

TRANSPORTATION OF ST-SEGMENT ELEVATED MYOCARDIAL
INFARCTIONS IN RURAL MONTANA TO PERCUTANEOUS CORONARY
INTERVENTION CAPABLE MEDICAL CENTERS AND ACHIEVEMENT OF
GOAL TREATMENT TIMES

by

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ABSTRACT

Background: Rapid reperfusion via primary percutaneous coronary intervention or thrombolytic therapy is critical to limit death and disability associated with ST-elevated myocardial infarction. However, the majority of Montanans reside in rural areas and require time consuming interfacility transportation for specialized cardiac care.

Purpose: The aim of this scholarly project is to analyze the treatment and transfer process of adult patients experiencing a ST-elevated myocardial infarction with initial presentation to a rural medical facility requiring interfacility transfer for specialized cardiac care to generate quality improvement recommendations for changes in the care and transfer process to decrease door-to-needle, door-to-door, and door-to-balloon times among this patient population.

Sample: Subjects were adults (18 years of age and older) diagnosed with a ST-elevated myocardial infarction at a rural medical facility and transferred to the nearest STEMI receiving medical facility for specialized cardiac services. Subjects transferred for primary PCI and post thrombolytic therapy were included in this project (n = 8).

Methods: Retrospective data analysis of deidentified quality metric data was utilized to examine if treatment benchmarks set forth by the American Heart Association were met during the data collection period of January 2018 through September 2018. A voluntary survey was implemented at the rural medical facility to provide supplementary and clarifying information related to the treatment and coordination of transportation of ST-elevated myocardial infarction cases from February 2018 through August 2018 (n=3).

Conclusions: Of the eight cases reviewed in this project, none met all of the applicable quality metric benchmarks; all eight met the door-to-ECG benchmark, one met the door-to-needle benchmark, none met door-to-door or door-to-balloon benchmarks. Providers in rural areas can provide quality care with positive clinical outcomes among ST-elevated myocardial infarction patients through adherence to treatment guidelines and working as a collaborative team with transporting agencies to facilitate rapid interfacility transportation (American Heart Association, 2015; National Clinical Guideline Centre, 2013).

CHAPTER ONE

INTRODUCTION

Background

Deaths caused by myocardial infarction (MI) fit under the umbrella category of cardiovascular disease related mortality rates. Cardiovascular disease is the leading cause of death in Montana and is credited with causing 28% of all deaths in the state (Montana DPHHS, 2013). Yet Montana is home to only nine hospitals with the ability to perform percutaneous coronary intervention (PCI) (AHA, 2015). The inability of rural health care facilities to provide this specialized intervention for MI patients presenting to rural hospitals and clinics results in patients requiring time consuming transfers to larger medical facilities.

Myocardial Infarction

An MI, also commonly referred to as a heart attack or acute coronary syndrome (ACS), occurs when the flow of blood in the coronary arteries is partially or completely blocked (Cunningham, Brashers, & McCance, 2014; Gatenby, Shelton, & Blackman, 2014). The impediment of oxygen rich blood to the myocardium (heart muscle) for more than a few minutes results in damage to the myocardial cells (Cunningham et al., 2014). The most common cause of coronary artery occlusion is the development of atherosclerotic plaques which lead to progressive narrowing of the coronary arteries (Cunningham et al., 2014). Atherosclerotic plaques may then become unstable and prone

to ulceration or rupture (Cunningham et al., 2014). This leads to platelet adhesion and thrombosis (blood clot) formation on the underlying tissues of the exposed arterial wall (Cunningham et al., 2014). Thrombosis development in an already narrowed coronary artery further obstructs the flow of blood to the myocardial cells, and if not rapidly reversed leads to a decreased oxygenation of myocardial cells. The extent of myocardial cell ischemia can vary. Myocardial cells are impacted by ischemia quickly, and after several minutes lose their ability to appropriately function (Cunningham et al., 2014). This impairs the pumping ability of the heart. Myocardial cells can withstand ischemic conditions for approximately 20 minutes before myocardial cells die and become narcotic (Cunningham et al., 2014).

STEMI. The most critical MI cases result from cellular damage extending through the whole heart wall causing severe cardiac dysfunction (Cunningham et al., 2014). Full-thickness heart attacks produce marked elevation in the ST-segment on an electrocardiogram (ECG) study of the heart's electrical function and are commonly referred to as STEMI. Figure 1 shows an example of a STEMI on an ECG. A STEMI may result in long term disability or death for the individual suffering the MI (Cunningham et al., 2014). This has led to STEMI's being classified as a time sensitive emergency which requires rapid medical intervention for improved short and long-term outcomes (Dickson, Patrick, Crocker, Ward, & Gleisber, 2017; Gatenby et al., 2014).

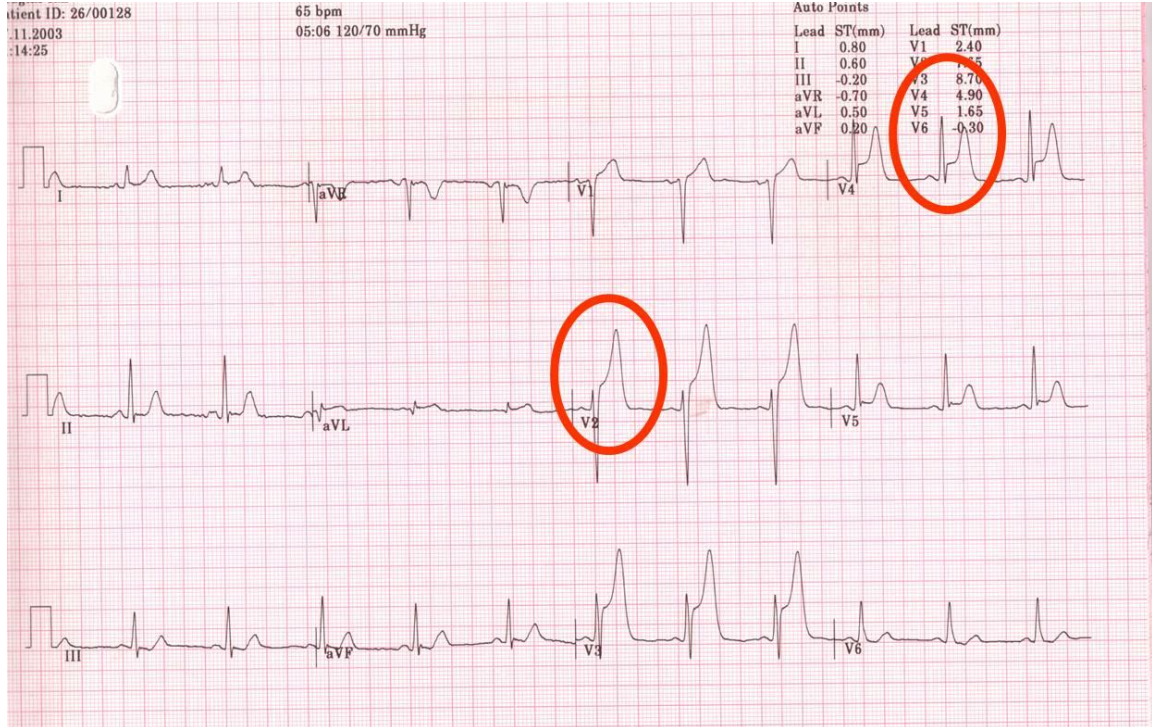


Figure 1. ECG Showing STEMI

Reperfusion

The restoration of normal blood flow to the myocardial cells through the coronary arteries is termed reperfusion. In the case of STEMI, rapid reperfusion is associated with greater potential benefits and decreased mortality (Gatenby, et al., 2014). There are two preferred reperfusion therapies for the management of the STEMI patient; PCI and thrombolytic medication (Gatenby, et al., 2014).

PCI. A nonsurgical procedure used for myocardial cell reperfusion through the introduction of an arterial cardiac catheter via the wrist or groin to the coronary arteries (National Heart, Lung, and Blood Institute, 2016). Contrast dyes are then utilized to visualize the arterial occlusion, and a balloon tip is inflated to re-open the coronary artery (National Heart, Lung, and Blood Institute, 2016). Under ideal circumstances, this results

in restoration of blood flow to the myocardium. Studies indicate that PCI is superior to thrombolytic medication and is considered the “Gold Standard” (Gatenby et al., 2014, p. 512) in STEMI treatment. The PCI procedure can be done as an initial reperfusion therapy option (primary PCI) or as a secondary therapy following administration of thrombolytic therapy (Krumholz et al., 2008).

Golden Window. Increased time to reperfusion leads to increased myocardial cell death for the individual experiencing a STEMI (Gatenby, et al., 2014). Hence the establishment of the “Golden 90 Minute Window” from time of presentation at the hospital door to the inflation of the PCI balloon; commonly referred to as door-to-balloon time (American Heart Association, 2014). Although, if the time from first medical contact to PCI is anticipated to exceed 90 minutes, then the patient should receive thrombolytics at the nearest medical facility followed by transfer to a PCI-capable facility with an adjusted goal door-to-balloon time ≤ 120 minutes (AHA, 2015).

Thrombolytic Therapy. Thrombolytic medications; such as Steptase (streptokinase) and TNKase (tenecteplase), are administered as intravenous infusions to break up the thrombosis obstructing the flow of blood to the myocardium (Drugs.com, 2017; Gatenby et al., 2014). Given the mechanism of these clot busting medications, administration of thrombolytic therapy presents an increased risk of bleeding. Due to this risk, not all STEMI patients are candidates for this reperfusion therapy. A summary of contraindications for thrombolytic therapy can be found in Appendix A. Candidates for thrombolytic therapy should have the medication transfusion initiated in ≤ 30 minutes

from arrival at a medical facility; commonly referred to as door-to-needle time (AHA, 2015). Literature on STEMI care often uses the terms thrombolytic therapy and fibrinolytic therapy interchangeably.

American Heart Association Treatment Guidelines

The American Heart Association (AHA) (2015) has published a practice guidelines for STEMI treatment (Appendix A). All health care facilities should strive to get an ECG within 10 minutes of first medical contact (AHA, 2015). Thrombolytic-eligible individuals should have a door-to-needle time ≤ 30 minutes (AHA, 2015). All STEMI patients should receive aspirin unless contraindicated (AHA, 2015). Patients requiring transfer to a PCI-capable facility should have an arrival to departure time from the non-PCI-capable medical facility of ≤ 45 minutes; commonly referred to as door-to-door time (AHA, 2015). Door-to-balloon time should be ≤ 90 minutes with an adjusted time of ≤ 120 minutes for cases unable to meet the 90 minute goal due to physical distance (AHA, 2015).

Rural

The term rural has many definitions and little agreement among these definitions (United States Department of Agriculture, 2018). The Montana Department of Health and Human Services (DPHHS) characterized rural areas by lack of essential resources; such as health care, with long commutes to these services. According to this definition, approximately 53% of Montanans and over one-sixth of Americans reside in rural or frontier areas (Montana DPHHS, 2013; Douthit, Kiv, Dwolatzky, & Biswas, 2015).

While the Health Resources and Services Administration (2017) defined rural as “all population, housing, and territory not included within an urban area” and reported an urban area consists “of at least 2,500 people”. For the purpose of this report, rural is defined as an area of lower population density with lack of essential resources.

Researchers have found evidence that disparities in access to quality health care services exist between rural and urban area with rural individuals experiencing comparatively higher rates of chronic disease and poorer health outcomes (Douthit et al., 2015). Limited health care options afforded to individuals electing to reside in rural areas further contributes to the health discrepancies between rural and more urban dwelling individuals.

Libby, Montana. Libby is located in Northwest Montana in Lincoln County, and is one of the rural, medically underserved areas in the state (Montana DPHHS, 2013; Health Resources & Services Administration, 2018). The small town is home to 2,656 of the county’s 19,687 residents (City-data.com, 2018; Public Health Lincoln County, 2018). The above state averages in unemployment and poverty rates; which are respectively reported as 7.3% unemployment rate and 17.9% residents living below poverty, level further contribute to the health disparities among Libby residents (City-data.com, 2018). In addition, one in five Libby residents is medically uninsured (Public Health Lincoln County, 2018).

Lincoln County also has an incidence rate for MI of 149.8 per 100,000 people, and an incident rate of 643.4 per 100,000 people for emergency department visits related to cardiovascular disease (Montana DPHHS, 2011; Public Health Lincoln County, 2018).

This is almost twice the reported incident rate for emergency department visits related to cardiovascular disease for the state of Montana (Public Health Lincoln County, 2018). Cabinet Peaks Medical Center (CPMC) is the only hospital in Lincoln County and is a 25-inpatient bed critical access hospital located in Libby. The hospital offers services in emergent care, inpatient medical-surgical care, minor general surgery, obstetrical care, laboratory, chemotherapy and infusion, imaging, physical therapy, occupational therapy, speech therapy, cardiopulmonary rehabilitation, dietary management, and more. The nearest medical facility offering interventional cardiology services is Kalispell Regional Medical Center (KRMC) located 90 miles away in Kalispell, Montana.

Interfacility transport from CPMC to higher level of care outside of Lincoln County is most often accomplished with an air ambulance service or a ground ambulance service. Two air ambulances take transports out of Libby. The Advanced Life-support and Emergency Rescue Team (A.L.E.R.T.) is an air ambulance service affiliated with KRMC and comes to Libby out of Kalispell. The second air ambulance is Life Flight which services Libby from their Sandpoint, Idaho base. Both air ambulance services require a 25-30 minute flight from their base to CPMC to retrieve patients for interfacility transfer and come with a hefty transportation fee upwards of \$20,000.

Four ground ambulance services assist CPMC in interfacility transports. Libby Volunteer Ambulance and Troy Volunteer Ambulance are located in Lincoln County and are the most frequently utilized ground transportation services. Libby Volunteer Ambulance is based less than a mile from CPMC, but interfacility transports require at least two off duty volunteer members to volunteer additional time for the transport.

Finding members willing to accept an interfacility transfer can be a time consuming process. Troy Volunteer Ambulance has a similar staffing issues for interfacility transfers and is based 23 miles from CPMC. Boundary Ambulance is a paid ambulance service based out of Bonners Ferry, Idaho. Interfacility transports from CPMC require Boundary Ambulance employees whom are off duty to volunteer to travel 52 miles to Libby to retrieve a patient, take the patient 90 miles to Kalispell, and drive the 142 miles back to Bonners Ferry. Evergreen Ambulance is a paid ambulance service based in Kalispell. Assisting CPMC in interfacility transports requires employees whom are off duty to volunteer to travel to Libby to retrieve a patient to bring back to Kalispell. Ground transportation runs in excess of \$1500. Additionally, ground and air interfacility transportation is not covered by all payor sources which generates large out of pocket bills for some individuals.

PICOT Question

In adults (18 years of age and older) experiencing a STEMI with initial presentation to a Montana critical access hospital emergency department that is a 90 miles drive from the nearest PCI-capable medical center for care, is there a delay in the achievement of the time sensitive treatment guidelines set forth by the AHA?

Project Description

The aim of this scholarly project is to analyze the treatment and transfer process of adult patients experiencing a STEMI with initial presentation to CPMC with interfacility

transfer to KRMC for PCI to generate quality improvement recommendations for changes in the care and transfer process to decrease door-to-needle, door-to-door, and door-to-balloon times among this patient population. The chief investigator operated under the hypothesis that there is a delay in consistent achievement of goal treatment and intervention times among this vulnerable population. It was further hypothesized that the delay is often associated with the coordination of the transfer of the patient. These hypotheses were developed by the chief investigator after years of experience as an emergency department nurse at CPMC and observing delays in care of time sensitive emergencies while attempting to coordinate transportation for interfacility transfer. Observations of other CPMC emergency department staff supports this hypothesis. Staff at CPMC have observed non-modifiable factors; such as weather and high patient volumes, and modifiable factors; such as availability of qualified transport staff, in-department time of transport crew, resistance to collaborate among the various volunteer ambulance services, and patient's ability to pay, contribute to prolonged door-in-door-out and door-to-balloon times.

Gatenby, Shelton, and Blackman (2014) found, "the earlier reperfusion occurs, the greater the potential benefit" (p. 515). This indicates the value of rapid reperfusion through consistently meeting the AHA objective door-to-needle, door-to-door, and door-to-balloon times. Through the utilization of patient care data, the chief investigator provides recommendations to decrease door-to-needle, door-to-door times, and door-to-balloon times among STEMI cases presenting to CPMC to empower health care

professions to overcome some of the health disparities rural Montana residents face when dealing with time sensitive emergencies.

Significance of Project

The inability of CPMC and other rural health care facilities to provide specialized, life-saving interventions for individuals experiencing a time sensitive emergency; such as STEMI, results in patients requiring time consuming transfers to larger medical facilities. “Nurses have a unique ability to apply their observational skills to understand the role of the designed environment to enable healing in their patients” (Zborowsky, 2014, p. 19). Nursing staff observations and treatment data from CPMC indicate delays in specialized intervention for the management of STEMI. Health care workers must remember “time is muscle” and expedited STEMI care provides improved one-year survival rates post MI (Martin et al., 2014, p. 112). Douthit, Kiv, Dwolatzky, and Biswas (2015) reported:

Rural residents have the same rights to quality health care as their urban counterparts. According to the World Health Organization, “Universal access to skilled, motivated and supported health workers, especially in remote and rural communities, is a necessary condition for realizing the human right to health, a matter of social justice.” This problem is pervasive, affecting both specialist and primary care, and services delivered directly by physicians, nurses and pharmacists alike. (p. 612)

These comments further support the need for proactive changes to decrease door-to-needle, door-in-door-out, and door-to-balloon times among rural health care facilities caring for STEMI patients. Staff observations related to STEMI care at CPMC indicate PCI treatment delays related to the transfer processes. The transfer of a critically ill

patient is a task designated to special care teams, often consisting of critical care certified paramedics and/or registered nurses, via helicopter or ambulance to the nearest appropriate health care facility. Most often, KRMC is the destination. Ground transport from Libby to the Kalispell is a 90 mile drive on a two-lane highway which is a 90 minute drive with good highway conditions. Helicopter transport presents a one-way flight time of 30 minutes once the helicopter team arrives from out of town to retrieve the patient at CPMC. Helicopter transportation is available out of Kalispell (ALERT) and Sandpoint (Life Flight) which is an approximate 30 minute flight from each helicopter base to Libby.

Physical distance and transport times are not the only barriers to achieving timely PCI among rural Montanans experiencing a STEMI. Nurses at CPMC have observed non-modifiable factors; such as weather and high patient volumes, and modifiable factors; such as availability of qualified transport staff, in-department time of transport crew, resistance to collaborate among the various volunteer ambulance services, and patient's ability to pay, contribute to prolonged door-in-door-out and door-to-balloon times. Although this is not a problem unique to Libby, as one observational analysis of 230 STEMI patients being transferred from rural, non-PCI-capable medical facilities to urban, PCI-capable medical centers in Illinois found that 67% of transport delays were attributed to prolonged wait times for transportation to arrive or depart (Aguirre et al., 2008). Another study further supports the need for change with their review of 115,630 STEMI patient with first medical contact in rural and urban medical facilities, whom underwent PCI within 12 hours of initial hospital presentation. They concluded

“dedicated strategies are needed to reduce delays associated with interhospital transfer of care” (Wang et al., 2010, p. 79).

CHAPTER TWO

REVIEW OF THE LITERATURE

A review of the current literature was conducted to evaluate the cumulative body of evidence related to the treatment and transfer of STEMI cases with initial presentation to a rural medical facility. Databases included in the literature review were CINAHL (Cumulative Index of Nursing and Allied Health), Cochrane, Medline (on Web of Science), PubMed, Google Scholar, and National Guideline Clearinghouse. The following search terms were used: “rural STEMI treatment”, “STEMI”, “myocardial infarction”, “thrombolytics”, “door-to-needle” & “STEMI, “door-to-door” & “STEMI”, “rural interfacility transfer” & “STEMI”. Treatment guideline and standard of care publications from cardiac care authorities; such as the American College of Cardiology (ACC) and AHA, were utilized as the foundation of this project. Supplementary evidence was selected based on the strength of the evidence and relevance to STEMI management in the rural setting and interfacility transportation. Research which contraindicated current treatment guidelines and standards of care in the United States was excluded. Additionally, research with low study participant numbers, lack of supporting literature review, and non-peer reviewed publications was excluded from this project.

STEMI Management

The ACC and AHA have taken a leadership role in reviewing the latest and strongest evidence to develop measures of quality for the care provided to individuals with

cardiovascular disease. In 2008, they published a “seminal document dedicated to characterizing deficiencies in delivering effective, timely, safe, equitable, efficient, and patient-centered medical care” (Krumholz et al., 2008, p. 2047). This document is used as the quality metric standard for the treatment of STEMI cases at CPMC.

The AHA has also published a quick reference and order sheet to facilitate treatment and interfacility transfer of STEMI cases in Montana (Appendix B). The cumulative body of evidence and treatment guidelines recommend the following for the management of STEMI cases:

- Immediately assess eligibility for coronary reperfusion therapy via primary PCI or thrombolytic therapy (National Clinical Guideline Centre, 2013)
- Obtain an ECG within 10 minutes of patient presentation with complaints of ACS to make a rapid and informed diagnosis of STEMI (AHA, 2015)
- Administer aspirin within 24 hours before or after hospital arrival unless contraindicated (AHA, 2015; Krumholz et al., 2008)
- Deliver selected coronary reperfusion therapy as quickly as possible (National Clinical Guideline Centre, 2013)
- Thrombolytic-eligible individuals should have a door-to-needle time of ≤ 30 minutes (AHA, 2015; Krumholz et al., 2008)
- STEMI patients should remain at a non-PCI-capable facility for no longer than 45 minutes to decrease time to PCI (AHA, 2015; National Clinical Guideline Centre, 2013)

- Rapid transport of all STEMI patients to a PCI-capable medical center following the administration of thrombolytics to start the reperfusion process and decrease time to necessary further evaluation and possible intervention (AHA, 2015; National Clinical Guideline Centre, 2013)
- ECG 60 to 90 minutes after administration of thrombolytic therapy. For those who have residual ST-segment elevation suggesting failed coronary reperfusion, emergent follow up PCI may be indicated. Do not repeat fibrinolytic therapy (National Clinical Guideline Centre, 2013)
- Door-to-balloon time for primary PCI of ≤ 90 minutes; adjusted to ≤ 120 minutes for cases which prolong transport is required for primary PCI (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013)

Coronary Reperfusion Therapy

Gatenby et al. (2014) reported primary PCI has well established superiority to thrombolytic therapy. Studies have indicated that performing PCI within 120 minutes of onset of ACS symptoms resulted in better STEMI survival rates than receiving early thrombolytic therapy (Choi et al., 2017). This is further supported by the findings of the integrated review done by Martin et al. (2014), which concluded a strong, positive relationship between decreased door-to-balloon-times and reduced in-hospital mortality.

It has been extensively proven that timely reperfusion improves survival among STEMI patients. Guidelines recommend PCI within 90 minutes or less from arrival at a PCI-capable hospital with the alternative of thrombolytic therapy ≤ 30 minutes for cases in which timely transfer to a PCI-capable hospital is not feasible (Krumholz et al., 2008;

AHA, 2015; National Clinical Guideline Centre, 2013). Therefore, thrombolytics play a key role in the management of thrombolytic eligible STEMI patients whom are unable to receive timely primary PCI. However, many hospitals in the United States still do not have the capacity to perform PCI and are located in geographical areas where timely transfer for PCI is not feasible (Hira et al., 2016). This results in failure to meet guideline-recommended timely reperfusion with primary PCI. Treatment data among transferred STEMI cases in the United States indicated achievement of a door-to-balloon of ≤ 2 hours in a little more than 25% of cases, between 2 and 4 hours in a little more than 50% of cases, and ≥ 4 hours in about 20% of cases (Krumholz et al., 2008). The ACC and AHA also recognized that rural areas present long distances to PCI and transfer is required for these patients. In keeping with current STEMI care guidelines, the ACC and AHA concluded if reasonable primary PCI times could not be achievable then thrombolytic therapy should be administered to eligible patients (Krumholz et al., 2008).

For every 10 minute delay in performing PCI, the mortality benefit of PCI compared to thrombolytic therapy is decreased by 1% (Hira et al., 2016). Both reperfusion strategies become almost equivalent at 62 minutes (Hira et al., 2016). This further supports that rural, non-PCI-capable medical facilities can adequately care for STEMI patients with thrombolytic therapy followed by immediate transfer to a PCI-capable medical center. The treatment of choice for STEMI patients when primary PCI cannot be performed in ≤ 120 minutes is thrombolytic therapy (Gatenby et al., 2014). Thrombolytic agents have been shown to be most beneficial when given within 4 hours

of onset of ACS symptoms with sequential PCI preformed within 24 hours (Gatenby et al., 2014).

Hira et al. (2016) conducted a retrospective analysis of data gathered for the Get with The Guidelines – Coronary Artery Disease (GWTG-CAD) database from January 2003 to December 2008. Data was analyzed using Cochran-Armitage test to assess trends in timeliness of reperfusion with a $P < 0.05$ considered statically significant. Researchers identified 29,190 STEMI cases from 229 American hospitals with 2441 (8.4%) cases receiving thrombolytic therapy. Of those cases, 38.2% achieved door-to-needle times \leq 30 minutes. Researchers also noted that median door-to-needle times increased from 36 to 60 minutes ($P=0.005$) while median door-to-balloon times decreased from 94 minutes to 64 minutes ($P=0.001$) over the study period. It was found that use of primary PCI and achievement of benchmark door-to-balloon times increased. Although in-hospital mortality increased as door-to-needle times for thrombolytic therapy as door-to-needle times increased. Researchers concluded that although quality metrics for primary PCI were improving, thrombolytic therapy remains an important reperfusion therapy for STEMI cases that are unable to achieve timely primary PCI and there are opportunities for improving STEMI care among this population.

Other research found similar results. Researchers reviewed of treatment data from the Acute Coronary Treatment and Intervention Outcomes Network Registry – Get With the Guidelines database between July 2008 and March 2012 to assess the association with inter-hospital transfer times to reperfusion strategy utilized among STEMI patients in the United States. Researchers identified 22,481 STEMI cases eligible for primary PCI or

thrombolytic therapy and transferred to one of 366 STEMI receiving centers for analysis. Data analysis was done by the National Cardiovascular Data Registry data center at the Duke Clinical Research Institutes using a $P < 0.05$ as statistically significant. It was found that among patients presenting to a non-PCI-capable hospital and transferred for PCI, only 51.3% of patients achieved door-to-balloon times of ≤ 120 minutes. Among patients eligible to receive thrombolytic therapy with estimated drive time over 60 minutes to a PCI-capable medical center, only 52.7% of patients received thrombolytic therapy. Median door-to-needle time was 34 minutes and only 43.8% of patients achieved a door-to-needle time of ≤ 30 minutes. Researchers concluded that nationwide, non-PCI-capable medical facilities frequently fail to achieve STEMI care benchmarks for reperfusion with thrombolytic therapy or primary PCI. Among patients with prolonged transport times to a PCI capable medical center, thrombolytic therapy was associated with no significant difference in mortality but presented an increased risk of bleeding compared to primary PCI. (Vora et al., 2015).

Hierarchical models were utilized to evaluate independent effect of door-to-needle time on in-hospital mortality in another study. It was found that in-hospital mortality was lower with shorter door-to-needle times (2.9% for ≤ 30 minutes, 4.1% for 31 to 45 minutes and 6.2% for > 45 minutes; $P < 0.001$ for trend). Compared with those experiencing door-to-needle times ≤ 30 minutes, adjusted odd ratios of dying were 1.17 (95% confidence interval 1.04 to 1.31) and 1.37 (95% confidence interval 1.23 to 1.52; $P < 0.001$ for trend) among patients with door-to-needle time of 31 to 45 and > 45 minutes. Researchers conclusion, timely administration of thrombolytic therapy continues to have

a significant impact on mortality in the modern era (McNamara et al., 2007). These findings were further supported by the Cooperative Cardiovascular Project evaluating 30 day mortality rates among individuals whom received thrombolytic therapy. Researchers found 30 day mortality rates significantly increased as door-to-needle time increased (12.5% for those treated \leq 30 minutes, 14.1% for those treated in 31 to 90 minutes, and 19.9% for those treated $>$ 90 minutes) (McNamara et al., 2007).

The majority of Montanans reside in rural areas which prevents them from reaching a PCI-capable medical facility within 30 minutes of onset of ACS symptoms (Montana DPHHS, 2013). Patients then seek treatment and evaluation at non-PCI-centers and require health care providers to intervene in situations where timely primary PCI is not possible. Nascimento, Sousa, Demarqui and Riberiro (2014) conducted a systematic review with quantitative analysis of 59 randomized trials to evaluate the impact of pharmaceutical treatment (thrombolytics, anticoagulants, and antiplatelets) and PCI on mortality, reinfarction, and major bleeding among STEMI patients. They found thrombolytics present a risk of a major bleed, but evidence indicates the clinical benefits outweigh the risk of bleeding among STEMI patients (Nascimento, Sousa, Demarqui, & Riberiro, 2014). Research also supports adherence to STEMI algorithms for rural community providers, and empowering providers to initiate reperfusion therapy with thrombolytics while coordinating interfacility transfer for primary or rescue PCI (Aguirre et al., 2008).

A quality improvement study conducted at a 131-bed, rural general hospital in New Zealand demonstrated the simple feasibility of improved door-to-needle times

among rural health care facilities. Researchers noted frequent failure to meet the goal door-to-needle time of ≤ 30 minutes; often missed by only 5 to 10 minutes. Through the utilization of low-cost interventions; such as educational sessions for staff, posters and training on use of remote ECG interpretation system, researchers found a steady improvement in door-to-needle times; 74% patients receiving thrombolytic therapy ≤ 30 minutes compared to a pre-intervention incidence of 43% (Jordan & Caesar, 2016).

Thrombolytic Therapy Rates of Reperfusion.

A recent study done in a Pakistan hospital reviewed the success of thrombolytic therapy among 83 STEMI patients treated with streptokinase from February 2015 to June 2015. Researchers found that out of the 59 (71.08%) STEMI patients whom received thrombolytic therapy within 12 hours of ACS symptom onset, 43 (72.88%) had complete resolution of STEMI, nine (15.25%) had partial resolution, and seven (11.86) failed to resolve per ECG findings. Of the 24 (28.92%) STEMI patients whom received thrombolytic therapy at > 12 hour of ACS symptoms onset, none had complete resolution, 12 (50%) had partial resolution, and 12 (50%) failed to resolve per ECG findings (Saleem, Khan, & Shafiq, 2016).

These findings are similar to those of a study analyzing STEMI treatment data from October 2011 to October 2013 related to the overall success rates of thrombolytic therapy among 100 randomly selected patients. It was found that the overall success rate of thrombolytic therapy using streptokinase and tenecteplase was 65% among STEMI patients. These findings were found to be comparable to the findings of a reported sub study which indicated resolution of STEMI in 54% of cases with streptokinase and

heparin administered \leq 90 minutes of arrival to the emergency department. Researchers concluded that the time frame to receiving thrombolytic therapy was the most powerful indicator of successful resolution of STEMI. Data showed that successful resolution of STEMI occurred among 80% of patients treated within 4 hours of ACS symptoms onset, 61.7% of patients treated after 4 hours but within 8 hours of ACS symptoms onset, and 30.7% of patients treated after 8 hours but within 12 hours of ACS symptom onset (Ronad & Dixit, 2015).

Interfacility Transfer

The Trial of Routine Angioplasty and Stenting After Fibrinolysis to Enhance Reperfusion in Acute Myocardial Infarction (TRANSFER-AMI) showed that high-risk STEMI patients receiving thrombolytic therapy and routine early PCI had improved short-term outcomes compared to patients receiving thrombolytic therapy alone or delayed PCI (Hira et al., 2016). This is further supported by research which states the rural providers can adequately care for STEMI patients (Aguirre et al., 2008). The research supports adherence to STEMI algorithms for rural community providers, and empowering providers to initiate reperfusion therapy with thrombolytics while coordinating interfacility transfer for primary or rescue PCI (Aguirre et al., 2008). Studies have also indicated that early reperfusion result in decreased mortality among STEMI, yet the interfacility transfer process from a non-PCI-center to a PCI-center accounts for substantial delays in STEMI care (Kawecki et al., 2017).

Transfer to a PCI-capable medical center post thrombolytic therapy initiation for PCI has been found to be associated with significant reduction of death, reinfarction, and

stroke compared to the more conservative, non-invasive treatment option of no thrombolytic administration and thrombolytic administration with admission for observation at a non-PCI-capable medical center (Bohmer, Hoffmann, Abdelnoor, Arnesen, & Halvorsen, 2010). Other research has recommended that among patients whom are unlikely to receive timely primary PCI, thrombolytic therapy should be administered to eligible patients prior to transfer for early cardiac angiography.

Researchers found that among 15,437 patients with estimated transport times of 30 to 120 minutes whom were eligible for thrombolytic therapy or primary PCI, only 5296 (34.3%) received pretransfer thrombolytic therapy with a median door-to-needle time of 34 minute. The median time to transfer to a PCI-capable medical center was found to be 48 minutes after receiving thrombolytic therapy with 97.1% of cases undergoing follow-up angiography (Vora et al., 2015).

An observational analysis of 230 STEMI patients being transferred from rural, non-PCI-capable medical facilities to urban, PCI-capable medical centers in Illinois found that 67% of transport delays were attributed to prolonged wait times for transportation to arrive or depart (Aguirre et al., 2008). Another study further supports the need for change with their review of 115,630 STEMI cases with first medical contact in rural and urban medical facilities, whom underwent PCI within 12 hours of initial hospital presentation. They concluded “dedicated strategies are needed to reduce delays associated with interfacility transfer of care” (Wang et al., 2010, p. 79).

Weisberg, Fitch, Towner, and Darling (2009) reported their findings from a quality improvement project in which a policy of transferring patients from a hospital

lacking specialized cardiac care capabilities to a hospital with cardiology services without continuous intravenous drips was implemented in Massachusetts for a hospital-based critical care air/ground transport system. Researchers found that the use of bolus only medications reduced in-department times among transferred STEMI patients.

Collaborative Care Approach

A seminal document from the ACC and AHA has commented on the importance of understanding the persistent gaps in the delivery of effective STEMI therapy to generate reduction in delays to reperfusion (Krumholz et al., 2008). Evidence has shown that “active collaboration between EMS [emergency medical service] and clinicians caring for patients with acute myocardial infarction is significantly associated with lower risk-standardized mortality rates and is an actionable opportunity for hospitals to improve their care for patients hospitalized with acute myocardial infarction” (Landman et al., 2012, pp. 185-186). The development of a collaborative team is proven to be an important factor in the delivery of high-quality and safe patient care and has been shown to result in improved core measure performance related to MI care (Landman et al., 2012).

Summary

Rapid myocardial cell reperfusion through primary PCI or thrombolytic therapy is key to limiting death and disability resulting from myocardial cell death among STEMI patients (Martin et al., 2014). Although primary PCI is revered as the “Gold Standard” in

STEMI care, individuals can have positive outcomes with rapid administration of thrombolytic therapy and transfer to a PCI-capable facility (Gatenby et al., 2014; Kawecki et al., 2017; Vora et al., 2015). The cumulative body of evidence discussed in this chapter supports the administration of thrombolytic therapy to eligible patients at a non-PCI-capable facility prior to transport to a PCI-capable facility in cases where PCI is not feasible in ≤ 120 minutes of first medical contact for treatment of STEMI (Vora et al., 2015, Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013). Moreover, this knowledge may stimulate efforts among referral hospitals, receiving hospitals, and transportation agencies to collaborate to review and improve their joint performance in the management of STEMI cases (Krumholz et al., 2008).

CHAPTER THREE

METHODS

IRB Approval

The project proposal was presented to the Montana State University (MSU) Institutional Review Board (IRB) and KRMC IRB. The scholarly project was approved and deemed exempt by both entities. Additionally, the project was approved by the director of nursing and medical director at CPMC.

Problem

The initial motivation of this quality improvement project was to provide insight and recommendations to limit delays in care for time sensitive emergencies among rural individuals requiring transfer for life saving intervention at an urban medical center.

Design

This scholarly project utilized retrospective data analysis of recorded quality metric data related to the management of adult patients experiencing a STEMI with initial presentation to CPMC emergency department and subsequent transfer to KRMC. The aim of the project was to determine if timely interfacility transfer coordination was hindering the achievement of goal treatment times set forth by the AHA and ACC among this vulnerable patient population. Each medical facility routinely extracts data related to achievement of goal interventions and treatment times for the care of STEMI patients for

reporting as quality care measures. This deidentified data was provided to the chief investigator from both medical facilities for analysis for qualifying STEMI cases between January 2018 through September 2018. Due to the low volume of STEMI patients presenting to CPMC's emergency department annually, quality metric data collect at CPMC from April 2016 through September 2017 was also reviewed to better identify trends in STEMI management at CPMC. Additional supplementary and clarifying information was not available for these cases due to reported difficulty extrapolating this older data, and this is inclusive of the transfer destination of these earlier STEMI cases.

Survey

The quality metric data provided by CPMC and KRMC (displayed in the following chapter) indicated if goal treatment interventions and times were achieved. However, this data fails to provide rationale to cases that do not meet treatment goals and does not clearly depict the coordination of the transfer. To address this data gap, a voluntary survey was implemented in the CPMC emergency department in February 2018 through August 2018 (Appendix B). The survey was designed by the chief investigator to further explore specific factors that have historically contributed to delays in STEMI care. The survey was designed as a post-event survey to be completed by emergency department staff at CPMC after transferring a STEMI patient. All staff (providers, nurses, and technicians) involved in the coordination of care and transfer of the patient were able to complete the voluntary and anonymous survey. Survey data was then paired with the intervention and treatment time data based on date and time of subject encounter. Data was not collected related to the characteristics of the respondents.

Subject Selection

Subjects were adults (18 years of age and older) diagnosed with a STEMI at CPMC; whom were not currently pregnant or incarcerated, requiring transfer for specialized cardiac services during the data collection period of this project of February 2018 through September 2018. Cases receiving thrombolytic therapy did not have recorded data related to STEMI care post therapy so all of the thrombolytic therapy receiving cases were included in this project.

Exclusion

STEMI cases which were transferred to higher level care other than KRMC for primary PCI were excluded from study. Extreme outliers are further discussed in the next chapter and excluded from data analysis.

Transfer Coordination Data

Additional data related to the coordination of transportation for interfacility transports from the CPMC emergency department was collected by emergency department staff separately from this project and shared by J. Thornton (personal communication, May 14, 2018). This data was collected during an overlapping time frame as this project (January 2018 through April 2018), and was collected to better quantify the difficulties coordinating interfacility transfers. A tally system was utilized to document transport entity contacted, acceptance or decline of the transport, and rationale to declined transports while attempting to secure ground or air transport.

Unlike the design of the project, data from this record was not diagnosis or accepting facility specific. The chief investigator elected to include this supplementary data in this project to provide additional insight into the issues CPMC faces when coordinating transportation to higher level of care related to weather, mechanical issues, staffing, and patient's ability to pay. Additionally, the data demonstrated rational to prolonged in department times for time sensitive emergencies.

Analysis

Data analysis was completed by the chief investigator and verified by the committee chair of this scholarly project. Outside data analysis was not utilized related to the limited number of cases reviewed and the simplistic nature of the required calculations. Basic statistical calculations of mean (average), median (middle), and mode (most often occurring) were utilized to quantify the achievement of quality metric STEMI care goals. Percentage calculations were also utilized to display the frequency of various occurrences analyzed in this project.

Nursing Theory

The chief investigator's goal is to present evidence that supports the alteration of available resources in a rural environment to effectively improve the outcomes of time sensitive emergencies. Florence Nightingale believed a nurse's function was to "manage the environment so as to put the patient in the best possible situation for the natural laws of health to act upon him or her; thus, the ultimate goal of nursing activities was patient

health” (Masters, 2015, p. 29). Her work supports the importance of caring for a patient in a holistic fashion with consideration for relationships between the patient’s environment and wellness (Medeiros, Enders, & Lira, 2015, p. 521). Nightingale’s Environmental Theory of Nursing is a time-tested model that “has concepts that serve today’s parameters, and its relevance is considered a landmark in the history of nursing” (Medeiros, Enders, & Lira, 2015, p. 518).

Nightingale did not set out to become the first nursing theorist, but her documents contain “philosophical assumptions and beliefs regarding all elements found in the metaparadigm of nursing” (Current Nursing, 2012) which can be utilized in modern settings and offer a strong framework for nursing research. The Environmental Model of Nursing also stresses the physical environment with recognition of social, external, and internal environments (Masters, 2015). Due to this, Nightingale’s Environmental Model of Nursing was selected as the guiding framework to provide structure for the evaluation of the effects of the rural environment on the care of the critically ill individual in this scholarly project. The Environmental Model of Nursing has been reported as a strong tool to assist nurses in the exploration of aspects of the designed environment that affect the quality of health care (Zborowsky, 2014).

Assumptions

Although Nightingale “did not explicitly state any theoretical assumptions, several assumptions can be extracted from her work” (Masters, 2015, p. 29). The investigator utilized some of these assumptions to develop this project. One of significance to this project is that “nursing is achieved through environmental alterations”

(Current Nursing, 2012). Nightingale's assumptions focused on managing the environment to improve health care motivated the investigator to explore the health disparities among rural Montanans and develop quality improvement recommendations to alter the resources available in the rural environment to improve health outcomes.

Change Theory

The Lewin's Theory of Change was utilized in this quality improvement focused scholarly project to provide structure to influence lasting changes based on the findings of this report. Although implementation of change is not included in this project, recommendations for change are made and this theory provided the chief investigator with structure for designing these recommendations. The theory is based on three major concepts (driving forces, restraining forces, and equilibrium), three stages (unfreezing, change, and refreezing), and requires that prior learning to be rejected and replaced. (Nursing Theory, n.d.; Nursing Theories, 2011).

Three Major Concepts

Driving forces push in a direction that influence change to occur (Nursing Theory, n.d.; Nursing Theories, 2011). These forces facilitate change by pushing in a desired direction and influencing a shift in equilibrium towards change. Restraining forces are the opposite of driving forces and counter the driving forces (Nursing Theory, n.d.; Nursing Theories, 2011). These forces may hinder changes by pushing in the opposite direction and oppose change. Equilibrium is the state where driving and restraining forces are equal, and no change occurs (Nursing Theory, n.d.; Nursing Theories, 2011). Driving and

restraining forces must be analyzed prior to implementing change in order to successfully implement lasting change (Nursing Theory, n.d.; Nursing Theories, 2011).

Three Stages

The first stage of Lewin's Theory of Change is unfreezing, which is the process of finding a method of making it possible to let go of old, counterproductive patterns (Nursing Theory, n.d.; Nursing Theories, 2011). Unfreezing is a necessary step to overcome the strains of individual resistance and group conformity (Nursing Theory, n.d.; Nursing Theories, 2011). Three methods can lead to achievement of unfreezing (increase driving forces that direct behavior away from the existing situation or status quo, decrease the restraining forces that negatively affect the movement from the existing equilibrium or finding a combination of the first two methods) (Nursing Theory, n.d.; Nursing Theories, 2011). Change is the second stage and is also referred to as the "movement stage" (Nursing Theory, n.d.; Nursing Theories, 2011). This stage is the process of change in thoughts, feeling, behavior, or all three that is more liberating or productive. The final stage is refreezing which is the process of establishing the change as the new habit to become the standard operating procedure (Nursing Theory, n.d.; Nursing Theories, 2011). Without this final stage, it is easy to go back to old habits.

Application

Major Concepts. Utilizing the framework provided by the Lewin's Theory of Change, the chief investigator identified driving forces for change as collaborators (team leaders and change champions) and facilitators (an abundance of supporting evidence,

documented success with similar quality improvement projects, and collaborators recognition of need for improvement). Restraining forces were found to be barriers (change resistant culture and lack of collaboration between stakeholders). Equilibrium was identified as the busy emergency environment and separation of individuals transporting and treating entities.

Stages. Lewin's Change Theory's three stages were also considered. The investigator plans to unfreeze by increasing the driving forces through educating project stakeholders on the importance of meeting AHA goal door-to-needle, door-to-door, and door-to-balloon times. Along with examples of how this has been successfully done at other facilities and has potential to result in improved patient outcomes. In short, this is the dissemination of evidence contained in chapter two of this essay. The change stage will be implemented later through small, low-cost changes which will theoretically result in stakeholders seeing improved productivity and patient outcomes. Refreezing will occur following the change through sharing patient care data related to door-to-balloon, door-to-door, and door-to-balloon times with staff to see the success of the implemented changes and enforce continuation of these changes as the practice norms.

CHAPTER FOUR

RESULTS

Quality metric data related to the treatment of STEMI cases at CPMC from January 2018 through September 2018 was analyzed in conjunction with the responses from the voluntary STEMI Transfer Survey implemented in the CPMC emergency department February 2018 through August 2018. Supplementary data was also provided related to patient arrival and depart time at CPMC. KRMC provided data related to cardiac catheterization lab arrival and PCI balloon inflation time for cases which thrombolytic therapy was contraindicated or not given. Door-to-door and door-to-balloon data was not available for cases that received thrombolytic therapy at CPMC prior to transfer, because this quality metric data is not applicable after thrombolytic therapy. Additional historical STEMI quality metric and transport coordination data were also analyzed in conjunction with the original project data.

Survey

The voluntary STEMI Transport Surveys had a response rate of 50%. Three of the six STEMI cases treated in the CPMC emergency department between February 2018 and August 2018 had the post-event survey completed. None of the cases had more than one survey completed. Table 1 displays the general findings of the surveys.

Table 1. STEMI Transport Survey Results

Date of Encounter	Mode of Transport to ER	Destination for Interfacility Transfer	Mode of Interfacility Transfer	Number of Calls Made to find Transport	Time Transport Agency Agrees to Transfer	Time Transport Agency Arrives at CPMC	Time Transport Agency Departs CPMC	Weather Conditions
2/22/18	Private Vehicle	KRMC	ALERT	1	N/A	N/A	N/A	“clear, able to fly”
4/10/18	Private Vehicle	KRMC	ALERT	1	1311	1338	1350	“rain moving in”
6/4/18	Ambulance	KRMC	ALERT	1	2043	2137	2148	“partly cloudy”

In-Department Time

In-department time is the number of minutes a transporting agency spends in the department from which they are retrieving a patient for transportation. This data is not a reported quality measure but has been repeatedly cited by clinical staff at CPMC as a potential source of delays in care. Thus, collection of arrival and depart time of transporting agency was included on the survey. Of the three surveys, two surveys provided this information. The in-department times for the two reported cases were found to be 12 and 11 minutes.

Coordination of Transport

All three of the cases with completed surveys (n=3) required only one call to arrange for accepting transportation via ALERT. However, Table 4 indicates that securing transportation is frequently compromised by weather, mechanical, staffing and patient diagnosis, which is not reflected in this small group of cases.

Prolonged Door-to-Door

Additionally, the survey asked if the patient was in the emergency department for more than 60 minutes. If the answer was “yes”, then staff were prompted to provide a free text explanation as to why. Two of the surveys indicated the patient was in the emergency department for more than 60 minutes. This was attributed to “waiting for ALERT to arrive” and “setting up transfer”. The third survey respondent incorrectly responded that the patient was not in the emergency department for more than 60 minutes, because quality metric data found that case was in the emergency department for 65 minutes.

Supplementary Case. Information on an additional STEMI case occurring outside the data review window was provided to the chief investigator by CPMC that clearly defined delays in care related to transportation of time sensitive emergencies expressed by CPMC staff. In October 2018, a STEMI case presented at a primary care clinic in Troy, Montana; located approximately 23 miles from CPMC. An ECG was completed and transmitted to the CPMC emergency department at 1207; 11 minutes after the local ambulance was dispatched. The emergency department physician was able to make initial contact with interventional cardiology at KRMC prior to the patient’s arrival at CPMC and resulted in ALERT getting dispatched shortly after KRMC was notified of the STEMI case; at approximately 1231. Records indicate that ALERT lifted off from KRMC at 1244 and returned at 1409; 98 minutes after being dispatched for the transfer. CPMC staff reported an arrival time of 1315 and depart time of 1338, resulting in an in-

department time of 23 minutes for a STEMI case which CPMC emergency department staff described as “stable”.

Door-to-ECG

Overall, CPMC met the bench mark for ECG ≤ 10 minutes of arrival to emergency department (see Table 2 and Table 3) (AHA, 2015). Of all the cases April 2016 through September 2018 (n = 18), the ECG times ranged from one minute to 14 minutes with 94.4% of cases achieving the ≤ 10 minute benchmark. This indicates delays in care are not related to delays in early identification of STEMI.

Table 2. STEMI Quality Metric Data April 2016 Through September 2017

Data Collection Period (Month/Year)	Case Number	Time to Thrombolytic Therapy (Door-to-Needle Time) Goal 30 min	Reason Documented for not Administering Thrombolytic Therapy	Time to Transfer to Another Facility for Primary PCI (Door-to-Door Time) Goal 45 min	Time to ECG Goal 10 min
Apr/May/June 2016	2016.1	44 min			14 min
Jul/Aug/Sep 2016	2016.2		No	138 min	6 min
Jul/Aug/Sep 2016	2016.3		No	297 min	6 min
Jul/Aug/Sep 2016	2016.4	30 min			8 min
Oct/Nov/Dec 2016	2016.5	28 min			11 min
Oct/Nov/Dec 2016	2016.6	22 min			6 min
Apr/May/June 2017	2017.1		Yes	85 min	6 min
Apr/May/June 2017	2017.2		No	221 min	54 min
Jul/Aug/Sep 2017	2017.3		N/A	74 min	6 min
Jul/Aug/Sep 2017	2017.4		N/A	96 min	5 min

Table 3. STEMI Treatment Data January 2018 Through September 2018

Date of Encounter	Arrival Time	Time to ECG Goal 10 min	Time to Thrombolytic Therapy (Door-to-Needle Time) Goal 30 min	Reason Documented for not Administering Thrombolytic Therapy	Time to Transfer to Another Facility for Primary PCI (Door-to-Door Time) Goal 45 min	PCI Balloon Time at KRMC (Door-to-Balloon Time) Goal 120 min	Depart Time
1/9/18	2342	9 min	68 min	*Documented reason for delay			0243 On 1/10/18
2/22/18	1216	5 min	41 min				1354
4/10/18	1254	6 min	31 min				1359
6/4/18	2033	5 min		Yes	76 min	2246 (133 min)	2149
6/18/18	0942	7 min	28 min				1055
7/14/18	1644	9 min	204 min	**Documented reason for delay			2045
7/16/18	1413	5 min		Yes	***Not reported		1648
9/6/18	1734	1 min		Yes	56 min	1928 (114 min)	1830

*Complete patient history with lengthy discussion with cardiology, patient, and patient's family related risks and benefits of thrombolytic therapy

** Initial ECG did not show ST-elevation but patient later in course experienced a rhythm change with ST-elevation noted

*** Patient determined to have Takasubo (broken heart syndrome) with clean cardiac catheterization

Door-to-Needle

The 2016 through 2017 quality metric data displayed in Table 2 indicates that out of the four patients that qualified for thrombolytic therapy (n=4), three achieved door-to-needle benchmark of ≤ 30 minutes (AHA, 2015; Krumholz et al., 2008). The fourth case missed the benchmark by 14 minutes; door-to-needle time reported as 44 minutes.

January 2018 through September 2018 quality metric data displayed in Table 3 indicates that of the five patients that qualified for thrombolytic therapy (n =5), one case achieved door-to-door time of ≤ 30 minutes with a mean door-to-needle time of 74.4

minutes. However, two of the cases had documented reasons for delayed thrombolytic therapy. Removal of these cases results in an adjusted mean door-to-needle time of 33.3 minutes for the remaining three cases (n=3).

Analysis of STEMI data related to door-to-needle times from both Table 2 and Table 3 shows that thrombolytic therapy was utilized as primary STEMI treatment in nine out of 18 cases; 40% (n=4) of cases 2016 through 2017 and 62.8% (n=5) of 2018 cases. It appears that CPMC is moving towards being more proactive in initiating early thrombolytic therapy. Although, these percentages are not adjusted for individual patient factors and documented reason for not receiving thrombolytic therapy.

Door-to-Door

The data displayed in Table 2 indicates that of the six patients diagnosed with a STEMI and transferred for PCI between April 2016 to September 2017 (n=6), none met the recommended door-to-door time of ≤ 45 minutes (AHA, 2015; National Clinical Guideline Centre, 2013). It was found that the door-to-door time ranged from 74 minutes to 297 minutes with a mean of 152 minutes. Table 3 displays two STEMI cases transferred for primary PCI in 2018 (n=2), neither of these case meet the benchmark door-to-door time of ≤ 45 minutes (AHA, 2015; National Clinical Guideline Centre, 2013). The mean door-to-door time for the 2018 data was found to be 66 minutes and indicates mean door-to-door time has improved over time.

Of the eight reported cases between April 2016 through September 2018 (n=8), the mean door-to-door time was found to be 130.4 minutes. Although two cases were

greater than 200 minutes and historical data related to the rationale behind this prolonged door-to-door time was not available. Removal of these two outliers finds an adjusted mean door-to-door time of 87.5 minutes among the remaining six cases.

Thrombolytic Therapy

Thrombolytic therapy most often results in full or partial reperfusion, yet some case still requires emergent PCI (National Clinical Guideline Centre, 2013). Evidence and treatment guidelines support transferring patients to facility with cardiology services following the administration of thrombolytic medication (AHA, 2015; National Clinical Guideline Centre, 2013). This supports expediting the transfer of STEMI cases following the initiation of thrombolytic therapy. To further explore this, the chief investigator manually calculated the door-to-door times of the STEMI cases which received thrombolytic therapy prior to transfer using arrival and depart times provided by CPMC. It was found that the range for door-to-door time among patients receiving thrombolytic medication prior to transfer was 65 minutes to 241 minutes. The 241 minute case did not have an initial presentation of STEMI and was transferred 37 minutes after receiving thrombolytics. Due to nature of this case, it was excluded from further calculations. Of the remaining five cases (n=5), it was found that the mean door-to-door time was 114.4 minutes.

Door-to-Balloon

During the projects full data collection period (February 2018 through August 2018), one patient was found to not be a thrombolytic therapy candidate and door-to-

balloon time was a utilized quality measure. This case also had an accompanying STEMI Transport Survey completed to provide additional data related to the coordination of the interfacility transport. As Table 1 and Table 3 indicate, the patient arrived at CPMC at 2033, ECG was completed at 5 minutes post arrival, dispatch of transporting agency at 2043, arrival of transporting agency at 2137 (54 minutes after dispatched), departure of transport agency with the patient at 2149 (66 minutes after dispatched), and door-to-door time of 76 minutes was reported. A total transport time of 42 minutes was calculated by the chief investigator. KRMC reported that the patient arrived at the cardiac catheterization lab at 2231 and had reperfusion with PCI balloon inflation at 2246. A door-to-balloon time of 135 minutes was calculated; indicating failure to achieve the \leq 120 minute door-to-balloon benchmark (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013).

An additional primary PCI case was reported outside of the surveyed time frame and the treatment data was included in Table 3. The patient arrived at the CPMC emergency department at 1734 and achieved a door-to-door time of 56 minutes. Quality metric data from KRMC indicated this case was transferred by ALERT directly to KRMC's cardiac catheterization lab with arrival at 1918 and reperfusion with inflation of the PCI balloon at 1928. This data was utilized to calculate a total transport time of 48 minutes with ALERT and a door-to-balloon time of 114 minutes; indicating the only case to achieve the \leq 120 minute door-to-balloon benchmark (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013). Also of note, the case synopsis from

KRMC indicates that thrombolytic therapy was ordered by KRMC's interventional cardiology but was never administered.

Data from January 2016 through September 2017 from CPMC does not indicate door-to-balloon time for patients transferred for primary PCI (see Table 2). Additional supplementary data related to door-to-balloon times during this time frame was not available from KRMC related to lack of specific treatment dates from CPMC to assist KRMC staff in recalling patient care data. Analysis of the two cases transferred by ALERT from CPMC to KRMC for primary PCI in 2018 indicated a mean transportation time of 45 minutes from departure at CPMC to arrival at the cardiac catheterization lab at KRMC. Both cases also displayed a 10 minute difference between arrival at the cardiac catheterization lab to achievement of reperfusion. Achievement of a door-to-balloon time ≤ 120 minutes would then require a door-to-door time of ≤ 65 minutes to account for the minimum 55 minutes required to get a patient to a cardiac catheterization lab and perform the procedure. Given that only one case had a door-to-door time of ≤ 65 minutes, it is easy to assume that none of the other primary PCI cases achieved the benchmark of ≤ 120 minute door-to-balloon time (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013).

Coordination of Transport

The STEMI Transport Survey failed to define the difficulties CPMC staff face while attempting to coordinate interfacility transportation for time sensitive emergencies. The data displayed in Table 4 was utilized to more clearly summarize this issue.

Transport Out of CPMC

J. Thornton shared data collected separately from this study in the CPMC emergency department to better quantify the difficulties coordinating interfacility transport from January 2018 through April 2018 (see Table 4) (personal communication, May 14, 2018). The data is not diagnosis or accepting facility specific. The number of transport requested and number of transports does not match related to some transports had multiple services contacted. It was found that the most common reason for declining s transport was weather and lack of staffing.

Table 4. CPMC Coordination of Interfacility Transfer January 2018 Through April 2018

Transporting Agency	Number of Requested Transports	Percentage of Transport Requests Accepted	Reasons for Declining Transport
ALERT	30	73%	Weather Mechanical
Life Flight	14	36%	Weather Mechanical
Libby Volunteer Ambulance	32	59%	Weather (3) Staffing (6) Mechanical (1) Patient Diagnosis (1) N/A (3)
Troy Volunteer Ambulance	33	88%	Weather (1) Staffing (2) Mechanical (1)
Boundary Ambulance	3	33%	Staffing (2)
Evergreen Ambulance	3	67%	Weather (1)

CHAPTER FIVE

DISCUSSION

RecommendationsDoor-to-Needle

Research has extensively proven that timely reperfusion results in improved outcomes among STEMI patients (Krumholz et al., 2008). It has also been extensively proven that primary PCI is the “Gold Standard” of STEMI reperfusion therapy (Gatenby et al., 2014, p. 512). However, non-PCI-capable medical facilities can adequately care for STEMI cases with administration of thrombolytic therapy to eligible STEMI patients whom are unable to receive timely primary PCI (Krumholz et al., 2008). Treatment guidelines state that thrombolytic-eligible individuals should have a door-to-needle time of ≤ 30 minutes (AHA, 2015; Krumholz et al., 2008). McNamara et al. (2007) further supported the importance of decreased door-to-needle times by proving that a door-to-needle of ≤ 30 minutes resulted in significantly decreased 30 day mortality rates.

Analysis of quality metric data from CPMC indicated that the door-to-need benchmark was met four times between April 2016 through September 2018. This indicates achievement of the door-to-needle benchmark in 57% of STEMI cases at CPMC without inclusion of cases with documented reasons for thrombolytic therapy delay. The data also suggested that CPMC is moving towards being more proactive with initiating early thrombolytic therapy opposed to delaying reperfusion attempting primary PCI. More recent data showed an increased frequency in the use of thrombolytic therapy

compared to older STEMI care data but did not account for individual patient factors and documented reasons for withholding thrombolytic therapy. STEMI cases with initial presentation to CPMC face an approximate 45 minute air or 90 minute ground transportation which makes achievement of timely primary PCI difficult and unlikely. The prolonged transport times indicate that administration of thrombolytic therapy to eligible patients in ≤ 30 minutes of arrival is best practice for the management of STEMI cases at CPMC (AHA, 2015; Krumholz et al., 2008). Strategies to achieve the ≤ 30 minutes door-to-needle benchmark should be put in place to achieve $> 57\%$ of STEMI cases meeting benchmark. Research has indicated that receiving thrombolytic therapy in ≤ 30 minutes results in decreased mortality, so it is theorized that implementing changes to decrease door-to-needle times at CPMC would result in improved STEMI patient outcomes (McNamara et al., 2007).

Door-to-Door

STEMI treatment guidelines recommend that patients should remain at a non-PCI-capable facility for ≤ 45 minutes to decrease time to PCI (AHA, 2015; National Clinical Guideline Centre, 2013). Research has indicated that primary PCI ≤ 120 minutes of onset of ACS symptoms results in improved STEMI outcomes compared to receiving early thrombolytic therapy (Choi et al., 2017). Other evidence supports these findings and concluded a strong, positive relationship between decreased door-to-balloon times and reduced in-hospital mortality (Martin et al., 2014).

The STEMI treatment quality metric data reviewed in this project indicated that CPMC did not have a single STEMI case achieve the ≤ 45 minute door-to-door

benchmark from April 2016 through September 2018. Adjusting for extreme outliers, the mean door-to-door time during this period was found to be 87.5 minutes; almost double the goal time. Although, is this a door-to-door time of ≤ 45 minute a realistic goal at CPMC?

Under ideal conditions, ALERT reports it takes approximately 35 minutes to get to Libby from the time they are dispatched. The goal in-department time reported by ALERT is less than 30 minutes for medically stable patients. Indicating that a STEMI patient would be in the CPMC emergency department ≤ 65 minutes waiting to be transported. Given that an ECG is to be completed within 10 minutes of arrival at the emergency department to identify a STEMI, a goal door-to-door time of ≤ 75 minutes for STEMI cases transported via medical helicopter has been identified as an achievable and a realistic goal for CPMC emergency department and transporting agencies to strive to achieve (AHA, 2015).

Minimizing door-to-door time would also be beneficial for STEMI cases occurring when air transportation is not available, and the patient must be transported via ambulance. As discussed, ground transportation from any of the four ambulance services that transport cases out of CPMC require finding a team of off duty crew members to accept the transport. A ground transport crew for a critical care case most often consists of three individuals; two basic emergency medical personal and a critical care trained individual (paramedic or registered nurse). The ground transport time from CPMC to KRMC is 90 minutes with clear road conditions. This time does not account for the time required to find an accepting ambulance service, transport crew, and time for the crew to

get to CPMC to retrieve the patient. If the CPMC emergency department achieved a door-to-door time of ≤ 45 minutes, STEMI patients would still fall outside of the benchmark door-to-balloon time of ≤ 120 minute when faced with the ≥ 90 minute ground transport (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013). Accounting for the 90 minutes minimum ground transport and the 10 minutes needed to prepare for and perform the procedure, leaves < 20 minutes for the CPMC emergency department to identify a STEM, care for the patient, coordinate transport, and get the accepting transport crew to the emergency department to have a chance of potentially ever achieving a door-to-balloon time of ≤ 120 minute with ground interfacility transport. A door-to-door time of < 20 minutes is not a practical recommendation given the general findings discussed in this project related to STEMI medical management and coordination of transport.

Post Thrombolytic Therapy. Research has found that transfer to a PCI-capable medical center following the administration of thrombolytic therapy is associated with improved outcomes compared to no thrombolytic administration and thrombolytic administration with admission for observation at a non-PCI-capable medical center (Bohmer et al., 2010; Martin et al., 2014). STEMI treatment guidelines recommend rapid transport of STEMI patients to a PCI-capable medical center following the administration of thrombolytics to start the reperfusion process and decrease time to necessary further evaluation and possible intervention (AHA, 2015; National Clinical Guideline Centre, 2013).

Administration of thrombolytic results in successful reperfusion in approximately 65 to 70% of cases when administered early and door-to-door is no longer a quality metric utilized in STEMI cases receiving thrombolytic therapy (Ronad & Dixit, 2015; Saleem et al., 2016). Due to this, the chief investigator reviewed arrival and depart time of STEMI cases that received thrombolytic therapy to evaluate if there was a prolonged door-to-door time among STEMI cases at CPMC receiving thrombolytic therapy prior to transfer to higher level of care. It was found that the adjusted mean door-to-door time among STEMI cases receiving thrombolytic therapy between January 2018 through September 2018 prior to transfer was 114.4 minutes. This is significantly higher than the adjusted mean door-to-door time for STEMI cases transferred for primary PCI from April 2016 through September 2018; 87.5 minutes. Strategies to decrease door-to-door time among thrombolytic eligible patients to a door-to-door time comparable to cases transferred for primary PCI is indicated. Considering that an estimated 30% of all STEMI cases which receive thrombolytic therapy do not have successful reperfusion, it is important to decrease the door-to-door among the STEMI cases receiving thrombolytic therapy to allow for rapid, rescue PCI and reperfusion following failed thrombolytic therapy.

Door-to-Balloon

Treatment guidelines and the cumulative body evidence supports a door-to-balloon time for primary PCI of ≤ 90 minutes and adjusted to ≤ 120 minutes for cases in which prolong transport time is required (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013). STEMI cases presenting to CPMC face a prolonged

transport to PCI due to the physical distance from Libby to the nearest cardiac catheterization lab in Kalispell. Although one case presented in this project demonstrated achievement of a 114 minute door-to-balloon time and showed a door-to-balloon time of ≤ 120 minutes is achievable under the right conditions; rapid STEMI identification, weather permitting safe flight, and flight crew immediately available.

ALERT reports it takes approximately 35 minutes to get to Libby from the time they are dispatched. This is under ideal conditions. The goal in-department time reported by ALERT is less than 30 minutes for medically stable patients. An additional 45 minutes is required to transport a STEMI patient to KRMC and perform PCI. Under ideal air transportation conditions, ALERT requires approximately 80 minutes to complete the round trip transportation of a cardiac patient from Libby to the cardiac catheterization lab in Kalispell. This time is not inclusive of the in-department time of the ALERT crew. This also means a door-to-balloon time of ≤ 120 minutes is potentially achievable under the right conditions if the ALERT crew is dispatched within 10 minutes of the arrival of a STEMI case at the CPMC emergency department and the transport crew has an in-department time of less than 30 minutes (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013). However, achievement of the benchmark ≤ 120 minute door-to-balloon time is not easily replicated for every STEMI case presenting to CPMC, and thrombolytic therapy remains the best primary reperfusion therapy option for most cases presenting to CPMC (Krumholz et al., 2008; AHA, 2015; National Clinical Guideline Centre, 2013).

Coordination of Transportation

The task of coordinating an interfacility transfer often falls onto CPMC emergency department staff whom are also tasked with direct patient care. At times, staff are having to prioritize placing phone calls to coordinate a transfer over providing direct patient care. Only air transport services have scheduled staff for transports out of Libby. Boulder County Ambulance and Evergreen Ambulance are paid services, but Libby is outside of their service areas and requires staff to come in on their days off to fulfill the transport needs of Libby without abandoning their own service areas. Libby Volunteer Ambulance and Troy Volunteer Ambulance services have a scheduled duty crew that needs to stay in-service locally for 911-calls. Interfacility transports require them to find members to volunteer extra time outside of their scheduled voluntary duty time. CPMC does not have an on-call staff schedule for registered nurses whom are trained and willing to assist with interfacility transports, so transport coordination can require calling multiple people from a list to find a critical care crew member. Time is also spent contacting the various transporting agencies to find an accepting agency with an available crew.

Weather and staffing were found to be the most frequently cited causes for interfacility transportation delays at CPMC. Weather is a non-modifiable factor, but an action plan to address interfacility transportation when weather conditions complicate the transportation of critical patients needs to be developed. A transport team with an ambulance and crew that would respond with one call from the emergency department would mitigate these difficulties and time spent coordinating transportation to expedite

ground transports. Additionally, this would foster a collaborative relationship between Libby Volunteer Ambulance, Troy Volunteer Ambulance, and CPMC with shared resources and team building. Collaboration between emergency medical services and clinicians has been found positively influence high-quality STEMI care and result in improved core measure performance (Landman et al., 2012).

Offering payment for involvement in the collaborative transportation teams would ensure skilled emergency medical personal are available for interfacility transports. March and Ferguson (n.d.) described the recruitment and retention difficulties volunteer-based ambulance services face and suggested that paid emergency medical services have higher retention rates and challenge their members to perform at a higher level. This translates into improved availability of highly trained personnel for care and transportation of critical patients. Paid emergency medical staff tend to be more accountable than volunteer members due to the decreased risk of losing employment. Establishing a paid ambulance service would result in improved accountability in providing evidenced-based emergency medical care (March & Ferguson, n.d.).

In-Department Time. Research has indicated that delays in timely PCI are frequently attributed to prolonged wait times for arrival and departure of interfacility transportation and measure need to be taken to overcome the delays associated with coordination of interfacility transportation (Aguirre et al., 2008; Wang et al., 2010). All three of the STEMI cases previously presented in this project that had STEMI Transport Survey completed depicted transfers occurring under ideal conditions; weather that permits flight, flight crew available, and reasonable in-department times. An additional

STEMI case was provided by CPMC to better depict some of the delays in care that staff have observed related to prolonged in-department times of transporting agencies. The supplementary case from October 2018 demonstrated an example of an in-department time of 23 minutes for a STEMI case which CPMC emergency department staff described as “stable enough to be have been standing at the helipad as [ALERT] came in”.

Dissemination

The chief investigator plans to disseminate the findings of this scholarly project among staff in the CPMC emergency department. Evidence related to decreased door-to-needle times and door-to-needle quality metric data from CPMC will be disseminated in the monthly department newsletter. The newsletter is sent to all emergency department staff by the department leadership in leu of a monthly staff meeting. A quick reference educational poster will be posted on the announcements board in the nurse’s station which will highlight STEMI standards of care in the rural setting. Previous quality improvement project in this department related achievement of quality metric goals in stroke care have been successful with sharing evidence and historical performance data among CPMC emergency department staff. The chief investigator anticipates similar results for door-to-needle time among STEMI patients.

Additionally, the chief investigator plans to present the general findings of this project to the Lincoln County emergency medical responders collaborative; a newly created committee consisting of CPMC administration, county commissioners, and two

leaders from the three major volunteer ambulance services in Lincoln County (Libby Volunteer, Troy Volunteer, and Eureka Volunteer ambulance services). This collaborative was developed to work to resolve the lack of resource sharing and interpersonal issues between the local volunteer ambulance services and emergency department. Lincoln County has a very limited tax base and collaboration among the emergency medical services is necessary to best serve the community. The chief investigator plans to present the current evidence and local treatment data related to STEMI care at CPMC to provide sound data and meaning to the significance and scale of the health care disparity this rural community faces. Bringing the findings of this scholarly project to the collaborative committee will ideally inspire and motivate them to better work together to make lasting changes for the betterment of the health of community members.

Change Theory

As discussed earlier, the Lewin's Theory of Change will be utilized in the dissemination of the findings of this scholarly project to influence lasting changes. Lewin's Theory of Change requires that prior learning to be rejected and replaced. (Nursing Theory, n.d.; Nursing Theories, 2011). Presentation of the finding of this project to CPMC emergency room leadership and the Lincoln County emergency medical responders collaborative will provide rationale to reject and replace the current approach to the management of time sensitive emergencies in Lincoln County. These individuals have been identified as the driving forces for change by the chief investigator. The abundance of supporting evidence, documented success with other similar quality

improvement projects, and the data presented in the project highlighting the need and areas for improvement will facilitate the implementation of lasting changes in STEMI and time sensitive emergency care while empowering the driving forces to work to overcome the barriers to change. The three stages of the Lewin's Change Theory will be initiated with unfreezing through the dissemination of the findings of this scholarly project and inspire the implementation of lasting change (Nursing Theory, n.d.; Nursing Theories, 2011).

Limitations

The small volume of annual STEMI cases presenting to the CPMC emergency department was a major limiting factor in this project. All of the STEMI cases that had a STEMI Transport Survey completed were done on cases that were transported by ALERT with one call to dispatch. This negated the initial goal of this project to more clearly define the difficulties rural medical facilities face when coordinating interfacility transportation and delays in care for time sensitive emergencies. Multiple factors contribute to the medial management and coordination of interfacility transfer of STEMI patients and it was difficult to account for and adjust data related to these factors. It was also difficult to clearly define some of these factors related to the inability to pull additional supporting and clarifying data from 2016 through 2017 STEMI cases.

Conclusion

Rapid myocardial cell reperfusion via primary PCI or thrombolytic therapy is key to limit death and disability resulting from myocardial cell ischemia (Martin et al., 2014). Montana is a large state with limited PCI-capable medical facilities. Individuals living in the state's rural areas do not have rapid access to primary PCI but may still have positive outcomes with rapid administration of thrombolytic therapy (Gatenby et al., 2014; Kawecki et al., 2017). Providers in rural Montana can provide quality care with positive clinical outcomes among STEMI patients though adherence to STEMI treatment guidelines for rapid assessment, treatment, and transportation of all STEMI patient to the nearest PCI-capable medical center following the administration of thrombolytic therapy to eligible STEMI patients (AHA, 2015; National Clinical Guideline Centre, 2013).

Delays in STEMI care are often attributed to the coordination of interfacility transportation. Within this project, staffing and weather were found to be the most frequently sited causes for interfacility transport delays at CPMC. Collaboration between medical facilities and transporting agencies has been found to be the most effect method to decrease delays in care in time sensitive emergencies (Aguirre et al., 2008; Wang et al., 2010; Krumholz et al., 2008). The chief investigator theorized that implemented changes to expedite interfacility transport of STEMI cases will also translate to other time sensitive emergencies to improve health outcomes for the rural Montana. However, more research is needed related to streamlining the coordination of interfacility transportation of time sensitive emergencies from rural medical facilities to larger, urban medical centers where specialized, life-saving intervention.

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APPENDICES

APPENDIX A

AHA Montana STEMI Inter-Hospital Transfer Guideline-Thrombolytic



Mission: Lifeline Montana STEMI Inter-Hospital Transfer Guideline-Thrombolytic

Benefis – Great Falls

Phone: 1-800-972-4000 or 406-455-4320 Fax: 406-455-4584

Billings Clinic - Billings

Phone: 1-800-325-1774 Fax: appropriate # given at time of phone call

Bozeman Deaconess - Bozeman

Phone: 406-414-1000 Fax: 406-414-5001

Community Medical Center - Missoula

Phone: 406-327-4171 Fax: 406-327-4504

Kalispell Regional Medical Center - Kalispell

Phone: 406-752-1733 Fax: 406-756-4717

St. James Healthcare - Butte

Phone: 1-844-202-2495 Fax: 406-723-2517

St. Patrick's Hospital - Missoula

Phone: 1-888-878-7287 Fax: 406-329-5639

St. Peter's Hospital - Helena

Phone: 406-444-2150 Fax: 406-447-2695

St. Vincent's Hospital - Billings

Phone: 1-800-331-0222 Fax: 406-237-4125

AHA Mission: Lifeline Ideal STEMI Treatment Goals (for all eligible patients receiving any reperfusion (PCI or fibrinolysis therapy):

- **First Medical Contact-to-First ECG** time \leq 10 minutes
- Fibrinolytic–eligible patients with **Door-to-Needle** time \leq 30 minutes
- Patients transferred for Primary PCI to a Receiving Center with referring center **Door in-Door out** time (*Length of Stay*) \leq 45 minutes (guideline recommendation is \leq 30 minutes)
- Patients transferred for Primary PCI to a Receiving Center with referring center **First Medical Contact -to-PCI device time** \leq 120 minutes (*includes transport time*)
- All STEMI patients without a contraindication receiving **aspirin** before ED discharge

For those patients with a contraindication to transfer for PCI, ensure the following are completed during their hospitalization:

- Aspirin within 24 hours of hospital arrival and aspirin at discharge
- Beta blocker at discharge |
- Statin therapy or lipid lowering drugs
- STEMI patients with left ventricular systolic dysfunction on ACEI/ARB at discharge

Upon Transfer Fax the following documents to the accepting facility: 12 Lead ECG, ED Record, Lab Results, Current Medication Record

**Mission: Lifeline MT STEMI (ST-Segment Elevation Myocardial Infarction)
PHYSICIAN ORDERS- THROMBOLYTIC OPTION**

Diagnostic Criteria for STEMI

- ST elevation at the J point in at least 2 contiguous leads of ≥ 2 mm (0.2 mV) in men or ≥ 1.5 mm (0.15 mV) in women in leads V2-V3 and/or of ≥ 1 mm (0.1mV) in other contiguous chest leads or the limb leads.
 - New or presumably new LBBB at presentation occurs infrequently, may interfere with ST-elevation analysis, and should not be considered diagnostic of acute myocardial infarction (MI) in isolation. If doubt persists, immediate referral for invasive angiography may be necessary. Consult with PCI receiving center.
 - ECG demonstrates evidence of ST depression suspicious for a Posterior MI consult with PCI receiving center.
- ***If initial ECG is not diagnostic but suspicion is high for STEMI consider serial ECG's at 5-10 minute intervals



ACTIVATE TRANSPORT and Determine transport mode

Contact PCI Center/Consult Cardiologist: **DO NOT DELAY MEDICATIONS BELOW**

<input type="checkbox"/> _____ Hospital <input type="checkbox"/> Call: _____ <input type="checkbox"/> Send records with patient upon transfer	Patient Name: _____ Allergies: _____															
<p style="text-align: center;">STANDARD ORDERS & LABS</p> <ul style="list-style-type: none"> • Apply Continuous Cardiac Monitor • Vitals q 5 min x3, then q 10 min (with automatic BP and pulse oximetry) • Insert (2) peripheral large bore IVs (0.9% NaCl @100mL/hr or Saline lock) • Portable CXR STAT • Labs: BMP, CBC, Troponin, Lipid profile, PT/INR, PTT, all labs STAT, do not delay transfer for results – Fax when available <p>Administer Oxygen as needed to keep SpO2 > 94%</p>	<p style="text-align: center;">Optional Medications</p> <p>Nitroglycerin IV or 0.4 mg SL Morphine Sulfate 1 - 5 mg IV Ondansetron (Zofran) 4 mg PO or IV Metoprolol 25 mg PO</p> <p style="color: red; font-size: small;">CONTRAINDICATIONS FOR METOPROLOL: Do not give if any of the following: Signs of heart failure or shock, heart rate less than 60 or more than 110, systolic blood pressure less than 100, second or third degree heart block, severe asthma or reactive airway disease</p>															
<p>ALL PATIENTS must receive:</p> <ol style="list-style-type: none"> 1. Aspirin 324 mg chewed 2. Heparin or Lovenox <p><input type="checkbox"/> Heparin IV Bolus (60 Units/kg, max 4,000 Units) AND Heparin IV Drip (12 Units/kg/hr, max 1,000 Units/h)</p> <p style="text-align: center; color: red; font-weight: bold;">OR</p> <p><input type="checkbox"/> Enoxaparin (Lovenox): Age < 75 yrs, 30 mg IV Push then 1 mg/kg SubQ 15 min later and then q 12 hours. SubQ Max Dose=100 mg OR</p> <p><input type="checkbox"/> Enoxaparin (Lovenox): Age > 75 yrs, 0.75mg/kg SubQ and then q 12 hours SubQ Max Dose= 75 mg</p>	<p style="text-align: center;">FIBRINOLYSIS CONSIDERATIONS</p> <p>ABSOLUTE CONTRAINDICATIONS FOR FIBRINOLYSIS (TNK) IN STEMI</p> <ol style="list-style-type: none"> 1. Any prior intracranial hemorrhage 2. Known structural cerebral vascular lesion (e.g., arteriovenous malformation) 3. Known malignant intracranial neoplasm (primary or metastatic) 4. Ischemic stroke within 3 mo except acute ischemic stroke within 4.5 hrs 5. Suspected aortic dissection 6. Active bleeding or bleeding diathesis (excluding menses) 7. Significant closed-head or facial trauma within 3 months 8. Intracranial or intraspinal surgery within 2 months 9. Severe uncontrolled hypertension (unresponsive to emergency therapy) <p>RELATIVE CONTRAINDICATIONS FOR FIBRINOLYSIS: (TNK) IN STEMI</p> <ol style="list-style-type: none"> 1. History of chronic, severe, poorly controlled hypertension 2. Significant hypertension on presentation (SBP > 180 or DBP > 110 mmHg) 3. History of prior ischemic stroke more than 3 months, dementia, or known intracranial pathology not covered in contraindications 4. Traumatic or prolonged CPR (> 10 minutes) 5. Major surgery (within last 3 weeks) 6. Recent internal bleeding (within last 2-4 weeks) 7. Noncompressible vascular punctures 8. Pregnancy 9. Active peptic ulcer 10. Current use of anticoagulants 															
<p>If first medical contact to balloon expected > 120 minutes</p> <ol style="list-style-type: none"> 1. FIBRINOLYSIS: Tenecteplase IV (TNKase) or available thrombolytic **Door to Lytic administration goal < 30 Minutes** <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td style="padding: 2px;">Less than 60 kg</td> <td style="padding: 2px;">30 mg</td> <td style="padding: 2px;">6 mL</td> </tr> <tr> <td style="padding: 2px;">60 or more but less than 70</td> <td style="padding: 2px;">35 mg</td> <td style="padding: 2px;">7 mL</td> </tr> <tr> <td style="padding: 2px;">70 or more but less than 80</td> <td style="padding: 2px;">40 mg</td> <td style="padding: 2px;">8 mL</td> </tr> <tr> <td style="padding: 2px;">80 or more but less than 90</td> <td style="padding: 2px;">45 mg</td> <td style="padding: 2px;">9 mL</td> </tr> <tr> <td style="padding: 2px;">90 or more kg</td> <td style="padding: 2px;">50 mg</td> <td style="padding: 2px;">10 mL</td> </tr> </table> <ol style="list-style-type: none"> 2. Plavix 300 mg PO (If patient > 75 yrs, reduce dosage to 75 mg PO) 	Less than 60 kg	30 mg	6 mL	60 or more but less than 70	35 mg	7 mL	70 or more but less than 80	40 mg	8 mL	80 or more but less than 90	45 mg	9 mL	90 or more kg	50 mg	10 mL	<div style="border: 1px solid black; padding: 2px; display: inline-block;">Rev. 12-2 15</div>
Less than 60 kg	30 mg	6 mL														
60 or more but less than 70	35 mg	7 mL														
70 or more but less than 80	40 mg	8 mL														
80 or more but less than 90	45 mg	9 mL														
90 or more kg	50 mg	10 mL														

APPENDIX B

Voluntary STEMI Transport Survey

STEMI Transport Survey

This is a voluntary and anonymous survey to be completed by any emergency room staff involved in the coordination of care and transfer of an adult (greater than 18-years-of-age) STEMI patient. More than one survey per case is welcome. If patient was incarcerated or pregnant then they are exempt from study.

Date: _____ Time: _____

How did the patient get to the ER: Ambulance Private Vehicle Other

Was a STEMI identified prior to arrival in the ER: Yes No

If "Yes"... where and by whom: _____

Approximate time (in minutes) from first medical contact to arrival in ER: _____

Time (in minutes) from patient arrival in ER to identification of STEMI: _____

If time greater than 10-minutes... why: _____

Where was the patient transported to: Kalispell Regional Medical Center Other

Name of the agency transporting the patient: _____

Mode of transport: Ground Helicopter Fixed Wing (Airplane)

Number of transport agencies contacted for transportation of patient: _____

Explain why more than one agency contacted for transport:

Time transport agency agrees to take patient: _____; arrives in department:
_____ ; departs with patient: _____

Did transport require CPMC staff: Yes No

If "Yes" ... What is their job title: Paramedic RN RT

Did this result in calling in off duty staff: Yes No

How many CMPC staff members did you attempt to call to fill this staffing need: _____

Number of calls **YOU** made to coordinate transportation (call center, report,
transportation): _____

Was patient in department greater than 60-minutes: Yes No

If "Yes"... explain why: _____

Was patient's ability to pay a factor in coordination of transportation: Yes No

Was weather a factor in coordination of transportation: Yes No

Current weather conditions: _____