HQCA
Health Quality Council of Alberta

CHART REVIEW OF FIXED-WING MEDEVAC PATIENTS WHO LANDED AT THE EDMONTON INTERNATIONAL AIRPORT

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PROJECT OVERVIEW

Introduction and background

From the time of the announcement by the City of Edmonton in July 2009 to the actual closure of the Edmonton City Centre Airport (ECCA) in March 2013, concerns have been raised regarding the extended transport time for critically-ill and time-sensitive patients from the Edmonton International Airport (EIA) to an Edmonton acute care hospital.

In April 2011, the Health Quality Council of Alberta (HQCA) completed its review of patient safety issues to be addressed when the medevac services were relocated from the ECCA to the EIA.[1] The 2011 report included 18 recommendations, which were accepted by the Minister of Health. Fifteen of the recommendations have been implemented, while the remaining recommendations are in the process of being implemented or have been staged (Appendix I).

As an example of the response to the 2011 recommendations, Alberta Health Services (AHS) opened a new air ambulance facility at the EIA on March 15, 2013. The 40,000 square foot building includes space to transfer patients from air to ground ambulance, facilities for the air and medical crews (including sleep accommodations), and a staffed six bed patient transition unit. It also includes office space for the AHS air ambulance (medevac) leadership team. The dedicated ground ambulance transfer crew is based at this facility. Space in this new facility has also been leased to STARS (Shock Trauma Air Rescue Service) as well as to the companies who have contracts with AHS for providing medevac services.

Despite this response to the 2011 recommendations, concerns from some members of the healthcare community and the public about the extended transport time from the EIA have continued.

Purpose and scope

As part of its monitoring role, HQCA independently conducted a review of the transport and care provided to medevac patients since the March 2013 ECCA closure. This review was conducted to determine implications for quality and patient safety as well as the outcomes for patients who received medevac services that landed at the EIA.

The scope of the review focused on patients who met the criteria of critically-ill or time-sensitive conditions or injuries. Refer to Appendix II for the Terms of Reference for the review.

Review team

This review was conducted under the HQCA's Quality Assurance Committee (QAC) in accordance with Section 9 of the *Alberta Evidence Act*[2]. The Medevac Chart Review Quality Assurance Review Team included:

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- Carmella Steinke, RRT, BHS(RT), MPA, Quality & Safety Review Team Lead HQCA
- Donna MacFarlane, RN, Patient Safety Lead HQCA
- Benjamin Higgins, MA, Health System Data Analyst HQCA
- Markus Lahtinen, PhD, Measurement Team Lead HQCA

BACKGROUND INFORMATION

Fixed-wing medevac services

For several decades patients have been transported from within Alberta and from remote communities outside Alberta by air ambulance (fixed-wing and rotary wing) for healthcare that they could not otherwise receive within their home communities. These patients require a spectrum of advanced care, ranging from time-sensitive critical care to specialized diagnostic and treatment services with a fixed appointment date and time.

The distances and geographic realities of Alberta and Canada make the use of dedicated medevac services essential to a highly functioning emergency medical service (EMS) and healthcare system. Medevac services are currently undergoing significant scrutiny in Canada (and elsewhere) as policy makers and associated EMS leaders are demanding more performance-based metrics and associated patient safety and care analytics.[3,4,5,6,7,8,9,10]

In Alberta the term 'medevac' is often used for all air ambulance transports and includes both fixed-wing (airplane) and rotary wing (helicopter) transports. The Alberta medevac process is complex and involves numerous providers from different departments within Alberta Health Services (AHS), other organizations and regulators. A 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/healthcare team and/or facility, as well as a "time-critical evaluation or intervention or for special monitoring, medication, equipment or expertise" during the journey. Logistics, aviation factors (such as weather, visibility and fuel) or lack of availability of "appropriate ground ambulance transport", and the problem of "excessive distance or rugged terrain that hinders transport to a care facility", are additional factors.[11]

Coding of patients' acuity

In 2010, AHS developed and implemented a new patient triage coding system for all interfacility EMS dispatches in Alberta including ground and air transports. This coding system is known as the "Inter-Facility Transport (IFT) Patient Transfer Matrix Guideline".[12] Relevant to this report are two of the four Matrix categories:

- **Red patient** is defined as "Immediate…having a clinical condition that is immediately threatening to life or limb with an unstable, time dependent emergency as identified by sending facility".
- **Yellow patient** is defined as "Time dependent ill…having a clinical condition that is potentially threatening to life or limb" with a defined goal of an EMS healthcare provider "being at the patient's side within 60 minutes" at the sending hospital.

The time metrics "immediate" and "60 minutes" are not precisely defined in the IFT Matrix document (i.e., time from initial call to arrival at patient's bedside versus time from medevac crew notification to patient bedside arrival, or otherwise). Examples of the diagnostic types of patients for both Red and Yellow patient triage categories are provided in the IFT Matrix document (Appendix III); in summary, these two categories represent the sickest patients eligible for medevac. The IFT Matrix document clearly states that the sending physician determines the triage category of the patient. The triage category can be modified during the patient's transport by the attending air medical team; however, the

analytic methodology of this report is based on the original triage category used to dispatch fixed-wing transport and not on subsequent modifications.

Generally, the Red patient category corresponds to the dispatch 911 ground code of "Card 37 Delta" response and a Yellow patient triage category corresponds to a "Card 37 Charlie" response for purposes of data collection and analysis within AHS EMS. This use of ground 911 EMS determinants to identify and categorize interfacility transports by the emergency communications officer at the central communication centre (CCC) helps to guide triage and prioritize ground and air resources. As noted, the colour triage of the patient can change based upon the patient's condition evolving or updates from the sending facility and air medical crew.[13]

Medevac process in Alberta

When a patient requires a higher level of care, the desired process to initiate a transfer is for the sending physician to contact RAAPID (Referral, Access, Advice, Placement, Information and Destination). RAAPID is a provincial call centre within AHS that facilitates transfers and or consultations with a tertiary care facility or a specialist (physician to physician) as well as coordinating repatriation of patients to their home community.[14]

The first question asked by RAAPID is "is your patient stable or unstable?" If the patient is stable (triaged as 'Yellow'), RAAPID reviews the system capacity, and then consults the required specialty service. RAAPID coordinates a conference call between the sending physician and the specialty service. If the patient requires transport to tertiary care, RAAPID locates a bed for the patient and notifies the receiving facility. At the end of the consultation the sending physician is then required to contact the CCC to arrange transport.

If the patient is unstable, the "Rural Red Patient Referral" process is initiated. RAAPID contacts the Shock Trauma Air Rescue Service (STARS) emergency link centre (ELC) and the required specialty service (e.g., trauma, cardiology). The ELC contacts the transport physician (TP) as well as the CCC. A conference call with all stakeholders (sending physician, RAAPID, ELC, TP, speciality service and CCC) takes place to make decisions about patient care and patient disposition. If it is deemed that the patient needs to be transferred, the mode of transportation (ground or air) is decided by the TP based on the patient condition and also with information provided by the CCC and the ELC (i.e., availability of aircraft, weather, and time out from hospital).

Dispatch of EMS resources is done in collaboration; STARS ELC deploys the STARS helicopter(s) and the CCC coordinates the other EMS transport resources. For fixed-wing this includes notifying the flight crew (pilots) and the air medical crew. The fixed-wing medical crew for Red and Yellow patients is advanced life support (ALS) trained (at least one paramedic level provider). If the requested aircraft is unavailable, the CCC contacts the next available medevac provider.

The TPs have expertise with emergency medicine and air transport, and can also guide and assist with the clinical care of the patient at the sending facility if required by the sending physician and healthcare team. The TP remains available to both the ground and air crews for medical advice during transport.[15] On rare occasions, the TP may accompany the transport crew depending on the criticality of the patient. The TPs are sometimes perceived to be available only to STARS for rotary wing transports; however, they are in fact available for all medevac patients in Alberta.

The medevac crew will arrive at the sending healthcare facility or rendezvous at the sending site airport, assess, treat the patient (if required) and depart the site with the patient for fixed-wing transfer to the EIA. Upon landing at the EIA, the aircraft taxis to the dedicated medevac hangar at the EIA where a ground ambulance is waiting for the air medical crew and patient. The patient is transferred to the ground ambulance and transported to the designated tertiary care facility. The ground transport may be done by a dedicated AHS crew or, in the case of a critical patient, the same air medical crew will accompany the patient in the waiting ground ambulance. In the very rare instance when the patient's condition warrants a faster transport, STARS rotary wing may be used to transport the patient from the EIA to the tertiary care facility.

Medevac evidence

The evidence for the use of medevacs (including rotary wing and fixed-wing) was well reviewed in the HQCA's April 2011 report.[16,17,18,19,20,21,22,23,24] Overall there is a relative scarcity of high level evidence in the literature for medevac use in the context of clear patient oriented outcomes, and most of the evidence that does exist is concentrated in the rotary wing component of medevacs rather than fixed-wing. Much of the positive observational evidence is associated with a critically-ill trauma cohort who benefit from timely rotary wing transport with a dedicated critical care paramedic team.[25,26,27] 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".[17,28] The classical term "the Golden hour" (denoting a paradigm of definitive resuscitative treatment in the first 60 minutes post injury) is most often ascribed in the past as a benchmark or standard of care for major trauma patients and associated trauma systems. However, most authorities regard it as a concept that is generally incorrect and not evidence-based.

Since the 2011 review of the literature by the HQCA, a number of new papers have been published to further define populations that may benefit from medevac interventions; again, most of this evidence resides in the rotary wing component of transport.[25,29,30,31,32,33,34,35] As well, this evidence is observational in the nature of the study designs. The geographic realities of Canada and associated large distances; however, bring a clear need for medevacs (rotary and fixed-wing) from a sheer logistics perspective and have become a seminal component of EMS scene response and interfacility transport in Alberta and Canada.[36,37,38]

As mentioned, evidence regarding time to definitive care was also reviewed in the 2011 HQCA report with an understanding that the classic paradigms such as the "golden hour" in trauma were not supported with robust evidence.[17,28,39] Although optimal times to intervention of certain conditions are appreciated (such as acute myocardial infarction/STEMI, stroke, or sepsis) it is also clear that other evolving elements of system-wide healthcare, for example telehealth and teleradiology, may play a much more important role for timely interventions than fixed-wing medevac.[40] That is, the intervention of choice (e.g., thrombolysis for an acute ischemic stroke syndrome with neuro-telehealth/CT support) for a patient oriented outcome such as mortality or neurologic function may be better handled in the initial facility. The patient could then be flown by fixed-wing transport post treatment for subsequent tertiary care.[41]

In a British Columbia review of the transport intervals between sending and receiving hospitals, Belway and colleagues could not show an association between transport times and subsequent in-hospital

mortality in critically-ill patients. Newgard and colleagues conducted a large observational study of severely injured trauma patients who were admitted to trauma hospitals and were unable to find any clear association between time and mortality for any of the intervals studied, including EMS transportation to hospital.[17] As summarized in the HQCA's 2011 medevac report, "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". While it is intuitively appreciated that time must play some role in patient outcomes that require a higher level of care, the definition of that optimal time interval in the context of many clinical conditions is unknown or controversial. Other provinces have published time intervals associated with trauma care and arrival at tertiary trauma hospitals and those times (in provincial EMS systems) vary from three to seven hours with no established national benchmarks.[29,36,42]

The use and key role of critical care teams for critically-ill patients and involving interfacility transport to a higher level of care has been studied in the Canadian setting. Singh et al have studied adverse events and the need for critical care team interventions in both ground critical care transports and air medical transports (including rotary wing and fixed-wing) and found that significant interventions for hypotension or mechanical ventilation issues occurred in one in 15 to 20 transports.[43,44] The authors concluded that a high level of care was essential in these transports and "that transport crews be well prepared to manage new hypotension…" and these challenging patients "…require an organized and well-trained transport system to address in-transit critical events…". When further evidence is reviewed regarding the transport of trauma patients specifically, from the original hospital of resuscitation to a hospital of a higher level of care, it is evident that a mature trauma system predicated upon a robust and well trained EMS component for interfacility transport is essential to optimal patient outcomes.[45,46,47]

METHODOLOGY

A formal chart[i] review was conducted and was also informed by the methodology of *Systematic Systems Analysis: A Practical Approach to Patient Safety Reviews*.[48] Elements of the report were also informed by information and details provided in the HQCA's 2011 report, as well as information gathered through discussions with key stakeholders within Alberta Health, Alberta Health Services (AHS) and STARS. The chart review methodology was predicated upon that recommended by Gilbert and Lowenstein except that the authors performed the data extraction in a nonblinded fashion.[49] The sample size (N = 232) was considered large enough and extended over enough time (see below) for basic statistical inference, but a formal sample size calculation was not performed.

This review was specifically concerned with potentially time-sensitive and critically-ill patients and their associated fixed-wing EMS transport and finally their ground transport from the Edmonton International Airport (EIA) to the two Edmonton tertiary care hospitals. However, initial care and time intervals in the pre-hospital environment and the sending healthcare facility were also considered as well as the time to definitive treatment at the tertiary care hospital.

Collection of information

Inclusion criteria for review were Red and Yellow patients (initial dispatch triage category) who were ultimately transported to University of Alberta Hospital (UAH) or Royal Alexandra Hospital (RAH) after fixed-wing medevac to the EIA. Exclusion criteria were neonatal transport patients.

In summary a Red patient ("immediate") is defined as one who "has a clinical condition that is immediately threatening to life or limb, is unstable and has a time dependent emergency as identified by the sending facility". A Yellow patient ("time dependent ill") is defined as a patient who has a "condition that is potentially threatening to life of limb" with a goal "to be at the patient's bedside within 60 minutes" (that is, for the transporting ALS paramedic team to be at the sending institution's patient bedside in sixty minutes).

The chart reviews of Red patients and a subset of Yellow patients transported by fixed-wing medevac to the EIA from March 15 to August 31, 2013 and January 1 to March 31, 2014 were undertaken in the fall of 2013 and spring of 2014. The patient cohort was identified with the administrative assistance of AHS EMS medevac services. The subset of Yellow patients was identified based on their clinical acuity. Patient charts were obtained from two destination hospitals, UAH and the RAH, which serve as tertiary trauma centres[ii] and interventional cardiac centres in Edmonton.

The chart review included sending healthcare facility patient records, ground EMS patient records (ground EMS to sending healthcare facility when available and from the EIA to the tertiary care

[i] Chart refers to a patient medical record.

[ii] UAH is a Level I trauma centre and RAH is a Level II trauma centre.

hospital), rotary wing patient care record (when pertinent), RAAPID (Referral, Access, Advice, Placement, Information and Destination) patient records, fixed-wing medevac patient care records (PCRs), and tertiary care hospital patient records. Missing data was noted per individual patient data summary, and missing data was not addressed by imputation or sensitivity analysis. Calculations were based upon complete available data with adjusted denominators as required.

The chart reviews and data extraction were performed over the following periods of time; October 1-3, October 28-29, 2013 and May 6-8, 2014. De-identified data was saved in Microsoft Excel (Version: Office 2010). Statistical analysis was performed using Stata (version 12.1) and included descriptive statistics, including mean and median values and ranges. Measures of central tendency include both means and medians, but when significant skewness of data was present, medians were used for analysis as noted. The final study cohort (see Figure 2 for cohort derivation) of patients included 152 Red patients and 80 Yellow patients (N = 232).

A priori data elements extracted during the chart review for the full cohort included: gender, age, initial diagnosis, time intervals (defined *a priori*, see Table 1 and Figure 1), therapeutic and diagnostic interventions, final sending healthcare facility, tertiary care hospital (UAH or RAH), discharge within 48 hours from admission to the tertiary care facility, and death within 24 hours post transport. Unadjusted mortality at 24 hours post transport was captured as it was assumed that death within this time period may more likely be associated with transport/transfer issues. A qualitative evaluation of the patient care record(s) including determination of the precision of initial Red/Yellow categorization was also performed.

Analysis of data

The data extracted by chart review was analyzed for basic descriptive statistics which included patient demographics (age, gender), diagnoses, time intervals, and outcomes (including discharge from tertiary care hospital at 48 hours after admission and mortality at 24 hours post transport). Where appropriate, percentages were rounded to the nearest whole number in this report. As well, bivariate analysis exploring the association between transport time and mortality and transport time and early discharge was performed. A further descriptive statistical analysis of trauma (e.g., motor vehicle crash or fall) versus non-trauma (e.g., sepsis, acute coronary syndrome) transport cases was also performed. The charts reviewed in the two time periods were originally analyzed separately. Statistical analysis demonstrated no differences between the two time periods, therefore all extracted cases were treated as one cohort. Sub-analyses of trauma versus non-trauma and Red versus Yellow cases was conducted separately.

Summative and individual information concerning therapeutic interventions (e.g., intubation, CPR, medication administrated) or diagnostic procedures (e.g., CT scanning) by the sending site or medevac crew was also performed. Bivariate analysis was performed using Chi-squared testing for categorical variables and parametric and non-parametric testing was used where appropriate to further summarize and analyze the data. All values reported are unadjusted and significance was defined a priori as a p value < 0.05 unless otherwise noted.

Particular emphasis was placed upon time metrics due to the original mandate of the study. Within healthcare systems that exist in northern Alberta and other parts of Canada, there are specific components of care involving EMS, healthcare facilities and transfer to definitive or higher level of care for critically-ill or time-sensitive patients. These elements of care have measureable time sequences or

intervals associated with them (e.g., EMS response, time in sending facility, time to call for transport, etc.) and are key to understanding the patient's entire journey and treatment from initial incident (either at a scene such as a motor vehicle crash (MVC) or initial presentation at the first healthcare facility) to tertiary care. Once these time intervals are defined and measured, areas of improvement extracted from these performance metrics can be identified and benchmarks of care and transport can be determined and monitored. Several time intervals used in this review (Table 1) have been used in other EMS studies and trauma studies.[28,30] Other time intervals can also be defined and used in individual components of healthcare systems as measures of patient care and safety and system performance.[50]

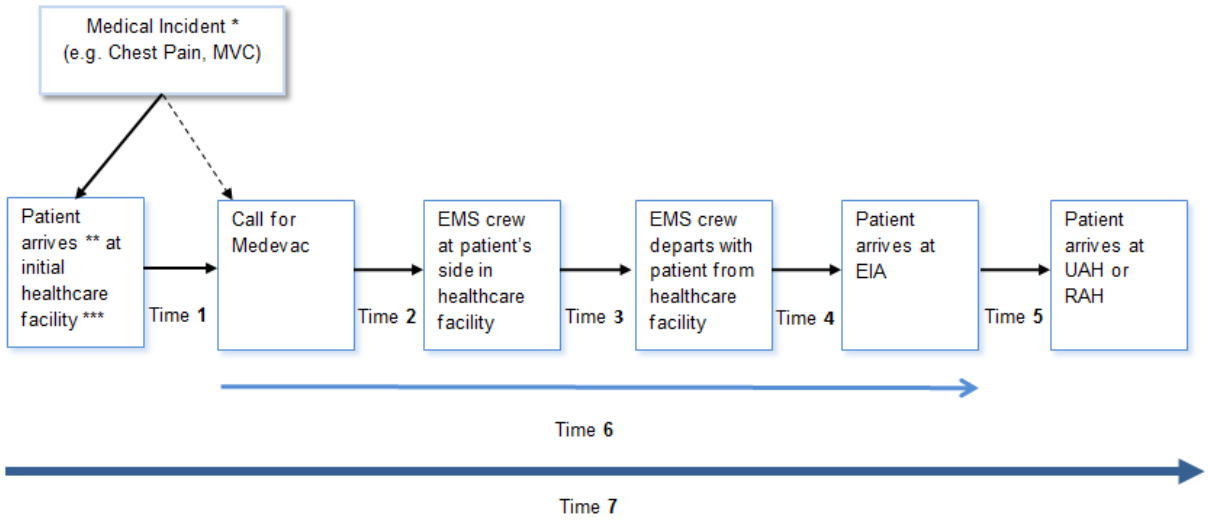
Table 1: Time interval definitions*

	Time interval start	Time interval end
Time 1	Patient arrives at initial healthcare facility	Call for medevac
Time 2	Call for medevac	EMS crew arrives at patient side
Time 3	EMS crew arrives at patient side	EMS crew departs with patient
Time 4	EMS crew departs with patient	Patient arrives at EIA
Time 5	Patient arrives at EIA	Patient arrives at tertiary care
Time 6	Call for medevac	Patient arrives at EIA
Time 7	Patient arrives at initial healthcare facility	Patient arrives at tertiary care

*Note that Times 1 through 5 are sequential and Times 6 and 7 are cumulative.

Figure 1 illustrates the time intervals used in a linear schematic. Of note, in certain cases, the medevac crew may meet the patient at the sending community's airport and not at the sending healthcare facility.

Figure 1: Time intervals in a linear schematic



* Medical Incident – time and place may be unknown
** Arrives – may be via car, self-presentation, EMS
*** Healthcare facility – may be hospital or health centre. In a rare instance 2 healthcare facilities may be involved prior to medevac
--> Trauma destination protocol

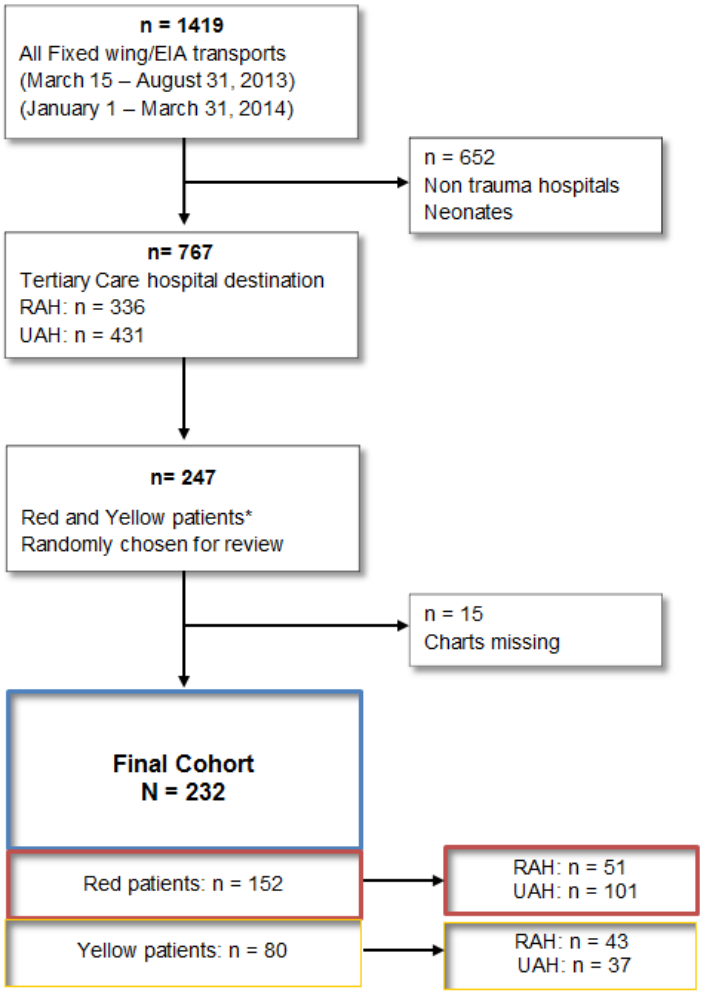
FINDINGS

Cohort derivation

During the study periods (March 15 to August 31, 2013 and January 1 to March 31, 2014) a total of 1419 Red and Yellow patients were transported by fixed-wing medevac to the EIA and subsequently to a final Edmonton hospital site.[iii] Seven hundred and sixty seven (767) of these patients had a final destination of University of Alberta Hospital (UAH) or Royal Alexandra Hospital (RAH) during the study periods. As described, a cohort of non-neonatal, critically-ill and time-sensitive Red and Yellow patients with the final destination of UAH or RAH were reviewed. Two hundred and forty seven (247) Red and Yellow patients were randomly identified for review. Fifteen charts (6 Red and 9 Yellow) were unavailable at the tertiary care hospitals for various reasons. Of this cohort (N = 232), 152 were Red patient cases and 80 were Yellow patient cases. The final sample of 232 patients represent approximately 30 per cent of the overall Red and Yellow patients transported from the EIA to UAH or RAH during the study periods, and was felt to represent a reasonable sample size for chart review and inclusion in the study (Figure 2).

[iii] University of Alberta Hospital, Grey Nuns Hospital, Mazankowski Heart Institute, Misericordia Community Hospital, Cross Cancer Institute, Royal Alexandra Hospital, Sturgeon Community Hospital, Glenrose Rehabilitation Hospital, Alberta Hospital Edmonton.

Figure 2: Cohort sample derivation[iv]



Most patients in the study cohort experienced a primary ground EMS transport to the initial healthcare facility, although a small number were self-presented (by family or friends). Some (but very few) of the cases experienced a rotary wing transport component in the initial EMS scene response before delivery of the patient to the initial hospital.

Figure 3 represents the sending institutions for the patient cohort. Of note, these data represent the final sending healthcare facility prior to fixed-wing transport to the EIA (and ultimately to RAH or UAH); some patients had two hospital/health centres involved prior to final fixed-wing medevac to the EIA.

[iv] *Red patient – a clinical condition (illness or injury) that is *immediately* threatening to life or limb.
Yellow patient – a clinical condition (illness or injury) that is *potentially* threatening to life or limb.

Figure 3: Sending institutions of the full patient cohort

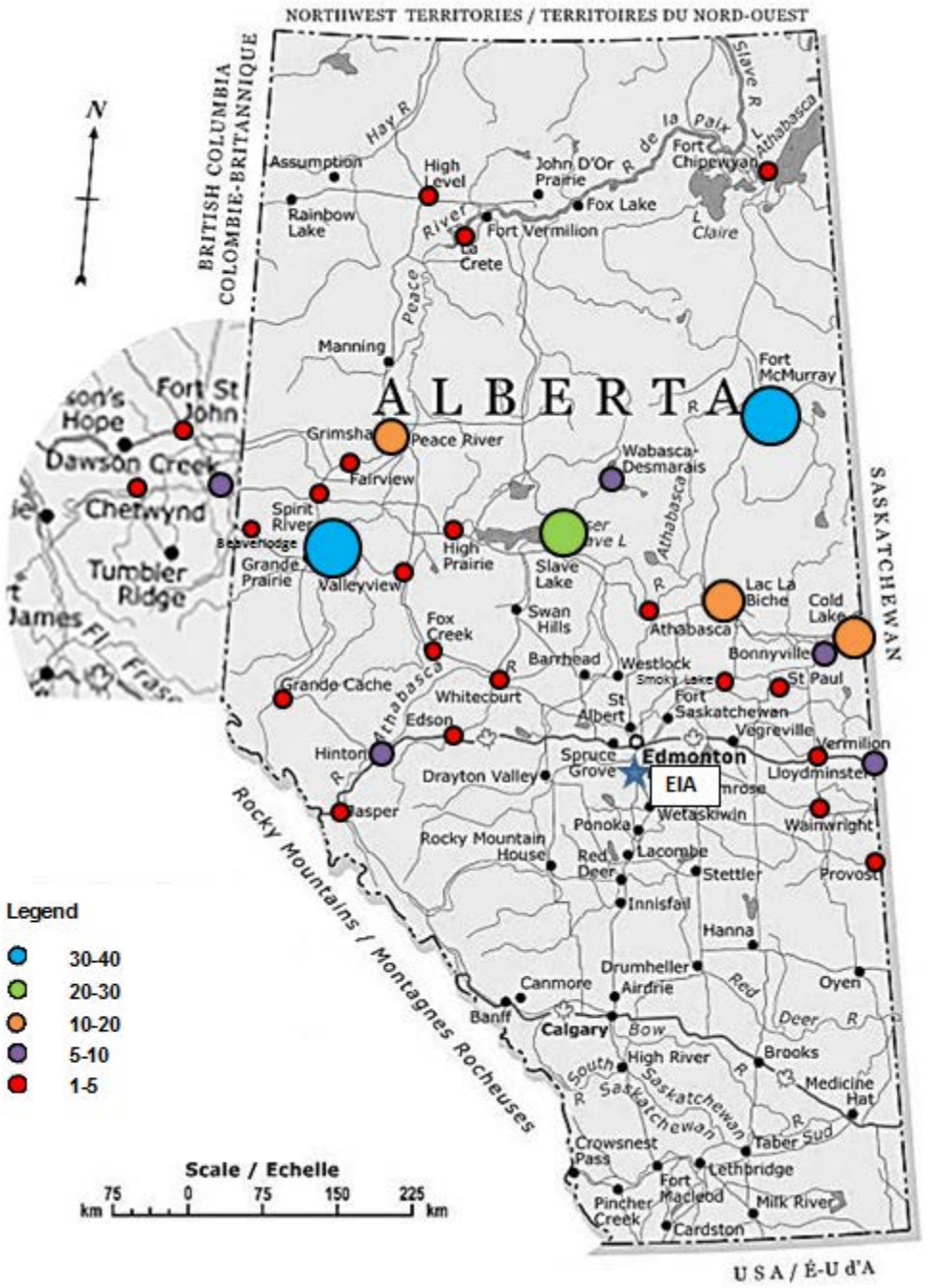


Table 2 summarizes the initial triage colour coding category of patients transported in relation to the tertiary care hospital in Edmonton.

Table 2: Distribution of cohort

	Full cohort N = 232	Red patients n = 152	Yellow patients n = 80
Royal Alexandra Hospital (RAH)	94 (41% of total cohort)	51	43
University of Alberta Hospital (UAH)	138 (59% of total cohort)	101	37

Patient characteristics

The patient characteristics in the review cohort are shown in Table 3 (full cohort), Table 4 (Red patients) and Table 5 (Yellow patients). Some differences can be clearly seen, especially those of age (trauma patients are younger) and gender (trauma patients are more often male)[51]. There is a more even gender distribution with non-trauma patients.

Table 3: Full cohort (all) patient characteristics

		Full cohort patient characteristics			*p*-values (Trauma v. Non-trauma)		
		All N = 232	Trauma n = 80	Non-trauma n = 152	χ^2 test	Wilcoxon-Mann-Whitney test	Equality of medians test
	Age (median)	48	32	52		0.0000***	0.000***
Gender	**Male**	65%	74%	60%	0.036*		
	Female	35%	26%	40%			

Significance:
(*) p<.05
(***) p<.001

Table 4: Red patient characteristics

		Red patient characteristics			*p*-values (Trauma v. Non-trauma)		
		All n = 152	Trauma n = 60	Non-trauma n = 92	χ^2 test	Wilcoxon-Mann-Whitney test	Equality of medians test
	Age (median)	48	32	54		0.0000***	0.000***
Gender	**Male**	70%	78%	65%	0.083		
	Female	30%	22%	35%			

Significance:
(***) p<.001

Table 5: Yellow patient characteristics

		Yellow patient characteristics			*p*-values (Trauma v. Non-trauma)		
		All n = 80	Trauma n = 20	Non-trauma n = 60	χ^2 test	Wilcoxon-Mann-Whitney test	Equality of medians test
	Age (median)	45	34	50		0.0413*	0.039*
Gender	**Male**	54%	60%	52%	0.517		
	Female	46%	40%	48%			

Significance:
(*) p<.05

Figures 4 to 7 describe the mechanism of injury and diagnosis of the Red versus Yellow patient cohorts. Figure 4 demonstrates that most Red trauma patients suffered blunt trauma (e.g., MVCs, falls); this pattern is similar in the Yellow trauma cohort (Figure 5). The Red non-trauma patients (Figure 6) have a wide collection of diagnoses with a predominance of acute cardiac syndromes (primarily STEMI – ST Elevation Myocardial Infarction). The Yellow non-trauma patients (Figure 7) demonstrated a predominance of acute cardiac syndromes, followed by obstetrical conditions.

Figure 4: Red trauma patient mechanism of injury

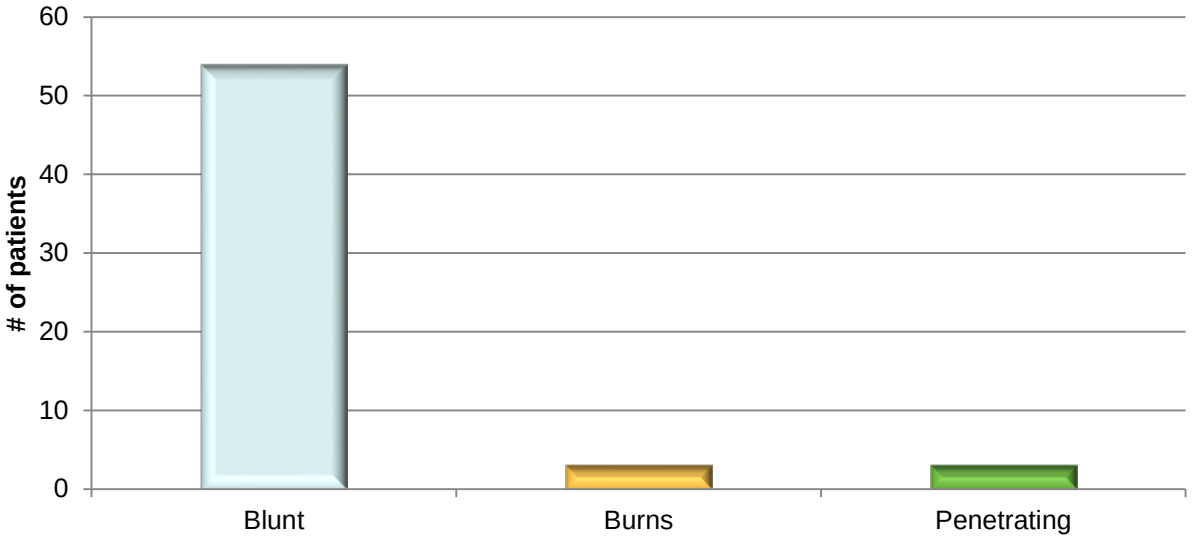


Figure 5: Yellow trauma patient mechanism of injury

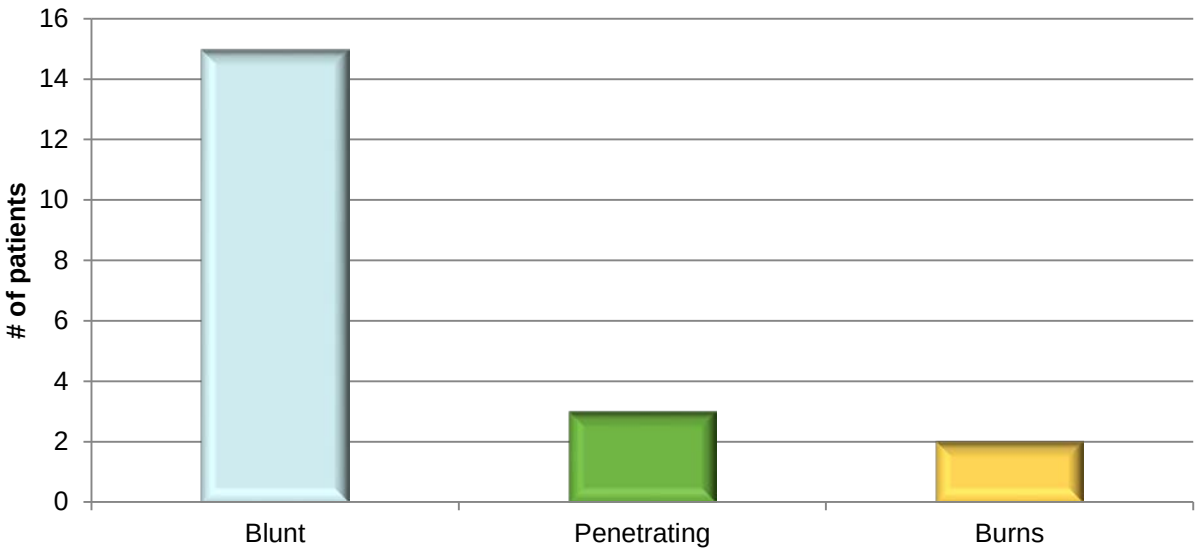


Figure 6: Red non-trauma patient diagnostic category

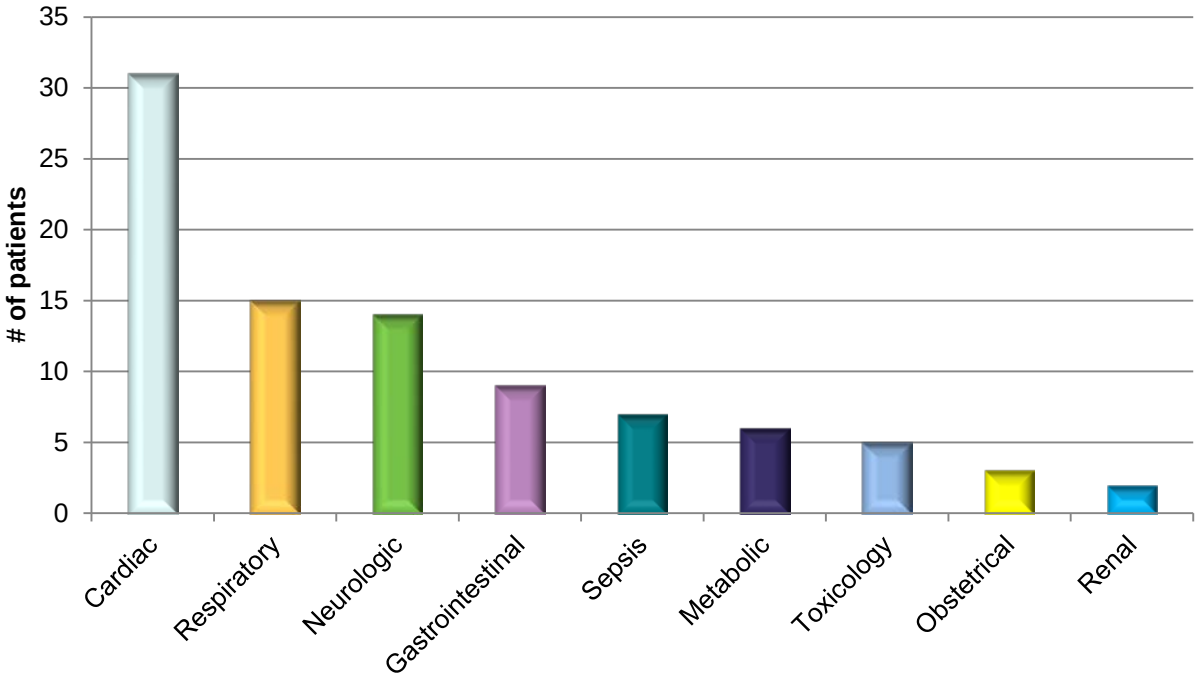
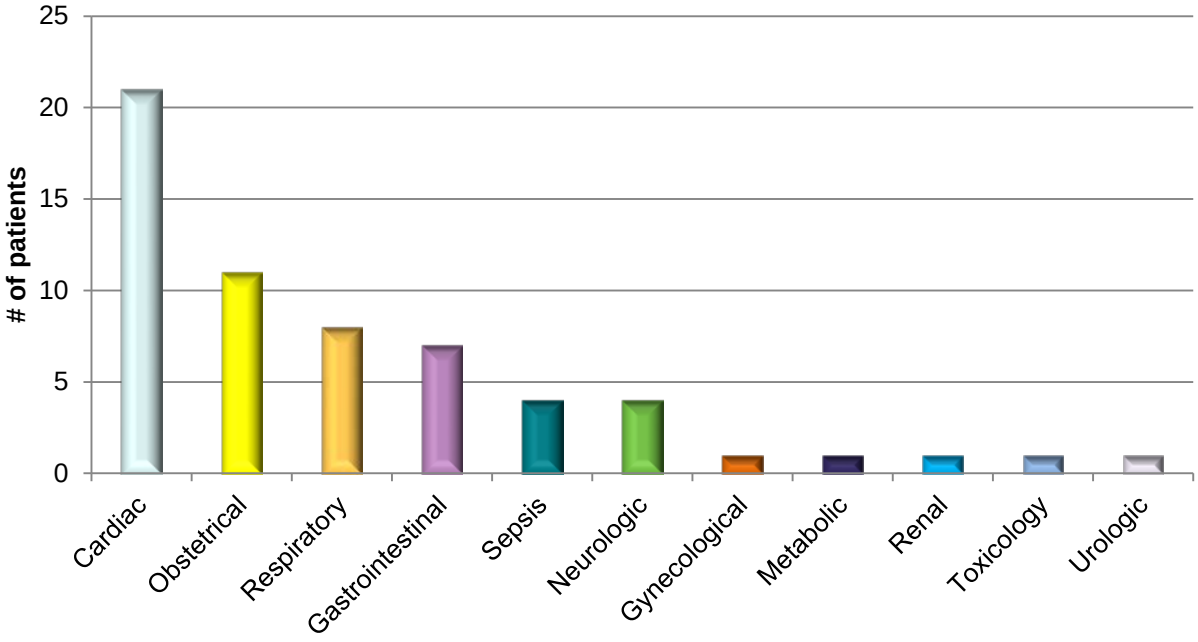


Figure 7: Yellow non-trauma patient diagnostic category



Time intervals

Table 6 (full cohort), Table 7 (Red patients) and Table 8 (Yellow patients) depict the process of care time intervals. Each table has two subcategories characterized as trauma and non-trauma patients. These two patient populations have very different pathology and often different epidemiology, as well as operative and procedural interventions. Complete time interval data were available for 70 to 94 per cent of cases reviewed (depending upon the defined interval). (See Table 1 and Figure 1 for the time interval definitions).

Table 6: Full cohort – time intervals

Time intervals		Full cohort time intervals hours : minutes			*p*-values (Trauma v. Non-trauma)	
		All	Trauma	Non-trauma	Wilcoxon-Mann-Whitney test	Equality of medians test
Time 1	Patient arrives at initial healthcare facility – Call for medevac	2:18	1:49	2:27	0.0531	0.421
Time 2	Call for medevac – EMS crew arrives at patient side	1:12	1:09	1:15	0.1787	0.059
Time 3	EMS crew arrives – EMS crew departs with patient	0:30	0:30	0:30	0.8885	0.839
Time 4	EMS crew departs with patient – patient arrives at EIA	1:12	1:10	1:14	0.3065	0.411
Time 5	Patient arrives at EIA – Patient arrives tertiary care	0:53	0:47	0:56	0.0312*	0.014*
Time 6	Call for Medevac – patient arrives at EIA	2:54	2:56	2:53	0.2530	0.456
Time 7	**Total journey** Patient arrives at initial healthcare facility – Patient arrives at tertiary care	6:03	6:00	6:19	0.0255*	0.654

Notes:
Medians reported for time variables and columns are not summative in reference to Time 7.
Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements.

Significance:
(*) p<.05

Table 6 shows that for Times 1, 2 and 3 there is no statistically significant difference between trauma and non-trauma patients. For Time 5, the time interval for trauma patients is significantly shorter than for non-trauma patients. For Time 7, the initial statistical testing (Wilcoxon-Mann-Whitney test) suggests that time intervals are significantly different between trauma and non-trauma patients but further confirmatory testing (using the equality of medians test) suggests that the medians are not

significantly different between trauma and non-trauma patients (i.e., 6 hours versus 6 hours and 19 minutes).

Table 7: Red patients – time intervals

Time intervals		Red patients time intervals hours : minutes			*p*-values (Trauma v. Non-trauma)	
		All	Trauma	Non-trauma	Wilcoxon-Mann-Whitney test	Equality of medians test
Time 1	Patient arrives at initial healthcare facility – Call for medevac	1:55	1:39	2:14	0.0234*	0.132
Time 2	Call for medevac – EMS crew arrives at patient. side	1:13	1:10	1:16	0.2740	0.242
Time 3	EMS crew arrives – EMS crew departs with patient	0:38	0:31	0:41	0.1828	0.308
Time 4	EMS crew departs with patient – patient arrives at EIA	1:12	1:11	1:13	0.5443	0.730
Time 5	Patient arrives at EIA – Patient arrives tertiary care	0:48	0:45	0:53	0.0812	0.006**
Time 6	Call for Medevac – patient arrives at EIA	3:09	3:06	3:12	0.1167	0.538
Time 7	**Total journey** Patient arrives at initial healthcare facility – Patient arrives at tertiary care	5:46	5:37	6:10	0.0088**	0.550

Notes:
Medians reported for time variables and columns are not summative in reference to Time 7.
Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements.

Significance:
(*) p<.05
(**) p<.01

Table 7 shows that for Times 1 and 7 the initial statistical testing (Wilcoxon-Mann-Whitney test) suggest that time intervals are significantly different between trauma and non-trauma patients but further confirmatory testing (using the equality of medians test) suggests that the medians are not significantly

different between trauma and non-trauma patients. For Times 2 and 3 there is no statistically significant difference in times between trauma and non-trauma cohorts. Confirmatory statistical testing for Time 5 (equality of means test) suggests that the difference is statistically significant for trauma versus non-trauma patients although, in reality, the difference of 8 minutes between the two populations is not of clinical significance.

Table 8: Yellow patients – time intervals

		Yellow patients time intervals hours : minutes			*p*-values (Trauma v. Non-Trauma)	
Time intervals		**All**	**Trauma**	**Non-Trauma**	**Wilcoxon-Mann-Whitney Test**	**Equality of Medians Test**
Time 1	Patient arrives at initial healthcare facility – Call for medevac	3:13	3:53	2:54	0.4520	0.333
Time 2	Call for medevac – EMS crew arrives at patient. side	1:11	1:06	1:13	0.3473	0.253
Time 3	EMS crew arrives – EMS crew departs with patient	0:26	0:28	0:25	0.3708	0.371
Time 4	EMS crew departs with patient – patient arrives at EIA	1:18	1:05	1:18	0.4296	0.483
Time 5	Medevac arrives at EIA – patient arrives tertiary care	1:04	1:01	1:05	0.4723	0.398
Time 6	Call for Medevac – patient arrives at EIA	2:39	2:42	2:39	0.4351	1.000
Time 7	Total journey Patient arrives at initial healthcare facility – patient arrives at tertiary care	6:52	8:02	6:27	0.7147	0.146

Notes:
Medians reported for time variables and columns are not summative in reference to Time 7.
Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements.

In Table 8 there is no statistically significant difference in times between trauma and non-trauma patient for Times 1, 2, 3, 5 and 7. The Yellow cohort time interval for Time 2 - call for medevac to medevac crew arrival – is 71 minutes. The expected time for Yellow patients according to the Triage

Matrix is "…at the patients side in 60 minutes". Time 2 for Red patients (73 minutes) as shown in Table 7 is similar to the Yellow cohort (71 minutes). The time spent at the sending healthcare facility (Time 3) by the medevac crew for Yellow patients was 26 minutes overall (trauma and non-trauma); whereas Red patients had a longer Time 3 of 38 minutes overall (trauma and non-trauma). This difference may have been due to Red patients representing more clinical complexity and thus needing more time for the crew to assess and treat.

Table 9 depicts Time 4, the transport time (overall) from departing sending healthcare facility to EIA arrival. This is the fixed-wing component of patient travel and as expected, this time is very similar for Red and Yellow cohorts which also assists with overall data integrity determination.

The median Time 5 - time from EIA to final hospital - is 48 minutes for Red patients (Table 7) and 64 minutes for Yellow patients (Table 8). The transport times from the EIA to the tertiary care hospitals (RAH and UAH) are shown in Table10. The transport time was shorter to UAH than RAH; the UAH is closer in proximity to the EIA. Red patients were transported more quickly than Yellow patients regardless of final hospital.

Time 6 (call for medevac to patient arrival at the EIA) is the time interval metric that shows how quickly the fixed-wing paramedic team responds to a call for transport, assesses the patient and arrives at the EIA. As expected, this time interval is a considerable portion of the overall patient journey. Of note, the median Time 6 for Yellow patients was 30 minutes less than that for Red patients. See Table 9.

Tables 7 and 8 show the median total journey time (Time 7) at 6:52 hours for Yellow patients and 5:46 hours for Red patients.

Table 9: Time intervals 4 and 6

Time interval	Red patients hours : minutes Median (mean)		Yellow patients hours : minutes Median (mean)	
Time 4 Departs sending healthcare facility to EIA arrival	1:12 (1:13)		1:18 (1:12)	
	Trauma	Non-trauma	Trauma	Non-trauma
	1:11 (1:12)	1:13 (1:14)	1:05 (1:08)	1:18 (1:14)
Time 6 Initial call for medevac to patient arrives at the EIA	3:09 (3:12)		2:39 (2:47)	
	Trauma	Non-trauma	Trauma	Non-trauma
	3:06 (3:00)	3:12 (3:20)	2:42 (2:41)	2:39 (2:49)

Note: Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements.

Table 10: Time interval 5 (from EIA to tertiary care hospital)

Cohort	Full cohort minutes Median (mean)	Red patients minutes Median (mean)	Yellow patients minutes Median (mean)
RAH	60 (64.0)	57.5 (58.1)	72 (72.5)
UAH	47 (52.0)	45 (48.2)	60 (62.4)

Note: Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements.

Table 11 summarizes the Time 7 data - total time from patient arrival at the sending healthcare facility to arrival at the tertiary care hospital in Edmonton (UAH or RAH) - for Red versus Yellow patients. Of note, and contrary to expectations, there is no statistically significant difference between Yellow and Red patients, although the median time is less for Red patients overall and for the subcategories. This Time 7 summary, while initially unexpected, may be of use to those mandated with updating triage categories given the minimal difference in 'time' service to these two triage populations.

Table 11: Time interval 7 (total time)

Time Interval	Red patients hours : minutes Median (mean)		Yellow patients hours : minutes Median (mean)	
Time 7 Arrival at initial healthcare facility to arrival at tertiary care hospital	5:46 (12:55)		6:52 (9:45)	
	Trauma	Non-trauma	Trauma	Non-trauma
	5:37 (14:27)	6:10 (11:51)	8:02 (7:44)	6:27 (10:31)

Note: Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements.
*Wilcoxon-Mann-Whitney test insignificant because p=0.1117 and Median test insignificant because p=0.092: no statistically significant difference in times between Red and Yellow patients.

Table 12 summarizes the Time 1 data for Red versus Yellow patients; that is, the time from arrival at initial healthcare facility to call for assistance/medevac. The only statistically significant difference is the shorter median time it takes for the sending hospital to call for assistance/medevac with Red trauma patients. Of note is the long length of time (median or mean) it takes to make that call, which is a key step in setting the entire medevac process in motion.

Table 12: Time interval 1 (time to call for medevac)

	Full cohort hours : minutes Median (mean)	Red patients hours : minutes Median (mean)	Yellow patients hours : minutes Median (mean)
Trauma patients	1:49 (9:59)	1:39 (10:13)	3:53 (9:11)
Non-trauma patients	2:27 (6:59)	2:14 (7:27)	2:54 (6:08)

Note: Only significant difference is less time to call for assistance/medevac for Red trauma patients.
Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements.

Table 13 summarizes the relative "time consumption" of Time 1 and Time 5 in relation to the overall time involved in the patient's journey to tertiary care (Time 7). Of note, Time 5 (time from EIA to final hospital) is a relatively small percentage of the total time and also small in comparison with Time 1 (time to call for assistance/medevac). This point is not made to de-emphasize the new EIA to final hospital time interval (compared to the old ECCA times, it is greater as previously noted), but rather to put it in perspective in relation to the overall patient medevac journey.

Table 13: Time consumption comparisons; Time 1 versus Time 5 as a percentage of Time 7

Time interval	% of patient journey	
	Red	Yellow
Time 1	33	47
Time 5	14	16

Note: Denominator adjustments were made based upon associated missing data and, as noted, no imputation was performed on missing data elements. All times reported as medians.

Time 1 - Time of arrival at sending hospital to call for medevac.
Time 5 - Time from EIA arrival to final tertiary care hospital (RAH or UAH).
Time 7 - Total patient journey from arrival at initial healthcare facility to final tertiary care hospital.

Patient interventions

Figures 8 and 9 illustrate the five most common resuscitative, higher level interventions or imaging done at the sending hospital upon the patient's arrival and prior to medevac crew arrival. Although other interventions were performed, only the five most common are represented and only one intervention (the highest level) was counted per patient. The most common intervention performed on the Red patient cohort was intubation (n=60) followed by medication administration. The Yellow patient cohort is different in this context with only two intubations being performed. Of note, the medevac crew intubated seven patients in the Red cohort prior to transport and none in the Yellow cohort. The most common higher level medication intervention was the administration of TNK, a thrombolytic given to treat STEMI, 15 times in the Red cohort and 9 times in the Yellow cohort.

Figure 8: Interventions at sending hospital prior to Medevac crew arrival: Red patients

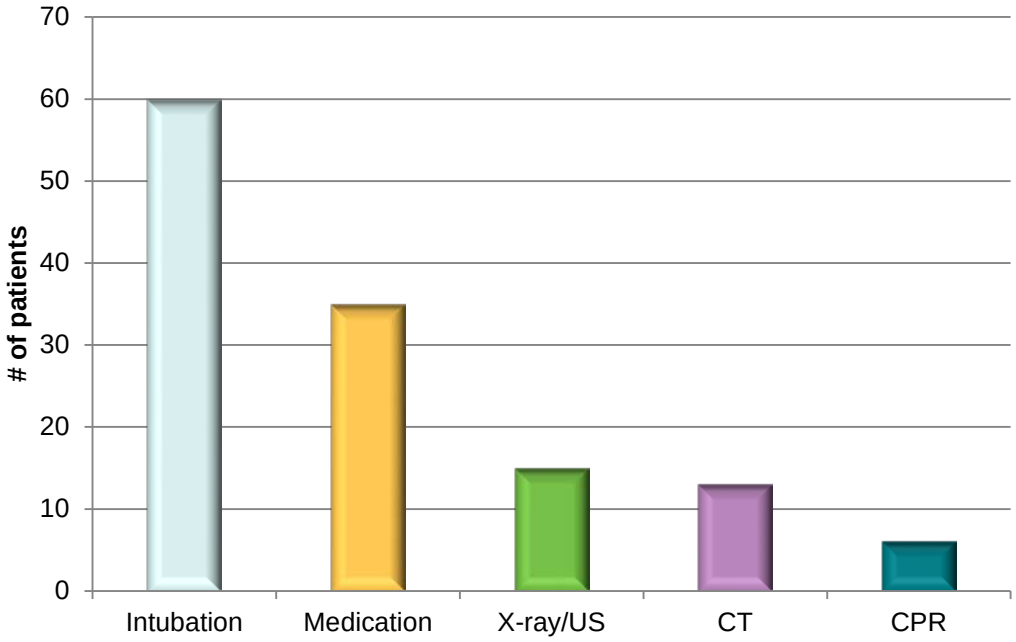
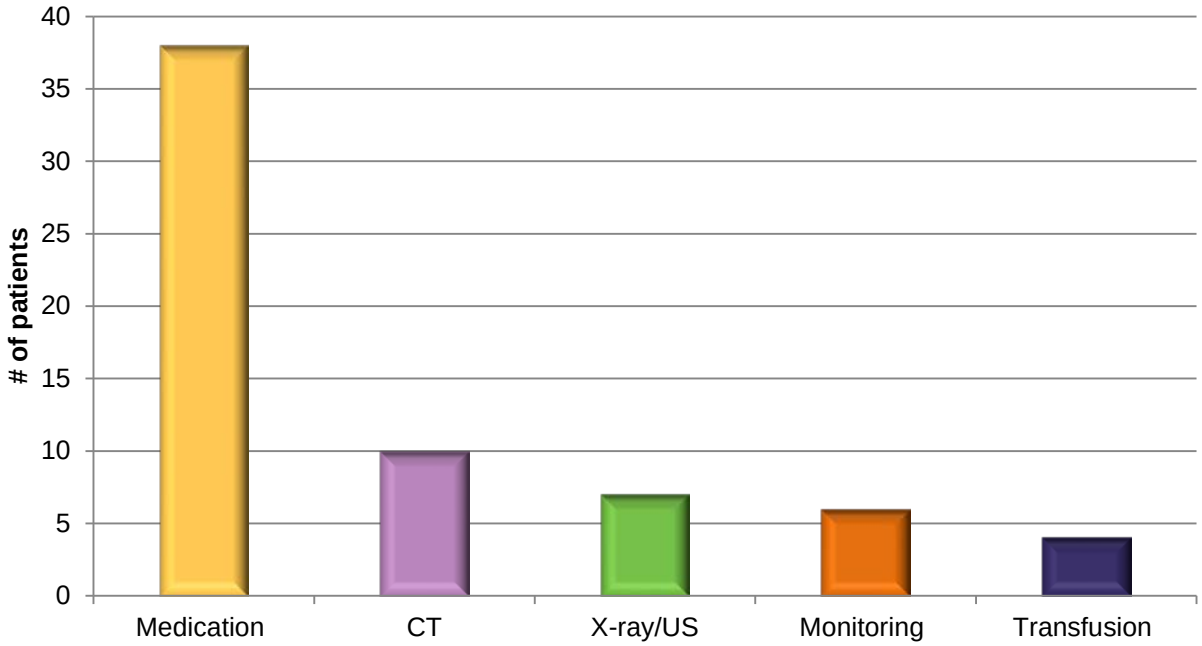


Figure 9: Interventions at sending hospital prior to Medevac crew arrival: Yellow patients



Patient outcomes

Death within 24 hours of medevac

Among the entire cohort of 232 patients, representing the sickest, most critically-ill patients moved by fixed-wing transport to RAH/UAH, there were eight deaths at the tertiary care hospital (RAH/UAH) within the initial 24 hour period post transport. This time period was chosen because it most closely aligns with those interventions or delays that may have been as a result of the medevac transport process and associated EMS care.

Each of these eight cases was individually reviewed by the primary author and then by one of two secondary reviewers. Seven of the deaths occurred within the Red patient cohort and one death within the Yellow patient cohort.

The unadjusted mortality rate (24 hours) for the Red patient cohort was 4.61 per cent (Table 14). Of the seven Red patient deaths reviewed, four were non-trauma cases and three were trauma cases. The cases were divided as to tertiary care hospital (2 for RAH and 5 for UAH). The three trauma deaths were characterized by massive head injury/encephalopathic changes and were deemed to be non-survivable. Two of the non-trauma deaths were cardiogenic shock, both of whom were undergoing CPR upon or preceding medevac crew arrival and one patient was in severe hemorrhagic shock refractory to resuscitative efforts upon arrival at the tertiary care hospital. One patient had a neurologic injury with unstable vitals and advice had been given to not transport the patient due to their terminal state.

The unadjusted mortality rate (24 hours) for the Yellow patient cohort was 1.25 per cent (Table 14). The one case in this cohort was a non-trauma case where the patient was in advanced cardiogenic shock.

No evidence could be found that care provided or time elements of medevac played any significant role in the deaths of these critically-ill patients.

Discharge within 48 hours

The inter-facility transport patient transfer matrix guideline (IFT Matrix) is intended to recognize and correctly identify patients who are critically-ill and/or in clear need of emergent/urgent transport to a higher level of care. The matrix triage categorization is informed by the sending physician/facility and may involve the TP to assist in that decision process. However, it was unclear how often the TP was used in decision making or for clinical support (for sending physician or for medevac crew).

A separate analysis was undertaken to assess potential false positive utilization of fixed-wing transport/medevac using a surrogate marker of discharge from the tertiary care hospital within 48 hours of transport. It was assumed that patients critically-ill enough to require medevac would not be discharged within that time frame (with rare exceptions) and that an analysis of this cohort may inform further prospective quality indices and case reviews as well as potential refinement of the IFT Matrix and/or TP utilization.

Within the Red triage cohort seven trauma patients (13 per cent of cohort excluding deaths and missing data) and 14 non-trauma patients (18 per cent of cohort excluding deaths and missing data) were discharged within 48 hours of fixed-wing transport. In the Yellow cohort, three trauma patients (16 per cent excluding deaths and missing data) and 16 non-trauma patients (29 per cent excluding deaths and missing data) were discharged within 48 hours as shown in Table 14. Final post transport diagnostic

characteristics of this overall cohort include: labour and delivery, minor trauma, seizure, respiratory tract infection, overdose and intoxication.

Table 14: 24 hour mortality and discharge within 48 hours

	Full cohort N = 232			*p*-values (Trauma v. Non-trauma)
	All	**Trauma**	**Non-trauma**	**χ^2 test**
Mortality (24 hours)	3.45%	3.75%	3.29%	0.855
Discharge within 48 hours	19.23%	13.70%	22.22%	0.137
	Red patients n = 152			***p*-values (Trauma v. Non-trauma)**
Mortality (24 hours)	4.61%	5.00%	4.35%	0.851
Discharge within 48 hours	15.67%	12.96%	17.50%	0.479
	Yellow patients n = 80			***p*-values (Trauma v. Non-trauma)**
Mortality (24 hours)	1.25%	0%	1.67%	0.561
Discharge within 48 hours	25.68%	15.79%	29.09%	0.253

Data challenges and issues

Several issues were encountered with missing data during the chart review and consequently denominator calculations were adjusted for analysis. Apart from time interval data elements, important records and/or data elements were missing in approximately 20 per cent of the charts reviewed. Some cases had several areas of missing data. The most common missing element was the patients' RAAPID form. Although the form is not currently recognized as a legal health record document it contains valuable information that assists in continuity of patient care and also for quality assurance and review purposes. The second most common missing element was the sending healthcare facility's patient record followed by the initial EMS ground transport patient care record.

From a time interval perspective, the majority of the associated time interval metrics were identified for the full patient cohort. However, the availability of this time interval data did vary from 70 per cent to 94 per cent, depending upon the defined time interval. Of note, many of these time interval measurements were recorded by the EMS crew by hand and may have been entered post hoc after the medevac was complete. Therefore, the overall accuracy of this data remains questionable. The single most common missed recorded time element was that of "time of patient arrival at sending hospital".

Other metrics and data that were not readily identified were the number of times a TP was contacted by the medevac crew. As mentioned the initial ground patient care record, defined as the original EMS crew who responded to the patient prior to arriving at the sending hospital (when EMS was used by the patient), was largely unavailable.

These issues represent an opportunity for patient care record (PCR) and data acquisition improvement, and may be addressed in the AHS EMS ePCR implementation that is currently underway.

Summary of findings

1. No adverse patient safety or care issues were identified that could be associated directly with the relocation of medevac services to the Edmonton International Airport (EIA) from the Edmonton City Centre Airport.
2. There were eight deaths in this critically-ill cohort of 232 patients at the tertiary care hospital within the initial 24 hour period post transport. No evidence was found that care or time elements of fixed-wing transport/EMS played any significant role in the death of these patients.
3. Time 5, defined as the transfer time from the EIA to tertiary care hospital time (University of Alberta Hospital or Royal Alexandra Hospital), represented approximately 15 per cent of the overall patient journey time. In comparison, the time of patient arrival at the sending facility to a call for assistance/medevac represented approximately 40 per cent of the overall patient journey time for both Red and Yellow patients.
4. For all cases reviewed, an advanced level of paramedic care (EMT-P) was maintained for the entire patient's journey from departing the sending facility to arrival at the tertiary care hospital and including the interval from the EIA to tertiary care hospital.
5. Time interval 3, representing the time the medevac team spent at the sending facility, was found to be short (median of 30 minutes), which represents less than 10 per cent of the overall patient journey time.
6. Important records and/or data elements were missing in approximately 20 per cent of the charts reviewed.
7. Fifteen of the 18 recommendations from the 2011 HQCA report have been implemented to date. These include: (1) the new patient transition unit at the EIA; (2) dedicated ground EMS vehicles and crew for immediate transport from the EIA; (3) utilization of the same ALS (advanced life support) medevac crew from the EIA for critically-ill, unstable patients eliminating associated handover issues and risks; and (4) upgrade of Villeneuve airport to function as a backup to the EIA. Further details on implementation of the 2011 recommendations are included in Appendix I.

RECOMMENDATIONS

The following recommendations are organized into themes to enhance the level of medevac care provided.

Decision to transport

One of the largest time intervals for the patient was that of the time spent in the sending healthcare facility prior to a call for assistance/medevac. Although the initial resuscitation of these patients can be challenging and complex, an earlier call may be warranted and may also represent an opportunity for education for sending facilities and physicians. As well, earlier involvement of the transport physician to provide clinical assistance and other support to the sending institution and medevac crew could improve care and efficiency by:

- Expediting the decision to transport for critically-ill and time-sensitive patients so that the medevac team can be put into motion while the sending healthcare facility team is performing resuscitation, interventions and imaging as required.
- Assisting with appropriate triage of the patient based on more detailed information of the patient condition and acuity (of note, a substantial number of patients had their initial high triage category down-graded by the medevac team after arrival at the sending hospital/healthcare facility).

In the 2011 medevac report the Health Quality Council of Alberta (HQCA) recommended the mandatory use of RAAPID (Referral, Access, Advice, Placement, Information and Destination), in part to support earlier engagement of the transport physician. It is recognized that Alberta Health Services has taken steps to implement this recommendation; however, it was identified during the current review that implementation of this recommendation has been a challenge and some healthcare providers continue to bypass RAAPID when transferring medevac patients to a higher level of care.

In addition, educational outreach to rural and remote communities could support healthcare teams to enhance the quality of care provided to these critical patients, as well as provide more education regarding the medevac (fixed-wing and rotary wing) program and associated processes.

Recommendation 1

Alberta Health Services emergency medical services (EMS) leadership establish a stakeholder committee that includes representation from rural physicians, sending facilities, RAAPID, EMS medical directors, transport physicians and STARS, in order to:

1. Develop and implement new strategies to ensure the mandatory use of RAAPID for all critically-ill and time-sensitive medevac patients.
2. Explore ways for further upfront utilization of the transport physician to assist with early mobilization of transport resources, level of transport care required and clinical support.
3. Delineate educational outreach opportunities for sending facilities and physicians regarding medevac patient care, preparation for transport, and triage/communication updates.

Documentation

Alberta Health Services EMS has made significant strides in standardizing documentation across the province and across the entire EMS portfolio, for both ground and air transport. However, it was noted that a number of key time stamps and patient information were either missing and/or not documented in the EMS patient care record. For example, the availability of accurate time interval data varied from 70 per cent to 94 per cent, depending upon the defined time interval. In addition many of these time interval measurements were recorded by the crew by hand and may have been entered after the medevac was complete.

Apart from time interval data elements, important records and/or data elements (e.g., ground EMS patient care record) were missing in approximately 20 per cent of the charts reviewed and some cases had several areas of missing data. The RAAPID form is not currently recognized as a legal document; however, it contains valuable information that assists in continuity of patient care and also for quality assurance and review purposes.

Recommendation 2

Alberta Health Services EMS further standardize documentation and identify mandatory data fields in the EMS electronic patient care record to ensure sharing of important medevac patient information, and to support quality assurance and quality improvement activities.

Recommendation 3

To support continuity of patient information, Alberta Health Services ensure all documentation related to patient transfer (i.e., pre transfer care, RAAPID transfer process and EMS care) is available to the patient's care team and remain a permanent part of the patient's healthcare record.

Monitoring and reporting

Currently there is limited data and data analysis available to efficiently and effectively assess and monitor the quality of medevac services on a continuous basis. It is recognized that Alberta Health Services EMS has made improvements to the data they are able to collect and monitor and that implementation of the EMS electronic patient care record will expand the capabilities for data analysis and monitoring of the medevac program. At this time, there are no metrics specific to medevac that are publicly reported on the AHS website.

Recommendation 4

With the implementation of the EMS electronic patient care record, Alberta Health Services EMS implement a comprehensive process to analyze and regularly report on quality metrics for the medevac program. Examples of service and performance metrics include, but are not limited to:

- time intervals (see Table 1)
- all clinical interventions by EMS/medevac crew at sending facility and/or enroute
- airway interventions by EMS/medevac crew at sending facility and/or enroute
- discharge within 48 hours from the tertiary care hospital

- deaths within 24 hours of transport
- transport physician utilization by the sending facility and the medevac crew

This process should include determining which metrics would be appropriate for public reporting.

Implementing medevac critical care teams

Air medical transport is an essential component of the healthcare system in Alberta and beyond the provincial borders. Medevac patients require a spectrum of advanced care, ranging from time-sensitive critical care to specialized diagnostic and treatment services with a fixed appointment date and time. There are over 7000 fixed-wing flights in Alberta for medevac annually and over 2700 of these are triaged as Red or Yellow (high acuity) patients.

Alberta Health Services had previously indicated a desire to change the distribution of medevac planes in Alberta to more appropriately match resources to demand, while introducing critical care medevac crews. However, following concerns voiced from the public, a decision was made to not implement the changes and to consult with stakeholders and communities to inform the development of a long-term air ambulance plan.[52]

Providing safe and appropriate patient care is as important as the transport time for medevac patients. The role of critical care teams for critically-ill patients involving inter-facility transports to a higher level of care has been studied in the Canadian setting, with the conclusion and confirmation that a high-level of care and a mature, organized transport system is essential to optimal patient outcomes.[43,44,45,46,47]

Although outside the original scope of this review, the HQCA recognizes the benefit of having critical care teams, which are trained to a higher-level than current ALS medevac crews, as part of the fixed-wing component of Alberta's air ambulance program.

Recommendation 5

As part of the planning process for the provincial air ambulance program, AHS EMS include the implementation of dedicated critical care teams in the fixed-wing environment, as well as review and optimize the allocation and the geographic positioning of air ambulance resources.

APPENDICES

APPENDIX I: Recommendation status from 2011 HQCA medevac report

Recommendation	Status	Comment
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.	Completed	
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.	Completed	
3. Traffic patterns be studied and an optimal ambulance route established from the Edmonton International Airport to tertiary care facilities.	Completed	
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 Opticom 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.	In Progress	The City of Edmonton's pilot study of Opticom equipment for use by fire trucks is in progress. AHS is awaiting an assessment regarding whether Opticom has benefited response times for emergency fire responses. If there is a benefit, EMS can consider its use.
5. All ambulances be equipped with a Global Positioning System so alternate routes can be determined when traffic is problematic.	Completed	
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.	Completed	
7. Arriving and departing medevac flights be given priority for landing, taxi and take-off.	Completed	

Recommendation	Status	Comment
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	Completed	Opened March 15, 2013.
9. The new facility/air ambulance hangar be located away from the general commercial traffic.	Completed	
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.	Completed	This recommendation was reviewed by Alberta Transportation (MOT). The MOT's evaluation indicated additional lanes and the proposed overpass would not decrease travel time of ambulances from EIA to Edmonton. However a new paved egress road from the new medevac hanger location to the highway was completed and provides a shorter more direct route from hanger to highway.
11. A standardized and agreed upon coding system is implemented for classifying and prioritizing patient transports, along with standardized use of the term 'medevac'.	Completed	The medevac coding system aligns with the ground interfacility transfer coding. The IFT Matrix is under revision to further clarify/separate patient acuity from hospital capacity issues.
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.	In Progress	There has been significant work to institute the Rural Red Patient Referral process throughout Alberta. However, some users remain resistant in the use of RAAPID, and work continues with this recommendation.
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.	Completed	
14. Equipment is standardized across the various ground and air ambulance providers (including fixed-wing and rotary wing).	Completed	

Recommendation	Status	Comment
15. Medical personnel who transport patients in ground ambulance, rotary or fixed- wing aircraft are cross trained in all modes of transport.	Completed	
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).	Completed	
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	Continuous	Quality improvement initiatives are a continuous process. There are multiple initiatives in progress. Having the provincial medevac data collated in one database provides many opportunities for quality improvement.
18. Another airport be considered as a backup within the Edmonton area with instrument landing system capabilities that can accommodate medevac flights.	Completed	Villeneuve airport is the back up. Infrastructure upgrades completed February 2014.

APPENDIX II: Terms of reference

HQCA
Health Quality Council of Alberta

Chart review of MEDEVAC patients who landed at the Edmonton International Airport

Terms of Reference

Purpose

Pursuant to section 3 (1), 6 (2), 15 (2), 16 (1) of the *Health Quality Council of Alberta Act*, the HQCA will independently conduct chart reviews of critically ill, time-sensitive patients who required MEDEVAC services that landed at the Edmonton International Airport (EIA).

Objectives

In follow-up to the *Review of the Safety Implications for Patients Requiring Medevac Services from the Edmonton International Airport*, the HQCA will conduct a chart review to determine implications for quality and patient safety as well as the outcomes of critically ill, time-sensitive patients who received MEDEVAC services that landed at the EIA.

Scope

This review will not include patients who do not meet the criteria of critically-ill or time-sensitive.

Stakeholders

Stakeholders that may be engaged in the review process include but are not limited to:

- Alberta Health Services (AHS)
- Alberta Health
- Physicians
- MEDEVAC crews

Deliverables and Timelines

A full report of the findings will be presented to the Senior Medical Director, Emergency Medical Services AHS, and will be made public.

Regular updates on the status of the review will be provided by the HQCA to AHS.

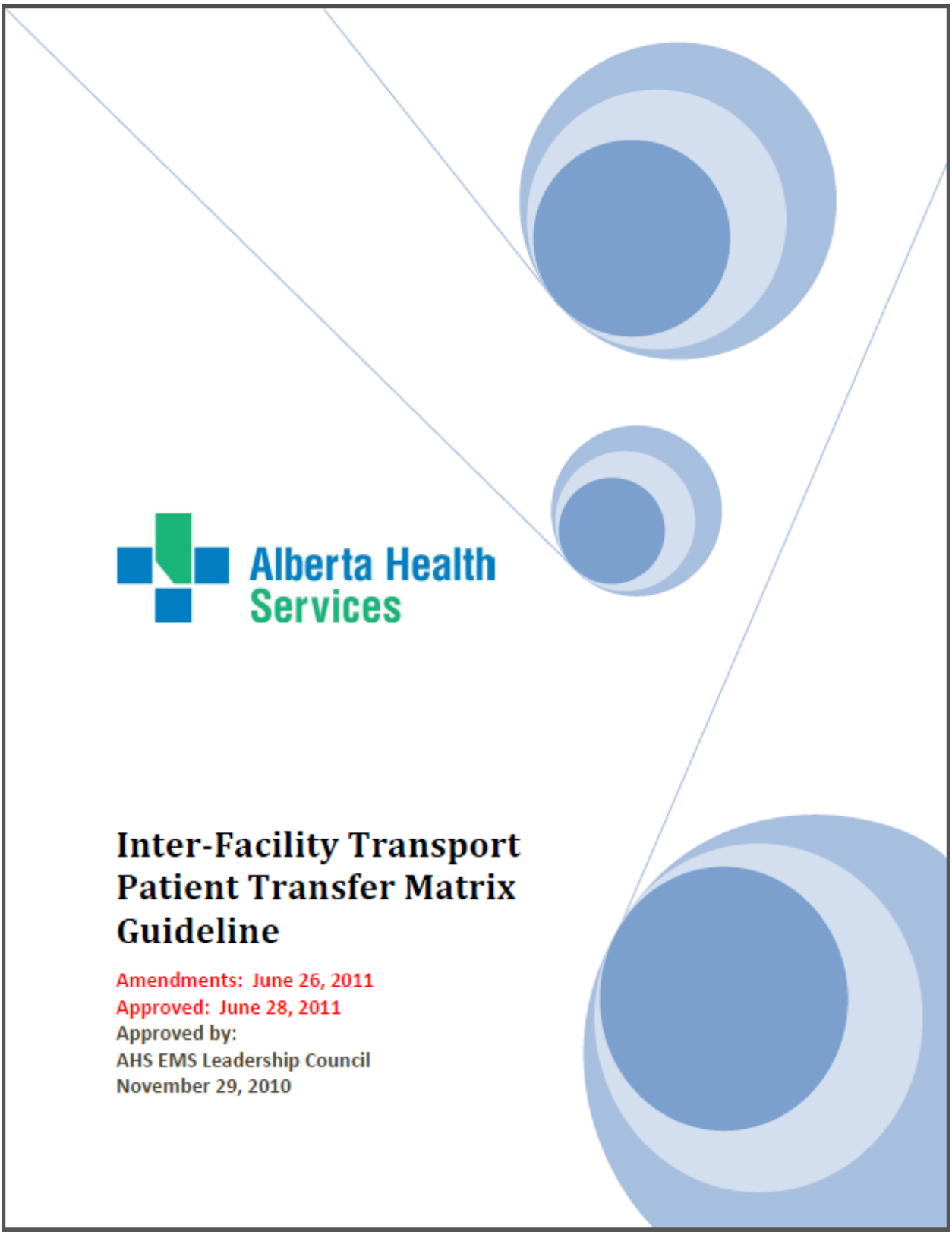
John W. F. Cowell M.Sc., MD, CCFP, FRCP
Chief Executive Officer
HQCA

July 23, 2013
Date

Dr. Ian Phelps MD, FRCPC
Senior Medical Director, EMS
Alberta Health Services

July 18, 2013
Date

APPENDIX III: AHS Inter-facility Transport Patient Transfer Matrix Guideline



Where Are We Now

In November 2010 AHS EMS approved and implemented the Inter-facility Patient Transfer Matrix Guidelines. These provincial guidelines have been implemented in a number of AHS EMS Communication Centers within Alberta. These triage guidelines continue to evolve as we introduce this tool to our all approved health facilities/sites. Currently we are educating approved health facilities/sites to this patient transport triage tool. As we continue to receive feedback from the health facilities/sites and physicians the patient transport triage matrix will continue to evolve and improve with time.

History

The EMS IFT Division of EMS gathered the different patient acuity guidelines used in the previous nine regional health legacies, air ambulance and dispatch centers. With feedback from the IFT/Dispatch Medical Director, the Air Ambulance Red Patient Referral System, and various EMS/Dispatch Providers, a consolidated Patient Transport Matrix was created that streamlined procedures on a provincial basis.

How the Matrix Works

The Patient Transfer Matrix is a colour coded system based on patient acuity, used to guide the Emergency Communication Officer (ECO). Please refer to the Patient Triage Matrix attached. The reference cards cite examples of each type of patient and where they can fit into the matrix.

Some Key Points

- Red Patients – this definition was mirrored after the Air Ambulance Red Referral Program. RAAPID conferences these requests for rural Alberta through STARS and the Communications Centers and in the urban centers the facilities call and book this patient sub-type directly through the Communications Centers.

- Demand Driven Protocol/Over Capacity Plan, Time Dependent Well Patients – This is a new entity. While the guideline mostly addresses patient acuity, we have taken into account new challenges within our Health System in regards to capacity in high priority areas. Keeping efficiency in mind, this enables the Emergency Communications Officer to triage and prioritize transports of the same acuity level to ensure system functionality.

- Mode of Transport – some patients may require no or minimal supportive care during transport for appointments or placements. This also encompasses returning the patient to an equal or lower level of care. In the metro areas, there are Non-Ambulance Transport (NAT) fleets in the IFT Division.

The Facility Educator Guideline

In conjunction with the Alberta Health Services EMS Communication and EMS Patient Transport (IFT) we will attempt educate all approved health facilities/sites that require or utilize Inter-Facility Transport. A central 1-877 booking number has been created for use across the province which will put approved health facilities/sites in touch with one of three AHS EMS Communication Centers responsible for scheduling inter-facility patient transports. This document is intended to help inform approved health facilities/sites when requesting inter-facility patient transports.

IFT Patient Triage Matrix – ECO Guideline

Acuity Level	Patient Status	Mode of Transport	Attendant	Transport Reason
IFT RED EMERGENCY TRANSFER • No lights & sirens •Dispatched immediately •AMPDS Card 37 Delta response • Patient transport to higher level of care • Time critical	•A patient who has a clinical condition (illness or injury) that is ***immediately*** threatening to life or limb • Unstable, time-dependent emergency as identified by sending facility	• Call received from: RAAPID / CCC / STARS • Closest available EMS Unit • Air Ambulance if warranted • ALS Ground Unit • If BLS: RN, Nurse Practitioner, Physician or EMT-P to accompany	• Must be at least one: - EMT-P - Nurse Practitioner - RN - Physician	• Refer to reference card

Acuity Level	Patient Status	Mode of Transport	Attendant	Transport Reason
IFT YELLOW URGENT TRANSFER • No lights & sirens •AMPDS Card 37 Charlie response • Patient transport to a higher level of care • Preferred target time: within 60 minutes to patient side •Demand Driven Protocol/Over Capacity Plan • Time dependent *ill* pt • Time dependent *well* pt	• A patient who has a clinical condition (illness or injury) that is ***potentially*** threatening to life and/or limb • When the Demand Driven Protocol/Over Capacity Plan is triggered in a site/Zone, transports are triaged to be higher priority over all time dependent events. • Appointment or return from appointment or high priority area • Non-Ambulatory	• Call received from: RAAPID / CCC / STARS • Air Ambulance if warranted • ALS Ground Unit • Closest, most appropriate EMS Unit • Communication centre will work with sending facility to determine need for ALS or BLS	• Must be at least one: - EMT-P - Nurse Practitioner - RN - Physician - and/or EMT when deemed by dispatch as appropriate	• Refer to reference card

3

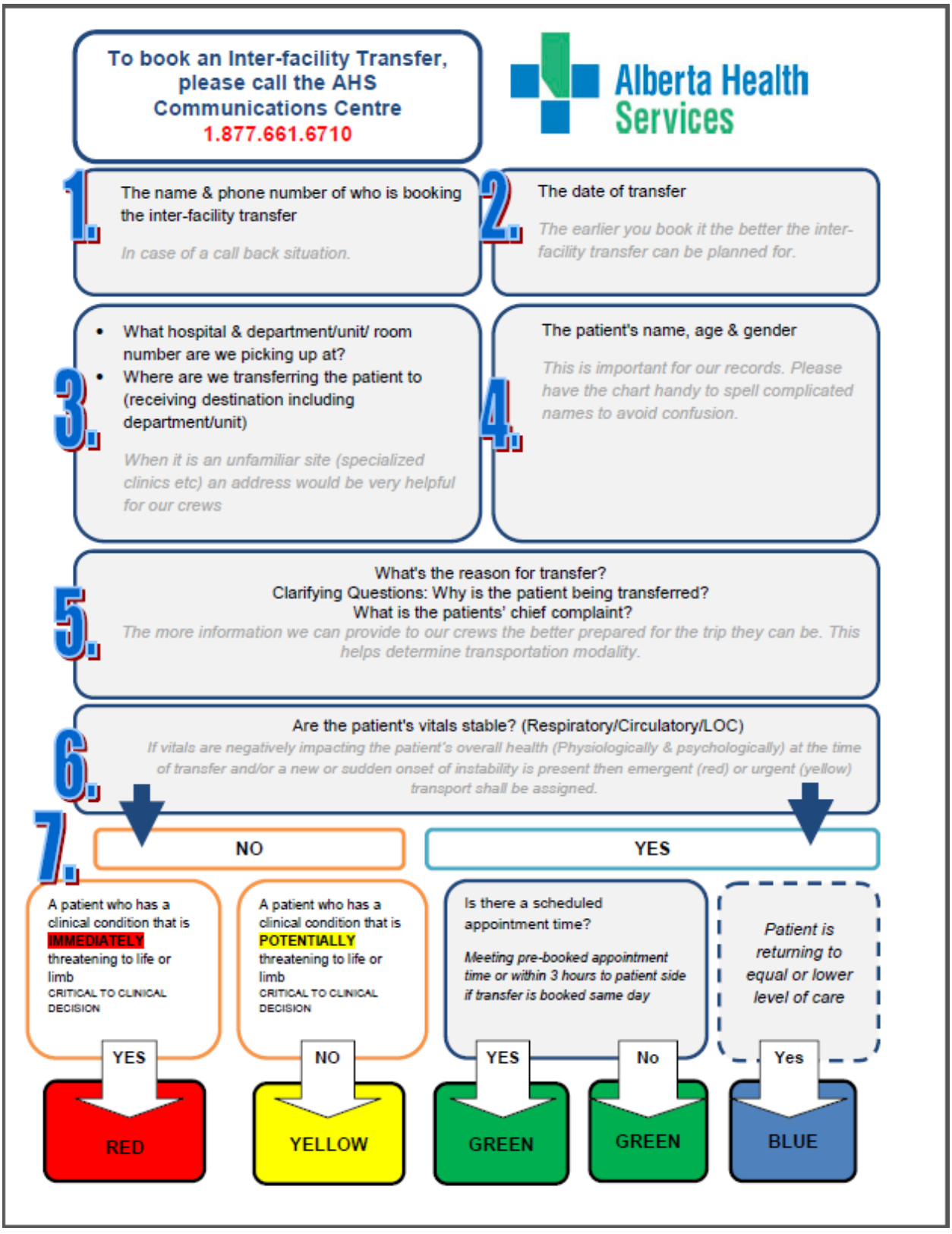
Acuity Level	Patient Status	Mode of Transport	Attendant	Transport Reason
IFT GREEN SCHEDULED TRANSFER • Patient transport to an appointment or return from an appointment (Clarify with sending facility/site if this is a wait and return) •AMPDS Card 37 Bravo response • The transfer is to be scheduled with the EMS Communication Center by the sending facility/site the day before the appointment or a minimum of 3 hours prior to the scheduled appointment time • Preferred target time: Meeting pre-booked appointment time or within 3 hours to patient side if transfer is booked same day	• Non-Ambulatory or ambulatory • May have an IV Infusion • Patient requires routine intervention; there is no immediate threat to life or limb • Transport should not be deferred from requested/agreed upon arrival time as this *could* impact patient care	• Air ambulance if distance warrants RAAPID / CCC • Communication centre will work with sending facility to determine need for ALS, BLS or non-ambulance transport Clarify with sending facility/site if this is a wait and return	• IF IV fluid infusion (with meds/blood products) but must be continued then at least 1 EMT-P • IF IV infusion (no meds/blood products) but IV must be continued then at least 1 EMT • IF IV saline lock (no meds/blood products) but must be continued then at least 1 EMR or care attendant	• Refer to reference card

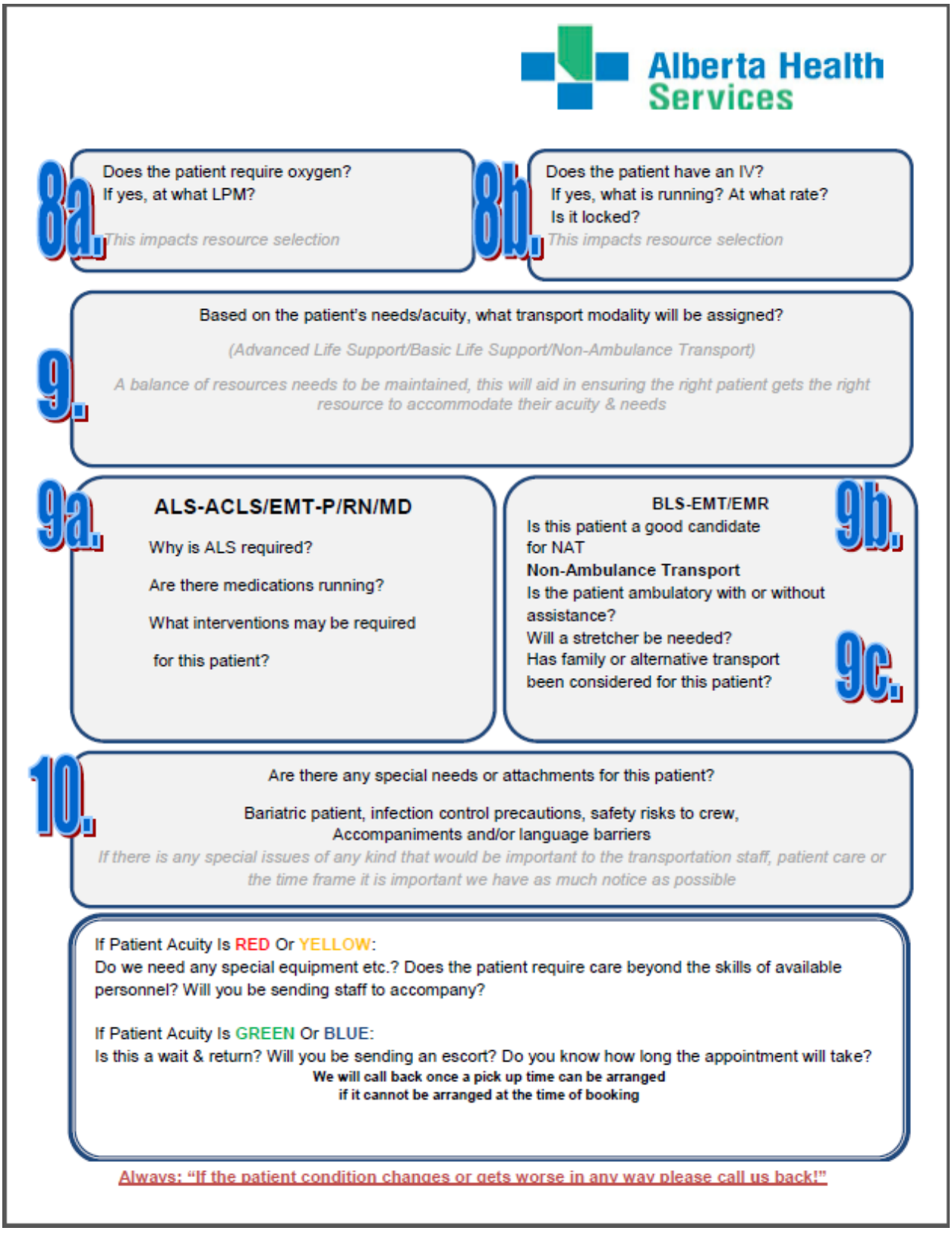
Acuity Level	Patient Status	Mode of Transport	Attendant	Transport Reason
IFT BLUE ROUTINE TRANSFER • Patient transport to equal or lower level of care •AMPDS Card 37 Alpha response • Preferred target time: within 24 hours to patient side	• Requires minimal assistance • Patient requires routine intervention; there is no threat to life or limb • Transport can be deferred from requested/agreed upon arrival time, as this would have no impact on patient care	• Has facility/site considered: Family, Taxi or Public transit • Wheelchair van • Non-Ambulance Transport • Ambulance transport as last resort • Air Ambulance or commercial airline if circumstance warrants • Communication centre will assess need for ALS, BLS or non-ambulance transport or alternative	• Accompanied by a family member, porter or caregiver as appropriate • EMR, EMT or EMT-P practitioner may be necessary for safe patient transport	• Refer to reference card

Reference Cards

RED	YELLOW
• Acute Altered Level of Consciousness • Acute Myocardial Infarction (MI) • Acute Obstetrical Emergencies • Acute Stroke/CVA • Acute Surgical Emergency • Burns • Cardiogenic Shock • Compromised Airway • Compromised Breathing • Compromised Circulation • Dissecting or Ruptured Abdominal Aortic Aneurysm (Triple A) • Emergency Hyperbaric (CO Poisoning) or Hemodialysis • High Risk NICU & PICU (As Per Local Service Standard) • Human Organ Procurement and Exchange (HOPE) • Intensive Care Unit (ICU) Transfers • Intracranial Hemorrhage/Major Head Injury • Ischemic Limb • Major / Polytrauma • Rescue Angioplasty • Resuscitated Cardiac Arrest • ST Elevation Myocardial Infarction (STEMI) • Ventilated / Intubated ***Closest, available EMS resource is to be dispatched immediately to sending site.	• Attachments (Chest Tubes, Central Lines, etc.) Needing Critical Care Monitoring • Central or Invasive Monitoring Ongoing • Emergency Consult for a Critically Ill or Symptomatic Patient • Medication Infusions (Blood or Blood Products, Vasopressors, etc.) Needing Critical Care Monitoring • Transfer to and From High Priority Area (Cath Lab, CCU, ICU, PICU, NICU, ED) • Urgent Diagnostics ***Demand Driven Protocol/Over Capacity Plan – When triggered in a site/Zone, transports are triaged to be higher priority over all time dependent events. *** *Time Dependent Ill* – A transfer that is given preference as deferral or delay could have significant impact on patient care. *** *Time Dependent Well* – A transfer that is given preference in order to create capacity and flow in identified high priority areas such as Emergency Department (ED).

GREEN	BLUE
Scheduled Transfer That Meets One or all of the Criteria Below: • Admission to Higher Level of Care • Consults (Specialists) • Convalescence • Diagnostics • Palliative • Radiation Therapy • Rehabilitation • Wait and return transfers	Routine Transfer That Meets One or all of the Criteria Below: • No Threat to Life or Limb and Transport Can be Delayed as There Would be No Impact on Patient Care • Routine Patient Transfer for Admission to Equal or Lower Level of Care


To book an Inter-facility Transfer, please call the AHS Communications Centre
1.877.661.6710
Alberta Health Services
1. The name & phone number of who is booking the inter-facility transfer
In case of a call back situation.
2. The date of transfer
The earlier you book it the better the inter-facility transfer can be planned for.
3. What hospital & department/unit/ room number are we picking up at?
Where are we transferring the patient to (receiving destination including department/unit)
When it is an unfamiliar site (specialized clinics etc) an address would be very helpful for our crews
4. The patient's name, age & gender
This is important for our records. Please have the chart handy to spell complicated names to avoid confusion.
5. What's the reason for transfer?
Clarifying Questions: Why is the patient being transferred?
What is the patients' chief complaint?
The more information we can provide to our crews the better prepared for the trip they can be. This helps determine transportation modality.
6. Are the patient's vitals stable? (Respiratory/Circulatory/LOC)
If vitals are negatively impacting the patient's overall health (Physiologically & psychologically) at the time of transfer and/or a new or sudden onset of instability is present then emergent (red) or urgent (yellow) transport shall be assigned.
7.
NO
YES
A patient who has a clinical condition that is IMMEDIATELY threatening to life or limb
CRITICAL TO CLINICAL DECISION
YES
RED
A patient who has a clinical condition that is POTENTIALLY threatening to life or limb
CRITICAL TO CLINICAL DECISION
NO
YELLOW
Is there a scheduled appointment time?
Meeting pre-booked appointment time or within 3 hours to patient side if transfer is booked same day
YES
GREEN
No
GREEN
Patient is returning to equal or lower level of care
Yes
BLUE


Alberta Health Services
8a.
Does the patient require oxygen?
If yes, at what LPM?
This impacts resource selection
8b.
Does the patient have an IV?
If yes, what is running? At what rate?
Is it locked?
This impacts resource selection
9.
Based on the patient's needs/acuity, what transport modality will be assigned?
(Advanced Life Support/Basic Life Support/Non-Ambulance Transport)
A balance of resources needs to be maintained, this will aid in ensuring the right patient gets the right resource to accommodate their acuity & needs
9a.
ALS-ACLS/EMT-P/RN/MD
Why is ALS required?
Are there medications running?
What interventions may be required for this patient?
9b.
BLS-EMT/EMR
Is this patient a good candidate for NAT
Non-Ambulance Transport
Is the patient ambulatory with or without assistance?
Will a stretcher be needed?
9c.
Has family or alternative transport been considered for this patient?
10.
Are there any special needs or attachments for this patient?
Bariatric patient, infection control precautions, safety risks to crew, Accompaniments and/or language barriers
If there is any special issues of any kind that would be important to the transportation staff, patient care or the time frame it is important we have as much notice as possible
If Patient Acuity Is RED Or YELLOW:
Do we need any special equipment etc.? Does the patient require care beyond the skills of available personnel? Will you be sending staff to accompany?
If Patient Acuity Is GREEN Or BLUE:
Is this a wait & return? Will you be sending an escort? Do you know how long the appointment will take?
We will call back once a pick up time can be arranged
if it cannot be arranged at the time of booking
Always: "If the patient condition changes or gets worse in any way please call us back!"

APPENDIX IV: List of tables and figures

Tables

Figures

APPENDIX V: Acronyms

AH	Alberta Hospital Edmonton
AHS	Alberta Health Services
ALS	Advanced Life Support
BLS	Basic Life Support
CCC	Central Communications Centre
CCI	Cross Cancer Institute
CPR	Cardiopulmonary Resuscitation
CT	Computed Tomography
ECCA	Edmonton City Centre Airport
ECO	Emergency Communications Officer
EIA	Edmonton International Airport
ELC	Emergency Link Centre
EMS	Emergency Medical Services
EMT	Emergency Medical Technician
EMT – P	Emergency Medical Technologist-Paramedic
ePCR	Electronic Patient Care Record
GNH	Grey Nuns Hospital
GRH	Glenrose Rehabilitation Hospital
HQCA	Health Quality Council of Alberta
IFT	Inter-Facility Transport
MAZ	Mazankowski Heart Institute
MIS	Misericordia Community Hospital
MVC	Motor Vehicle Collision
PCR	Patient Care Record
QAC	Quality Assurance Committee
RAAPID	Referral, Access, Advice, Placement, Information and Destination
RAH	Royal Alexandra Hospital
RN	Registered Nurse
SH	Sturgeon Community Hospital
STARS	Shock Trauma Air Rescue Service
STEMI	ST Elevation Myocardial Infarction
TNK	Tenectaplase
TP	Transport Physician
UAH	University of Alberta Hospital

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