ATHABASCA UNIVERSITY

ST-ELEVATION MYOCARDIAL INFARCTION: CAN EMERGENCY MEDICAL SERVICES MEET RECOMMENDED TREATMENT TIMELINES?

BY

TREVOR DOUBLET

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF

MASTER OF HEALTH STUDIES

FACULTY OF HEALTH DISCIPLINES

ATHABASCA, ALBERTA

MARCH, 2023

Athabasca University
Faculty of Graduate Studies

Approval of Thesis

The undersigned certify that they have read the thesis entitled

ST-ELEVATION MYOCARDIAL INFARCTION: CAN EMERGENCY MEDICAL SERVICES MEET RECOMMENDED TREATMENT TIMELINES?

Submitted by

Trevor Doublet
In partial fulfillment of the requirements for the degree of

Master of Health Studies

The thesis examination committee certifies that the thesis
and the oral examination is approved

Supervisor:
Dr. Shawn Fraser
Athabasca University

Committee Member:
Dr. Jennifer Knopp-Sihota
Athabasca University

External Examiner:
Dr. Alka Patel
University of Calgary

February 9, 2023

Dedication

I dedicate this thesis to the paramedics around the world who continue to provide care and development our profession, ensuring that all patients receive the best possible care regardless of where they may need that care.

Acknowledgement

I want to thank Dr. Shawn Fraser whose support and encouragement saw this study develop from a question to a published thesis. I also want to thank all the other professors and staff at Athabasca University who continue to develop programs that allow individuals to pursue an advanced education in a non-traditional, and often challenging environment.

I also want to thank Dr. Ian Blanchard, Gregory Vogelaar, and all staff members on the Alberta Health Services Emergency Medical Services Research Committee for your assistance with obtaining the required data for this study, and encouraging prehospital research within Alberta and in Canada.

Lastly, I want to thank my wife, Calla. While I started on this path with a different end goal in mind, your unwavering support, encouragement and positivity during this period ensured that I was able to complete this study and publish a thesis that I am proud of.

Abstract

The advanced skill sets and abilities of paramedics and emergency medical services systems are increasingly being recognized as beneficial to the health system. In the case of ST elevation myocardial infarction (STEMI) the recommendation has been made to include prehospital care provided by paramedics. This study evaluated the treatment timelines for both STEMI treatment protocols (i.e., PCI or thrombolytics) administered in a provincial emergency medical service system. Times were compared to the recommended treatment timelines to determine if the current system is meeting the recommendations. Defining success in meeting the recommended timelines is dependent on defining where the first point of medical contact occurs in the prehospital environment. Having this definition is important as EMS can either be successful in over 90% of cases, or they can be successful in less than 75% of the STEMI cases.

Keywords: STEMI, prehospital thrombolytics, Paramedics

Preface

As a paramedic practicing in the rural areas of Alberta I have developed a general interest in cardiology, participating on various committees focused on STEMI care. As the province of Alberta assumed EMS delivery, to develop a provincially administered EMS service, I saw the need and had the desire to create a study that aligned my professional interests with my desire to ensure that rural residents in Alberta have access to timely, efficient, and advanced emergency medical care with an evidence based focus. After all;

> *"We cannot rely solely on rapid transport to definitive care due to the remote regions of our province."*
>
> – Alberta Health Services Emergency Medical Services

Table of Contents

List of Tables

List of Figures

List of Symbols, Nomenclature or Abbreviations

CPR – Cardiopulmonary resuscitation

EMS – Emergency Medical Services

ECG – Electrocardiogram

PCI – Percutaneous coronary intervention

SD – Standard deviation

SEM – Standard error of the mean

STEMI - ST elevation myocardial infarction

Chapter 1: Introduction

Introduction

In 2009, Alberta Health Services assumed responsibility of emergency medical services in the province of Alberta. Although there has been a standardization of such items like uniforms or ambulance design, there remains differing specialized protocols in various regions of the province.

One such protocol that differs based on the where the patient resides is the ST elevation myocardial infarction (STEMI) treatment protocol. This study looks to address the differences in treatments, the research behind pre-hospital STEMI care, and provided evidence for future protocol and policy development.

Background and Statement of the Problem

The Canadian Cardiovascular Society makes recommendations for the treatment of ST segment elevation myocardial infarction (STEMI). Since the first publication of these recommendations, there have been updates, most recently in October of 2019, to continually improve the treatment of this serious type of heart attack. Among the recommendations, the Canadian Cardiovascular Society has set specific targets for the time in which specific treatment should be administered. The recommended timeline from first point of medical contact to reperfusion by primary percutaneous coronary intervention (PCI), formerly known as angioplasty with stent, has recently been increased from 90 to 120 minutes, while cardiac reperfusion using thrombolytic medication remains at 30 minutes (Wong et al., 2019). The Canadian Cardiovascular Society had recognized that the 90 minute timeframe is optimal, however the recommended 120 minute timeline

was selected to align with STEMI care when patient seek medical care through non EMS means. This 120 minute timeline was also selected to maximize the number of rural and remote patients that that can be treated through PCI (Wong et al., 2019) The most recent update also includes a recommended timeline for health care practitioners to obtain a diagnostic electrocardiogram within the first 10 minutes of patient contact.

Beyond the changes and additions to the recommended timelines, the most current update continues with the trend toward integrating prehospital care professionals, or paramedics, and Emergency Medical Services (EMS) systems into the care of the patient diagnosed with a STEMI. Particularly, recommendations are made to improve or decrease the time from diagnosis by paramedics in the field to time the patient receives reperfusion therapy in hospital or before arriving at the hospital. This may include initiatives such as bypassing the closest hospital in favor of a facility capable of advanced cardiac care and bypassing the emergency departments of these hospitals in favor of direct transfer to the catheterization laboratory for primary PCI (Wong et al., 2019).

Alberta residents are fortunate in that the provincially administered EMS system currently has in place protocols for paramedics to follow that specifically address STEMI care, as shown in Appendix A, B, and C. Unfortunately, the care that the patient receives, and the protocol that the paramedic follows is based on the geographic location of the patient at the time of the event. For patients who are in the North, Central, and Edmonton Zones of Alberta Health Services, a program called, the Vital Heart Program, shown in Appendix D (Alberta Health Services, 2020), has paramedics working in conjunction with an on-call physician to determine patient care. This may involve the prehospital administration of a thrombolytic, which is stocked on the responding ambulance. In other

areas of the province, if the patient is within a specific estimated transport time to a tertiary acute care facility capable of preforming primary PCI, they will be rapidly transported to that facility, also under the direction of an on-call physician. In Alberta there are three facilities that can perform primary PCI; Foothills Medical Centre in Calgary; the University of Alberta Hospital in Edmonton; and the Royal Alexandra Hospital in Edmonton. If the patient falls outside of this estimated transport time, the on-call physician may direct the paramedics to transport the patient to a closer rural facility to receive thrombolytic therapy, and then be transported to one of the specialized cardiac facilities to receive specialized cardiac care and primary PCI.

In the time since Alberta Health Services EMS has been using these treatment protocols, the population of Alberta has seen tremendous growth. Additionally, both Edmonton and Calgary have seen significant growth and changes in the geographic size through urban sprawl (Alberta Government, 2019). With the growth in the size of the cities and in the population, there are many new delays that can challenge the health care system and in particular the ability of EMS to reach the recommended target timelines for the treatment of STEMIs. These delays can occur at many points from the time the 911 call is received to the time the reperfusion treatment of choice (i.e., primary PCI or thrombolytic therapy) is administered. With a better understanding of the true measure of time spent by EMS while treating and transporting a STEMI patient, we will then be able to determine if the timelines recommended by the Canadian Cardiovascular Society are being met. In addition, this information will identify areas where paramedics and EMS systems can improve response times or change current practices to ensure the most appropriate patient treatment based on geographic location in the province.

Purpose

The purpose of this study was to evaluate the current timelines in Alberta for the treatment of STEMI patients whose first point of medical contact was prehospital care providers, or paramedics. More specifically, I studied the timelines of paramedics when responding to the patient's address; treating the patient on scene; and transporting the patient to the hospital. This time was compared to the recommended timelines of the Canadian Cardiovascular Society. The research also examined these data to identify factors that influenced the timeline to treatment, such as the geographic location or the time of day.

Research Questions

For Alberta-based patients who are diagnosed with a STEMI and whose first point of medical contact is prehospital EMS care providers:

1. Do the current EMS treatment times meet the recommendations for STEMI care as recommended by the Canadian Cardiovascular Society?
2. What system and patient factors positively and negatively influence the time from the first point of medical contact to treatment?

Definition of Terms

Electrocardiogram – A type of diagnostic test performed in hospital and in pre-hospital environments in which transdermal stickers are placed on the patient's arms, legs, and chest. These stickers measure the electrophysiology of the heart and display the electrical activity of the heart on a printout which can be interpreted to determine if the patient is suffering from a number of different cardiac related illnesses. (Heart and Stroke Foundation of Canada, n.d.)

Primary percutaneous coronary intervention (PCI) – A medical procedure in which a small wire is inserted into the arterial system of the patient. The wire is then advanced through the arterial system to the coronary vessels under the guidance of medical imaging. In conjunction with angiography, the procedure can determine the amount of blockage in the particular vessel and place medical devices, such as stents, to improve blood flow to cardiac tissue. (Heart and Stroke Foundation of Canada, n.d.)

ST segment elevation myocardial infarction (STEMI) – A particular type of heart attack in which a coronary blood vessel becomes 100% occluded. This type of heart attack is unique in that diagnosis can be performed through interpretation of a diagnostic ECG, unlike other forms of myocardial infarction which are diagnosed though analysis of the patient's blood. (Heart and Stroke Foundation of Canada, n.d.)

Thrombolytic – A type of medication that is administered intravenously. The actions of this medication work to dissolve blood clots in the patient's vascular system, and in the case of STEMI patients the goal is to dissolve the blood clot in the coronary blood vessels, thereby re-establishing blood flow to the cardiac muscle tissue. (Heart and Stroke Foundation of Canada, n.d.)

Significance of the Research

In the last decade there has been a trend toward including paramedics in the health care systems, transitioning them away from a role that is solely involved in emergency management (National Highway Traffic Safety Administration, 1996; Ontario Paramedics Association, 2020; Shared Health Inc., 2020). Along with this transition there has been the desire to for medical treatment protocols, used by paramedics, to be

developed utilizing evidence informed practice to ensure that patients receive the best care possible (Health Quality Council of Alberta, 2013).

This research aligns with the Alberta Health Services 2017 to 2020 business plan (2017). In particular, this research meets objective 5 of the business plan, *to improve health outcomes through clinical best practices with a focus on wait times and access*. The use of an evidence-based approach to make recommendations and support evidence-based best practices within EMS also meets objectives 11 of the business plan (Alberta Health Services, 2017). Most notably, research will also aim to improve the effectiveness, efficiency, and performance of Alberta's emergency medical service which aligns with objective 1 of the Alberta Ministry of Health 2019-2023 business plan (Government of Alberta, 2019). It has also been determined that thrombolytic administration can achieve similar flow rates to primary PCI, based on thrombosis in myocardial infarction (TIMI) flow rate (Armstrong et al., 2013; Gerslick et al., 2013). With the evidence of the timeline to treatment for STEMI patients, Alberta Health Services EMS can develop an effective strategy that ensures all patients, regardless of geographic location, receive the most effective treatment for reperfusion of coronary tissue with oxygenated blood. This research also has the ability to affect patient care policies, protocols, and procedures within Alberta, as well as in EMS systems outside of the province. Lastly, the research has the ability to affect patient care outcomes for STEMI patients who initially present to prehospital care providers in Alberta and outside the province.

Summary

The differences in treatment plans for STEMI patients, often based on geography, is still linked to traditional healthcare programs that were in place prior to Alberta Health

Services assuming EMS delivery. STEMI specific pre-hospital research, while previously limited, aligns the with the current business objectives of Alberta Health Services, and with the current trend in emergency medical services to develop evidence based treatment protocols.

Chapter 2: Literature Review

Introduction

Emergency Medical Services is still making the transition into health care from a role traditionally dominated by emergency response and preparedness. As such, specific research into the ST segment elevation myocardial infarction (STEMI) treatments in the pre-hospital environment is extremely limited. Understanding the current research around STEMI treatments, health care delivery models, and specific EMS call intervals will improve our understanding of the challenges faced in the current model.

What is STEMI

ST segment elevation myocardial infarction is a type of heart attack that involves the complete blockage of a coronary blood vessel in the heart. This specific type of heart attack is unique in that an electrocardiogram (ECG) can be used as a diagnostic tool, in which medical practitioners are able to visually see an elevation portion of the ECG which correlates with the heart muscle being damaged. This is different than a non-ST segment elevation myocardial infarction (NSTEMI) in which the ECG will appear normal, however the heart muscle is still experiencing damage due to oxygen deficiency in the cardiac cells. The Public Health Agency of Canada (2017) has found that males are 4 times more likely to experience ischemic heart disease when compared to females, and STEMI patients are a part of the ischemic heart disease population. In 2012 and 2013, 10% of men over the age of 20 years experienced ischemic heart disease, with 2.9% of those patients being diagnosed with acute myocardial infarction. In the same period of time, 6.3% of females 20 years and older were diagnosed with ischemic heart disease

with 1.2% of this subset being diagnosed with an acute myocardial infarction. For both males and females there is a continued increase in the percentage of the population being diagnosed with both ischemic heart disease and acute myocardial infarction (Government of Canada, 2017).

Current Health Services Delivery Model

In Alberta, the majority of health care is provided by Alberta Health Services utilizing a regional based model. Regionalized models of health care delivery offer certain medical procedures at larger, centralized hospitals, in major cities. This health care delivery model offers many benefits including: preventing the duplication of costly medical procedures; improving patient access and equality to certain medical procedures; controlling the costs of the provincial healthcare system; and concentrating the delivery of specific medical procedures into centres of excellence (Lewis & Kouri, 2003; Singh & MacDonald, 2009). There are also drawbacks to the regionalized model of health delivery. The drawbacks include the time delay that can occur as patients in need of specific medical procedures must travel long distances or be placed on a waiting list for procedures in high demand (Singh & MacDonald, 2009).

When it comes to STEMI treatment in the province of Alberta, patients are treated within a similar regionalized model. The definitive treatment for a STEMI is reperfusion of the blocked coronary blood vessel, which can be accomplished in two ways (American Heart Association, 2018). One treatment is to administer a thrombolytic medication that will break down the clot and allow blood to flow through the blocked vessel. Based on the ability of the thrombolytic medication to relieve the symptoms and re-establish blood flow, the patient will then be transported on an urgent or non-urgent basis to specialized

cardiac care centres in the Foothills Medical Centre in Calgary, or at the University of Alberta Hospital or Royal Alexandra Hospital in Edmonton depending on their geographic location. The second treatment is to have the patient undergo primary PCI at one of three regionalized cardiac catheterization laboratories in Alberta; Foothills Medical Centre in Calgary, or at the University of Alberta Hospital or Royal Alexandra Hospital in Edmonton (Patel et al., 2007).

Patel (2007) studied the model of STEMI treatment in Alberta, finding that this method of delivery ensures that approximately 70% of Alberta residents over 20 years of age had access to one of these facilities, and could be transported to the facility in under 90 minutes. This study looked at prehospital treatment in an idealized environment, which often uses EMS target timelines as measures for timeliness. This method of using the idealized environment fails to account for many of the delays that occur from the onset of patient symptoms to mechanical (i.e., PCI) or chemical reperfusion (i.e., thrombolytics). These proposed timelines assume that from the time the 911 call is received to time of ambulance arriving on scene is 8 minutes; an on scene time of 8 to 15 minute; a 30 minute ambulance transport time; and 30 minutes from arrival at the hospital to coronary reperfusion in the catheter laboratory by primary PCI (Studnek et al., 2010; Patel et al., 2010). Any delays in treatment increase the mortality rate of STEMIs.

Primary Percutaneous Coronary Intervention vs. Thrombolytic Therapy

Which treatment for the treatment of STEMI is superior has been studied and reported in many journals. Comparison of the two treatments shows that when patients receive primary PCI they are at a lower risk for re-occlusion of the coronary artery, have a lower risk of adverse effects such as stroke, and a lower rate of mortality (Lettino,

2009). The benefits of primary PCI are reduced when the time from onset of symptoms approaches 120 minutes, and thus the use of a thrombolytic to achieve reperfusion is a comparable treatment option after this time period (Wong et al, 2019, Joy et al, 2016; Armstrong et al, 2004).

First Point of Medical Contact

The first point of medical contact can be defined as, "the first point of entry each time care is needed for a health problem" (Lamire, 2017, p. 256) or, "the first opportunity for health care professionals and the health system to intervene" (Welsh et al., 2009, p. 26). When it comes to the first point of medical contact within EMS systems, there are two differing opinions as to who is considered the first point of medical contact. The first opinion sees the first point of medical contact being the paramedics who respond to the patient' location, as these are the first trained medical professions to start providing medical care (Bata et al, 2009; Welsh et al., 2009; Wong et al., 2019)

The second opinion is that EMS system response begins at the time the 911 call is placed. In addition to speaking with the 911 caller and dispatching an ambulance, the emergency communications officer provides medical care, more commonly known as pre-arrival instructions, while the ambulance is responding. This is also known as a zero-minute response and is one of the positive benefits of the medical priority dispatch system (Clawson & Hauert, 1990; Clawson & Martin, 1996). The Medical Priority Dispatch System is a card set of 33 different patient priority complaints that contain several scripted questions emergency communications officers use for different patient priority complaints. This system was developed to help the emergency communications officer dispatch an ambulance with the appropriate response. The emergency

communications officers, employed by Alberta Health Services, operate under physician directed medical oversight, which allows them to provide medical care and instructions to the 911 caller while the ambulance is responding. In the case of patients who call with a complaint of chest pain, the emergency communications officers will ask a series of follow-up questions, and based on the answers, may recommend that the patient take acetylsalicylic acid (ASA) (e.g., Aspirin) if they have access to it. Based on this ability, the emergency communications officer is part of the emergency medical response (Clawson & Martin, 1996) and the timeline for STEMI care would start at this "zero minute."

Emergency Medical Services Intervals

EMS Response Times

The idealized ambulance response target for serious medical calls is 8 minutes. According to standard 1710 of the National Fire Protection Association (2016), an emergency unit capable of providing advanced life support should arrive at the scene of an emergency call within 480 seconds, or 8 minutes. Further evidence for an 8-minute response was published in 1979 by Eisenberg et al, which provided evidence for improved survival rates from cardiac arrest when CPR was performed within 4 minutes and defibrillation was performed within 8 minutes (Eisenberg et al., 1979). Ambulance services around the world have adopted this 8-minute standard as a goal to measure system performance for a specific subset of the population who make emergency calls. For example, the National Health Service in the United Kingdom has set a goal of ambulance responses to category A calls as under 8 minutes, 75% of the time (United Kingdom House of Commons, 2017). Alberta Health Services has recognized that there

is a disparity between geographically different areas within the province and has thus set different median and 90th percentile response targets for the four groups of geographic areas in the province. For Metro/urban areas, the median response target is 8 minutes and the 90th percentile target is 12 minutes. Communities with a population of greater than 3,000 people have median response target of 10 minutes and 90th percentile of 15 minutes. Rural areas have a 20-minute median response target and 40 minute 90th percentile target. Remote areas have a median response target of 40 minutes and a 90th percentile response target of 75 minutes (Alberta Health Services, 2020). The response time targets for Alberta Health Services start at the time of 911 call received and end when the ambulance arrives on scene. As well these targets are only for the most serious "delta" and "echo" level ambulance response codes. Blanchard et al evaluated (2012) ambulance response times in the City of Calgary and found that 24% of the time ambulance response was greater than 8 minutes for ambulance calls with a delta or echo coding, the most critical coding under the medical priority dispatch system.

Appendix D contains a map which is used to determine which areas in the province are within each of these response areas. This map follows the rural-urban continuum which Alberta Health Services initially developed in 2010 as a means for specific health statistics (Alberta Health Services 2018). The most recent update to this document occurred in 2018. Metro/urban areas consist of the larger cities in Alberta where the population is greater than 500,000 people. AHS EMS also measures response times in individual communities where the population is more than 3,000 people. As such these communities make up their own sample population. Rural and remote areas are generally a combination of towns, villages, hamlets and larger agriculture areas. While

the populations of these areas is less than 10,000 people, the distinction comes in the distance the areas are from large urban centres. Rural areas are within a 200-kilometer range of the large metro centre, while the remote areas are beyond this 200-kilometer range (Alberta Health Services, 2018).

EMS Scene Times

The time that the paramedic crew spends on scene performing treatment and determining the patient's medical needs has not been studied in depth, and Alberta Health Services does not make this information public. In one study, that evaluated Albertan's access to cardiac care facilities, the paramedic scene times were assumed to be 8-9 minutes (Patel et al., 2010). Studnek et al. (2010) have idealized the paramedic scene time to be 15 minutes. Most logically, the paramedic scene time should be as limited as possible, as the time spent on scene performing medical interventions results in a longer time to definitive treatment (Gratton et al., 1991; Studnek et al., 2010).

EMS Transport Times

Transporting the patient from the scene of the emergency to an acute care hospital, capable of performing primary PCI, is often performed with the emergency lights and sirens activated. This method of transport is often considered the most rapid form of transport as the ambulance will often drive above the posted speed limit and has the ability to rapidly move through heavy traffic and progress through traffic control devices. Although, this method of transport may not be any faster than if the ambulance were to drive within the traffic laws as time savings that ambulances can achieve are modest. When considered in the grand scheme of clinical relevance, this method of transport does not result in a clinically significant time savings (Dami et al., 2014; Hunt

et al., 1995; Marques-Baptista, 2010; O'Brien et al., 1999). In some cases, the use of emergency lights and sirens may even result in a longer transport time or may even result in a collision between the ambulance and another vehicle, further delaying transport to definitive care (Clawson et al., 1997; Khan et al., 2001).

The use of airplanes or helicopters to transport patients to the hospital is often utilized in an attempt to decrease transport time. While this method of transport is often faster, there are several logistical challenges that may make the use of ground transport faster. When considering the use of airplane, or fixed-wing aircrafts, there are only a few areas in Alberta where this method of transport will result in a patient arriving at the appropriate destination within the recommended timelines (Patel et al., 2007). The delays for fixed wing aircraft occur because there they are limited in where they can land. Due to this limitation, they also require the use of an ambulance to drive the patient from the scene of the emergency to the aircraft, and then from the landing strip in the urban centre, to the recommended hospital. Helicopters, or rotary-wing aircraft, have the advantage being able to land closer to the scene of the emergency and can also land directly at the destination hospital. In the case of chest pain, or other calls for symptoms related to a STEMI, the helicopter is not automatically dispatched (Moens et al., 2015). The responding ambulance crew would have to make the request once they arrive on scene and confirm the diagnosis. Considering the time required for helicopter dispatch, launch, and flying to scene, ground ambulance may be a faster option of transport for calls occurring close to the destination hospital. For calls that occur further from the treatment hospitals, the use of rotary-wing transport may speed up transport; however, this takes a well-coordinated effort to reduce the delays that may occur (Moens et al., 2015). There

are other factors that can prevent both fixed wing and rotary wing aircrafts from flying. These factors most notably include weather conditions. In Alberta, there is also limited quantity of resources that are available as Alberta Health Services only operates 11 fixed-wing aircraft and contracts 5 rotary wing aircrafts. (Alberta Ministry of Health, 2020).

Hospital Treatment Delays

Studies have found an average time of 30 minutes from arrival at the hospital to reperfusion with primary PCI (Danchin et al., 2014; Studnek et al., 2010; Terkelsen et al., 2008), which is consistent with the 30-30-30 rule. The 30-30-30 rule assigns 30 minutes to prehospital EMS, 30 minutes to the emergency department, and 30 minutes to the catheterization laboratory (Welsh et al., 2009). While these studies and recommendations are idealized, once the patient arrives at the hospital, there may be certain delays that add time to when the patient can receive definitive care by primary percutaneous coronary intervention. In a busy regionalized hospital, heavy demand for the catheterization laboratory may result in the arriving patient having to wait for another patient's procedure to be finished (Danchin et al., 2014). If the patient arrives after hours, the staff for the laboratory may have to be called in, which due to logistical challenges, may have the patient arriving at the hospital before the cardiac team, leading to further treatment delays (Foo et al, 2019). In the model utilized in Alberta, paramedics can activate the catheterization team with early notification to the receiving hospital. When early notification was used Welsh et al. (2009) found that early notification resulted in an approximate time savings of 15 minutes from arrival at the hospital to coronary reperfusion. Alberta Health Services does not specifically report the time from patient arrival at the hospital to the time of reperfusion by primary PCI. However, in a recent

study by Foo et al (2019), the median “door to balloon” time for STEMI patients undergoing primary PCI was 88:30 minutes with 38% of patients in the study having a door to balloon time greater than 90 minutes. In this study, longer treatment times led to a higher risk of adverse patient outcomes.

Summary

The current research into health care delivery models, EMS event intervals, and STEMI treatments have provided the foundation on which EMS STEMI treatment protocols have been developed. A study specifically directed to evaluate the current delivery model will add to the existing body of knowledge, and also provide evidence from a provincially administered EMS system on which to develop future treatment strategies.

Chapter 3: Methods

Introduction

To answer the research questions, a retrospective study on EMS patient care reports, in a provincially administered EMS system was undertaken. Additionally, ethics approvals were sought, and the study was designed in accordance with the Health Information Act of Alberta.

Setting

Alberta Health Services is responsible for ambulance delivery within the province of Alberta (Alberta Ministry of Health, 2020). In Alberta there are approximately 550 ground ambulances, 278 of which are operated by Alberta Health Services EMS (Alberta Health Services, 2020) with ambulance contract providers operating the remaining 272 ground ambulances. Alberta Health Services operates an additional 11 fixed-wing ambulances stationed throughout the province, and contracts 5 rotary-wing aircraft (Alberta Ministry of Health, 2020). Regardless of their location in the province, all paramedics working on ground ambulances, and those working on fixed-wing aircraft provide medical treatments as directed by a group of physicians who provide medical oversight (Alberta Health Services, 2020).

Alberta Health Services operates 106 acute care facilities through the province. Of these 106 facilities, only three hospitals are equipped to perform primary PCI. These hospitals are the University of Alberta Hospital and Royal Alexandra Hospital, both of which are in Edmonton and the Foothills Medical Center, located in Calgary (Alberta Health Services, 2020).

Research Design

This was a retrospective administrative data base study evaluating STEMI treatment timelines from January 1, 2016 to December 31, 2018. We included all male and female Alberta-based patients 18 years of age and older, who had been diagnosed with a STEMI and met the current Alberta Health Services EMS treatment criteria as outlined in Appendices A, B and C. Additionally those included in the study had pre-hospital care providers as the first point of medical contact, and did not receive either primary PCI or thrombolytic therapy prior to EMS care. We excluded all patients under the age of 18 years, and any interfacility transfer patients who had already been assessed or received treatment at a small rural centre and were being transferred to a cardiac care unit in another hospital. Patients whose first point of medical contact was pre-hospital care providers, and had been diagnosed as a STEMI, but did not meet the criteria for treatment under the current Alberta Health Services EMS STEMI treatment protocols, as outlined in the EMS patient treatment protocols in Appendices A, B, and C, were also excluded from the study.

Measures

We grouped the sample population by age, sex, and geographic location. The independent variable was the treatment received; either thrombolytic administration by the attending pre-hospital care provider or rapid transport to a facility capable of performing primary PCI. Dependent variables were the time measured from first point of medical contact, time of 911 call received or arrival on scene of the paramedic crew, to treatment received, and the patient's time from first point of medical contact to discharge. This study evaluated the first point of medical contact to occur when the 911 call was

received and also when the paramedic crew arrived on scene, comparing the success rates of each point on contact.

To determine system factors that influenced treatment timelines and patient outcome, call response timelines were measured, along with ambulance response and transport distances, and patient's geographic location. The call response timelines that were measured in this study were the times allocated to; EMS dispatch and response; EMS on scene time; EMS transport time; and EMS arrival to time of reperfusion in hospital. In the case of patients who received thrombolytic medication by paramedics, the measures of time included; EMS dispatch and response; EMS on scene time; EMS transport time; and time from EMS dispatch to EMS medication administration.

Data Source

Patient demographic data, ambulance call response times, and patient treatment times are all contained on the patient care report, which is completed by the paramedic during the call. The patient care report utilized by Alberta Health Services EMS is an electronic patient care report called Siren and developed by Medusa Medical Technologies (Halifax, Nova Scotia, Canada). Data from these patient care reports were compiled by Alberta Health Services EMS. Additionally, patient's healthcare number, if available and documented in the EMS care report was cross-linked with data from the National Ambulatory Care Reporting System (NACRS) as well as the Discharge Abstract Database (DAD).

Data Analysis

Raw data were reviewed case by case to determine if study inclusion criteria were met. Each case was also reviewed with the supplied post-linkage data to determine if the

patient was diagnosed with a STEMI. Of the 1,413 cases supplied by Alberta Health Services, 277 cases were removed, as they did not meet the inclusion criteria for the study, as they were not STEMI related EMS events. The remaining cases were further reviewed, and an additional 37 cases were removed as the data supplied contained errors in their provided times which were due to the EMS practitioner input. The remaining 1,099 cases were included and underwent analysis to answer the study questions.

Participants were grouped depending on the treatment they received and data analysis was completed using parametric and nonparametric testing. This testing was completed using the statistical IBM SPSS 26 software for Mac OS (Markham, Ontario, Canada.). Statistical analysis was conducted to determine the mean time and 95% confidence interval for the ambulance response time, on scene time, and transport time. Further, the mean time and 95% confidence intervals were determined for the time to obtain an electrocardiogram and administer thrombolytic medication. Timelines based on geography and time of day were also analyzed and a further analysis of variance (ANOVA) was used to test for differences between the groups. Mean emergency department wait times, and mean length of time to patient admission was found and through analysis of variance, differences between the three facilities was determined.

Ethical Considerations

Alberta Health Services is currently the custodian for health information and data within the province of Alberta. As the custodian of this information, data were disclosed under the Health Information Act, ensuring compliance with the principles of the highest degree of anonymity; least amount of information; and the need to know (Health Information Act of Alberta, 2020).

Ethical approval for this research was obtained from the Research Ethics Board at Athabasca University and from the Health Research Ethics Board of Alberta, at the University of Alberta, as found in Appendix E. This study was also approved by the Alberta Health Services EMS Research Committee.

Highest Degree of Anonymity

The study plans utilized data that had been completed and stored as part of the patient care report. Information such as patient's names, date of birth, address and pertinent health care information is contained within this document. Information that could have been used to identify the patient was removed from the data file provided by Alberta Health Services EMS, and from the file created for data analysis. Electronic data from the provided sample were kept in an encrypted file on a password protected computer. Alberta Health Services EMS supplied no physical data, and no physical data were created. Electronic data will be disposed of in accordance with Athabasca University and Alberta Health Services policies, once no longer required.

Least Amount of Information

For all included patients we created a data set, which included the patient’s age, geographic location from postal codes, transport destination, which hospital they were transported to, and the timelines of the ambulance call. Data files supplied by Alberta Health Services EMS did not include identifying information, and no other information outside of the requested data was provided to the researchers.

Need to Know

In accordance with the Health Information Act and as the custodian of the health record, there exists no requirement to disclose to the patient the nature of the study, or a need to obtain consent in order to access the health record. With that being said, no personally identifying information is contained within the dataset that was used for analysis.

Summary

Utilizing a retrospective design allowed for consideration of the ethical and legal constraints on this study. Data were obtained with permission of the Athabasca University Research Ethics Board and Alberta Health Services as noted above in an effort to answer the research questions.

Chapter 4: Results/Findings

Introduction

Utilising the research methods described in Chapter 3, data were analyzed to evaluate EMS call time intervals. These data also allowed for analysis of the hospital facilities, the geographic areas, the distance travelled by the ambulances, and the time of day when the cases where occurring.

Description of the Sample

Of the 1,099 cases reviewed, 760 cases had rapid transport for primary PCI, 295 cases received paramedic administered thrombolytics in the field, 36 cases were treated through the rural STEMI pathway, and an additional 8 cases were classified in the "other" category. The mean age of the complete sample was 64 years (SD=12.85 years) with 769 cases (70%) being male and 330 cases (30%) were female patients.

Table 1

Description of the Sample

	Total Province	Communities			
		Metro/Urban n (%)	> 3,000 n (%)	Rural n (%)	Remote n (%)
Total Cases	1,099	841 (76.5)	82 (7.5)	165 (15.0)	11 (1.0)
Demographics					
Male	769 (70.0)	588 (76.5)	52 (6.8)	122 (15.9)	7 (0.9)
Female	330 (30.0)	253 (76.7)	30 (9.1)	43 (13.0)	4 (1.2)
Mean Age years (SD)	64.17 (12.85)	64.05	66.96	63.61	60.73
Treatment					
PCI	760 (69.2)	662 (87.1)	34 (4.5)	62 (8.2)	2 (>0.0)
Thrombolytic	295 (26.8)	169 (57.3)	35 (11.9)	83 (28.1)	8 (2.7)
Rural Pathway	36 (3.3)	10 (27.7)	13 (36.1)	20 (55.6)	1 (2.8)
Transport Destination					
University of Alberta Hospital	320 (29.1)	254 (79.4)	18 (5.6)	48 (15.0)	0
Royal Alexandra Hospital	363 (33.0)	293 (80.7)	19 (5.2)	51 (14.0)	0
Foothills Medical Centre	286 (26.0)	249 (87.1)	16 (5.6)	21 (7.3)	0
Other – Urban	51 (4.6)	33 (64.7)	8 (15.7)	6 (11.8)	4 (7.8)
Other - Rural	50 (4.5)	3 (6.0)	19 (38.0)	25 (50.0)	3 (6.0)
Rendezvous with Air	13 (1.2)	2 (15.4)	1 (7.7)	9 (69.2)	1 (7.7)
Time of Day					
0700-1900	671 (61.1)	512 (76.3)	50 (7.5)	104 (15.4)	5 (0.7)
1900-0700	428 (38.9)	329 (76.9)	32 (7.4)	61 (14.3)	6 (1.5)

Sex Based Analysis

The current gender make of the Alberta Health Services EMS workforce is currently 47% female practitioners (Cook, 2021). Female patients commonly report symptoms of heart attacks differently than male patients, who generally report the feeling of chest pain or pressure. As such, the researcher sought to determine if the difference in

symptom reporting had a significant effect on the mean ambulance call interval times, or if there was a significant difference in the mean call time intervals that could be attributed to other factors, such as an unconscious bias by male practitioners, which could be determined with further research. The results of the data analysis based on the patient gender are reported in Table 4.2.

Table 2

Mean Ambulance Interval Times Based on Sex

Variable	Male			Female			Total		
	Mean	n	Standard Deviation	Mean	n	Standard Deviation	Mean	n	Standard Deviation
Response Time	12:23	766	7:35	12:08	330	7:03	12:18	1096	7:26
On Scene Time	25:25	753	9:59	28:58	327	10:40	26:30	1080	10:19
Transport Time	22:38	747	22:25	21:39	321	22:23	22:20	1068	22:24
Dispatch to Thrombolytic	44:14	204	16:28	43:34	83	14:44	44:02	287	15:58
Unit Arrive to Thrombolytic	29:25	198	11:27	31:05	82	12:30	29:54	280	11:46

Note. All times reported in minutes:seconds

To test the appropriateness of conducting an ANOVA to examine gender differences, a check of homogeneity of variances was conducted. The test of homogeneity of variances using Lavene's statistic determined that there was not a statistically significant difference between the two gender samples for response time: $F(1,1094)=0.26$, $p=0.61$; On Scene Time $F(1, 1078)=2.42$, $p=0.12$; and Transport Time $F(1, 1066)=0.26$, $p=0.61$. Further when patients were treated with a prehospital thrombolytic, there was again no statistically significant differences between the two groups' variances regardless of when the time measurement started [Dispatch to

thrombolytic F(1,285)=0.68, p=0.41; Unit arrive to thrombolytic F(1, 278)=0.96, p=0.33]. Thus, conducting an ANOVA was deemed appropriate.

There were statistically significant differences in the mean on scene times between males and females, F(1,1078)=27.55, p<0.001. This amounts to a two minute and thirty-four second faster on scene response time for males than females. Previous research however has shown that the difference in the scene time between sex carries no clinical significance, as the interventions that would be performed at the hospital could not be performed within the time difference (Dami et al 2014; Hunt et al 1995; Marques-Baptista et al 2010; O'Brien et al 1999). There was no statically significant difference between the groups when comparing the response time, F(1,1094)=0.28, p=0.60, or the transport time, F(1,1066)=0.43, p=0.51. Analysis of the electrocardiogram data found no statistically significant differences between the groups if the time to ECG was measured from the time the 911 call was received F(1, 949)=1.91, p=0.17 or if the time was measured from when the ambulance arrived at the patient F(1,934)=3.04, p=0.8. Analysis to the time for paramedics to administer thrombolytics also found a not significant difference if the time was measured from when the 911 call was received F(1,285)=0.10, p=0.75 or from when the ambulance arrive F(1,278)=1.16, p=0.28.

Treatments

Primary Percutaneous Coronary Intervention (PCI)

The primary PCI group had 760 cases with a mean age of 65 years (SD=13.13 years). Of these, 533 (70.1 %) were male and 227 (29.9%) were female. For EMS calls where patients were treated with primary PCI, the mean times for the ambulance calls are reported in Table 4.3.

Table 3

Average Ambulance Interval Times for Primary Percutaneous Coronary Intervention

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Response Time	11:22	759	5:45	0:12	10:58	11:47
On Scene Time	24:30	750	9:01	0:19	23:52	25:19
Transport Time	18:47	744	14:40	0:32	17:43	19:50

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

When these patients were transported to the receiving emergency department, they spent a mean time of 124.36 minutes (n=652 SD=164.60) before being discharged from the emergency department for further treatment and admission to other departments in the facility. Following treatment, PCI patients had a mean admission time of 5.13 days (n=556 SD=7.53).

The mean response distance for these patients was 6.40 KM (n=759 SD=7.40). The subsequent mean transport distance to the receiving facility was 20.29 KM (n=749 SD=24.78).

With a first point of medical contact to device inflation of recommendation of 90 minutes, and assuming the receiving facility is able to have the device inflated within the recommended door to device inflation timeline of 30 minutes, EMS has 60 minutes to arrive at the receiving facility. EMS was successful in 531 (71.5%) of the 760 cases, with 212 cases (28.4%) outside the first point of medical contact to arrival at the receiving facility of 60 minutes. If we remove time from when the 911 call was received to unit arrival, the success rate for EMS increases to 88.4% (n=658) with an 11.4% (n=85) failure rate. Under the 2019 recommendations which gives EMS an additional 30 minutes

to arrive at the hospital, while still maintaining the 30 minute window for the receiving facility's recommended door to device inflation time, the success rate for EMS is 93.7% (n=713) with a failure rate of 3.4% (n=26). If the period from 911 call received to arrive on scene were removed, an additional 8 cases would meet the time to be considered successful under the new recommendations. With regard to the recommendation to have a diagnostic electrocardiogram completed within 10 minutes from the first point of medical contact, EMS was successful in 55 cases (8.3%) and was unable to meet this recommendation in 611 cases (91.7%). If, however, the response time is removed, the success rate rises to 87.2% (n=574).

Thrombolytics

Paramedics administered thrombolytics in the field to 295 cases; 206 (70.8%) were male and 86 (29.2%) females with a mean age of 61years (SD=11.81 years). The mean response time, on scene time and transport time, with standard deviation, standard error of the mean, and 95% confidence interval are reported in Table 4.4. Table 4.4 also contains data for the electrocardiogram recommended timeline, as well as data relating to the timeline recommendation for pre-hospital administration of thrombolytics.

Table 4

Average Ambulance Interval Times for Prehospital Administered Thrombolytics

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Response Time	14:04	293	9:54	0:34	12:56	15:12
On Scene Time	32:18	286	11:28	0:40	30:58	33:38
Transport Time	31:38	282	31:52	1:53	27:54	35:22
911 Call Received to Thrombolytic Administration	44:02	287	15:58	0:56	42:11	45:53
Unit Arrive to Thrombolytic Administration	29:54	280	11:46	0:42	28:31	31:17

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

After hospital arrival, patients who received thrombolytics in the field spent a mean time of 157.19 minutes in the emergency department (n=206 SD=141.38). It should also be noted that multiple patients in this group bypassed the receiving emergency department and paramedics transported the patient directly to the coronary care unit. After admission patients in this sample spent a mean 4.47 days (n=187 SD=5.37) in the hospital before discharge.

The mean response distance for the ambulance was 10.83 KM (n=295 SD=15.25), and the mean transport distance was 46.77 KM (n=278 SD=56.67).

The success rate for paramedic administered thrombolytics, according to the Canadian Cardiovascular Society, is 30 minutes from first point of medical contact. For the sample in this study, EMS was able to meet this recommendation 31 times or 10.8% of the time and was unable to meet the recommended timeline in 257 cases (87.1%). Removing the response time from the calculation, EMS was able to meet the

recommended timeline in 184 cases (62.4%) and was unable to meet the recommendation in 99 cases (33.6%). The success of EMS to obtain an ECG in the recommendation of 10 minutes from the first point of medical contact was 6.1% (n=15) with a failure rate of 93.9% (n=232). Again, if the response time is removed, EMS was successfully able to obtain an ECG in 10 minutes 89.2% (n=214) of the time and was unable to meet this recommendation in 8.8% (n=26) of the cases.

Rural Pathway

The third route of treating STEMI patients under the Alberta Health Services EMS protocols is to transport the patient to a rural facility, where the hospital will consult with a cardiac specialist, possibly administer thrombolytics and/or transport the patient to a facility capable of performing PCI. In this study EMS followed this pathway in 36 cases. Twenty-three (63.9%) of these patients were males and the remaining 13 (36.1%) were females with a mean age of 64.81 years (SD=11.53). The ambulance call intervals, are reported in Table 4.5.

Table 5

Average Ambulance Interval Times for Rural Treatment Pathway

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Response Time	17:57	35	10:53	1:50	14:13	21:41
On Scene Time	23:13	35	8:32	1:26	20:17	26:09
Transport Time	26:27	33	40:50	7:06	11:58	40:55

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

When following this pathway, the ambulance had a mean response distance of 18.00 KM (n=36 SD=23.38) and a mean transport distance of 37.34 KM (n=35 SD=37.34).

The mean time that the patient spent in the emergency department was 122.46 minutes (SD=95.04 SEM= 17.96) and the mean days that the patient spent admitted in the hospital was 11.50 days (SD=10.61 SEM=7.50)

Electrocardiogram

In the treatment of STEMI patients, it is recommended that healthcare professional obtain a diagnostic ECG within the first 10 minutes of making contact with that patient. For patient treated by paramedics in this study, the time to obtain an ECG is reported in Table 4.6.

Table 6

Mean Time to Obtain an Electrocardiogram Based on Treatment Pathway

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Primary Percutaneous Coronary Intervention						
911 Call Received to Electrocardiogram	17:12	664	6:54	0:16	16:40	17:43
Unit arrive to Electrocardiogram	5:21	657	4:13	0:09	5:32	6:10
Paramedic Administered Thrombolytics						
911 Call Received to Electrocardiogram	19:27	248	10:31	0:40	18:09	20:46
Unit arrive to Electrocardiogram	6:28	241	5:50	0:22	5:44	7:12

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

Table 4.6 reports the ECG time from when the paramedic crew arrives at the patient side, and when the 911 call is placed. As there is no standard definition when the first point of medical contact occurs within the prehospital environment, the study further determined how response times affected the mean time to obtain an ECG, and the success rate of obtaining an ECG within the recommended timeline. If we were to begin measuring the time from when the paramedics arrived at the patient side, the study found a success rate of 87% to obtain an ECG in under 10 minutes. With response times included in the time measurement, these success rates decreased to 9%.

Further analysis of ECG time based on the patient gender was also analyzed and reported in Table 4.7.

Table 7

Mean Time to Obtain an Electrocardiogram Based on Sex

Variable	Male			Female			Total		
	Mean	N	Standard Deviation	Mean	N	Standard Deviation	Mean	N	Standard Deviation
Dispatch to ECG Unit	17:49	666	8:17	18:39	285	8:57	18:04	951	8:30
Arrive to ECG	5:53	655	4:43	6:29	281	453	6:04	936	4:46

Note. All times reported in minutes:seconds

To test the appropriateness of conducting an ANOVA to examine gender differences, a check of homogeneity of variances was conducted using Lavene's statistic. There was no statistical difference in variances between the genders in regard to the time for an ECG to be obtained when the crew arrives at the patient side $F(1, 934)= 0.20$, $p=0.65$, or if this time is measured from when the 911 call is placed $(1, 949)=1.61$,

p=0.21.A one-way ANOVA found no statistically significant gender differences for dispatch times, F(1,949) = 1.908, p=0.17, or unit arrival times F(1,934) = 3.04, p=0.08.

Receiving Hospitals

University of Alberta

In those patients transferred to the University of Alberta Hospital, 173 (22.7%) received PCI and 147 (49.8%) of the cases received paramedic administered thrombolytics. The mean time that patients spent in the emergency department was 164.21 minutes (n=295 SD 163.73). The mean admission time for the patients in the University of Alberta Hospital was 5.12 days (n=189 SD=8.47).

Royal Alexandra

The Royal Alexandra Hospital received 281 (36.9%) of the PCI cases and 81 (27.5%) of the prehospital thrombolytic cases. The mean time in the emergency department was 121.54 minutes (n=263 SD=118.78) and the mean time patients were admitted in the hospital was 4.60 days (n=302 SD=6.23).

Foothills Medical Centre

Foothills Medical Centre received a total of 286 (37.6%) cases. As the current prehospital thrombolytic program does not operate in southern Alberta, no cases where paramedics administered thrombolytics were transported to Foothills Medical Centre. Patients spent a mean time of 108.63 minutes (n=260 SD=195.79) in the emergency department. The patient spent a mean time of 5.24 days (n=251 SD=6.79) admitted in the facility.

Comparison of Facilities

Table 8

Post hoc Analysis Based on Destination Facility

		n	Mean (SD)
Time (minutes) in the Emergency Department	University of Alberta	285	164.2[a] (163.7)
	Royal Alexandra Hospital	263	121.5 (118.8)
	Foothills Medical Centre	260	108.6[a] (195.8)
	Other Site - Metro	40	207.4 (373.4)
	Other Site - Rural	43	125.4 (86.7)
Days in Hospital	University of Alberta	189	5.1 (8.5)
	Royal Alexandra Hospital	302	4.6 (6.2)
	Foothills Medical Centre	251	5.2 (6.8)
	Other Site - Metro	5	4.8 (7.4)
	Other Site - Rural	2	11.5 (10.6)

Note. Location means with the same superscript are significantly different ($p < 0.05$)

Conducting a comparison of means from one-way ANOVA of the facilities, it was found that there is no significant difference between the time patients remained admitted in the facility $F(4, 744) = 0.74$, $p = 0.56$, $\eta^2 = 0.01$. Post hoc comparison using the Tukey HSD test found a significant difference in the amount of time the patient spends in the emergency department when comparing the University of Alberta Hospital, with

Foothills Medical Centre (M=55.58 SD=14.97 $p<0.01$, $\eta^2=0.03$). There were no significant difference between the Royal Alexandra Hospital and the other two facilities.

Geographic

A comparison of the geographic regions where EMS responded to the STEMI patients was conducted to determine if the geographic region plays a factor in the prehospital treatment of STEMI patients.

Metro/Urban

The majority of the STEMI cases in the sample occurred in a metro/urban environment (n=841). Of these cases 662 (78%) followed the PCI pathway and 169 (20.1%) followed the prehospital thrombolytic pathway. The remaining 10 (1.2%) cases were either transported to a wrong facility within Calgary or Edmonton, or they were treated in large centres in one of the other major cities in Alberta. Most notably these included the cities of Grande Prairie, Red Deer, Fort McMurray, Medicine Hat and Lethbridge. The mean response distance for events in the metro/urban environment was 5.12 KM (n=840 SD=3.83) and the mean transport distance was 15.69 KM (n=832 SD=18.95).

Table 4.9 shows the mean response time, on scene time, and transport time for STEMI cases that occurred in a metro/urban environment.

Table 9

Average Ambulance Interval Times for Events in a Metro/Urban Environment

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Response Time	10:37	840	4:50	0:10	10:17	10:56
On Scene Time	24:14	834	9:03	0:18	24:37	25:51
Transport Time	16:07	827	10:58	0:22	15:22	16:52

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

If the patient was treated with prehospital thrombolytics, the mean time from 911 call received to medication administration was 37 minutes and 52 seconds (n=162 SD=10:21). Removing the response time, the mean time of medication administration from the arrival of EMS at patient side was 16 minutes and 7 seconds (n=162 SD=10:58).

Communities Over 3,000 People

Eighty-two of the STEMI cases occurred in communities outside of the metro/urban area, with a population greater than 3000 people. 34 (41.5%) of these patients were transported to a facility capable of performing primary percutaneous coronary intervention. Thirty-five (42.7%) of the patients were treated with prehospital thrombolytics, and the remaining 13 (15.9%) of the patients were treated along the rural pathway. In these communities the mean response distance was 5.06 KM (n=82 SD=7.02) and the mean transport distance was 61.08 KM (n=80 SD=65.95).

Table 4.10 shows the mean ambulance call intervals for these cases.

Table 10

Average Ambulance Interval Times for Patients in Communities With a Population >3,000

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Response Time	12:25	80	5:46	0:38	11:08	13:42
On Scene Time	32:58	78	13:12	1:29	29:59	35:57
Transport Time	42:05	79	42:53	4:49	32:28	51:41

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

If the treatment followed the prehospital thrombolytic pathway, the mean time from 911 call received to administration of medication was 46 minutes and 45 seconds (n=35 SD=13:02). Removing the response time portion of the case, the mean time for thrombolytic administration was 34 minutes and 51 seconds (n=33 SD=11:47).

Rural

In the rural areas of Alberta there were 165 STEMI cases. Sixty-two (37.6%) of these cases were treated with rapid transport for PCI; 83 (50.3%) of the cases were treated with prehospital thrombolytics; and 20 (12.1%) of the cases were treated with the rural protocol. The mean response distance for rural cases was 22.30 KM (n=165 SD=18.70) and the mean transport distance was 72.54 KM (n=151 SD=50.75)

The mean interval times for these cases are presented in Table 4.11.

Table 11

Average Ambulance Interval Times for Patients in a Rural Environment

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Response Time	20:24	165	11:55	0:55	18:34	22:14
On Scene Time	29:51	160	12:35	0:59	27:53	31:49
Transport Time	44:16	154	28:43	2:18	39:41	48:50

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

When treating these patients with prehospital thrombolytic the mean time including the response time was 53 minutes and 58 seconds (n=82 SD=20:09). The mean time from EMS arrival at the patient to the administration of the thrombolytic medication was 32 minutes and 48 seconds (n=79 SD=14:24).

Remote

Within the sample 11 cases occurred in the remote areas of the province. Two (18.2%) of these cases were transported for PCI; 8 (72.7%) of the cases were treated with prehospital thrombolytics and 1 case was treated along the rural pathway. The mean response distance in the remote areas was 32.18 KM (n=11 SD=39.43). The mean transport distance was 91.71 KM (n=7 SD=84.59).

The ambulance response, on scene, and transport intervals are reported in Table 4.12.

Table 12

Average Ambulance Interval Times for Patients in a Remote Environment

Variable					95 % Confidence Interval	
	Mean	n	SD*	SEM**	Lower Bound	Upper Bound
Response Time	19:46	11	10:25	3:08	12:45	26:46
On Scene Time	27:23	8	27:23	5:34	14:11	40:34
Transport Time	48:41	8	48:41	20:35	***	97:23

Note. All times reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

The mean time administration of thrombolytic medication was 55 minutes and 10 seconds (n=8 SD=14:47). The time for thrombolytic medication administration with the response time removed was 25 minutes and 32 seconds (n=7 SD=4:15).

Comparison of Geographic Areas

Table 13

Post hoc Analysis Based on Geographic Area

		n	Mean (SD)
Response Time	Metro/Urban	840	10:37[a] (4:50)
	>3000	80	12:25[b] (5:46)
	Rural	165	20:24[ab] (11:55)
	Remote	11	19:46[ab] (10:25)
On Scene Time	Metro/Urban	834	25:14[c] (9:03)
	>3000	78	32:58 (13:12)
	Rural	160	29:51[c]

(12:35)

Table 13 (continued)

	Remote	8	27:23 (15:46)
Transport Time	Metro/Urban	827	16:07[d] (10:58)
	>3000	79	42:05[d] (42:53)
	Rural	154	44:16[d] (28:43)
	Remote	8	48:41[d] (58:15)
Dispatch to Thrombolytic	Metro/Urban	162	37:52[e] (10:21)
	>3000	35	46:45[e] (13:02)
	Rural	82	53:58[e] (20:09)
	Remote	8	55:10[e] (14:47)
Unit Arrive to Thrombolytic	Metro/Urban	161	27:39[f] (9:51)
	>3000	33	34:51[f] (11:47)
	Rural	79	32:48[f] (14:24)
	Remote	7	25:32 (4:15)

Note. Location means with the same superscript are significantly different ($p < .05$)

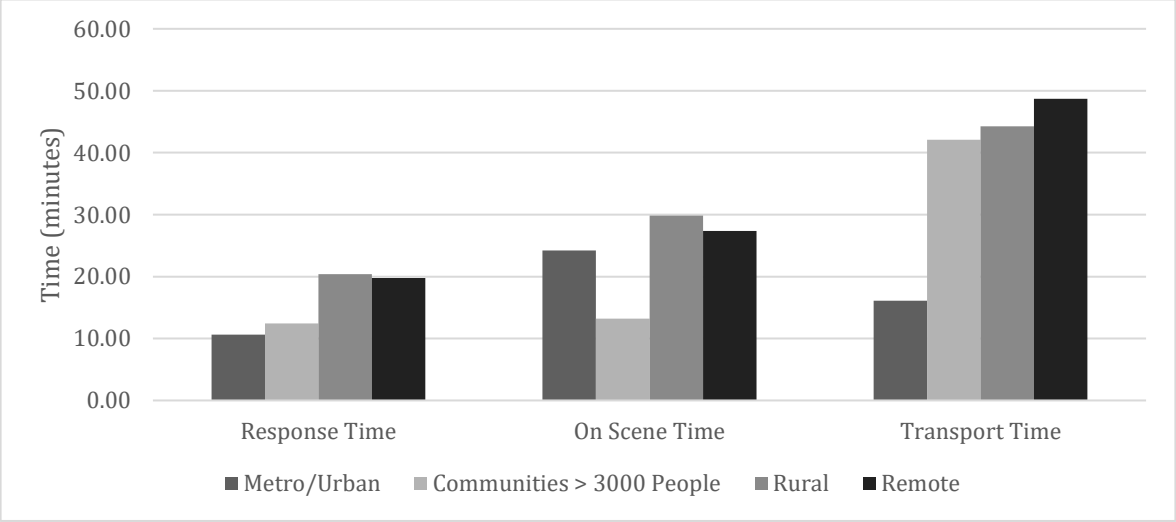
One way ANOVA was conducted based on the geographic areas to compare the mean times for the response $F (3, 1092) = 107.97$, $p<0.01$, on scene time $F (3, 1076) = 21.13$, $p<0.01$) and transport time $F (3, 1064) = 128.43$, $p<0.01$. One-way ANOVA for

dispatch to thrombolytic administration F (3, 1094) = 195.62, p<0.01 and unit arrive to thrombolytic F (3, 1066) = 179.61, p<0.01 based on geography was also conducted.

Further post hoc testing using Tukey HSD was completed based on these reported statistically significant differences. Significant differences were between the response times of metro/urban areas (M=10:38) and the rural (M=20:24) (p<0.01, η^2=0.23) and the remote (M=19:46) (p<0.01, η^2=0.23) areas of the province. There were significant differences in the response times between communities with greater than 3,000 people (M=12:25) and the rural (M=20:25) (p<0.01, η^2=0.23) and remote (M=19:46) (p<0.01, η^2=0.23) areas. Statistically significant differences in the on scene times were found when comparing the metro/urban areas with the communities >3,000 people (M=32:58) and the rural (M=29:51) (p<0.01, η^2=0.06) areas. Metro/urban areas had a statistically significant different transport time when compared to the communities with >3,000 people (M=42:05) the rural areas (M=44:16) (p<0.01, η^2=0.24) and the remote areas (M=48:41) (p<0.01, η^2=0.24).

Figure 1

Histogram Comparing Mean Ambulance Call Intervals



Post hoc analysis using Tukey HSD was used to compare the thrombolytic administration timelines based on geography. The mean time from 911 call received to the thrombolytic administration was statistically significantly different between the metro/urban group (M=37:52) and the communities with >3000 group (M=46:45) ($p<0.01$, $\eta^2=0.22$), the rural group (M=53:58) ($p<0.01$, $\eta^2=0.22$) and the remote group (M=55:10) ($p<0.01$, $\eta^2=0.22$). From unit arrived to administration of thrombolytic, a statistically significant difference was observed between the metro/urban group (M=27:39) and the communities with >3000 group (M=34:51) ($p<0.01$, $\eta^2=0.07$) and the metro group (M=27:39) and the rural group (M=32:48) ($p<0.01$, $\eta^2=0.07$).

Table 14

Post hoc Analysis of Ambulance Distances

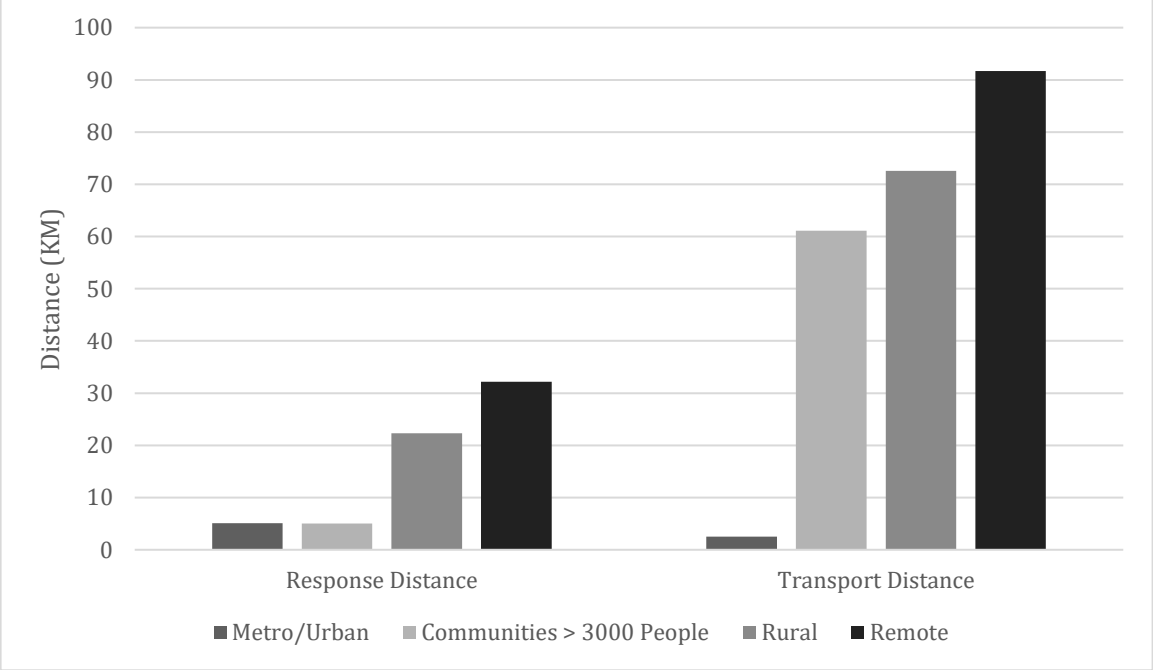
		n	Mean (SD)
Response Distance	Metro/Urban	840	5.12[a] (3.83)
	>3000	82	5.06[b] (7.02)
	Rural	165	22.30[abc] (18.70)
	Remote	11	32.18[abc] (39.43)
Transport Distance	Metro/Urban	832	15.69[d] (18.95)
	>3000	80	61.08[de] (65.95)
	Rural	151	72.54[de] (50.75)
	Remote	7	91.71[d] (84.59)

Note. Location means with the same superscript are significantly different ($p < .05$)

Post hoc analysis using Tukey HSD of the mean response distance found statistically significant differences between the metro/urban group (M=5.12) and the rural (M=22.30) ($p<0.01$, $\eta^2=0.35$) and remote (M=32.18) ($p<0.01$, $\eta^2=0.35$) groups. Statistically significant differences were also observed between the communities with >3,000 (M=5.06) response distance and the rural (M=22.30) ($p<0.01$, $\eta^1=0.35$) and remote (M=32.18) ($p<0.01$, $\eta^2=0.35$) response distances, as well as the rural (M-22.30) and remote (M=31.18) ($p<0.01$, $\eta^2=0.35$) response distances. Comparing the mean transport distances, the metro/urban group (M=15.69) showed statistically significant difference between the communities with >3,000 people (M=61.08) ($p<0.01$, $\eta^2=0.34$), rural (M=72.54) ($p<0.01$, $\eta^2=0.34$) and remote (M=91.71) ($p<0.01$, $\eta^2=0.34$) areas. There was also a significant difference between the communities with >3000 people (M=61.08) and the rural area (M=72.54) ($p<0.05$, $\eta^2=0.34$).

Figure 2

Histogram Comparing Response and Transport Distances



Time of Day

The differences in ambulance staffing levels and crew complements changes based on the geography of the ambulance and the time of day. The time of day was analyzed and compared to determine if there was a difference between the frequency of calls and if the time of days has an effect on the call time benchmarks.

0700-1900

During the time of 0700-1900 (day shift), 671 cases occurred within the sample. Five hundred and four (75%) patients were treated with rapid transport for PCI; 137 (20.4%) cases were treated with prehospital thrombolytics; and 24 (3.6%) cases were treated along the rural pathway.

Of the 671 cases, 512 (76.3%) occurred in the metro/urban areas or the province; 50 (7.4%) occurred in communities with a population greater than 3000 (7.4%); 104 (15.5%) of cases occurred in rural areas; and 5 (0.8%) cases occurred in remote areas.

1900-0700

Between the hours of 1900 and 0700 hours (night shift), 428 cases occurred in the sample. Of these cases, 256 (59.8%) cases were treated with rapid transport for PCI; 158 (36.9%) cases were treated with prehospital thrombolytics; and 12 (2.8%) cases were treated under the rural pathway.

Three hundred and twenty-nine (77.9%) of the cases that occurred between 1900 and 0700 hours occurred in the metro/urban areas; 32 (7.5%) cases occurred in communities with a population greater than 3,000 people; 61 (14.3%) cases occurred in rural areas of the province; and 6 (1.4%) occurred in remote areas.

Comparing Time of Day

One way ANOVA comparing the individuals ambulance calls time benchmarks between the two time periods found a statistically significant difference between the on scene times $F(1, 1078) = 4.48$, $p<0.04$. There was no significant difference between the response time $F(1, 1094) = 0.92$, $p = 0.34$ and the transport times $F(1, 1066) = 2.05$, $p = 0.15$ based on time of day.

Table 15

Response Time Based on Time of Day

Variable		Mean	n	SD*	SEM**	95% Confidence Interval	
						Lower Bound	Upper Bound
Response Time	0700-1900	12:29	669	7:52	0:18	11:53	13:05
	1900-0700	12:02	427	6:41	0:19	11:24	12:41
On Scene Time	0700-1900	25:58	659	10:21	0:24	25:10	26:45
	1900-0700	27:19	421	10:13	0:29	26:21	28:18
Transport Time	0700-1900	23:07	653	22:57	0:53	21:21	24:53
	1900-0700	21:06	415	21:29	1:03	19:02	23:11

Note. Time reported in minutes:seconds
* SD –Standard Deviation.
** SEM – Standard Error of the Mean

Dispatch Accuracy

In this sample of 1,099 cases 2 cases were missing the call type data thus 1,097 cases were used for review. 777 (70.8%) cases were dispatched under the chest pain card type. Following chest pain, the most dispatched complainant type was breathing difficulty with 74 (6.7%) cases, interfacility transfer/palliative care with 56 (5.1%) cases, unconscious/unresponsive with 53 (4.8%) cases, and heart palpitations with 29 (2.6%)

cases. Overall the 1,097 cases were dispatched through a combination of 21 different complaint types.

Reviewing the dispatch priority, 1057 (96.4%) of the cases called for a lights and siren response and 39 (3.6%) of the cases called for a response that requires the ambulance to drive within normal driving parameters. In 1 case the EMS crew was able to arrive at the location of the incident before the dispatch centre was able to fully process the call, thus the call started in “prealert” status.

Summary

Analysis of the data has shown that paramedics can meet the recommended timelines for both treatment plans, but the timelines can be altered as factors such as the response or transport distances have an impact. .

Chapter 5: Discussion

Introduction

The results of this study have provided numerous areas for discussion beyond the original intent to determine if EMS systems are able to meet the recommended timelines. This study also provided an interesting area in which future research will further determine EMS call time intervals, and impact future policy and protocol development of STEMI care in the pre-hospital environment, and in the development of other nonspecific EMS policies and protocols.

First Point of Medical Contact

The most notable topic for discussion in this study surrounds what is the first point of medical contact. In the prehospital world there is no standard definition for the point at which medical contact first occurs. As Alberta Health Services EMS has stated, in Alberta the first point of medical contact in the prehospital environment is considered to have occurred when the 911 call is answered. This belief is due to a number of factors, one as the ability of 911 call-takers to provide pre-arrival instructions such as how to control and protect an unconscious person's airway, or instructions and assistance in providing CPR during a cardiac arrest (Alberta Health Services 2019, Clawson & Hauert 1990). In our particular study, Alberta Health Services EMS call takers have the ability to, under written protocols and medical direction, recommend that the patient take acetylsalicylic acid (ASA), or Aspirin, as part of the advanced medical priority dispatch system that AHS EMS utilizes for dispatching the responding ambulances. While the ability for 911 call takers to recommend ASA administration exists, it is not dependent on

a specific dispatch card type, or call response determinant, but is at the discretion of the call taker. Others have the belief that because a call taker is dependent on the information they are receiving over the phone they cannot truly assess a patient, and thus are not the first point of medical contact. Instead medical contact should be defined as the point in which a trained medical professional arrives at the patient's side and is capable of performing diagnostic and physical assessments (Wong et al., 2019; Welsh et al, 2009; Beta et al 2009).

Determining what is considered the first point of medical contact is of great importance in the determination of success in meeting the recommended timelines. As we have seen in this this study, the response time for an ambulance, which is inclusive of the time from 911 call received to ambulance personnel arriving at the patients side, can range from 10 minutes in a larger urban environments, to 20 minutes in the more rural and remote areas of the province. As such it can greatly impact the timeline to treatment and thus greatly impact the success rates for both the rapid transport for PCI and paramedic administered thrombolytic pathways. Thus until a standard definition of what is considered the first point of medical contact in the prehospital environment is agreed upon, it will be difficult to accurately judge success and compare success between specified regions on a greater national or international scale.

Geography

In this study and in the province of Alberta, there are three designated hospitals that receive STEMI patients and are capable of providing PCI for surgical intervention. The location of these hospitals covers a large portion of the population in Alberta, and majority of the STEMI cases that occurred in the province. However, due to the location

of these facilities, there remains people who reside outside of what could be considered an acceptable transport time from the hospital. While the specific cases are isolated in this study and dependent on a number of other factors, the northwest location of the Foothills Medical Centre in the City of Calgary saw some of STEMI cases where patients are unable to meet the recommended timelines when residing in the deep SE quadrant of Calgary. Increased and continued urban sprawl, as predicted by the Government of Alberta (2020) population growth predictions, could see the need for additional facilities, or strategically located facilities which will see a greater coverage for an increasing population. Strategic placement of PCI capable facilities may also see the reach of the rapid transport for PCI expand as populations in the areas of the province which currently do not meet the criteria for an acceptable transport time, find themselves within an acceptable transport time.

Standardization and Equality of Care

If standardization and equality of patient care is the goal of the EMS system then the concurrent administration of both treatment protocols must be available to all paramedics within the systems so long as it meets their scope of practice. In this study the centralized delivery model of STEMI care in the province, combined with the large geographic area served by the EMS system ensured that there were populations where the standard of care was not equal. Further this study found that paramedics are able to meet the timelines for thrombolytic administration and for rapid transport, albeit with a caveat to determine what the first point of medical contact is. As Wong et Al (2019) stated, pre-hospital systems and paramedics need to be considered part of the STEMI treatment pathway, and thus to optimize treatment this may mean having the ability to administer

thrombolytic medication if the system is unable to meet the transport requirements for PCI due to the geographic location of the patient, or in times of increased demand on the health system. Alternatively, if the system is able to meet the timeline for rapid transport to PCI, efforts should be focused on improving delays to decrease the time the cardiac tissue remains ischemic. Interestingly the findings from this study align with findings by Foo et al (2019) which found that 38% of patients in their cohort had a door to balloon time in excess of 90 minutes, further highlighting the need for prehospital systems to be integrated into a STEMI care pathway.

It is also noted that when speaking of equality of care, there was a significant difference in the amount of time that practitioners spend on scene when comparing male and female patients. While this time difference is statistically significant, the clinical significance is minimal and previous research has shown that no clinical interventions could be performed in the difference in times. Further investigation into understanding the reasons why the statistical time difference is present, will better help researchers understand and find ways in which to equalize care between the genders.

Future Research

Based on the results of this study there are a number of different areas in which there are opportunities for future research.

The first area for future research would be to evaluate how accurate the dispatch call centre is in administering ASA to the appropriate patients. Research into this would further define the question of first point of medical contact.

Secondly, there exists the potential for research that undertakes the transport times to each facility and through the use of GIS mapping develops hot zones for rapid

transport versus thrombolytic administration. This would be a beneficial adjunct to improving patient care as it would give paramedics and physicians the ability to accurately determine which treatment regime will meet the recommendations at that particular time, and in turn have a beneficial impact on patient care.

Lastly, a study that looks at the process for prehospital STEMI care could further evaluate where time savings could be made. As we have seen in this study, the emergency department is currently a place where a large portion of time is spent as the patient waits for definitive care. Expanding the current paramedic protocols and equating the care across the province may reduce the time in the emergency department. Further, potentially bypassing the emergency department completely, except in extenuating circumstances, in favor of catheterization lab or cardiac care unit admission may improve patient outcomes and decrease the patient load on the emergency departments of the receiving facilities.

Limitations

This study has limitations that are beyond the control of the researcher. Most notably, the ambulance call times are dependent on the practitioners on the ambulance pushing the buttons on the mobile dispatch terminal or communicating with the dispatch centre. Recent changes in the technology of the mobile dispatch terminal; automated vehicle locators; and dispatch centre interface will reduce or remove this limitation in future studies as ambulances recently gained the ability to create these benchmarks without practitioner input. Additionally, which patients were included in the study was based on the paramedic's documentation in their patient care report, and which protocols they documented using. As such, it is the belief of the researcher that the actual case

numbers are higher than reported, particular in the Calgary and South zones, where practitioners may not believe that STEMI reperfusion strategy is the correct protocol choice for rapidly transporting a patient to a PCI capable facility.

Following the patient through the health system also proved difficult and potentially limited the statistical analysis for the time the patient spends in the emergency department and the number of days the patient spends admitted in the hospital. While EMS is part of the health care system, the EMS technology is not linked into the healthcare system. This prevented follow through on some patients, particularly those patients who were transported to another site for care.

Practical and Policy Applications

Practical application of this study to individual paramedic practice is not expected as paramedics currently work under medical direction and written protocols. For example, in the province of Alberta all paramedics work under a standard set of written protocols, and under the direction of a group of physicians acting as medical direction. However, knowledge of the results of this study can allow individual paramedics to advocate for their patient when they are managing and treating STEMI cases in the field. Additionally, sharing the results with individual paramedics can allow them to advocate for protocol and system changes to improve STEMI care as a whole.

On a larger scale, EMS medical directors and administrators operating in municipal, provincial, or national systems, both within Canada and internationally can use the results of this study. As previously mentioned there is a continued trend to incorporate EMS into the healthcare system, coupled with the need for evidenced based protocols and procedures. Thus the results of this study can be utilized to inform STEMI

treatment strategies, and ultimately ensure that the healthcare system as a whole is providing the most appropriate resource and treatment, that provides the best possible outcome for the patient, whether PCI or prehospital thrombolytic administration, and also meeting the recommended treatment timelines.

Chapter 6: Conclusion

Defining success in this study is difficult based on the lack of a standard definition for the first point of medical contact. Assuming the first point of medical contact is defined as the paramedics arriving at the patient's side, Alberta Health Services Emergency Medical Services is currently meeting the recommended timelines in more than 90% of the STEMI cases for both rapid transport for PCI and paramedic administered thrombolytic treatment regimes. If the first point of medical contact is defined as 911 call received, thus including the EMS response time, success decreases to 72% for PCI cases and 62% for paramedic administered thrombolytic cases. Further the success of obtaining an ECG within the recommended 10 minute timeframe is below 9% when the EMS response time is included, however is above 87% if the first point of medical contact is when the paramedics arrive at the patient's side.

References

Alberta Health Services. (n.d.) 2017-2020 Health Plan & Business Plan. Retrieved April 10, 2020, from https://www.albertahealthservices.ca/about/page13365.aspx

Alberta Health Services. (n.d.) Emergency Medical Services. Retrieved April 16, 2020 from https://www.albertahealthservices.ca/ems/ems.aspx

Alberta Health Services. (2018) Official Standard Geographic Areas. Retrieved September 29, 2020 from https://open.alberta.ca/dataset/a14b50c9-94b2-4024-8ee5-c13fb70abb4a/resource/70fd0f2c-5a7c-45a3-bdaa-e1b4f4c5d9a4/download/official-standard-geographic-area-document.pdf

Alberta Health Services. (n.d.) Interventional Cardiac Services Needs Assessment and Options Analysis. Retrieved April 16, 2020 from https://www.albertahealthservices.ca/assets/about/org/ahs-lrp-central-planning-ics-report-faq.pdf

Alberta Health Services. (2020). Quarterly Emergency Medical Services Dashboard. Retrieved April 16, 2020 from https://www.albertahealthservices.ca/assets/info/ems/if-ems-dashboard.pdf

Alberta Health Services. (n.d.). Vital Heart Response Program. Retrieved April 10, 2020, from https://www.albertahealthservices.ca/maz/vital-heart-response.aspx

Alberta Ministry of Health. (n.d.) Ambulance and Emergency Health Services. Retrieved April 16, 2020 from https://www.alberta.ca/ambulance-and-emergency-health-services.aspx

American Heart Association. (2018) Cardiac Procedures and Surgeries. American Heart Association. Dallas, Texas. Heart Procedures and Surgeries | American Heart Association

Armstrong, P.W., Gershlick, A.H. Goldsteing, P., Wilcox, R., Danays, T., Lambert, Y., Sulimon, V., Ortis, F.R., Ostojic, M., Welsh, R.C., Carvalho, A.C., Nanas, J., Arntz, H.R., Halvorsen, S., Huber, K., Grajek, S., Fresco, C., Bluhmki, E., Regelin, A., Vandenberghe, K., Bogaerts, K., Van de Werf, F. (2013). Fibrinolysis or Primary PCI in ST-Segment Elevation Myocardial Infarction. *The New England Journal of Medicine.* 368, 15: 1379-1387. https://doi.org/10.1056/NEJMoa1301092

Armstrong, P.W., Bogaty, P, Buller, C.E., Dorian, P., O'Neill, B.J. (2004). The 2004 ACC/AHA Guidelines: A perspective and adaptation for Canada by the Canadian Cardiovascular Society Working Group. *Canadian Journal of Cardiology*. 20.11: 1075-79.

Bata, I., Armstrong, P.W., Westerhout, C.M., Travers, A., Sookram, S., Caine, E., Christenson, J., Welsh, R.C. (2009). Time from first medical contact to reperfusion in ST elevation myocardial infarction: A Which Early ST Elevations Myocardial infarction Therapy (WEST) substudy. *Canadian Journal of Cardiology.* 25.8: 463-68. https://doi.org/10.1016/s0828-282x(09)70118-7

Blanchard, I.E., Doig, C.J., Hagel, B.F., Anton, A.R., Zygun, D.A., Kortbeek, J.B., Powell, G., Williamson, T.S., Fick, G.H., Innes, G.D. (2012). Emergency Medical Services Response time and Mortality in an Urban Setting. *Prehospital Emergency Care* 16: 142-51. https://doi.org/10.3109/10903127.2011.614046

Clawson, J.J., Hauert, S.A. (1990). Dispatch Life Support: Establishing Standards That Work. *Journal of Emergency Medical Services*. 15.7: 82-8.

Clawson, J.J., Martin R., Lloyd, B., Smith, M., Cady, G. (1996). The EMD as a Medical Professional. *Journal of Emergency Medical Services*. 12.5: 68-77.

Clawson, J.J., Martin, R.L., Cady, G.A., Maio, R.F. (1997). The Wake Effect – Emergency Vehicle-Related Collisions. *Prehospital and Disaster Medicine*. 12.4: 41-4. https://doi.org/10.1017?S1049023X00037791

Cook, H. (2021) Sistering. *Canadian Paramedicine.* 44.3: 45-47.

Dami, F., Pasquier, M., Caron, P.N., (2014) Use of lights and siren: is there room for improvement? *European Journal of Emergency Medicine*. 21: 52-6. https://doi.org/10.1097/MEJ.0b013e328364b607

Danchin, N., Dos Santos Teixeira, N., Puymirat, E. (2014). Weakness in Regional Primary Coronary Angioplasty Programs: Is there Still a Role for a Pharmoco-invasive Approach? *Revista Espanola De Cardiologia*. 67.8: 659-65. https://doi.org/10.1016/j.rec.2014.04.004

Eisenberg, M.S., Bergner, L., Hallstom, A. (1979). Cardiac resuscitation in the community. Importance of rapid provision and implications for program planning. *Journal of the American Medical Association*. 241.18, 86-92.

Foo, C.Y., Andrianopoulos, N., Brennan, A., Ajani, A., Reid, C.M., Duffy, S.J., Clark, D.J., Reidpath, D.D., Chaiyakunapruk, N. (2019) Reexamining the effect of door-to-balloon delay on STEMI outcomes in the context of unmeasured confounders: a retrospective cohort study. *Scientific Reports.* 9. 19978. https://doi.org/10.1038/s41598-019-56353-7

Gershlick, A.H., Banning, A.P., Myat, A., Verheugt, F.W.A., Gersh, B.J. (2013). Reperfusion therapy for STEMI: is there still a role for thrombolysis in the era of primary percutaneous coronary intervention? *The Lancet*. 382, 624-632. https://doi.org/10.1016/S0140-6736(13)61454-3

Government of Alberta Ministry of Health. (2020) Ministry Business Plan: Health. Retrieved from 2020-23 Health Business Plan (February 2020) (alberta.ca)

Government of Alberta Office of Statistics and Information. (2019) Quarterly Population Report: Second Quarter 2019.

Government of Alberta. (2020) Health Information Act, R.S.A. 2000 c H-5. Retrieved from https://kings-printer.alberta.ca/1266.cfm?page=h05.cfm&leg_type=Acts&isbncln=9780779839414

Gratton, M.C., Bethke, R.A., Watson, W.A., Gaddis, G.M., (1991). Effect of standing orders on paramedics scene time for trauma patients. *Annals of Emergency Medicine* 20.12: 1306-9. https://doi.org/10.1016/s0196-0644(05)81071-6

Health Quality Council of Alberta. (2013). Review of the Operations of Ground Ambulance Service in Alberta. https://www.hqca.ca/wp-content/uploads/2018/05/Review_of_the_Operations_of_Ground_EMS_in_Alberta_Final_Report.pdf

Heart and Stroke Foundation of Canada. (n.d.). *Electrocardiogram*. Retrieved April 16, 2022, from https://www.heartandstroke.ca/heart-disease/tests/electrocardiogram

Heart and Stroke Foundation of Canada. (n.d.). *Heart Attack*. Retrieved April 16, 2022, from https://www.heartandstroke.ca/heart-disease/conditions/heart-attack

House of Commons. (2017). NHS Ambulance Services (pp. 5-38). London, England: The National Audit Office.

Hunt, R.C., Brown, L.H., Cabinum, E.S., Whitley, T.W., Prasad, N.H., Owens, C.F., Mayo, C.E. (1995). Is Ambulance Transport Time With Lights and Siren Faster Than Without? *Annals of Emergency Medicine*. 25: 507-11. https://doi.org/10.1016/S0196-0644(95)70267-9

Joy, E.R., Kurian, J., Gale, C.P. (2016). Comparative effectiveness of primary PCI versus fibrinolytic therapy for ST elevation myocardial infarction: a review of the literature. *Journal of Comparative Effectiveness Research*. 5.2. https://doi.org/10.2217/cer-2015-0011

Khan, C.A., Pirrallo, R.G., Khun, E.M. (2001). Characteristics of Fatal Ambulance Crashes in the United States: As 11-year Retrospective Analysis. *Prehospital Emergency Care*. 5.3: 261-69. https://doi.org/10.1080/10903120190939751

Lamire, F. (2017). First contact: what does it mean for family practice in 2017? *Canadian Family Physician*. 63.3: 256.

Lettino, M. (2009). Why and when PCI, why and when thrombolysis? *Internal and Emergency Medicine*. 4: 7-9.

Lewis, S., Kouri, D. (2003) Regionalization: making Sense of the Canadian Experience. *Healthcare Papers*. 5.1, 12-31. https://doi.org/10.12927/hcpap.2004.16847

Marques-Baptista, A., Ohman-Strickland, P., Baldino, K.T., Prasto, M., Merlin, M.A. (2010). Utilization of warning lights and siren based on hospital time-critical interventions. *Prehospital Disaster Medicine.* 25: 507-11. https://doi.org/10.1017/s1049023x0000830x

Moens, D., Stipulante, S., Donneau, A.F., Hartsein, G., Pirotte, O., D'orio, V., Ghuysen, A. (2015). Air versus ground transport of patients with acute myocardial infarction: experience in a rural-based helicopter medical service. *European Journal of Emergency Medicine*. 22: 273-78. https://doi.org/10.1097/MEJ.0000000000000149

National Fire Protection Association. (2020). NFPA 1710: Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments. https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1710

National Highway Traffic Safety Administration. (1996). Emergency Medical Services Agenda for the Future. https://one.nhtsa.gov/people/injury/ems/agenda/emsman.html

O'Brien, D.J., Price, T.G., Adams, P. (1999). The Effectiveness of Lights and Siren Use During Ambulance Transport by Paramedics. *Prehosptial Emergency Care*. 3: 127-30. https://doi.org/10.1080/10903129908958920

Ontario Paramedic Association. (2019). EMS Vision – Ontario 2050. https://www.ontarioparamedic.ca/misc/the_consolidated_plan_20190126-1-1.pdf

Patel, A.B., Tu, J.V., Waters, N.W., Ko, D.T., Eisenberg, M.J., Huyhn, T., Rinfret, S., Knudtson, M., Ghali, W.A. (2010). Access to primary percutaneous coronary intervention for ST- segment elevation myocardial infarction in Canada: a geographic analysis. *Open Medicine*, 1.1, E13-E21.

Patel, A.B., Waters, N.W.M., Ghali, W.A. (2007). Determining geographic areas and populations with timely access to cardiac catheterization facilities for acute myocardial infarction care in Alberta, Canada. *International Journal of Health Geographics*. 6.47. https://doi.org/10.1186/1476-072X-6-47

Public Health Agency of Canada. (2017). Heart Disease in Canada: Highlights from the Canadian Chronic Disease Surveillance System. Government of Canada. Retrieved September 17, 2020, from https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/diseases-conditions/heart-disease-fact-sheet/heart-disease-factsheet-eng.pdf

Shared Health Inc. (2020). Emergency Response Services. Retrieved April 13, 2020 from https://sharedhealthmb.ca/services/emergency-response/

Singh, J.M., MacDonald, R.D. (2009). Pro/con debate: Do the benefits of regionalized critical care delivery outweigh the risks of interfacility transport? *Critical Care* 13.4, 219. https://doi.org/10.1186/cc7883

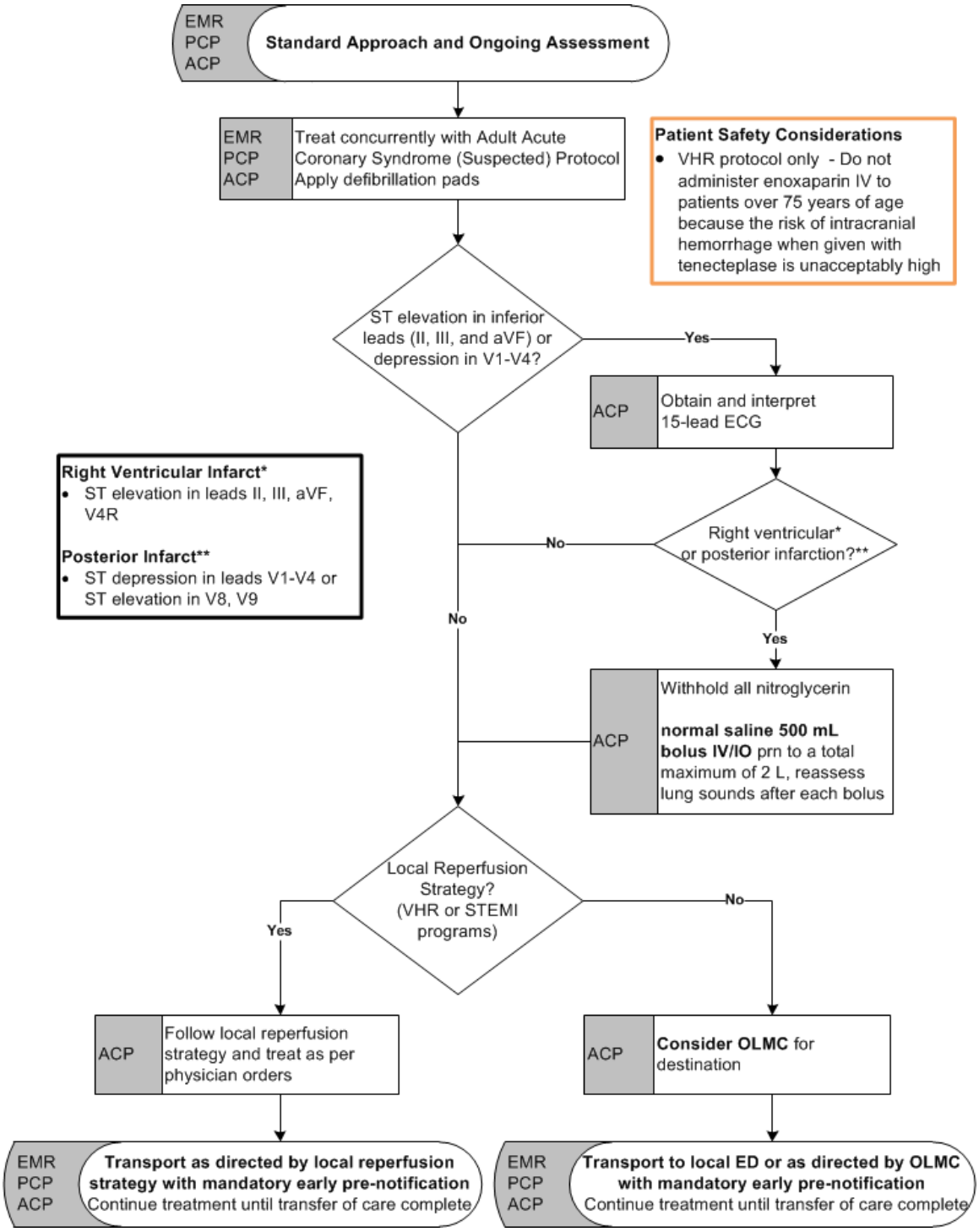
Studnek, J.R., Garvey, L., Blackwell, R., Vandeventer, S., Ward, S.R., (2010). Association Between Prehospital Time Intervals and ST-Elevation Myocardial Infarction System Performance. *Circulation*. 122, 1464-69. https://doi.org/10.1161/CIRCULATIONAHA.109.931154

Terkelsen, C.J., Sorensen, J.T., Nielsn, T.T. (2008). Is there Any Time Left for Primary Percutaneous Coronary Intervention According to the 2007 Updated American College of Cardiology/American heart Association ST-Segment Elevation Myocardial infarction Guidelines and the D2B Alliance? *Journal of the American College of Cardiology*. 51.15: 1211-15. https://doi.org/10.1016/j.jacc.2008.05.061

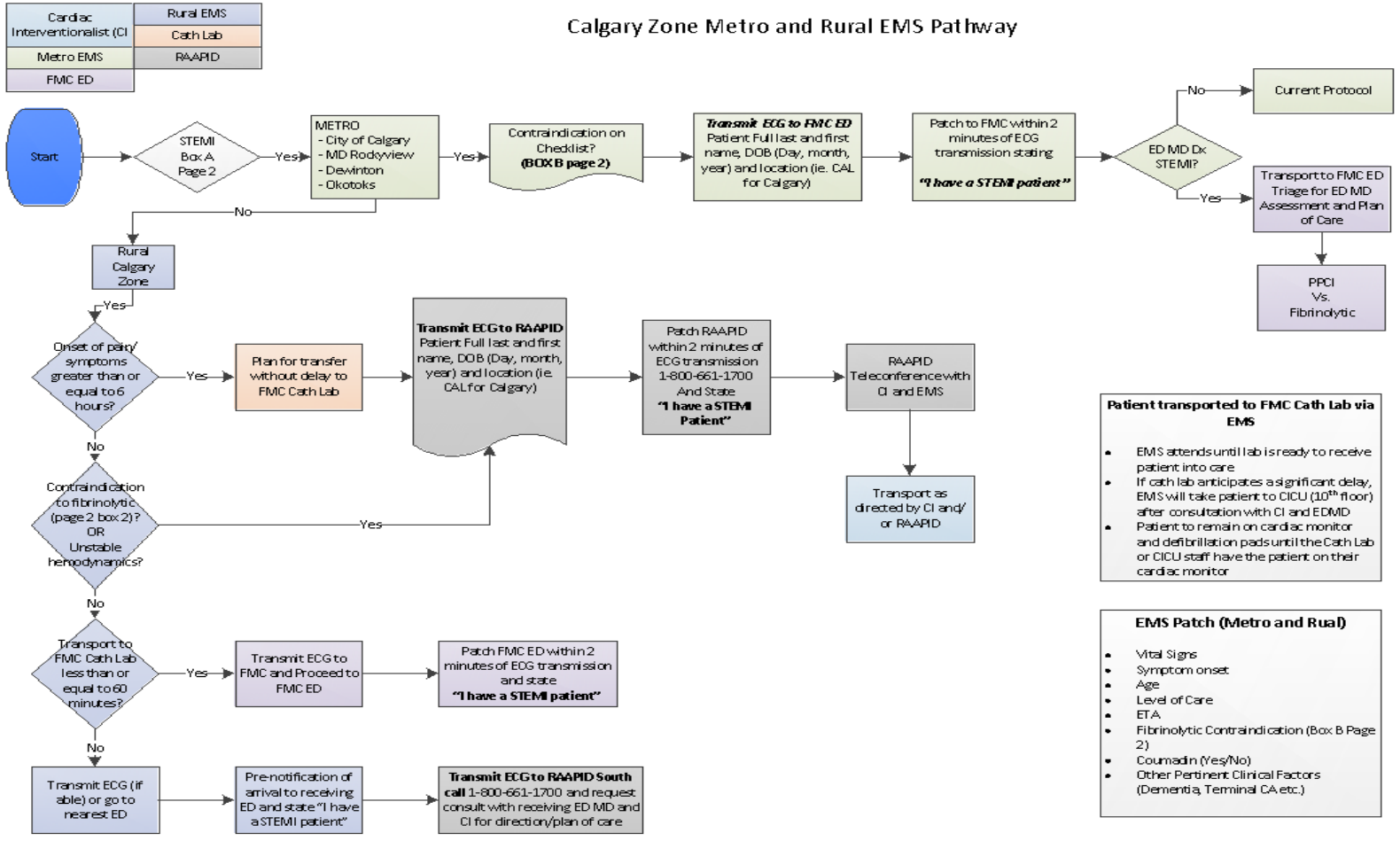
Welsh, R.C., Travers, A., Huynh, T., Cantor, W.J. (2009) Canadian Cardiovascular Society Working Group: Providing a perspective on the 2007 focused update of the American College of Cardiology and American Heart Association 2004 guidelines for the management of ST elevation myocardial infarction. *Canadian Journal of Cardiology*. 25.1: 25-32.

Wong, G.C, Welsford, M, Ainsworth, C., Abuzeid, W., Fordyce, C.B., Greene, J., Huynh, T., Lambert, L., Le May, M., Lutchmedial, S., Mehta, S.R., Natarajan, M., Norris, C.M., Overgaard, C.B., Arnesen, M.P., Quraishi, A., Tanguay, J.F., Traboulsi, M., Van Diepen, S., Welsh, R., Wood, D.A., & Cantor, W.J. (2019). 2019 Canadian Cardiovascular Society/Canadian Association of Interventional Cardiology Guidelines on the Acute Management of ST-Elevation Myocardial Infarction: A Focused Update on Regionalization and Reperfusion. *Canadian Journal of Cardiology, 35(2019),* 107-132. https://doi.org/10.1016/j.cjca.2018.11.031

Appendix A - Alberta Health Services Emergency Medical Services Adult STEMI Reperfusion Protocol



Appendix B - Alberta Health Services EMS Calgary Zone EMS STEMI Pathway



Appendix C - Alberta Health Services/Covenant Health Vital Heart Response Program Protocol

Alberta Health Services | Covenant Health

Do Not Leave ER/Cath Lab Until Patient Label Placed Here

Vital Heart Response Protocol (VHR)
ST Elevation Myocardial Infarction Reperfusion Orders
Emergency Medical Services / Urgent Care Centres

Patient Name:_____ **Date:**_____ **EMS Service:**_____

Date of Birth:_____ **Age:**_____ **Weight (kg):**_____ **Allergies:**_____

Time of Symptom Onset:_____ **Time of Diagnostic ECG:**_____
Arrive Patient:_____ **Time VHR MD Notified:**_____

Trial MONA

Oxygen to keep SpO2 greater than 91%
Acetylsalicylic acid (ASA) 160 mg PO chewed & swallowed
Nitroglycerin* 0.4 mg SL Q5min PRN if SBP greater than 100 mmHg & chest pain persists
**Do not give nitroglycerin with RV infarction*
MorphINE 2.5-5 mg IV PRN for pain

1. **TRANSMIT 12 lead ECG to VHR PHYSICIAN, or fax to 1-866-568-5009** (See 'Inclusion Criteria')
2. Review 'Exclusion Criteria for Fibrinolytic' with patient
3. **Contact VHR** physician to discuss reperfusion
   ***EMS* - Contact Dispatch** (**Radio**, or call **per Local Protocol**)
   ***UCC/ED* –** Call **RAAPID NORTH (1-800-282-9911) OR 780-914-5947 OR 1-877-914-5947**
4. Obtain frequent ECGs (Q15-30 minutes)

Reperfusion Eligibility Criteria

Inclusion Criteria *(they must have both of these to be eligible for reperfusion)*

1. MI symptom onset within 6 hours or ongoing symptoms with onset 6-12 hours
2. ECG evidence of STEMI
   - anterior (at least 2mm in at least 2 of leads V1-V6)
   - inferior (at least 1mm in at least 2 of leads II, III, aVF or V4R if suspected RV MI)
   - lateral (at least 1mm in 2 of leads V5, V6, I, aVL)
   - posterior (at least 1mm depression in V1-V2 and ≥1mm elevation in V8, V9)

Exclusion Criteria for Fibrinolytic

Absolute Contraindications *(they cannot have any of these and be eligible for reperfusion)*

- Bleeding in the brain
- Structural anomaly of the veins or arteries in the brain
- Brain tumor
- Ischemic stroke within 3 months (except if it's within last 3 hours)
- Significant closed head or facial trauma in past 3 months

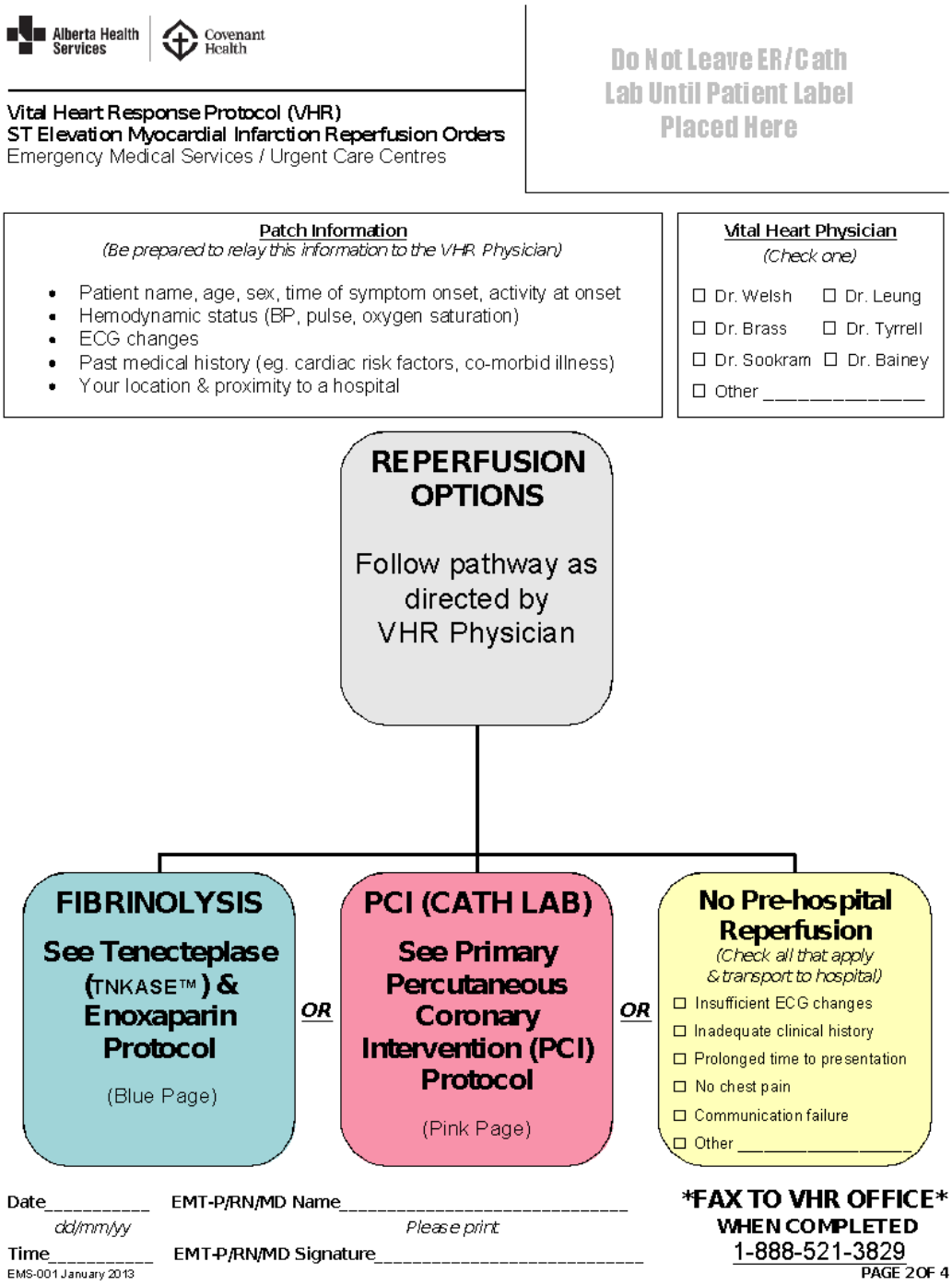
Relative Contraindications *(patient may be eligible for reperfusion if benefit outweighs risk)*

- History of severe, uncontrolled high BP
- Severe, uncontrolled high BP on presentation (SBP greater than 180 mmHg or DBP greater than 110 mmHg)
- Ischemic stroke more than 3 months old, dementia or other brain anomaly
- Traumatic or prolonged CPR (greater than 10 minutes)
- Surgery within last 3 weeks
- Internal bleeding in last 2-4 weeks
- Non-compressible bleeding from IV attempts
- Pregnancy
- Active stomach ulcers
- Patient currently taking warfarin (COUMADIN)

Date_____ **EMT-P/RN/MD Name**_____
dd/mm/yy *Please print*
Time_____ **EMT-P/RN/MD Signature**_____

FAX TO VHR OFFICE
WHEN COMPLETED
1-888-521-3829

EMS-001 January 2013


Alberta Health Services
Covenant Health
Vital Heart Response Protocol (VHR)
ST Elevation Myocardial Infarction Reperfusion Orders
Emergency Medical Services / Urgent Care Centres
Do Not Leave ER/Cath Lab Until Patient Label Placed Here
Patch Information
(Be prepared to relay this information to the VHR Physician)
Patient name, age, sex, time of symptom onset, activity at onset
Hemodynamic status (BP, pulse, oxygen saturation)
ECG changes
Past medical history (eg. cardiac risk factors, co-morbid illness)
Your location & proximity to a hospital
Vital Heart Physician
(Check one)
Dr. Welsh
Dr. Leung
Dr. Brass
Dr. Tyrrell
Dr. Sookram
Dr. Bainey
Other _____
REPERFUSION OPTIONS
Follow pathway as directed by VHR Physician
FIBRINOLYSIS
See Tenecteplase (TNKASE™) & Enoxaparin Protocol
(Blue Page)
OR
PCI (CATH LAB)
See Primary Percutaneous Coronary Intervention (PCI) Protocol
(Pink Page)
OR
No Pre-hospital Reperfusion
(Check all that apply & transport to hospital)
Insufficient ECG changes
Inadequate clinical history
Prolonged time to presentation
No chest pain
Communication failure
Other _____
Date_____
dd/mm/yy
EMT-P/RN/MD Name_____
Please print
Time_____
EMT-P/RN/MD Signature_____
FAX TO VHR OFFICE
WHEN COMPLETED
1-888-521-3829
EMS-001 January 2013
PAGE 2 OF 4

Alberta Health Services | Covenant Health

Vital Heart Response Protocol (VHR)
ST Elevation Myocardial Infarction Reperfusion Orders
Emergency Medical Services / Urgent Care Centres

Do Not Leave ER/Cath Lab Until Patient Label Placed Here

TENECTEPLASE (TNKASE™) & ENOXAPARIN PROTOCOL

Select appropriate treatment based on patient age

Time	Patients 75 years of age or less	OR	Time	Patients over 75 years of age
	Tenecteplase (TNKASE™) _____ mg IV push over 5 seconds *(see dosing chart below)			**Tenecteplase** (TNKASE™) (HALF DOSE) _____ mg IV push over 5 seconds *(see dosing chart below)
	Enoxaparin (LOVENOX®) 30 mg IV (blue label syringe)		>>>>>> >>>>>> >>>>>> >>>>>> >>>>>>	***Do NOT** give Enoxaparin IV* *(Risk of intracranial hemorrhage in elderly patients when given with Tenecteplase)*
	Clopidogrel (PLAVIX®) 300 mg PO			Clopidogrel (PLAVIX®) 75 mg PO
	Enoxaparin (LOVENOX®) 1 mg/kg _____ mg subcutaneous (black label syringe) (maximum dose 100 mg) *see dosing chart in kit*			Enoxaparin (LOVENOX®) 0.75mg/kg_____ mg subcutaneous (black label syringe) (maximum dose 75 mg) *see dosing chart in kit*

Patient Weight (kg)	Patient Weight (lbs)	TNK (mg)	Mixed TNK (mL)	OR	OVER 75 YEARS TNK (mg)	Mixed TNK (mL)
< 60	< 132	30	6		15	3
≥ 60 to < 70	≥ 132 to < 154	35	7		17.5	3.5
≥ 70 to < 80	≥ 154 to < 176	40	8		20	4
≥ 80 to < 90	≥ 176 to < 198	45	9		22.5	4.5
≥ 90	≥ 198	50	10		25	5

TRANSPORT AS DIRECTED BY VHR PHYSICIAN OR DISPATCH/RAAPID
Obtain serial ECGs, monitor vital signs, watch for arrhythmias & bleeding etc…

Record Times
Left Scene _____ Arrived at Hospital_____

Date_____ EMT-P/RN/MD Name_____
dd/mm/yy *Please print*
Time_____ EMT-P/RN/MD Signature_____

FAX TO VHR OFFICE
WHEN COMPLETED
1-888-521-3829

EMS-001 January 2013

Alberta Health Services | Covenant Health

Vital Heart Response Protocol (VHR)
ST Elevation Myocardial Infarction Reperfusion Orders
Emergency Medical Services / Urgent Care Centres

Do Not Leave ER/Cath Lab Until Patient Label Placed Here

PRIMARY PERCUTANEOUS CORONARY INTERVENTION (PCI) PROTOCOL

Time	For ALL patients selected for PCI by the VHR Physician (Enoxaparin at discretion of VHR Physician)
	Enoxaparin (LOVENOX®) 30 mg IV (blue label syringe)
	Ticagrelor (BRILINTA®) 180 mg PO (if unavailable, consider clopidogrel (Plavix®) 600 mg PO)
	Enoxaparin (LOVENOX®) 1 mg/kg _____mg subcutaneously (maximum dose 100 mg) (black label syringe) *see dosing chart in PCI kit*
	Transmit 12 – Lead ECG to designated cath lab (RAH or UAH PCI lab) & obtain serial ECGs

Transport to Cardiac Catheterization Lab (PCI Lab)

University of Alberta Hospital

1. ED - obtain Swipe Pass to PCI Lab or request escort (Security or Porter)
2. Take ED Elevator to *2nd floor, Turn left - Mazankowski Alberta Heart Institute*

OR

Royal Alexandra Hospital

1. Report to ED Triage – Admit pt. in ED - ensure Lab is ready to receive
2. Proceed to PCI lab - Main Floor *CK Hui Heart Centre* (past DI)

Record Times

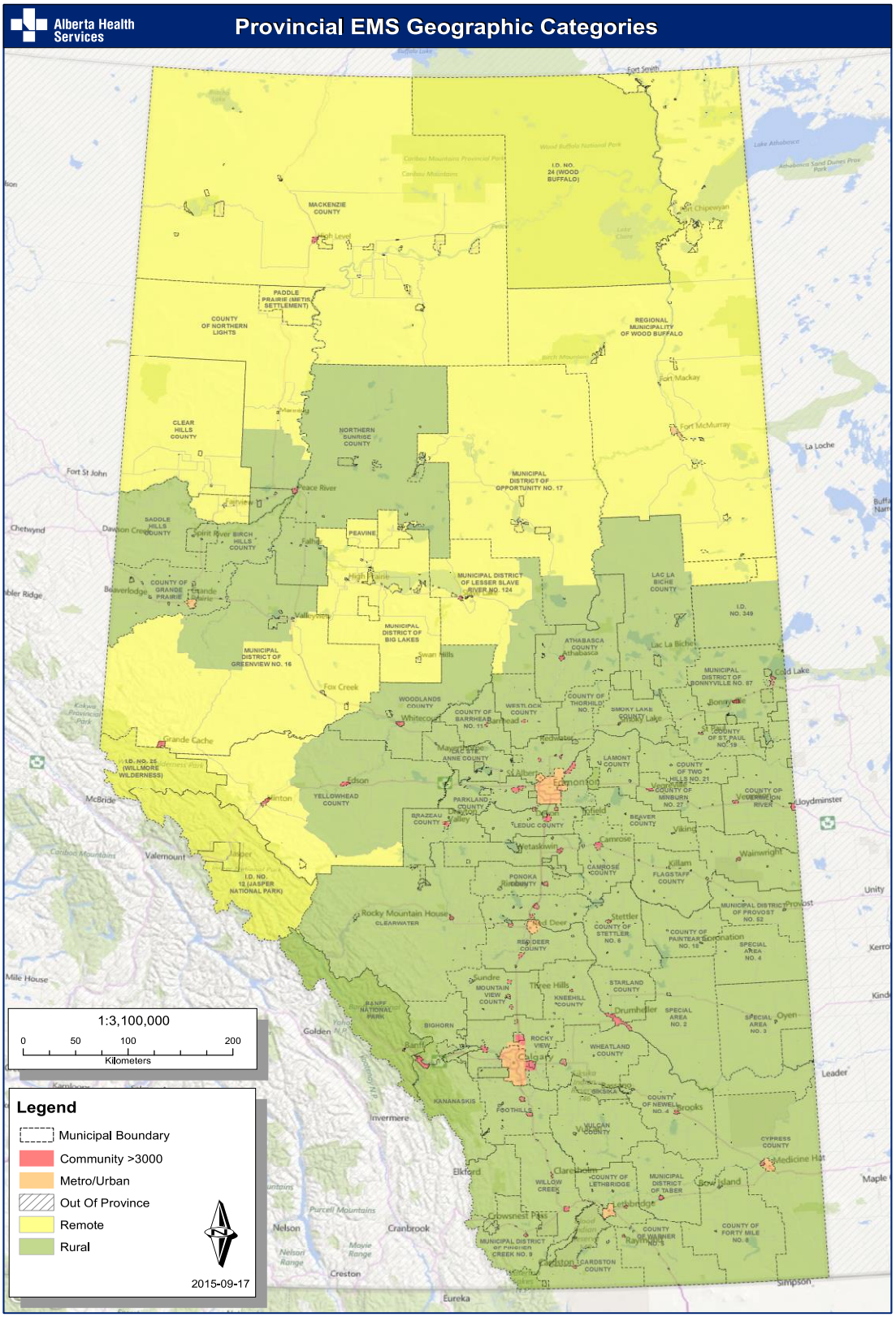
Left Scene _____ Arrived at Hospital _____ Arrived at Cath Lab _____

Date_____ EMT-P/RN/MD Name_____
dd/mm/yy *Please print*

Time_____ EMT-P/RN/MD Signature_____

FAX TO VHR OFFICE
WHEN COMPLETED
1-888-521-3829

Appendix D - Alberta Health Services Emergency Medical Services Geographic Category Map



Appendix E – Athabasca University Research Ethics Approval

Athabasca University
RESEARCH CENTRE

CERTIFICATION OF ETHICAL APPROVAL

The Athabasca University Research Ethics Board (AUREB) has reviewed and approved the research project noted below. The AUREB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS) and Athabasca University Policy and Procedures.

Ethics File No.: **23076**

Principal Investigator:
Mr. Trevor Doublet, Graduate Student
Faculty of Health Disciplines\Master of Health Studies

Supervisor:
Dr. Shawn Fraser (Supervisor)

Project Title:
STEMI Treatment: Can Emergency Medical Services Meet the Recommended Timelines?

Effective Date: August 14, 2018 **Expiry Date**: August 13, 2019

Restrictions:

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

Ethical approval is valid *for a period of one year*. An annual request for renewal must be submitted and approved by the above expiry date if a project is ongoing beyond one year.

A Project Completion (Final) Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: Date: August 14, 2018

Donna Clare, Chair
Faculty of Health Disciplines, Departmental Ethics Review Committee

---

Athabasca University Research Ethics Board
University Research Services, Research Centre
1 University Drive, Athabasca AB Canada T9S 3A3
E-mail rebsec@athabascau.ca
Telephone: 780.675.6718

Appendix F - Athabasca University Research Ethics Approval Renewal

Athabasca University
RESEARCH CENTRE

CERTIFICATION OF ETHICAL APPROVAL - RENEWAL

The Athabasca University Research Ethics Board (AUREB) has reviewed and approved the research project noted below. The AUREB is constituted and operates in accordance with the current version of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS) and Athabasca University Policy and Procedures.

Ethics File No.: **23076**

Principal Investigator:
Mr. Trevor Doublet, Graduate Student
Faculty of Health Disciplines\Master of Health Studies

Supervisor:
Dr. Shawn Fraser (Supervisor)

Project Title:
STEMI Treatment: Can Emergency Medical Services Meet the Recommended Timelines?

Effective Date: July 12, 2019 **Expiry Date**: September 1, 2020

Restrictions:

Any modification or amendment to the approved research must be submitted to the AUREB for approval.

A request for renewal must be submitted and approved by the above expiry date if a project is ongoing.

A Project Completion (Final) Report must be submitted when the research is complete *(i.e. all participant contact and data collection is concluded, no follow-up with participants is anticipated and findings have been made available/provided to participants (if applicable))* or the research is terminated.

Approved by: Date: July 12, 2019

Carolyn Greene, Chair
Athabasca University Research Ethics Board

Athabasca University Research Ethics Board
University Research Services, Research Centre
1 University Drive, Athabasca AB Canada T9S 3A3
E-mail rebsec@athabascau.ca
Telephone: 780.675.6718

Appendix G – Health Research Ethics Board Approval

Health Research Ethics Board

308 Campus Tower
University of Alberta, Edmonton, AB T6G 1K8
p. 780.492.9724 (Biomedical Panel)
p. 780.492.0302 (Health Panel)
p. 780.492.0459
p. 780.492.0839
f. 780.492.9429

Approval Form

Date: September 14, 2018

Study ID: Pro00083983

Principal Investigator: Trevor Doublet

Study Title: STEMI Treatment: Can Emergency Medical Services Meet the Recommended Timelines

Approval Expiry Date: September 13, 2019

Thank you for submitting the above study to the Health Research Ethics Board - Health Panel. Your application has received a delegated review and has been approved on behalf of the committee.

The Health Research Ethics Board assessed all matters required by section 50(1)(a) of the Health Information Act. It has been determined that the research described in the ethics application is a retrospective review of data for which subject consent for access to personally identifiable health information would not be reasonable, feasible or practical. Subject consent therefore is not required for access to personally identifiable health information described in the ethics application.

In order to comply with the Health Information Act, a copy of the approval form is being sent to the Office of the Information and Privacy Commissioner.

A renewal report must be submitted next year prior to the expiry of this approval if your study still requires ethics approval. If you do not renew on or before the renewal expiry date (September 13, 2019), you will have to re-submit an ethics application.

Approval by the Health Research Ethics Board does not encompass authorization to access the patients, staff or resources of Alberta Health Services or other local health care institutions for the purposes of the research. Enquiries regarding Alberta Health Services approvals should be directed to (780) 407-6041. Enquiries regarding Covenant Health approvals should be directed to (780) 735-2274.

Sincerely,

Anthony S. Joyce, PhD.
Chair, Health Research Ethics Board - Health Panel

Note: This correspondence includes an electronic signature (validation and approval via an online system).

UNIVERSITY OF ALBERTA Alberta Health Services Covenant Health

Appendix H – Health Research Ethics Board Approval Renewal

Health Research Ethics Board

308 Campus Tower
University of Alberta, Edmonton, AB T6G 1K8
p. 780.492.9724 (Biomedical Panel)
p. 780.492.0302 (Health Panel)
p. 780.492.0459

Notification of Approval (Renewal)

Date:	July 17, 2019
Amendment ID:	Pro00083983_REN1
Principal Investigator:	Trevor Doublet
Study ID:	MS1_Pro00083983
Study Title:	STEMI Treatment: Can Emergency Medical Services Meet the Recommended Timelines
Approval Expiry Date:	Thursday, July 16, 2020

Thank you for submitting this renewal application. Your application has been reviewed and approved.

This re-approval is valid for another year. If your study continues past the expiration date as noted above, you will be required to complete another renewal request. Beginning at 30 days prior to the expiration date, you will receive notices that the study is about to expire. If you do not renew on or before the renewal expiry date, you will have to re-submit an ethics application.

All study related documents should be retained so as to be available to the Health REB upon request. They should be kept for the duration of the project and for at least 5 years following study completion.

Sincerely,

Anthony S. Joyce, PhD.
Chair, Health Research Ethics Board - Health Panel

Note: This correspondence includes an electronic signature (validation and approval via an online system).

UNIVERSITY OF ALBERTA Alberta Health Services Covenant Health