCgUzEqVhHqXNAvIw&hl=en&mra=ls&sll=53.41288,-113.55129&sspn=0.296313,0.889206&ie=UTF8&z=11
Edmonton International Airport	Royal Alexandra Hospital	40	31.9	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+International+Airport,+Edmonton,+Alberta&daddr=Royal+Alexandra+Hospital,+Edmonton,+Alberta&hl=en&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFeI0MQMdNiY8-SHkJb_-xp1wPA&mra=ls&sll=53.412806,-113.551254&sspn=0.261934,0.326843&ie=UTF8&ll=53.431628,-113.534088&spn=0.261818,0.326843&z=11
Edmonton International Airport	Sturgeon Community Hospital	53	53.9	http://maps.google.ca/maps?f=d&source=s_d&saddr=YEG:+Edmonton+International+Airport,+Edmonton+Alberta+T5J+2T2&daddr=Sturgeon+Community+Hospital+201+Boudreau+Rd.+St.+Alberta+AB+T8n+6C4&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFY-yMgMdNC06-SGh0pj94QEiiyl5g1Dn-iWgUzEocv9WPsij-g&hl=en&mra=ls&sll=53.41288,-113.55129&sspn=0.296313,0.889206&ie=UTF8&z=10
Edmonton International Airport	University of Alberta Hospital	31	28.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+International+Airport,+Edmonton,+Alberta&daddr=8440+112+Street,+Edmonton,+AB+T6G+2P4+(University+Of+Alberta+Hospital)&hl=en&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFQKoMAMdns47-SGPP32BuRUwtQ&mra=ls&sll=53.545306,-113.517609&sspn=0.065279,0.081711&ie=UTF8&z=11

APPENDIX X: Distances and Times to Tertiary Care in Eleven Canadian Cities (Google)[104]

City/Province	Airport	Hospital	Google		
			Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
Edmonton, AB	Edmonton City Centre Airport (YXD)	Royal Alexandra	5	2.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=Royal+Alexandra+Hospital,+Edmonton,+Alberta&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFeI0MQMdNiY8-SHkJb_-xp1wPA&mra=ls&sll=51.234407,-133.154297&sspn=35.473374,41.835938&ie=UTF8&z=14
		University of Alberta	13	7.1	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+City+Centre+Airport,+Edmonton,+Alberta&daddr=8440+112+Street,+Edmonton,+AB+T6G+2P4+(University+Of+Alberta+Hospital)&hl=en&geocode=FXFtMQMdcMs7-SEMIwaMHmu7TQ%3BFQKoMAMdns47-SGPP32BuRUwtQ&mra=pd&sll=53.545402,-113.521638&sspn=0.065279,0.081711&ie=UTF8&ll=53.545306,-113.517609&spn=0.065279,0.081711&z=13
	Edmonton International Airport (YEG)	Royal Alexandra	40	31.9	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+International+Airport,+Edmonton,+Alberta&daddr=Royal+Alexandra+Hospital,+Edmonton,+Alberta&hl=en&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFeI0MQMdNiY8-SHkJb_-xp1wPA&mra=ls&sll=53.413445,-113.534075&sspn=0.261929,0.326843&ie=UTF8&ll=53.431628,-113.534088&spn=0.261818,0.326843&z=11
		University of Alberta	31	28.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Edmonton+International+Airport,+Edmonton,+Alberta&daddr=8440+112+ST,+Edmonton,+Alberta&hl=en&geocode=FcZiLQMdW-06-SHt-xLDe08i5w%3BFX2pMAMdjs47-SnPyfMCHiKgUzHoQfH_hgriqw&mra=ls&sll=53.545612,-113.517609&sspn=0.065279,0.081711&ie=UTF8&z=11
Vancouver, BC[91]	Vancouver International Airport (YVR)	Vancouver General Hospital	21	12.1	http://maps.google.ca/maps?f=d&source=s_d&saddr=Vancouver+International+Airport,+Grant+McConachie+Way,+Richmond,+British+Columbia&daddr=855+West+12th+Avenue,+Vancouver,+BC+V5Z+1N1+(Vancouver+General+Hospital)&hl=en&geocode=FVKi7gIdtmeo-CEeVxHxxMHxzA%3BFbar7wIdyk6p-CFnuTvo5oaU8A&mra=pd&sll=49.236856,-123.148695&sspn=0.143467,0.163422&ie=UTF8&z=13

City/Province	Airport	Hospital	Google		
			Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
		BC Women's and Children's Hospital	17	9.0	http://maps.google.ca/maps?f=d&source=s_d&saddr=Vancouver+International+Airport,+Grant+McConachie+Way,+Richmond,+British+Columbia&daddr=4500+Oak+Street,+Vancouver,+BC+(B.C.+Women's+Hospital+%26+Health+Centre)&hl=en&geocode=FVKi7gIdtmeo-CEeVxHxxMHxzA%3BFfVl7wIdb0Gp-CF3ffczKl_SeilR5WmXjnOGVDF1WfkcQOZG1A&mra=pd&sll=49.219055,-123.152618&sspn=0.071759,0.081711&ie=UTF8&ll=49.217821,-123.154163&spn=0.071761,0.081711&z=13
		St. Paul's Hospital	24	13.4	http://maps.google.ca/maps?f=d&source=s_d&saddr=Vancouver+International+Airport,+Grant+McConachie+Way,+Richmond,+British+Columbia&daddr=St.+Paul's+Hospital,+Vancouver,+British+Columbia&hl=en&geocode=FVKi7gIdtmeo-CEeVxHxxMHxzA%3BFZ307wId8Tep-CHB8mbUCdAohinNeD_a1HOGVDEFIgs_eV5f-Q&mra=ls&sll=49.217821,-123.154163&sspn=0.071761,0.081711&ie=UTF8&z=12
Victoria, BC	Victoria International Airport (YYJ)	Victoria General Hospital	27	23.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Victoria+International+Airport,+Victoria,+British+Columbia&daddr=Victoria+General+Hospital,+Hospital+Way,+Victoria,+British+Columbia&hl=en&geocode=FeIx5gIdE5qk-CFeKOBaB0F2qg%3BFUiK4wIdmI-k-CFTiT8vFWvVZyk5XMT25nKPVDF1uerrRiKZBQ&mra=ls&sll=49.235915,-123.153355&sspn=0.143469,0.163422&ie=UTF8&z=11
		Royal Jubilee Hospital	30	27.5	http://maps.google.ca/maps?f=d&source=s_d&saddr=Victoria+International+Airport,+Victoria,+British+Columbia&daddr=Royal+Jubilee+Hospital,+Bay+Street,+Victoria,+British+Columbia&hl=en&geocode=FeIx5gIdE5qk-CFeKOBaB0F2qg%3BFQAK4wIdnyqm-CG5dvEN2qzd1g&mra=ls&sll=48.55301,-123.41024&sspn=0.290886,0.326843&ie=UTF8&ll=48.537068,-123.379211&spn=0.290978,0.326843&z=11
Kamloops, BC	Kamloops Airport (YKA)	Kamloops Royal Inland Hospital	18	11.2	http://maps.google.ca/maps?f=d&source=s_d&saddr=Kamloops+Airport,+Kamloops,+British+Columbia&daddr=Hospital+Royal+Inland,+Kamloops,+British+Columbia&hl=en&geocode=FWuzBQMdLDTS-CHOh05ka84XOg%3BFfguBQMdENjT-CG-Paibk1aiGSnx_PUaUyx-UzEi79Mn-_q_XQ&mra=ls&sll=48.537068,-123.379211&sspn=0.290978,0.326843&ie=UTF8&z=12

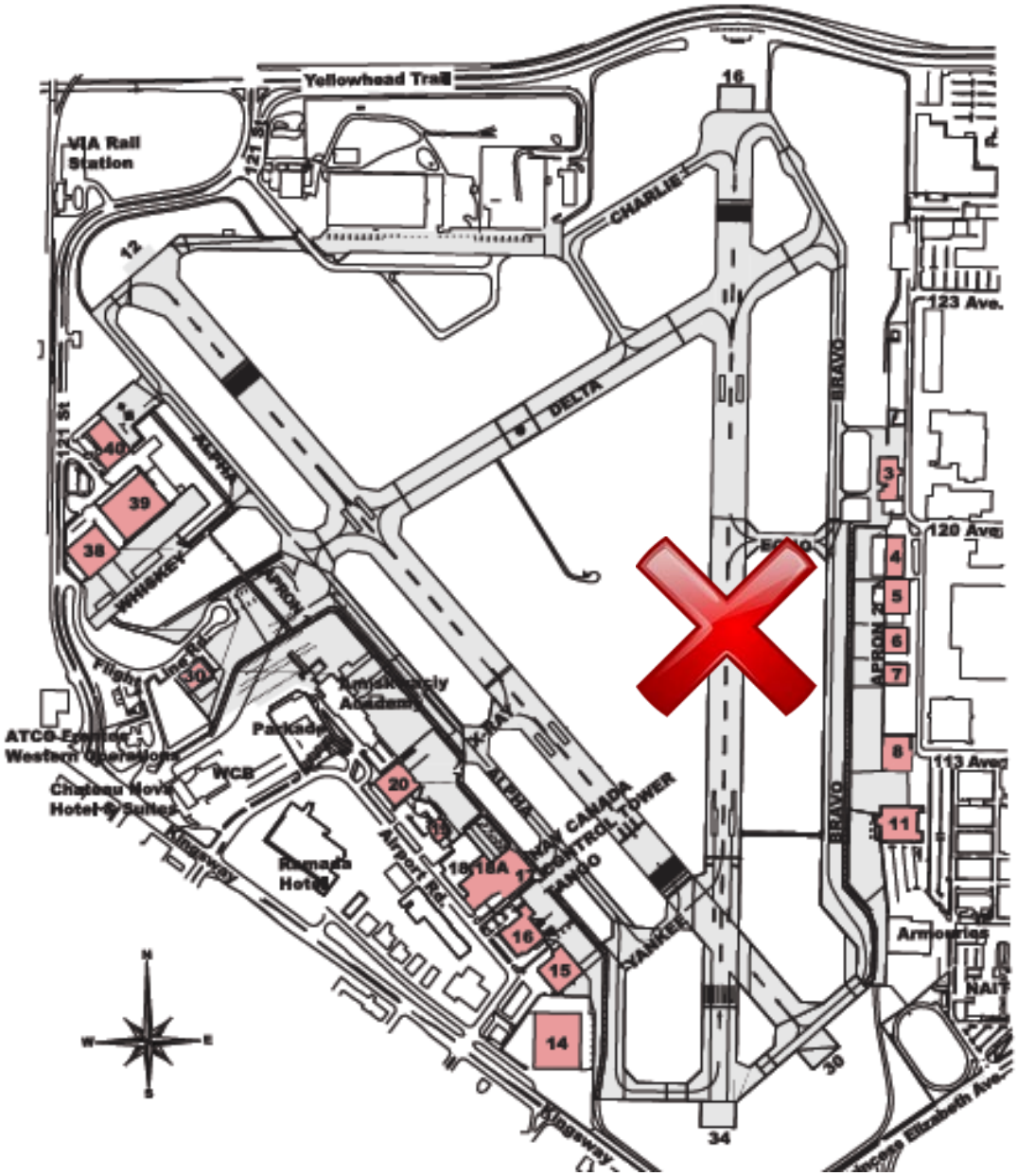
City/Province	Airport	Hospital	Google		
			Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
Calgary, AB[92]	Calgary International Airport (YYC)	Foothills Medical Centre	18	18.9	http://maps.google.ca/maps?f=d&source=s_d&saddr=Calgary+International,+Airport+Road+Northeast,+Calgary,+Alberta&daddr=foothills+medical+centre&hl=en&geocode=Fc08DAMdJVE0-SG8bWU7SDf6Gw%3BFdstCwMdRHQy-SFlkHOE_q_MPymhQ7XOrW9xUzGlWKBX02ZfwQ&mra=ls&sll=50.690045,-120.38815&sspn=0.1392,0.163422&ie=UTF8&z=12
		Peter Lougheed Centre	13	9.4	http://maps.google.ca/maps?f=d&source=s_d&saddr=Calgary+International,+Airport+Road+Northeast,+Calgary,+Alberta&daddr=3500+26+Avenue+Northeast,+Calgary,+AB+T1Y+6J4+(Peter+Lougheed+Centre+Of+The+Calgary+General+Hospital)&hl=en&geocode=Fc08DAMdJVE0-SG8bWU7SDf6Gw%3BFSljCwMdD8I0-SH7vKHMWgIjLild6ygAxGRxUzHuCOqTQNN0xw&mra=pd&sll=51.105787,-113.997417&sspn=0.068981,0.081711&ie=UTF8&ll=51.106001,-113.996887&spn=0.068981,0.081711&z=13
Saskatoon, SK[93]	John G. Diefenbaker International Airport (YXE)	Royal University Hospital	16	11.5	http://maps.google.ca/maps?f=d&source=s_d&saddr=Saskatoon,+SK+S7L+5X8+(Saskatoon+John+G.+Diefenbaker+International+Airport)&daddr=Royal+University+Hospital,+Hospital+Drive,+Saskatoon,+Saskatchewan&hl=en&geocode=FUMNHAMdLAmk-SFzb8xpBUgcvA%3BFfJ3GwMdpsik-SFeW4FdJPKF_g&mra=pd&sll=52.14966,-106.66578&sspn=0.067412,0.081711&ie=UTF8&ll=52.149396,-106.650467&spn=0.067413,0.081711&z=13
		St. Paul's Hospital	12	9.2	http://maps.google.ca/maps?f=d&source=s_d&saddr=Saskatoon,+SK+S7L+5X8+(Saskatoon+John+G.+Diefenbaker+International+Airport)&daddr=1702+-+20th+Street+West,+Saskatoon,+SK,+SK+S7M+0Z9+(St+Paul's+Hospital)&hl=en&geocode=FUMNHAMdLAmk-SFzb8xpBUgcvA%3BFehhGwMdjPKj-SHXk7m42WXqyyl1-JXTOfcEUzHbWxjE9bEfdw&mra=pd&sll=52.148132,-106.693382&sspn=0.067415,0.081711&ie=UTF8&ll=52.148027,-106.705227&spn=0.067415,0.081711&z=13
Regina, SK	Regina International	Regina General Hospital	10	4.9	http://maps.google.ca/maps?f=d&source=s_d&saddr=Regina+International+Airport+(YQR),+Regina,+Saskatchewan+S4W+1A9&daddr=1499+1

City/Province	Airport	Hospital	Google		
			Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
	Airport (YQR)				4th+Ave,+Regina,+Saskatchewan+(Regina+General+Hospital)&hl=en&geocode=FYeMAQMdnhXD-Sm_jyjT7R0cUzELyJPYNTKDvQ%3BFZ22AQMdEefD-SEKMwcUNpnAZg&mra=pd&sll=50.433159,-104.63971&sspn=0.139961,0.163422&ie=UTF8&z=13
		Pasqua Hospital	7	3.5	http://maps.google.ca/maps?f=d&source=s_d&saddr=Regina+International+Airport+(YQR),+Regina,+Saskatchewan+S4W+1A9&daddr=Saskatchewan+S4T+4L5+(Pasqua+Hospital,+Regina,+SK)&hl=en&geocode=FYeMAQMdnhXD-Sm_jyjT7R0cUzELyJPYNTKDvQ%3BFQ_eAQMdDlXD-SG_9fZdYNqq-g&mra=pd&sll=50.436079,-104.655418&sspn=0.069976,0.081711&ie=UTF8&z=14
Winnipeg, MB[94]	Winnipeg International Airport (YWG)	Winnipeg Health Sciences Centre	14	6.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Winnipeg+International,+Winnipeg,+Manitoba&daddr=820+Sherbrook+Street,+Winnipeg,+MB+R3A+1R9+(Health+Sciences+Centre)&geocode=FQt3-QIdL3A0-iFYa2qbazwdvA%3BFXF3-QIdAYE1-iHyv58VovKXHw&hl=en&mra=pd&sll=49.90337,-97.191067&sspn=0.052296,0.119305&ie=UTF8&ll=49.90547,-97.191582&spn=0.052294,0.119305&z=13
		St. Boniface Hospital	20	11.9	http://maps.google.ca/maps?f=d&source=s_d&saddr=Winnipeg+International,+Winnipeg,+Manitoba&daddr=St.+Boniface+General+Hospital,+Winnipeg,+Manitoba&hl=en&geocode=FQt3-QIdL3A0-iFYa2qbazwdvA%3BFbEs-QIdGP41-iE8sjQTHuGXqilbWzMJS3HqUjHEmX8kVMqkNw&mra=ls&sll=49.90604,-97.19319&sspn=0.070757,0.081711&ie=UTF8&z=12
Moncton, NB[95]	Moncton International Airport (YQM)	Dr. Georges-L. Dumont Regional Hospital	11	7.8	http://maps.google.ca/maps?f=d&source=s_d&saddr=Dieppe,+NB+E1A+7P5+(Moncton+International+Airport)&daddr=Dr.+georges+l+dumont+regional+hospital&hl=en&geocode=FW6IvwIdBN0k_CFb8pOfBxnYAg%3BFW9mvwIdcHEj_CFdaWR44_s7oinbOm_JLrmgTDGDn7AhFGkEQA&mra=pd&sll=46.107517,-64.737282&sspn=0.152338,0.163422&ie=UTF8&ll=46.097995,-64.739685&spn=0.152364,0.163422&z=12
		Moncton City Hospital	14	9.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Dieppe,+NB+E1A+7P5+(Moncton+International+Airport)&daddr=135+MacBeath+Ave,+

City/Province	Airport	Hospital	Google		
			Time to Tertiary Care (min)	Distance to Tertiary Care (km)	URL
					Moncton,+NB+E1C+6Z8+(Moncton+Hospital+The-Moncton+Zone+Health+S+ervices)&hl=en&geocode=FW6IvwIdBN0k_CFb8pOfBxnYAg%3BFZGBvwId-iIj_CHAQYX3RS1ydymPs5DCzbigTDG5rX-gKEEo0g&mra=pd&sll=46.091662,-64.782878&sspn=0.304763,0.326843&ie=UTF8&z=12
Saint John, NB	Saint John Airport (YSJ)	Saint John Regional Hospital	23	24.7	http://maps.google.ca/maps?f=d&source=s_d&saddr=Saint+John+Airport,+Saint+John,+New+Brunswick&daddr=saint+john+regional+hospital&hl=en&geocode=FfqqswIdhZgS_CFsH38twB7CpA%3BFa85swId66EP_CFLlYpVgMNc9SmhaLSENLOnTDGbpIDmyypbKA&mra=ls&sll=45.341225,-65.986815&sspn=0.308885,0.326843&ie=UTF8&z=11
Fredericton, NB	Fredericton International Airport (YFC)	Dr. Everett Chalmers Hospital	17	15.3	http://maps.google.ca/maps?f=d&source=s_d&saddr=Fredericton+International+Airport,+Fredericton,+New+Brunswick&daddr=Priestman,+Fredericton,+NB+E3B+5N5+(Dr+Everett+Chalmers+Regional+Hospital)&geocode=Fd72uwIdL9UI_CGcapIG3mXsYQ%3BFdgCvQId7eMG_CmJxzYNFSKkTDEuut2jF_9zXQ&hl=en&mra=ls&sll=45.906733,-66.593628&sspn=0.112996,0.238609&ie=UTF8&z=12

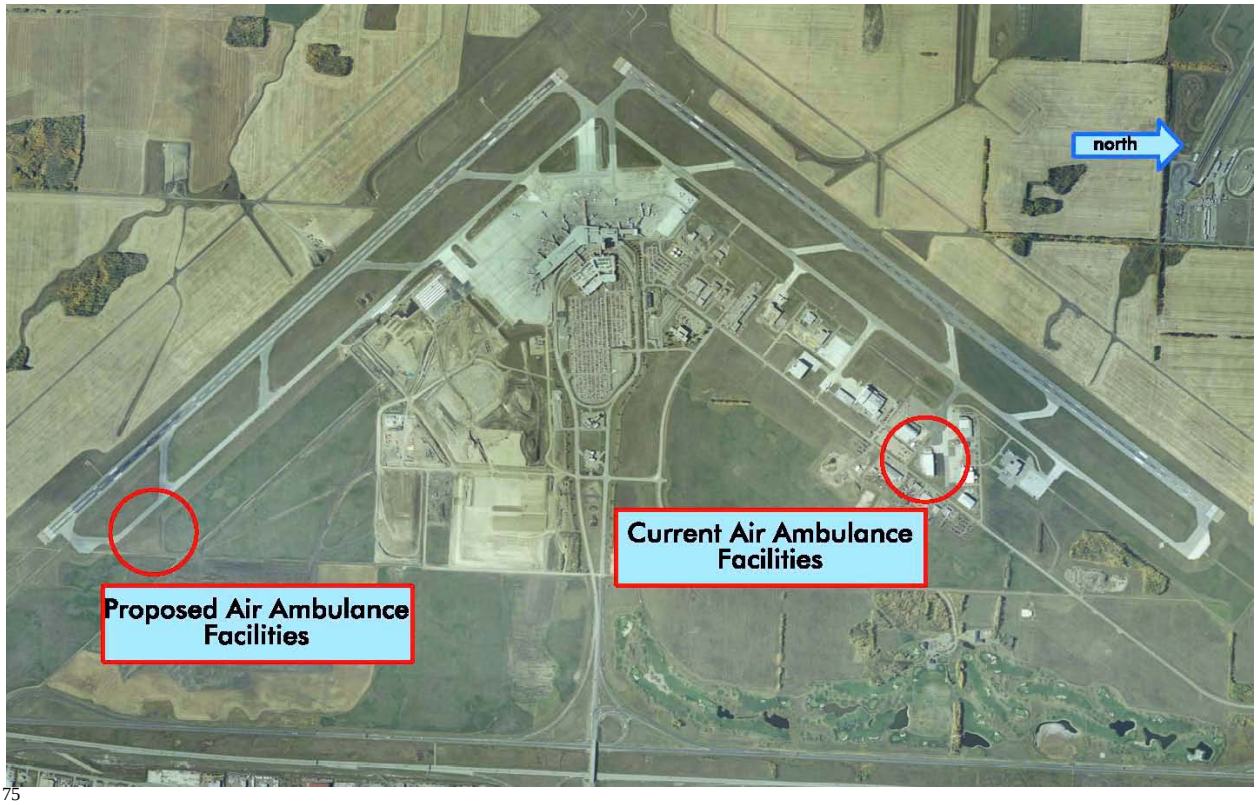
APPENDIX XI: AIRPORT RUNWAYS

Edmonton City Centre Airport



Runway 16/34 is now closed[105]

Edmonton International Airport



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LIST OF FIGURES AND TABLES

ACRONYMS

AHS	Alberta Health Services
AHW	Alberta Health and Wellness
ALS	Advanced Life Support
AMI	Acute Myocardial Infarction
AMPA	Air Medical Physician Association
BLS	Basic Life Support
CCC	Central Communications Centre (formerly PFCC - Provincial Flight Coordination Centre)
CMOH	Chief Medical Officer of Health aka CMO (Chief Medical Officer)
CTAS	Canadian Triage and Acuity Scale
DM	Deputy Minister
EAA	Edmonton Airport Authority
ECCA	Edmonton City Centre Airport (YXD) aka Edmonton Municipal (Muni) Airport
EIA	Edmonton International Airport (YEG)
EMR	Emergency Medical Responder
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EMT-P	Emergency Medical Technician - Paramedic
FBO	Fixed Base Operator
FP	Flight Plan
IFR	Instrument Flight Rules
ILS	Instrument Landing System
MCP	Medical Control Protocols
MD	Medical Doctor
MOH	Medical Officer of Health aka MO (Medical Officer)
NICU	Neonatal Intensive Care Unit
NP	Nurse Practitioner
OR	Operating Room
PFCC	Provincial Flight Coordination Centre (now called CCC - Central Communications Centre)
PICU	Pediatric Intensive Care Unit
RAAPID	Referral, Access, Advice, Placement, Information & Destination
RAH	Royal Alexandra Hospital
REP	Referral Emergency Physician
RFP	Request for Proposal
RN	Registered Nurse
RT	Respiratory Therapist
RVR	Runway Visual Range
STARS	Shock Trauma Air Rescue Services
STEMI	ST-Segment Elevation Myocardial Infarction
SVT	Supraventricular Tachycardia
UAH	University of Alberta Hospital

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