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Clinical Inquiry Project

Survey Analysis of Pre-hospital Acute Myocardial Infarction Communication

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The Clinical Problem

Heart disease carries the highest mortality among disease related deaths in the United States (US) with coronary artery disease (CAD) accounting for the majority of those cardiac fatalities (Roger et al., 2012). Nearly all acute myocardial infarctions (AMIs) are caused by CAD. AMI is diagnosed through the clinical assessments of physical presentation, electrocardiogram (ECG), cardiac biomarkers, and pathophysiological sequelae (Van de Werf et al., 2008). The range of acute myocardial injury and ischemia, known as Acute Coronary Syndromes (ACS), includes unstable angina (USA), non-ST-Segment Elevation MI (NSTMI), and ST-Segment MI (STEMI) (Krumholz et al., 2008). Immediate goals of therapy in ACS are: 1) limit myocardial damage in order to preserve ventricular function; 2) prevent major adverse catastrophic events, including cardiogenic shock or death; 3) emergently treat acute life threatening arrhythmias such as ventricular fibrillation and asystole; 4) provide appropriate ACS treatment as recommended in national guidelines (Krumholz et al., 2008; O'Connor et al., 2010; Antman et al., 2008). Rapid diagnosis and treatment for AMI can provide the best benefit to limit myocardial injury, damage, and death.

Coronary artery thrombosis and subsequent vessel occlusion that is caused by cholesterol plaque rupture results in acute ischemic symptoms and dramatic electrocardiogram (ECG) changes. Many of the ECG changes of AMI are seen in a section of the altered electrical pathway, the ST-segment, which reflects injury to the myocardium caused by an occluded coronary artery. The thrombosis laden cholesterol plaque that causes arterial occlusion can be emergently "debulked," or unburdened, by mechanical or pharmaceutical means, allowing the coronary artery to reperfuse blood flow to the myocardium. Revascularization re-establishes blood flow through the coronary artery to myocardium, thus

preserving viable heart tissue. Percutaneous Coronary Intervention (PCI) is the process that mechanically opens blood flow through coronary arteries during AMI. If this intervention is not completed within a time-limited window of opportunity, the result is irreversible myocardial damage and its consequences.

Known delays to reperfusion can occur when patients do not activate Emergency Medical Services (EMS) for immediate medical attention (Nallamothu et al., 2005). Medical delays to PCI can occur due to atypical patient presentation, such as seen in female, elderly, and diabetic patients who may arrive with complaints of dizziness, pallor, nausea, dyspnea, back pain, or epigastric discomfort (Nallamothu et al., 2005). Delays in recognizing AMI symptoms will delay ECG acquisition and communication of STEMI alert to PCI centers (O'Connor et al., 2010). Once the STEMI ECG is acquired, delays may occur due to incorrect interpretation or delayed notification to PCI center (Rokos et al., 2010). The acutely altered electrical pathways that normally regulate myocardial pulsation are seen as ST-segment elevations and abnormalities on specified leads of the 12-lead ECG tracings and must be interpreted accurately to assure the correct diagnosis of AMI. Multiple challenges may occur that cause delays to emergent treatment in AMI.

Timely identification of STEMI is an important first step to expedite treatment to PCI facilities. Common reasons for delay to PCI following ECG identification may occur before or during active transfer, including extended distance to a rural hospital or to PCI site, catastrophic events such as cardiac arrest, or hazardous road or flight conditions due to weather or terrain.

Expedited PCI is the preferred therapeutic treatment for reperfusion, ideally performed at a Primary Percutaneous Coronary Intervention (PPCI) facility that is available for emergent

service on a 24/7 basis (Afolabi, Novaro, Pinski, Frokin, & Bush, 2007; Baruch, Rock, Koenig, Rokos, & French, 2010; Keeley, Boura, & Grimes, 2003). The national benchmark set by the American Heart Association (AHA) and American Academy of Cardiology (ACC) to maintain viable heart tissue and reduce mortality is 90 minutes from arrival in an emergency department to rapid revascularization of the infarction site related artery. A patient who is transferred to a facility that can provide coronary artery reperfusion by PCI must meet a different benchmark of 120 minutes from first medical contact (FMC) to myocardial reperfusion (Krumholz et al., 2008) in order to prevent myocardial injury and necrosis. FMC can be defined as the arrival on scene of the emergency medical system (EMS) personnel, or patient call to 9-1-1 dispatch. FMC can also be the time of patient arrival at an emergency department (ED) or a transferring agency such as a Critical Access Hospital (CAH) or provider clinic. Although PCI is the gold standard treatment for STEMI, thrombolytic drug therapy may be administered at a referring site if PCI is predicted to be greater than 120 minutes from FMC (Jollis et al., 2012).

Clinical inquiry project (CIP) purpose

The purpose of the clinical inquiry project is to review current evidence-based literature for pre-hospital ECG's when STEMI is a concern, and analyze regional barriers and challenges to effective and timely PPCI hospital pre-notification of STEMI arrival. Based on the study findings, recommendations for improving quality of care for this critical STEMI population may be formulated. The focus of the study is to assess perceptions and practice efforts of health care (HC) professionals who care for STEMI patient’s throughout Idaho and eastern Oregon. National recommendations for the ideal STEMI treatment process are based on emergency medical systems of care that utilize the pre-hospital ECG and shared protocols. The protocols critically implement best practices, and alert appropriate health care (HC) personnel into action (Brown,

Mahmud, Dunford, & Ben-Yehuda, 2008; Krumholz et al., 2008; Ting et al., 2008; Van de Werf et al., 2008).

Pre-hospital notification of STEMI arrivals to an ED or PCI center allows time to alert hospital staff and providers who arrive from an "on call" status, to be set up for rapid, emergent cardiac intervention as soon as the patient arrives. The on call response and arrival time expectation is typically 20 minutes, and the set up time may take between 10 to 15 minutes. This system of care expedites the process, and results in fewer delays to reperfusion (Ting et al., 2008). It is known that pre-hospital STEMI ECG's can decrease the time to intervention (Ting et al., 2008) but it is not known how many PCI centers receive information about STEMI's before patient arrival or how the delays may occur. For PCI facilities that have the capability to receive communication about STEMI's before patient arrival, it is not known what methods of ECG STEMI communication are utilized to notify the PCI site, and what barriers or gaps exist to be able to provide pre-arrival notification. Perceived barriers to effective communication based on evidence based practice (EBP) for STEMI populations have not been published for Idaho, or eastern Oregon.

According to the most recently published AHA ACTION registry National STEMI database (ACTION Registry2011), a southwest Idaho PPCI facility's STEMI patient "ED arrival to reperfusion" is 48 minutes, well below the 90 minute benchmark. However, occasionally the FMC "transfer facility-to-PCI time*"* is greater than the 120 minute benchmark. While the majority of STEMI transfers arrive well below the 120 minute benchmark, the range is 35 to 290 minutes with five cases above the 120 minute benchmark. In order to improve quality of care at the pre-hospital level, an analysis of various pre-hospital STEMI ECG communications that alert

PPCI staff of incoming arrivals may demonstrate perceived gaps and barriers that cause delay, and potential geographic areas that may need focused support.

Despite national data and guidelines that have been available for many years, approximately 20% of STEMI patients do not receive emergent reperfusion therapy even though there is immediate availability and no contraindication for intervention (Ting et al., 2008). In order to improve outcomes for STEMI patients, "systems of care" have been trialed, and proven to be effective in improving the percent of patients who receive reperfusion within the benchmark goal of less than 90 minutes. However, less than 50% of STEMI patients who do receive the therapy are provided the service within the national benchmark goals (Roger et al., 2012).

Literature review, synthesis of evidence

A comprehensive literature review was conducted to assess recent and current research for defining and improving outcomes for the STEMI process and emergent care for AMI. The search was limited to adults over 19 years of age, full text reports, and between 1980 to current publications in 2012. English language and publications from the United States were also limitation sets. Literature searches were reviewed in May, July, September, and October 2012. Databases included MEDLINE/Ovid, Google Scholar, CINAHL, PubMed, The Cochrane Library, Government clinical trials web sites, national database systems, national organization web sites (American Heart Association and American College of Cardiology), and systematic reviews. Internet sites were also searched. Key MeSH terms included acute myocardial infarction, ST elevation myocardial infarction, electrocardiogram, pre-hospital care, emergency care systems, nursing, and rural health. Search terms were assessed separately, resulting in over 2 million articles, then combined and limited to narrow the results to less than 1,000 articles. Cardiovascular disease was used as a search term to assess preventative measures and risk, as

well as global and national ethical and policy issues. Abstracts and titles were reviewed for appropriateness and further revision. Bibliographies from the final selected articles were also reviewed, adding 24 additional potential resources.

Several evidence based reviews and national guidelines that focused on the AMI topic were available and included medical, pharmaceutical or non-pharmaceutical therapies, and risk factors. Five articles included descriptions of the pathophysiology of AMI, prevention, epidemiology, etiology, and evidence based treatment. Various means of pre-hospital communication were identified but the comprehensive literature review did not reveal a single or combined best practice of the process for communicating STEMI notification to a PCI center in order to achieve the national benchmark for transfer patient from FMC to PCI.

The search demonstrated a lack of research and non-research based articles specific to STEMI pre-hospital care and communication gaps or barriers. A search for nursing articles that specifically focused in this arena of pre-hospital STEMI communication assessment did not reveal any articles. Yet, many research based articles emphasized the need for excellence in emergent STEMI care and demonstrated the pre-hospital process as a crucial facet. Articles also cited that there is a delay in timely pre-hospital care to PCI facility (Afolabi, et al., 2007; Antman, et al., 2008; Jollis, et al., 2012; Krumholz, et al., 2008; Rokos et al., 2010).

Idaho government statistic banks have no published state-wide health care data available publicly except through national data systems such as Behavioral Risk Factor Surveillance System (BRFSS) and the Center for Medicare and Medicaid Services (CMS), 2011; Centers for Disease Control and Prevention (CDC), 2011). Oregon cardiovascular data is also available through BRFSS and CMS.

Hospitals that utilize pre-notification of STEMI arrivals can reduce time of EMS arrival to the hospital, and overall time to reperfusion (Antman et al., 2008; Diercks et al., 2009; Krumholz et al., 2008; LeMay, Dionne, Maloney, & Poirier, 2010; Ting et al., 2008; Van de Werf et al., 2008). Many gaps and delays to AMI reperfusion occur, especially in emergent care for vulnerable populations such as those in rural areas (Bove et al., 2011). Rural areas may not have the resources or EMS structure to sustain advanced and emergent life support programs of care. Additionally, populations in rural or frontier area may find geographical distance and terrain to be an impedance to rapid, advanced medical care. Elderly patients are at highest risk for AMI's, and highly vulnerable for the consequences of delayed therapies for AMI (Alexander et al., 2007).

National and regional studies that focus on pre-hospital emergent care for STEMI populations, with assessments regarding rapid communication of arriving STEMI cases, have great potential to improve care to this high-risk group. The benefits of reduced morbidity and mortality by using a STEMI system of care have been validated. The process to achieve pre-hospital efficiency on a systems level within the Idaho and eastern Oregon region has yet to be studied to provide improvement. This CIP survey proposes to assess pre-hospital communication of STEMI arrival to assist in identification of gaps and areas where potential improvement can be effected.

Organizational and local knowledge

National research reveals variations in FMC protocols, including those for ECG acquisition, interpretation, and communication to PCI facilities (Jollis et al., 2012). Jollis et al. (2012) analyzed and reported findings from AHA's Mission: Lifeline national database and reported significant data, including the following information:

- Paramedic or other advanced Emergency Medical Technicians (EMTs) had ambulances available for transport 62% of the time (*n* = 237), while 30% (*n* = 115) of the ambulances were staffed with basic or intermediate EMTs
- Helicopter transport was available 66% of the time (*n* = 248).
- Half, 55% (*n* = 209) of those in the data set, had ECG devices in their ambulances, but 41% did not have devices available (*n* = 155)
- ECGs could be transmitted to hospitals from the ambulance for 35% (*n* =132) but an additional 36 % could not transmit their ECGs.
- Preliminary ECG interpretation was most commonly made through transmission to a hospital, paramedic interpretation, or ECG device computer interpretation.
- Once a STEMI was identified, cardiac catheterization laboratories (CCLs) were then alerted through ED- triggered activation, typically without cardiology involvement.
- Most systems (61%) had protocols in place to allow EMS direct transport to a PCI hospital and bypass nearest facilities that did not have PCI capability. This enables a rapid FMC to PCI reperfusion time by avoiding unnecessary stops enroute.

Similar issues plague Idaho and Oregon. The region utilizes a variety of EMT levels of service. Protocols for EMS ECG acquisition and interpretation vary by state, county, and provider agency within the state of Idaho. Some agencies may not have 12 lead ECG devices available to record abnormalities due to cost or limited EMS members' scope of practice. For many PPCI and EMS systems of care, the equipment, upkeep, training, liability, and STEMI transmission to PCI centers may be cost prohibitive and plagued with inconsistent training and reliability (Ting et al., 2008). Not all rural health care sites and clinics have 12 lead ECG devices

and resources for accurate interpretation despite the high prevalence and mortality of cardiovascular disease in rural and frontier areas (Jenkins et al., 2011).

Idaho does not collect data related to morbidity and there is no current EMS statistical database for AMI care or transport. State mortality data is accessed through national databases such as the Centers for Medicare and Medicaid Services (CMS). According to Roger et al. (2012), the annual first time AMI occurrence in the US is estimated at 785,000 in the US, with about 470,000 having a recurrent AMI. The annual US mortality from AMI's is 406,351 (Roger et al., 2012). In the southwest Idaho regional health care system ACTION Registry Database (ACTION Registry, 2011), the AMI age range is 19 to 101 years with the greatest concentration occurring between ages 55 to 80. According to Roger et al., 2012 and Centers for Disease Control and Prevention, 2011:

- National mortality rates from CVD are lower compared to 20 years ago, but the burden of heart disease continues at a high level through escalation in contributing risk factors.
- Prevalence of poor control of risk factors that can be improved through life-style modification is of great concern for the US healthcare system: one-third of US adults are hypertensive; one fourth of US adults abuse tobacco with 46% of nonsmokers exposed to second hand smoke.
- Thirty-five and seven tenths percent of US adults are obese, and 17% of US children are obese. Lack of vigorous physical activity is reported among 36% of adults and contributes to CVD.

Clinical Inquiry Project (CIP) question

This CIP proposed to survey and analyze responses by HC professionals in Idaho and eastern Oregon who cared for STEMI patients. ED and interventional cardiology physicians, Registered Nurses (RNs), Nurse Practitioners (NPs), Physician Assistants (PAs), and EMT staff were invited to participate. Family practice physicians and NP's in rural areas were also included because they often staff the ED's or provide clinic STEMI referrals. The survey focused on communication complexities in the acquisition of the pre-hospital STEMI ECG.

The STEMI communication survey also proposed to assess and analyze the various means of communicating pre-hospital arrival ECG STEMI to PPCI facilities. Clinical inquiry questions addressed were:

1. What are the perceived barriers to rapid pre-hospital notification of STEMI by providers, EMS, nurses, and other personnel who provide direct care to STEMI patients?
2. What percent of STEMI ECG's are communicated to the PPCI center before STEMI patient arrival?
3. What types of communication are used to notify the PPCI center of STEMI identification and arrival?

Four major geographic areas service Idaho (ID) and eastern Oregon (OR) populations with PCI-capable sites that are available on a 24/7 basis. Kootenai, ID, provides emergent cardiac intervention to northern Idaho counties. Pocatello and Idaho Falls service eastern Idaho. A medical center in Twin Falls, and facilities in Boise and Meridian are able to support southwest and central Idaho, and eastern Oregon. Although this is a large "regional" area, there are some common characteristics in that PPCI centers tend to be located in areas of greater population density, surrounded by large geographical areas of rural and frontier territories.

Desired Outcomes

By assessing and analyzing pre-hospital STEMI communications, trends in most effective means of communication may be identified, as well as gaps and areas for improvement. Gaps may include prolonged times to PCI among rural areas with identification of barriers that may be improved. It was hoped that by assessing and analyzing adherence to best practices, the information could be identified and shared. If best practices cannot be achieved, then causal analysis may help identify sources, and collaborative brainstorming with stakeholders may help to achieve improved care in smaller steps to best practices. The overarching goal was to improve the STEMI ECG identification time to reperfusion and ultimately reduce CVD morbidity and mortality by improving the pre-arrival process.

Approach to the Conduct of the Project

Study setting

This practice proposal study involved HC professionals who provided care to STEMI patients. Collectively they worked to provide the best care that they could, ultimately reducing ACS morbidity and mortality throughout Idaho, and eastern Oregon. The Oregon counties included in the study were Baker, Gilliam, Grant, Harney, Malheur, Morrow, Umatilla, Union, Wallowa, and Wheeler. Representatives from PPCI facilities and rural area STEMI HC professionals were invited to participate.

"Time is muscle" is a relevant saying that concisely describes the increase in irreversible necrosis and injury to myocardium during prolonged and increased time to intervention and reperfusion. The function of the setting was to provide a stage to analyze pre-hospital STEMI communication on local and regional levels. Idaho and eastern Oregon have STEMI systems and available protocols that are based on evidence based practice. However delays between STEMI

recognition at the pre-hospital level, to transfer STEMI PCI time, is known to be above the national benchmark despite aggressive outreach and education programs. There is room for quality improvement to reduce time to reperfusion and save viable myocardium.

Nationally, there are wide variations in pre-hospital STEMI ECG acquisition and analysis processes (Ting et al., 2008). Boston implemented one of the first STEMI systems of care that incorporated pre-hospital ECG's. Their paramedics are empowered to identify, interpret, and notify the nearest PPCI facility of STEMI arrival. However, only municipal paramedics are included since private EMS providers do not participate. Los Angeles County, California, covers over 4,000 square miles and 2,500 paramedics from 27 agencies. Rather than train all EMS providers, the paramedics rely on computer generated analysis to interpret the AMI to trigger a STEMI alert to a nearby PPCI facility (Ting et al., 2008). Both EMS systems empower EMTs to bypass non-PCI capable facilities, and transport directly to PPCI hospitals.

In order to improve outcomes and patient care, PPCI facilities and STEMI HC professionals are eager to improve systems, education, and protocols. This is evident in well attended statewide STEMI task force meetings conducted by the Idaho Department of Health and Welfare that have representatives from EMS, EDs, cardiology, and nursing. Regional STEMI meetings are also well attended by similar professionals. Idaho STEMI Summit conferences include attendance by administrators, physicians, and all levels of staff RNs and EMTs, including those from rural areas.

The survey proposed to delineate the various ways of communicating pre-arrival STEMI, frequency of use by transferring services and PCI centers, and perceived barriers within the region. Anticipated barriers and challenges for using a survey methodology included potential delays in IRB survey approval, delays in survey delivery to participants, poor participant response rate within

the survey timeframe, missing data, inappropriate responses, unanticipated communication problems, and unknown stakeholders among responders. It was possible that responses may have only been received from specific areas, such as urban sites, so that biases might have resulted; likewise, responses may have held larger, or too few, responses from certain professions. To minimize some of these survey issues, accurate verbiage and carful survey setup were closely reviewed. The survey process was also closely reviewed and monitored. Additional potential barriers were anticipated in unidentified costs, unpredicted changes in support through organizational structures, or unknown restrictions by review boards or organizations. Investigations into those arenas were thorough with confirmations from each source for costs, processes, and rules. See appendix one and two for a sample of the survey and appendix three, four, and five for tables and graphs related to survey results. Table six includes correlational tables of survey results.

Participants and population

Participation inclusion for the survey prioritized HC professionals who cared for STEMI patients in eastern Oregon and Idaho, and who could ultimately influence rapid care transitions for reperfusion of coronary arterial circulation.

Participation in the study excluded healthcare professionals who did not interact with adult STEMI patients. No patients or their families were contacted or included in the project. The project had IRB expedited approval before the survey was distributed.

Since no participant identifiers were included in the survey, participation was anonymous. Although zip-codes were requested, multiple participants from various professions were included in the mail lists, and it was not possible or desired to identify participants who replied to the survey. Additionally, participation was voluntary and withdrawal from the survey was an option at any point in the survey process. Participants were assured protection through the IRB approval process.

The number of the survey participants depended on the number of HC professionals who were contacted and responded to the survey in eastern Oregon and Idaho. The recruitment plan was to access potential subjects through PCI site ED and CCL contacts, professional organizations, EMT contacts, Urgent Care clinics, and Critical Access Hospital (CAH) site contacts in both eastern Oregon and Idaho. APRNs, RNs, physicians, and PAs who worked in ED's and Family Practice Clinics were contacted to participate. The final survey distribution list had 543 potential participants who represented stakeholders in four major PPCI regions of Idaho as well as eastern Oregon. The estimated number of inclusive responses was projected to be 10-15% of total surveys distributed. Email addresses or postal addresses were available for distribution to potential participants, and the mode of delivery depended on the available means of contact. The survey distribution utilized SurveyMonkey® for email survey distribution, and United States Postal Service for mailed surveys. Mailed postal surveys had a stamped, self-addressed return envelope to a local post office box.

No intervention was planned, but results may be included in future education and STEMI quality committee presentations with goals of brainstorming for improvement with all stakeholder representatives. Recommendations and qualitative responses may be considered in future collaborative directions with stakeholders.

Data measures, collection, analysis

- An electronic survey was sent by SurveyMonkey® to STEMI stakeholders who had email addresses available. If email contact was unknown, a hard copy of the survey was mailed through US postal services. Contact information was accessed through professional and organizational lists. Appendix 1 and 2 contains the survey sample, and appendix 3a presents the response location data.

- The survey demographics section was intended to help determine services to, and geographical locations of, participants to aid in the analysis related to needs, disparities, and gaps.
- The survey inquiry addresses potential known variations of communicating STEMI notification to PPCI facilities, based on national data (Jollis et al., 2012). The survey drew perceptions of these variations at regional levels, reflected on a Likert scale, and two open-ended qualitative narrative areas for additional feedback. The results were intended to quantify different means of pre-notification, and identify barriers and gaps in timely, optimal care.
- SurveyMonkey® was used to collect the electronically submitted data. At the completion of the survey, data was exported into Excel. The data was set up in charts using pivot tables, then analyzed through frequency chart postings for each possible response and for each item ("always, sometimes, rarely, never"). Appendix 3 and appendix 4 presents the participant response data in tables and graphs. The optional comment section in appendix-5 provided qualitative themes related to gaps, barriers, and suggestions for future education.
- Hard copy survey responses were transcribed into the SurveyMonkey® excel database. The two data sets were combined into one database before tables were calculated and listed. Appendix 3 and appendix 4 presents the data in tables and graphs, and appendix 5 lists qualitative responses
- Geographic areas that did not provide pre-notification to PCI facilities, or provided limited notification were of great interest since this lack of action may be one cause of delay to reperfusion.

- There was no previous literature regarding this type of survey, so a validated tool was not available. The reliability and validity of the created survey tool has not been evaluated.
- Pivot tables with associated graphs or charts revealed patterns. Results were further reported per item and by geographic areas, to view patterns of variance or related to potential delays to provide initial assessment towards intervention for AMI.
- This was a descriptive study from a survey inquiry. It was the first step in analyzing various means of communicating emergent STEMI arrival to PCI facilities, and has potential for future regional projects to assess additional pre-hospital quality improvement processes that have been demonstrated in national research data. Follow-up interventions, such as focused education that aims to improve STEMI FMC to PCI analysis and communication, may also be surveyed in the future.
- Since several levels of HC professionals are surveyed, inferential statistical analysis may also be considered in future studies that include larger numbers of responses.

Implementation and outcome results

The CIP survey was implemented and conducted as a descriptive study utilizing a quality improvement methodology to analyze the variations in communication of STEMI identification during pre-hospital care. Although national research describes causes of pre-hospital STEMI delays to reperfusion (Antman et al., 2008; Le May et al., 2010; O'Connor et al., 2010; Rokos et al., 2010), no publications were found that provided data specific to the Idaho-Oregon region. This survey assessed conditions within the region and in the final analysis is compared to national research. Additionally, armed with data for this region, regional PPCI centers may be better prepared to improve education, protocols, and activation for STEMI care.

An Institutional Review Board (IRB) expedited review was submitted and granted in November-December 2012. Mail lists were complied, then SurveyMonkey® surveys were emailed in February. Responses were accepted for three weeks before closing the survey. A slightly longer time was allotted for development of postal set up, mailings, and replies. A total of 543 surveys were delivered to potential participants. A return rate of 13% resulted in 70 surveys received. However, 18 of those surveys were respondents who replied that they did not provide care to STEMI patients, so were excluded. The remaining 52 provided valuable data in the survey results.

The SurveyMonkey® mechanism enabled mandatory responses before subjects could advance to subsequent questions in appropriate sequence. Mailed hard-copy surveys could not control for omissions so there were a number of missing data elements or inappropriately placed data within the mailed surveys. Zip codes, for instance, were missing on five hard-copy submissions. Since all participants responded to geographic location of their workplace, general information about rural versus urban could still be extracted. Geographic delineations, as listed in the survey, were represented in the responses. Respondents identified themselves as residents of urban or metropolitan, suburban, rural, or frontier locations (appendix 3d). The zip codes that were submitted demonstrated a geographical range of responses that represented eastern Oregon, and north, eastern, central, and southwestern Idaho (appendix3a). Definitions for "metropolitan/urban," "suburban," "rural," and "frontier" were not provided. Consequently this lack of concrete description may be a limitation related to a wide range of perceived definitions through the self-report responses.

Representatives from each "role" category selected for the survey submitted responses. Physicians selected their specialized practice (ED, Cardiology, or Family Practice), and Registered Nurses (RNs) defined their professional role as staff, management. Advanced Practice RN's (APRN

NPs), also responded as APRNs or NPs. Emergency Medical Technicians (EMTs) responded as first responders, basic/intermediate/advanced EMT's, or paramedics. PA's also made their selections. Physicians and RNs provided the majority of responses at approximately 35% each, with an additional 15% APRN's and 7.7% EMTs (appendix 3b). Participants from rural areas accounted for 57.69% of responses, and 21.5% were from urban locations (appendix 3d).

Most respondents were involved in transporting STEMI patients directly *to* metropolitan areas (50.9%, $n = 27$), which is the nationally expected standard of care (appendix 3f). It is a strong national recommendation that EMTs who are transporting a known STEMI patient should bypass CAH's and transport the patient directly to a PPCI center to save time and minimize myocardial damage (Jollis, et al., 2012; Rokos 2011). Historically, before a STEMI system of care was introduced and promoted nationally, STEMI patients were taken to a CAH and the ED physician took the time to assess the patient, take sequential vital signs and ECG's, run lab work, then await lab and chest x-ray results before notifying the PPCI center of STEMI arrival. The subsequent delay-to-intervention promoted high levels of morbidity and mortality.

PPCI centers are predominantly located in urban locations. Those who did not transport directly to urban centers were in rural/frontier areas and transport to CAH's (43%, $n = 23$, appendix 3f and 6d). The actual reasoning for this was not elicited in the survey. It is not uncommon that provisions for advanced emergency AMI care, such as direct contact to PPCI centers, air transport or advanced care, critical drug therapies, and advanced technologies, can be supported at CAH's before emergent transportation to PPCI facilities. Many rural and frontier EMTs are first responders (FR), Basic (EMT-B), or Intermediate (EMT-I) level of certification, and cannot provide those specialized and advanced services since their scope of practice allows only patient transportation and basic life support service as needed. Most urban paramedics (EMT-P) can

provide Advanced Cardiac Life Support (ACLS), but depending on county regulations, may be restricted in their scope of practice as well. If coronary intervention cannot be provided within 120 minutes of first medical contact, then thrombolytic therapy is the next standard of care. This critical drug therapy may be provided by a CAH physician, RN, or NP as part of a standardized STEMI protocol pre-written order set, depending on their scope of practice. PCI, though, is the preferred gold standard of care due to better outcomes and less risk of complications such as catastrophic bleeding. Results from the survey demonstrated that a majority of the emergent medical transportations to PPCI STEMI centers was from rural/frontier areas, including clinics and CAH's.

A wide range of EMT levels of practice serviced Idaho and Oregon, especially in rural/frontier areas (appendix 3h). The majority of paramedics, the advanced level of EMT's, worked predominantly in urban/suburban areas. Rural areas were supported by both volunteers and paid EMT's who may be first responders, basic through advanced levels, or occasionally paramedic. The significance of the level of EMT to STEMI identification is that first responders and basic level EMTs cannot apply, analyze, or record ECG's so will not have 12 lead ECG devices with them. Therefore, identification of AMI in the field for these EMT's is not possible. The majority of EMT's who were allowed to record ECG's were also empowered to identify and notify PPCI facility or CAH's of their arrival with a STEMI emergency (59%; appendix 3i). Physicians were second in frequency to those who provided first analysis and identification of STEMIs (17%; appendix 3i). Those physicians worked primarily in EDs or family practice clinics, or were cardiologists who received the patients in the PCI facilities. Once STEMI was identified, pre-notification of STEMI arrival was provided at 34% (n = 15) "all of the time," and 50% (n = 22) for "some of the time" (appendix 3j). Twenty four percent (n = 11) rarely or never provided pre-notification (appendix 3j).

Many physicians and nurses who responded to a question regarding levels of concern for financial challenges (appendix 3k) noted affirmatively that "financial issues influence STEMI care" (appendix 6c: physician, n = 18 , 34%; Registered Nurses, *n* = 18, 34%). Some professionals from urban areas did not feel this way *(n* = 2, 7.8%, appendix 6b). EMTs also identified this as a concern, but with less frequency (*n* = 8, 6%, appendix 6b). The monetary influences were identified most frequently by those in rural areas (*n* = 17, 50%), and less frequently by those in urban areas (*n* = 12, 41%, appendix 6b).

There were wide variations in the means by which STEMI ECG's were communicated to PPCI centers (appendix 4a, appendix 6f). Urban/suburban area respondents utilized satellite transmission more often than rural/frontier areas (rural/frontier, *n* = 6, 37.5%; urban/suburban *n* = 9, appendix 6f). Rural/frontier area respondents used hard copy ECGs sent with the patient to the hospital, equally as often as urban/suburban respondents (urban/suburban, *n* = 20, 50%; rural/frontier, *n* = 20, 50%; appendix 6g). Dispatch call was utilized more frequently among rural area respondents than urban/suburban respondents (urban/suburban n = 17, 44%; rural *n* = 22, 56%; frontier area did not utilize dispatch mode; appendix 6h). Direct phone call contact was used more often among rural/frontier respondents for STEMI communication with PPCI or ED notification (urban/suburban n = 17, 47%; rural/frontier *n* = 19, 53%, appendix 6g). "Smart phone" and phone applications were not commonly used among participants (rarely/never/does not apply, *n* =44, 88%, appendix 4e). Fax was also not commonly used (rarely, never, does not apply, *n* = 34, 68% appendix 4c). Telehealth was rarely used (rarely/never/does not apply, *n* = 44/49, 90%, appendix 4h). Direct admission from EMS to CCL was used mainly in urban/suburban areas (*n* = 18, 64%, appendix 6e) and least often utilized in rural areas (*n* = 10, 36%, appendix 6e).

Limitations

Limitations to this study included a small study sample so that results could not be generalized. The survey was a cross sectional study so results were limited to data that was captured during the allotted timeframe. There were no previous studies to provide a validated tool. This pilot survey may provide the means to introduce a validation process.

The narrow scope of the study's pre-hospital communication of STEMI processes may also be a limiting factor. Future study topics might include a wider range of inquiry that includes other aspects of communication or process days to PCI. Examples might include quality improvement studies to improve rural ECG capabilities or elevating the EMS rural certification to paramedic level throughout both Oregon and Idaho. There were no definitions provided regarding urban, rural, suburban, and frontier delineation, so that perceptions of each respondent's geographical work location may vary. Future studies would benefit from geographical definitions especially in the delineation of rural and urban distinction (Bushy, A. 2000; Winters & Lee 2013).

There are inherent limitations in mailed survey studies due to the short timeframe, relatively small number of populations surveyed, and imposed requirements to only respond in the manner provided, such as the Likert scale, with little allowance for explanation or variance. There was no way to know if appropriate subjects were recruited or in adequate numbers, except for the option to reply "no" and decline the survey if respondents did not care for STEMI patients. However, given the importance of EMTs in pre-hospital setting for STEMI care, and the small number of EMT responses (*n*= 4, 7.69%, appendix3b), more effort should be given to recruit a larger pool of First Responders and EMT's in future studies.

Discussion

Context

A practical means of assessing the microsystem of STEMI system of care is by utilizing Nelson, Batalden and Godfrey's (2007) concept of a "5 P's Framework," a review of purpose, patients, professionals, processes, and patterns. The following utilizes that framework to overview the "STEMI pre-hospital communication study." The microsystem study is a quality assessment survey as reflected by STEMI healthcare professionals in the Idaho-eastern Oregon region. This is a secondary study and utilizes a focused area from larger national research studies to demonstrate the efficacy and benefits of collaborative STEMI patient care, and assess for areas of improvement.

The *purpose* of the CIP included the following: the "*Survey to Assess Pre-hospital STEMI Communication"* served as a reflection of Idaho and eastern Oregon systems of STEMI care as perceived by HC professionals who provided first-line care to AMI patients. Although the number of responses was small, the trends in the study reflect much of what has been speculated regionally, especially regarding rural disparities. The study also mirrored that which has been documented in national research in the prevalence, distribution, and interrelations of pre-hospital AMI support (ACTION Registry, 2011; Rokos, et al., 2013; Jollis, et al., 2012). Rural areas continue to lack resources to provide standard of care provisions to their populations and comparable care to that provided in urban areas. The concern for continued disparities in care to rural populations persists despite technological advances and efforts as Accountable Care Organizations with outreach programs to provide a continuum of care to communities. Influences to improve timely STEMI care to rural and other vulnerable populations by APRN leaders with DNP degrees can be effective at multiple levels with organizational, regional, and national systems. However, APRN leaders must also have an awareness of the uniqueness of individual rural communities and their perceptions of health care (Bushy 2000; Winters & Lee. 2013).

A review of "*patient's"* in STEMI populations includes the following assessment: ST elevation myocardial infarction is known to carry one of the highest mortality levels for disease-related deaths nationally and in Idaho/eastern Oregon. Despite research that shows a reduction in CAD mortality over 20 years of data surveillance, the burden of the disease continues at a high level due to concerning untreated risk factors and unhealthy lifestyles. Preventative care and education is an important aspect of any CVD study. Patient centered improvements include a need for public acknowledgement that EMS can only be activated to initiate emergent STEMI services if patients or their families/friends make the initial contact, a call to 9-1-1. Community awareness and reinforcement of public health messages regarding heart attack signs and symptoms and emergency care activation are an important component of patient responsibilities within STEMI systems of care. Additional awareness of needs and provisions of support to vulnerable populations may improve disparities. The study results from this survey reflect data that parallels known results from national research regarding a lack of up-to-date care and poor adherence to national guidelines in rural areas (Jenkins, 2011; Ting, et al., 2008). Both the qualitative and quantitative responses in the CIP study reflect a lack of resources and technologies that are found in urban areas (appendix 3, 4, and 5), and fewer, if any, pre-notifications of STEMI arrival (appendix 3j). Follow up quality endeavors can include quality improvement goals and collaboration with ED's and EMS units.

"Professional" STEMI communication assessment includes the following: as in the Jollis, et al. (2012) national study analysis, this regional STEMI study similarly demonstrated a wide range of EMT levels of service and scopes of practice, from volunteer first responders to RNs and paramedics. Jollis, et al. (2012) also noted that ambulances may be available 62% of the time (N 237), with ECG devices in 55% (n 209) of those transport vehicles. No ECG device was available in 41% (N 155) of vehicles in the Jollis study. Occasionally in rural Idaho areas, the ambulance is a

private vehicle with First Responder or Basic to Intermediate level EMS or EMT support so that no ECG device is available on those ambulances. Only some of the advanced or paramedic level EMTs can perform an ECG, depending on county regulations. Despite attempts by air transport agencies to place helicopters in strategic geographic areas of need, additional time is required to "power up" and arrive at rural destinations within designated landing zones, and poor weather conditions my preclude both air and ground travel.

National and local data also shows that a variety of HC professionals may be involved in analyzing and communicating STEMI arrivals to PCI facilities. The initial pre-hospital ECG STEMI analysis in this survey was predominantly EMT-driven (*n* = 17, 53%), although physicians were also involved (*n* = 5, 17%; appendix 3i).

Although the national recommendation for pre-hospital notification is ideally "all of the time," only 34% of pre-hospital STEMI ECG's in this survey were communicated to PPCI facilities "all of the time," and 22% of the respondents rarely or never provided notification (appendix 3j). No explanation was sought or provided except in the rural/frontier areas where no ECG device was available. It would be a relevant topic for future studies to assess causes for the lack of pre-notification all of the time.

"Process" STEMI assessments include the following: despite national protocols and researched "best practices," many inconsistencies and challenges exist in pre-hospital settings. Although regional systems of STEMI care have been initiated, wide variations in roles and effective, efficient care continue to persist, predominantly (but not exclusively) in rural areas as evidenced by responses listed below.

The physicians and nurses who responded to question 11 noted affirmatively that "financial issues influence STEMI care," (physicians, *n* = 4. 21%; RNs *n* = 12, 63%, appendix 6c), although

26% of professionals from urban areas did not feel this way ("rarely-never" *n* = 15, 29%; appendix 6b). The monetary influences were identified equally by those in rural areas, and suburban/urban (*n* = 17, 50% each; appendix 6b). EMTs also identified this as a concern, but with less frequency (9%, appendix 6c). However, the EMT survey response rate in general was low (*n* = 4, 7.7%, appendix 3b). Clearly, since the majority of pre-hospital STEMI ECGs were obtained, analyzed, and communicated to PPCI's by EMT's (53%; appendix 3i), their recruitment and input in all aspects of pre-hospital STEMI care should be given high priority in future related studies.

One variable is the means by which STEMI ECG's were communicated to PPCI centers, and may be related to geographic location and cost (appendix 6b). Urban area respondents utilized more current technologies and higher budget communication systems such as satellite transmission (rural 37.5%; suburban/urban 62.5%, no frontier response; appendix 6f). The set up for satellite transmission and download, although the most efficient system for ECG pre-notification, is proprietary and device-driven by the company. The initial expense outlay is several thousands of dollars in addition to the cost of the 12 lead ECG device, supplies, and upkeep. Rural/frontier area respondents used the lower cost & basic technologies such as hard copy ECGs sent with the patient (urban/suburban 28%; rural 19%; appendix 6g), dispatch call (urban/suburban 44%, rural 56 %, frontier response, "does not apply;" appendix 6h), or direct hospital phone call contact to PPCI facility or ED site notification (urban/suburban *n* = 17, 47.3%, rural/frontier *n* = 19, 52.8%). "Smart phone" and phone applications were not commonly used (rarely/never/does not apply 88% appendix 6j), but may well increase with technological improvements and lower cost. Since the survey there have been multiple inquiries and discussions regarding smart phone applications specifically regarding ECG transmission. However, there may be inherent HIPPA concerns related

to the transmission. Cell phones also have limited capability and may not work well in certain environments, depending on access capability.

Faxed STEMI notification was not commonly used (rarely, never, does not apply, 68%, appendix 4c), possibly due to outdated technology and HIPPA concerns if contact number is entered or sent incorrectly, and occasional "send" failures with older machines. Telehealth response was also entered as rarely used, possibly since this is a relatively new mode of use for STEMI identification or analysis (rarely/never/does not apply, 90%, appendix4h). However, it may be used more frequently in the future as expert coverage becomes more available to ED's in rural areas in Idaho and eastern Oregon. Responses regarding direct admission from EMS to CCL reflected predominantly urban/suburban areas (64%; appendix 6e) where it has been shown to add efficiency and speed to the intervention time, with a door to PCI time of 14 to 26 minutes in 2012 by one facility (ACTION Registry 2011). EMS direct admission to CCL was not often used by rural areas (36%; appendix 6e), and many of those are noted in the ACTION Registry as CAH transfers to PPCI centers. This may also represent the longer time for ground or flight transportation to arrive near the originating site, and depart from the rural areas in expedited timeframes. If PCI cannot be achieved in less than 120 minutes from FMC time, it may not be realistic to target an EMS to CCL expedited deliverable, especially with mountainous terrain or inclement weather conditions.

Given the rapid improvements in technological advances for healthcare, such as utilization of e-ICUs in EDs and cell phone application use for pre-hospital ECG transmission, it would be of value to do a follow up study to assess changes in modes of pre-hospital STEMI communication.

Assessment of responses related to *patterns* includes the following: Jollis et al.'s (2012) national AMI data assessment showed that 35% alerted PCI facilities of pre-arrival STEMI

(appendix3j), but 36% could not transmit the information ahead appendix 4a). In this regional study, pre-notification of STEMI arrival is provided at least "some or all of the time" in 72% of respondents (appendix 3j), although there was a great variation in how this was done and only 32% actually *transmitted* pre-arrival STEMI ECGs at least some of the time to PCI facilities (appendix4a). There is room for education and improvement since research and the national standard of care suggest that morbidity and mortality can be reduced if pre-notification is provided *all of the time* (Ting et al., 2008).

Rural disparities persist in Idaho and eastern Oregon where STEMI care is concerned (Jenkins, 2011). This concept is reinforced in regional data that shows pre-hospital ECG acquisition is less likely to be done in rural and frontier areas which may be due to a lack of resources, funding, and personnel (appendix 5a).

Implementation in relation to literature

National research and publications regarding STEMI Systems of care demonstrate the benefits of those systems across regions that have access to PPCI centers. The PCI facilities provide an impetus and the vehicle for timely reperfusion when an acute myocardial infarction occurs. A standardized STEMI protocol based on researched evidence, coupled with education and rationale for the process, can facilitate best practices. However, research related systems of STEMI care are predominantly conducted by physicians and focused on broad, national events related to the process (Brown, Mahmud, Dunford, & Ben-Yehuda, 2008; Krumholz et al., 2008; Ting et al., 2008; Van de Werf, F., et al., 2008; Rokos, I.C., et al, 2011). While the national overview provides evidence based guidelines from a larger perspective, the guidelines may not provide awareness for local needs, gaps, or locally focused quality improvement needs. It is the task of regional processes to assess the application of evidence based practice to local efforts. This effort may help to

discover trends and gaps in that region, when compared to nationally recommended practices. The national benchmark for ED to PCI is 90 minutes, unless the STEMI patient is transferring from another facility. In those cases, the FMC to PCI benchmark is 120 minutes in order to sustain viable myocardial tissue. To achieve the benchmark regionally, an assessment of regional characteristics is essential before collaborative partnerships can be effectively supported. The process to understand the challenges and barriers to timely ECG and PCI requires focused identification and analysis of process parts in order to formulate questions.

Outcomes in relation to literature

Results from the "Survey to Assess Pre-hospital STEMI Communication" paralleled national publications and presentations (Jenkins, R.R., et al., 2011; Ting, H.H., et.al. 2011). Whenever 12 lead ECGs can be completed in pre-hospital STEMI emergencies, and communicated before arrival to PPCI facilities, the FMC time to PCI is well within benchmark standards. This is the ideal situation and regional HC professionals who are able to meet these standards are able to deliver timely and effective care according to the national recommendations. However, the "STEMI Survey" also demonstrated the perceived and real disparities in those geographical areas that do not have the resources, knowledge, or support to perform 12 lead ECGs and ECG analysis in order to define STEMI situations. Rapid clinical identification of potential AMI and expedited transport to a CAH or PPCI is prudent if one of the first steps in STEMI identification, the ECG acquisition, is not possible in those situations. Currently, it may be difficult to transport a frontier STEMI patient within benchmark time to avoid compounding morbidity and mortality. Urban and suburban pre-hospital communication was consistent and effective in contributing to timely reperfusion, but greater perceived challenges and gaps occur in rural and frontier areas of Idaho and eastern Oregon. The greatest concerns are the delaying elements that escalate chances of cardiac

tissue necrosis, loss of viable tissue, and resulting disability or death during extended times to treatment. These are the areas that can benefit from collaborative strengths in advocacy, creative resolution, and quality support.

Although appropriate stakeholders are involved in STEMI care, the majority of physician specialists in emergency medicine and cardiology are located in urban and suburban areas, while rural areas rely on family practice and primary care HC providers to support STEMI care. Likewise, paramedics are primarily located in urban and suburban areas, while rural regions often rely on volunteers, or basic to intermediate EMT's. Some rural paramedics have a scope of practice that does not allow them to perform or interpret ECGs. While NPs are helping to impact ED's and rural health care, the survey's qualitative responses reflected RN and APRN interests in educational programs, especially those in support of ECG and STEMI recognition.

Clinical implications and recommendations

Qualitative responses are provided in 11 of 52 survey replies (appendix 5a). The majority (82%) are from rural participants and in total reflect many challenges, including:

- A lack of resources and education
- Budgetary constraints that limit or impede optimal care
- No 12 lead ECG devices or capability
- Limited, or full lack of capability, to provide pre-hospital STEMI ECG notification.

Suggestions for education include ECG training in general, and more intermediate-to advanced concepts of STEMI analysis such as STEMI equivalents and confounders. STEMI equivalents are those ECG patterns that do not show ST elevation, such as posterior AMI's, but are actually the equivalent to a STEMI. Confounders are ST elevations that are not AMIs, such as

pericarditis. This is a relevant suggestion since "false positive" and "false negative" STEMI ECGs are possible and should be avoided to improve patient and financial outcomes.

Outreach programs from PPCI facilities can collaborate with CAH facilities to assess their specific needs and brainstorm for creative means of support. Education efforts, for instance, need to support those characteristics specific to a particular region. Urban areas did not provide input regarding education needs, but rural areas had specific requests. Additionally Bushy (2000) and Winters and Lee (2013) both emphasize learning the specific identities, needs, and "ruralness" of each rural neighborhood before any intervention is attempted. National benchmarks can be drawn into the education program, but should include input and perspectives of the stakeholders to whom the program is presented so that particular gaps and challenges can be addressed. Even small steps towards improvement may have a long term positive effect on STEMI survival and ultimately reduce morbidity and mortality.

Recent philanthropic support helped to purchase 12 lead ECG devices for two counties in Idaho. Local EMT-paramedic programs in community colleges now utilize outdated ECG devices. The devices were contributed to the classroom practicum sessions so that students can learn how to correctly run the devices and interpret ECGs on equipment that is similar to those in current pracitce.

Conclusions

Research based national guidelines for STEMI care provide tools for implementing and improving quality care. APRNs with Doctor of Nurse Practice (DNP) degrees can be leaders in assuring that the populations who receive the care, and the health care providers who initiate the care, are provided with appropriate information to optimize health outcomes for those populations. Specialized advanced knowledge as DNP APRNs includes an understanding of organization and

systems leadership that can ultimately influence quality and improvement in care to STEMI patients. The doctoral level of education provides the tools to learn, understand, and implement current STEMI evidence based practice in order to support professional collaborations. The advanced skills and knowledge application can be used to facilitate and promote related population health outcomes and preventative health efforts. DNP APRN education also provides an understanding of financial influences that impact care, an aspect that is not a part of Master's level nursing education or physician education. The knowledge and skills that DNP APRNs possess enables leadership with unique qualifications to initiate positive change and advance healthcare to STEMI patients.

Collaboration with public health efforts to increase awareness of heart attack signs and symptoms, and advance awareness of the importance of rapid actions to access emergency care are essential to reduce the morbidity and mortality of AMIs. DNP APRNs can initiate partnerships with HC professionals of all disciplines involved in STEMI care, including involvement in roundtable conferences. These collaborative meetings can utilize technological advances to embrace dialogue focused on improving and advancing care to this population and include large geographical regions and states. Regional webinars, teleconferences, or individual facility presentations, can include STEMI education and case presentations to demonstrate angiographic correlation of STEMI to ECG abnormalities and best practices. Opportunities to question care and analysis of processes can help to improve care. Means of identifying STEMIs, STEMI confounders, mimickers, or STEMI equivalents can all be integrated into monthly or quarterly sessions as the cases or requests arise. Continued quality assessment and evaluation is needed in order to identify areas of excellence and challenges for improvement.

Communication is essential to implement and improve processes and requires input from all stakeholders. Pre-hospital communication of STEMI ECGs can improve coronary reperfusion time, but it is necessary to identify areas of challenge, gaps and sources for the gaps when delays in the process occur. Participation by all involved to assist in the improvement process can aide in a collective accountability.

DNP APRNs can lead quality improvement efforts in treatment of STEMI patients and processes at local, regional, and national organizational levels. The Institute of Medicine (IOM) report, "Crossing the Quality Chasm," (Rosenthal, et al., 2001), described six focus characteristics of quality, evidence based health care: Safe, effective, patient centered, timely, efficient, and equitable. The 2006 IOM report, "The Future of Emergency Care" (Warden, et. al., 2006) described health care as "fragmented" and described the need for future focus on emergency health care delivery to be regionalized, coordinated, and accountable. Armed with the knowledge and skills to apply cost effective and scientific applications at an organizational and systems level of care, DNP APRN's can be leaders in transforming and assuring evidence-based, quality care in emergency care delivery. Not all health care facilities in Idaho have adequate resources to provide the most appropriate and the high level of care for acute critical illnesses. Collective partnerships for patient centered care may help to develop STEMI care that is safe, effective, patient centered, timely, efficient, and equitable, as the IOM report envisions for the future of quality driven health care. Effective coordination of care by HC professionals is needed to assure appropriate and equitable care.

Dougherty and Conway (2008) from the Agency for Healthcare Research and Quality (AHRQ) provide a simple guide to improve care: by identifying "what works," "who benefits," and "how to deliver quality care" across all settings. These concepts can be applied to STEMI systems

of care. Although regionalization has been effective in streamlining the process, effective communication is essential to assure ongoing quality emergency care. Accountable care organizations (ACOs) are implementing process changes to be fiscally viable while providing quality care for Medicare beneficiaries. Urban PCI centers in Idaho have effective processes that meet national standards, and benefit STEMI patients. Barriers to implementing outstanding care throughout diverse communities may include highly complex organizations, information technology expenses, legal issues, ongoing healthcare disparities, and sustaining financial stability (Rokos, 2011).

DNP APRNs can lead organizations in quality care for STEMI populations within the context and support to ACO's by championing regionalized care that supports the attributes of ACO models. This includes organized care, ongoing performance measurement, and value-based healthcare delivery that integrates payment reform considerations. DNP APRN's continuing to participate in national databases to monitor benchmarks and research trends can provide benchmarks for continuation of enhancement of evidence based regionalized STEMI care. Reaching and exceeding benchmarks will ultimately provide reduction in disparities, especially in those areas that do not have advanced specialists and technologies at hand, and this may ultimately provide rapid access to quality care.

Idaho's Department of Health and Welfare emergently initiated a newly formed statewide taskforce workgroup to develop a plan to address "time-sensitive emergencies." Idaho is one of a few states without organized systems of care for the highest mortality conditions in the state, specifically trauma, stroke and STEMI. This effort is a result of *House Concurrent Resolution 10* following a recommendation from the Health Quality Planning Commission to the 2013 Legislature. This is Idaho's first effort to monitor and ultimately improve quality of care through

surveillance, followed by initiatives to close gaps in care. APRN participation on this taskforce is essential to improve care to STEMI patients.

Finally, financial improvement can be realized in an effective, regionalized STEMI system of care, as Minnesota's research has shown, when there is a reduction in mortality, readmissions, reinfarction, and revascularization or complications (Rokos, 2011). The current emphasis on value rather than volume creates and ideal position for DNP APRNS to influence care through doctoral level advanced nursing practice. By participating in organizational, regional, state-wide, and national STEMI quality measures DNP APRNs can help health organizations improve fiscal balance by monitoring care in real-time, prevent costly complications and devastating AMI events, prolonged hospitalizations, and costly readmissions in Idaho and eastern Oregon. DNP APRNs can also champion creative means of budget neutral support such as philanthropic contributions, provisions for education through regional STEMI symposiums, and expert outreach sessions.

Summary

The regional survey to assess pre-hospital STEMI communication provided small but revealing data. The descriptive study drew participant responses from four regions across Idaho, and representation from eastern Oregon. Role representation included physician specialists from ED's, cardiologists, Family Practice, and Primary Care. Registered Nurses were represented by staff, management, and APRNs. EMS representatives, voluntary and paid, were First Responders, and EMT-B; EMTs included EMT-I, EMT-A, and Paramedic levels of certification. Physician Assistants also responded to the survey. Urban, suburban, rural, and frontier HC professionals from each of the STEMI stakeholder disciplines were represented.

Notable trends within the survey, as related to national recommendations, included major concerns in rural areas that could be contributors to lower capability to assure that STEMI

benchmarks in quality care are met. While the majority of urban and suburban participants transported STEMI patients directly to metropolitan areas where PPCI facilities are located, many rural and frontier participants responded that they transport the STEMI patients to CAH's. This is concerning since the national recommendation is to bypass non-PCI facilities and transport directly to PPCI capable facilities. A stop at a CAH causes longer time from FMC to PCI. However, the reasons for the stop were not elicited or explained. Since many EMTs in rural areas cannot record ECGs and are not empowered to analyze and notify PPCI's of STEMI arrivals, it is assumed that the CAH arrival is intended to provide an advanced level of care, capture an ECG, stabilize, or arrange for a critical care level transport, or air transportation, to a PPCI facility.

Another significant trend is that paramedics typically provide emergency care to urban and suburban areas. They are able to acquire ECGs and are empowered to analyze and provide pre-arrival STEMI notification to PPCI facilities. Many are also empowered to transport STEMI patients directly to the cardiac cath lab for immediate PCI, bypassing the ED, thus improving time to PCI. Rural EMT capabilities range from first responder to occasional paramedic, and many do not have ECG devices. Clearly rural areas could benefit from improved EMT capability as well as access to ECG devices if AMI emergent care provision can be addressed. DNP APRNs can be influential in supporting education and legislative action to influence HC access and improved care. Future regional STEMI studies may include more definitive exploration of findings related to rural needs and gaps.

Despite national publications and efforts to increase awareness of the high mortality rate associated with STEMI's, only 40% of AMI patients call 9-1-1 for emergent transportation (O'Connor et al., 2010; Ting et al., 2008). The patients who contact EMS expect care to be efficient, safe, and effective. DNP APRNs can be advocates, organizers, and participants in

community awareness efforts regarding the signs, symptoms, and necessary actions for heart attack survival, and the important lifesaving decision to call 9-1-1.

Preventative care is essential as a part of STEMI objectives. Although national mortality from CVD is declining, the burden of disease remains high (Roger et al., 2012). Risk factors for heart disease that can be lowered through life style modification are a public health concern. These major contributors to advancing CVD include uncontrolled hypertension, tobacco abuse, hypercholesterolemia, obesity and metabolic syndrome, and lack of exercise. DNP APRNs can be highly influential as role models in healthy life styles, community educators, and legislative advocates for policy changes for healthy environments and workplaces.

The STEMI survey study questions have been addressed in a microcosm. There are many perceived barriers throughout Idaho and eastern Oregon, predominantly in rural and frontier areas where there are fewer resources and means of support. STEMI pre-notification of arrival to PPCI facilities is provided "all of the time" in urban areas, and rarely-to-never in rural and frontier locations. STEMI pre-arrival notification is communicated in a wide variety of ways but the systems that are used most consistency in urban area transmission are also costly, and rarely-to-never used in rural and frontier territories. Future directions can include education support to nurses, NP's and EMT's in a way that supports their level of need. Further DNP APRN activities can include collaborative efforts with STEMI leaders in rural areas to improve STEMI care: the challenge, now, is to take STEMI care to the next level of action.

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Table of appendix listings

APPENDIX 1: STEMI Survey Document

OREGON HEALTH & SCIENCE UNIVERSITY

TITLE: Clinical Inquiry Project: Survey Analysis of Pre-hospital Acute Myocardial Infarction Communication

PRINCIPAL INVESTIGATOR:

Gary Laustsen, PhD, FNP, RN, Associate Professor, OHSU School of Nursing, One University Blvd, La Grande, OR 97850. Phone: 541-962-3132

CO-INVESTIGATOR:

Jane Miller, MS, RN, OHSU DNP student

PURPOSE:

You have been invited to participate in this survey because you have actual or potential contact with patients who are evolving an acute myocardial infarction, specifically ST-Elevation Myocardial Infarctions (STEMI). We would appreciate your responses and comments to help us learn about variations in communication with PPCI facilities that may lead to delays to coronary artery reperfusion. We are contacting STEMI stakeholders throughout Idaho and eastern Oregon with the survey. Stakeholders include EMS, Physicians, Registered Nurses (RN's), Advanced Practice RN's (APRN's), and Physician Assistants.

PROCEDURES:

Participation in this survey takes approximately 15 minutes. Section 1 covers demographic information; section 2 asks for responses to questions regarding STEMI communication with PPCI facilities. Some surveys are emailed using Survey Monkey; others are

being mailed through postal services. Electronic surveys will be returned to us automatically and anonymously upon completion. If you are completing a paper copy of the survey, please return it using the postage-paid envelope provided; these responses are also anonymous.

RISKS AND DISCOMFORTS:

There are no risks or discomforts projected for participants. The survey is anonymous and no individual can be identified; multiple people are being contacted from each geographic area, and all data will be reported as group data. Results of this survey may be presented at local conferences. Studies on human participants are reviewed by the Oregon Health & Science University Institutional Review Board committee to protect your rights and welfare. Questions or concerns may be directed to the Oregon Health & Science Institutional Review Board, 3181 S.W. Sam Jackson Park Rd, Portland, OR 97239-3098; or phone 503-494-7887; or by email, irbinbox@ohsu.edu.

BENEFITS:

Although there are no direct benefits for your participation, the knowledge gained may benefit STEMI patients in Idaho and eastern Oregon.

ALTERNATIVES:

If you decline participation in the survey, your decision will be anonymous.

CONFIDENTIALITY:

Research records may be reviewed and copied by the OHSU Institutional Review Board and the Office of Human Research Protections

COSTS:

There is no charge for your participation and there is no cost to you. You are not offered payment for your participation.

PARTICIPATION:

By completing and submitting the survey, you are consenting to participate in this study.

If you have any questions regarding your rights as a research subject, you may contact the OHSU Research Integrity Office at (503) 494-7887. You do not have to join this research study; participation is voluntary. If you join and later change your mind, you may quit at any time. If you refuse to join or withdraw early from the survey, there will be no penalty or loss of any benefits.

Participation is voluntary and you are free to choose not to participate in this protocol for any reason. You may withdraw from the study at any time without affecting your relationship with the investigators.

This information is yours to keep.

APPENDIX 2: Pre-hospital STEMI communication survey

Survey
ST Elevation Myocardial Infarction (STEMI)
I. Demographic information

1. Please enter the Zip Code of the facility or agency you are associated with:

_____

2. Check the appropriate box that corresponds most closely to your title/role:

	Volunteer	Paid
A. EMS:		
a. Emergency Medical or First Responder (EMR/FR)		
b. Emergency Medical Technician (EMT)		
EMT-Basic		
EMT-Intermediate		
EMT-Advanced		
EMT-Paramedic		

B. Physician:	
a. Emergency Department	
b. Cardiology	
c. Internal Medicine	
d. Family Practice	
e. Primary Care	
f. Administration	
g. Other (Please Specify)	
C. Advanced Practice RN (APRN):	
a. Nurse Practitioner	
b. Clinical Nurse Specialist	
D. Registered Nurse	
a. Management	
b. Staff	
E. Physician's Assistant	
F. Other (Specify)	

3. If you are employed by a hospital, what is the size?

a. ≤ 25 beds	

b. 26 to 150 beds	
c. 151 to 250 beds	
d. 251 to > 350 beds	

4. Identify your primary geographic work location(s):

a. Urban	
b. Suburban	
c. Rural	
d. Frontier	

5. Are you involved in the care of, or have potential to care for, STEMI patients?

a. YES	
b. NO	

If "YES" please continue and answer questions below.
If "NO," thank you for participating. STOP here and end survey. Please return survey in self-addressed stamped envelope if using hard copy survey; follow survey monkey instructions if taking electronic survey

6. STEMI patients I am involved with are transported to (check all that apply):

a. Metropolitan/Urban areas	
b. Rural areas	
c. Clinics/Urgent care facilities	
d. Critical Access Hospitals	
e. Frontier	
f. Does not apply	

7. STEMI patients I am involved with are received from (check all that apply):

a. Metropolitan/Urban areas	
b. Rural areas	
c. Clinics/Urgent care facilities	
d. Critical Access Hospitals	
e. Frontier	
f. Does not apply	

8. EMS providers within a 50-mile radius of my service agency are: (check all that apply)

a. First responder (EMR)	
b. EMT Basic or Intermediate	
c. EMT Advanced	
d. Paramedic	
e. Does not apply or unknown	

9. Who/what analyzes the first pre-hospital STEMI ECG and determines pre-hospital STEMI?

a. EMS	
b. Physician	
c. APRN	
d. Staff nurse	
e. ECG computer	

SURVEY					
Please mark appropriate response(s) as:	**a. All of the time**	**b. Some of the time**	**c. Rarely**	**d. Never**	**e. Does not apply**
1. My facility or agency sends or receives pre-notification of STEMI arrival :					
2. ***Financial limitations*** affect ECG device acquisition or maintenance, optimal pre-hospital STEMI communication, or adequate ECG training. Please specify and elaborate below in # 11 comments section.					
3. My facility or agency receives or sends pre-arrival STEMI notification of 12-Lead ECG's by ***ECG-DEVICE SATELLITE TRANSMISSION:***					

4. My facility or agency receives or sends pre-arrival STEMI notification by **Emergency Medical Service (EMS) or transport *DISPATCH PHONE/VOICE NOTIFICATION*:**					
5. My facility or agency receives or sends pre-arrival STEMI notification by ***FAXED ECG PRINT OUT*** to an Emergency Department:					
6. My facility or agency receives or shares STEMI notification with a ***HARD COPY OF 12 LEAD STEMI ECG*** ON PATIENT ARRIVAL TO ED OR DIRECT ADMISSION TO CARDIAC CATH LAB (CCL):					
7. My facility or agency receives or sends STEMI ECG identification by **PHONE CAMERA PHOTO TRANSMISSION,** "SMART PHONE" APPLICATION TRANSMISSION, OR OTHER MOBILE PHONE TRANSMISSION OR MESSAGING:					
8. My facility or agency receives or sends pre-hospital STEMI notification by **DIRECT PHONE CALL OR MESSAGING TO THE ED OR CARDIOLOGIST:**					
9. My facility or agency receives or sends pre-hospital STEMI notification for **DIRECT EMS ADMISSION TO CCL FOR EMERGENT PCI REPERFUSION:**					
10. My facility or agency receives or sends pre-arrival notification of STEMI through **TELE-HEALTH TRANSMISSION, COMPUTER, OR CAMERA**:					

11. Please add any comments that you feel help identify barriers to effective, rapid STEMI communication including financial concerns:

12. Please list any CME, APRN, EMS training, or CNE topics related to STEMIs that would be of interest to you or your colleagues

APPENDIX 3: Survey Demographic Results

APPENDIX 3a. "What is your workplace ZIPCODE*?*"

Eastern Oregon Zip codes

97814	Baker City
97838	Hermiston
97850	La Grande
97883	Union
97914	Ontario

North Idaho Zip code

83814	Cour D'Alene

Eastern Idaho Zip codes

83201	Pocatello
83422	Driggs

Central Idaho Zip codes

83213	Arco
83330	Gooding
83332	Hagerman
83333	Triumph
83338	Jerome
83340	Sawtooth City
83352	Shoshone

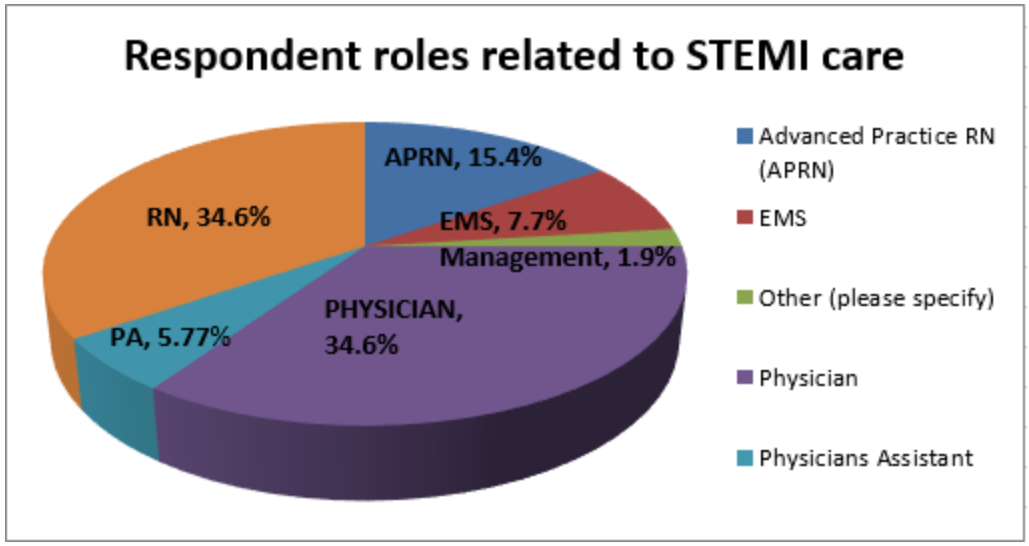
West/Southwest Idaho Zip codes

83612	Council
83656	Notus
83660	Roswell
83661	Payette
83686	Nampa
83605	Weitz
83642	Meridian
83702	Boise
83704	Boise
83709	Boise
83712	Boise

Missing data (5), no zip code provided

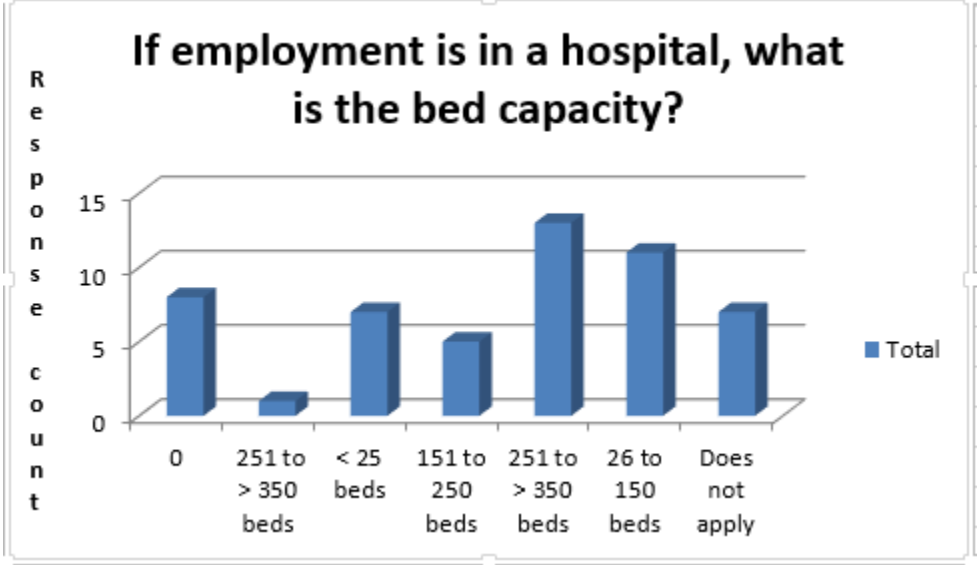
APPENDIX 3b: What is your tile/role?

Row Labels	count	Percent
Advanced Practice RN (APRN)	8	(15.38%)
EMS	4	(7.69%)
Other (please specify: Director)	1	(1.92%)
Physician	18	(34.61%)
Physician Assistant	3	(5.77%)
Registered Nurse	18	(34.61%)
Grand Total	**52**	100%



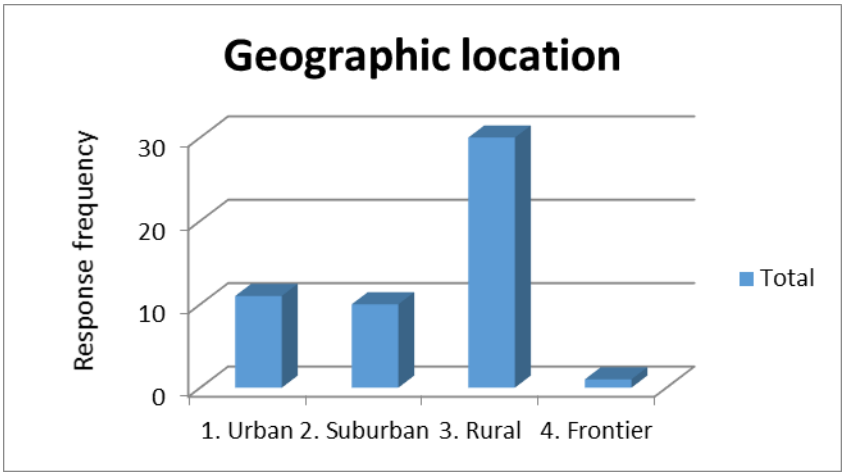
APPENDIX 3c: If you work in a hospital, what is the bed capacity?

Bed capacity	Count
0 (No reply)	8
251 to > 350 beds	1
< 25 beds	7
151 to 250 beds	5
251 to > 350 beds	13
26 to 150 beds	11
Does not apply	7
Grand Total	**52**



APPENDIX 3d: What is your geographic location?

Row Labels	Count	%
1. Urban	11	(21.15%)
2. Suburban	10	(19.23%)
3. Rural	30	(57.69%)
4. Frontier	1	(1.92%)
Grand Total	**52**	100%



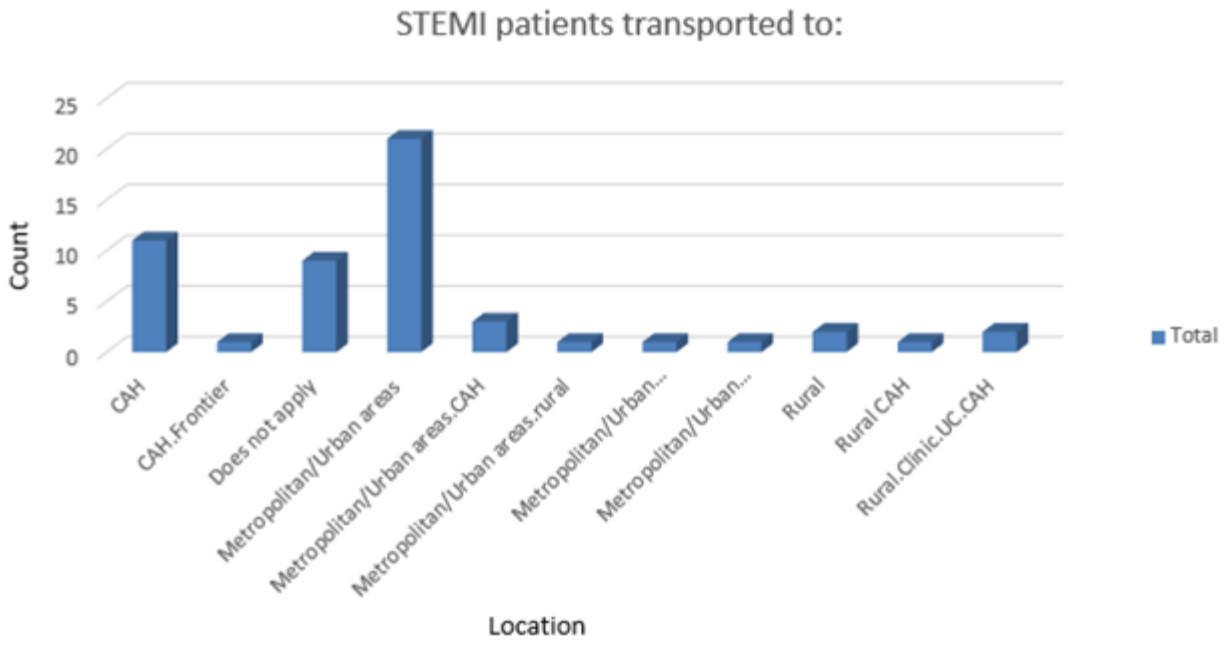
APPENDIX 3e: Do you care for STEMI patients?

YES: *n*= 52 (included in data analysis)

NO: *n* =18 (deleted from data analysis)

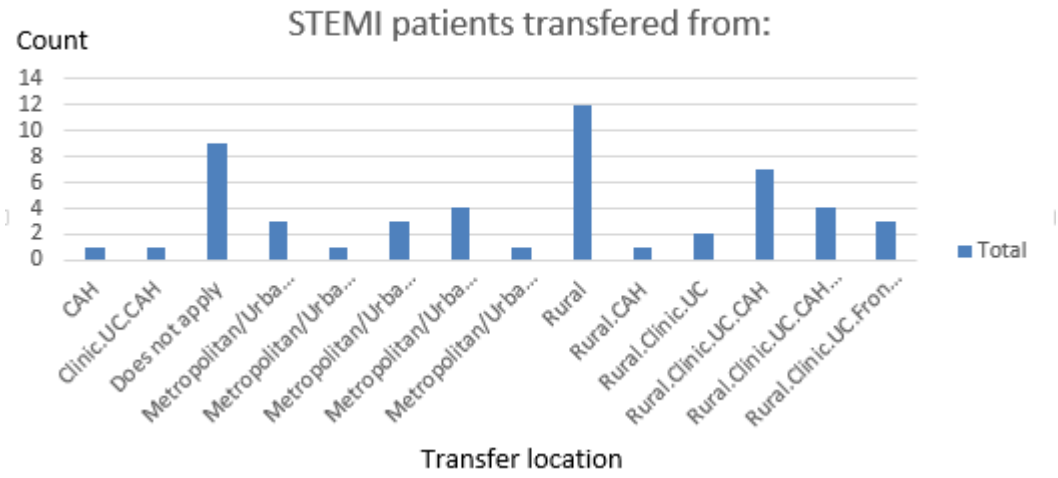
APPENDIX 3f: STEMI patients are transported *to* (location), check all that apply

Row Labels	Count	%
CAH	11	20.75
CAH.Frontier	1	1.89
Does not apply	9	16.98
Metropolitan/Urban areas	21	39.62
Metropolitan/Urban areas.CAH	3	5.66
Metropolitan/Urban areas.rural	1	1.89
Metropolitan/Urban areas.rural.clinic.UC.CAH	1	1.89
Metropolitan/Urban areas.Rural.Clinic.UC.CAH.Frontier	1	1.89
Rural	2	3.77
Rural CAH	1	1.89
Rural.Clinic.UC.CAH	2	3.77
Grand Total	**53**	100



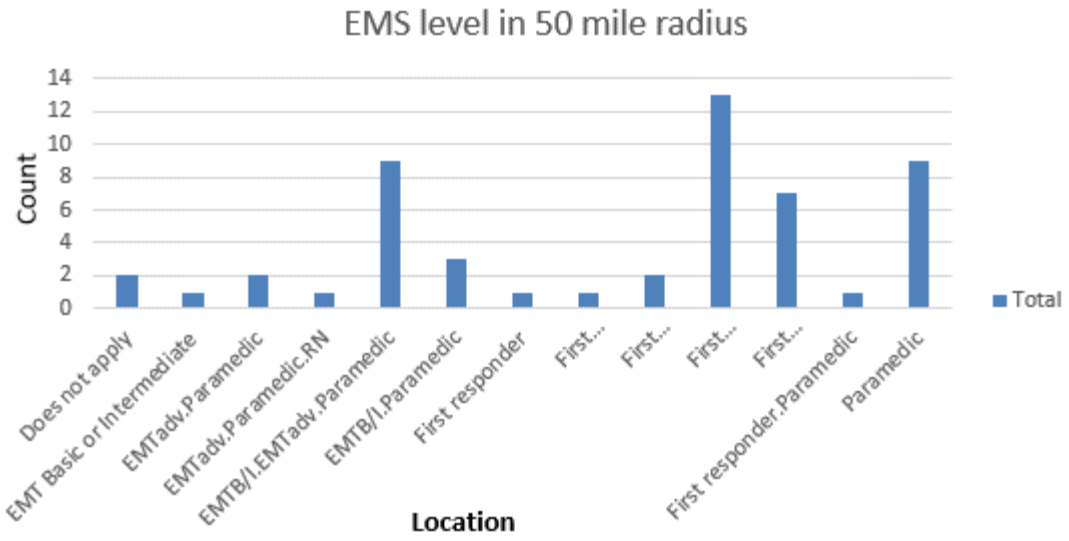
APPENDIX 3g: STEMI patients are transported *from* (location), check all that apply

Row Labels	Count	%
CAH	1	1.9
Clinic.UC.CAH	1	1.9
Does not apply	9	17.3
Metropolitan/Urban areas	3	5.8
Metropolitan/Urban areas.CAH	1	1.9
Metropolitan/Urban areas.Rural.Clinic.UC.CAH	3	5.8
Metropolitan/Urban areas.Rural.Clinic.UC.CAH.Frontier	4	7.7
Metropolitan/Urban areas.Rural.Clinics.UC	1	1.9
Rural	12	23
Rural.CAH	1	1.9
Rural.Clinic.UC	2	3.8
Rural.Clinic.UC.CAH	7	13.5
Rural.Clinic.UC.CAH.Frontier	4	7.7
Rural.Clinic.UC.Frontier	3	5.8
Grand Total	**52**	100



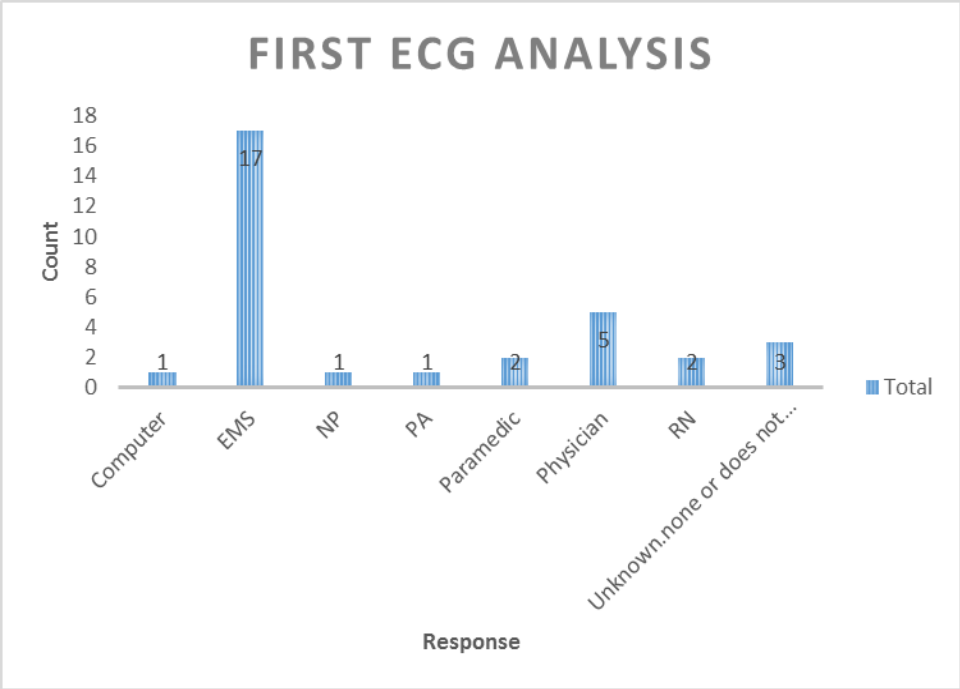
APPENDIX 3h: EMS levels in a 50 mile radius

Row Labels	Count	%
Does not apply	2	3.85
EMT Basic or Intermediate	1	1.92
EMTadv.Paramedic	2	3.85
EMTadv.Paramedic.RN	1	1.92
EMTB/I.EMTadv.Paramedic	9	17.3
EMTB/I.Paramedic	3	5.76
First responder	1	1.92
First responder.EMTadv.Paramedic	1	1.92
First responder.EMTB/I.EMTadv	2	3.85
First responder.EMTB/I.EMTadv.Paramedic	13	25
First Responder.EMTB/I.EMTadv.Paramedic.RN	7	13.46
First responder.Paramedic	1	1.92
Paramedic	9	17.3
Grand Total	**52**	100%



APPENDIX 3i: Who analyzed first pre-hospital ECG?

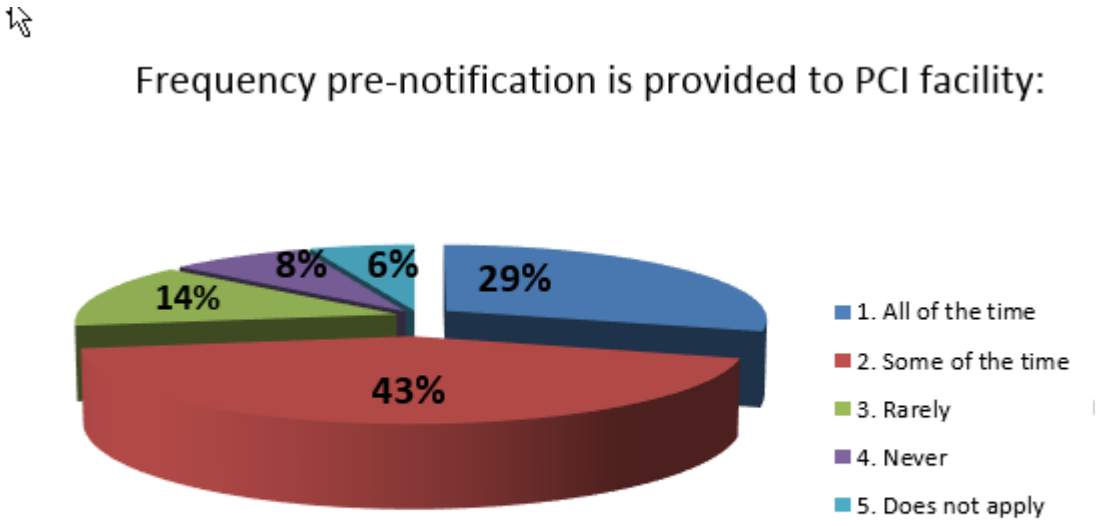
Row Labels	Count	%
Computer	1	3
EMS	17	53
NP	1	3
PA	1	3
Paramedic	2	6
Physician	5	17
RN	2	6
Unknown.none or does not apply	3	9
Grand Total	**32**	100



APPENDIX 3j: Frequency of STEMI pre-notification

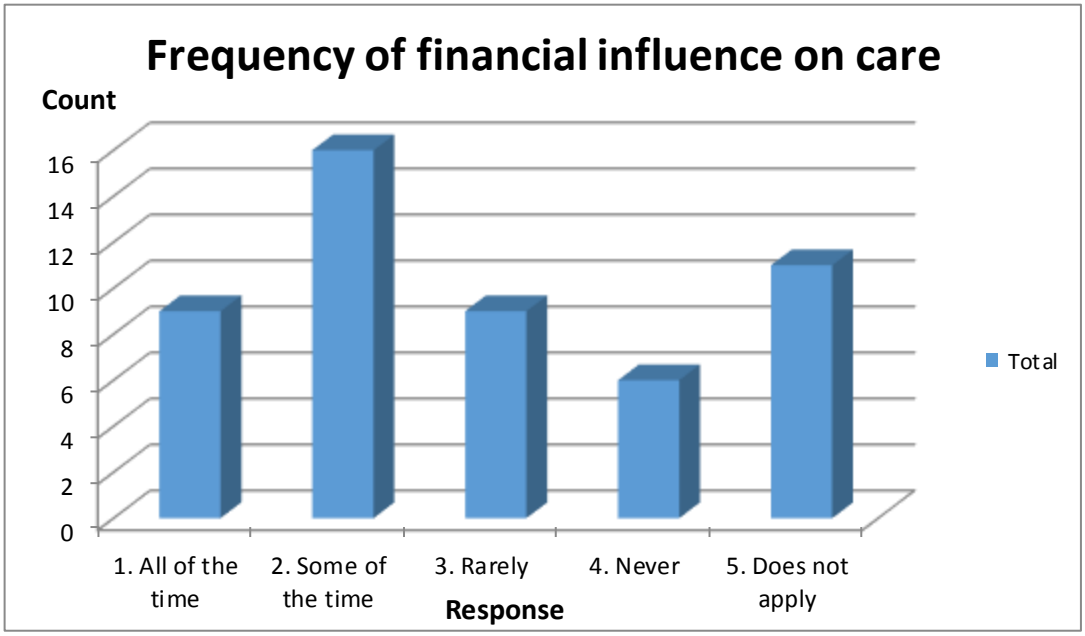
Provision of pre-notification

Row Labels	Count	%
1. All of the time	15	29%
2. Some of the time	22	43%
3. Rarely	7	14%
4. Never	4	8%
5. Does not apply	3	6%
Grand Total	**51**	100%



APPENDIX 3k: **Frequency of financial concerns that affect pre-hospital ECG** communication

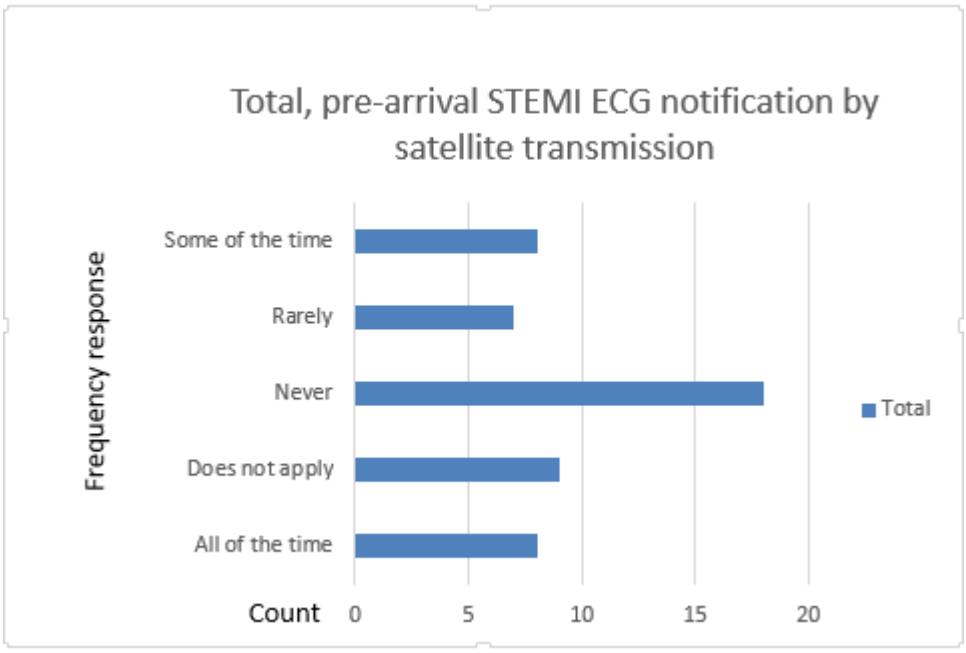
Row Labels	Count	%
1. All of the time	9	17.64
2. Some of the time	16	31.37
3. Rarely	9	17.64
4. Never	6	11.76
5. Does not apply	11	21.57
Grand Total	**51**	100



APPENDIX 4: Survey pre-notification results, tables and graphs

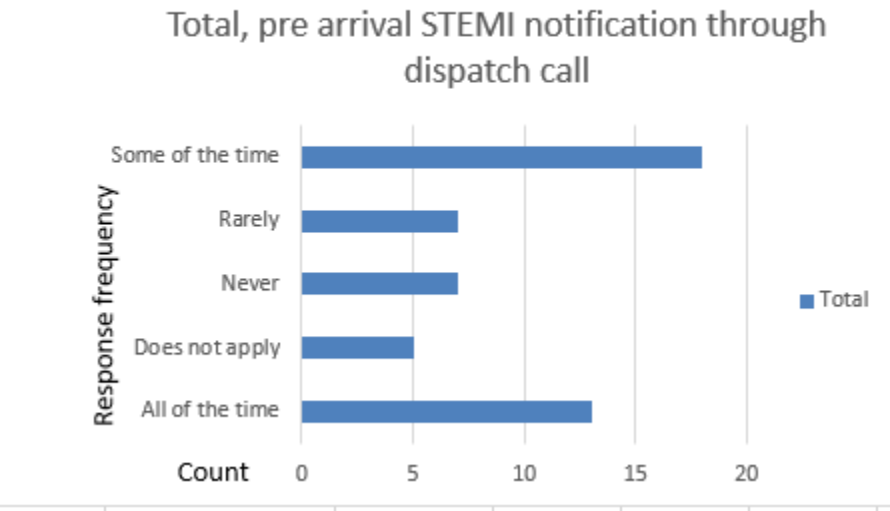
APPENDIX 4a: STEMI pre-notification, satellite transmission

Row Labels	Count	%
All of the time	8	16
Does not apply	9	18
Never	18	36
Rarely	7	14
Some of the time	8	16
Grand Total	**50**	100



APPENDIX 4b: STEMI pre-notification, dispatch

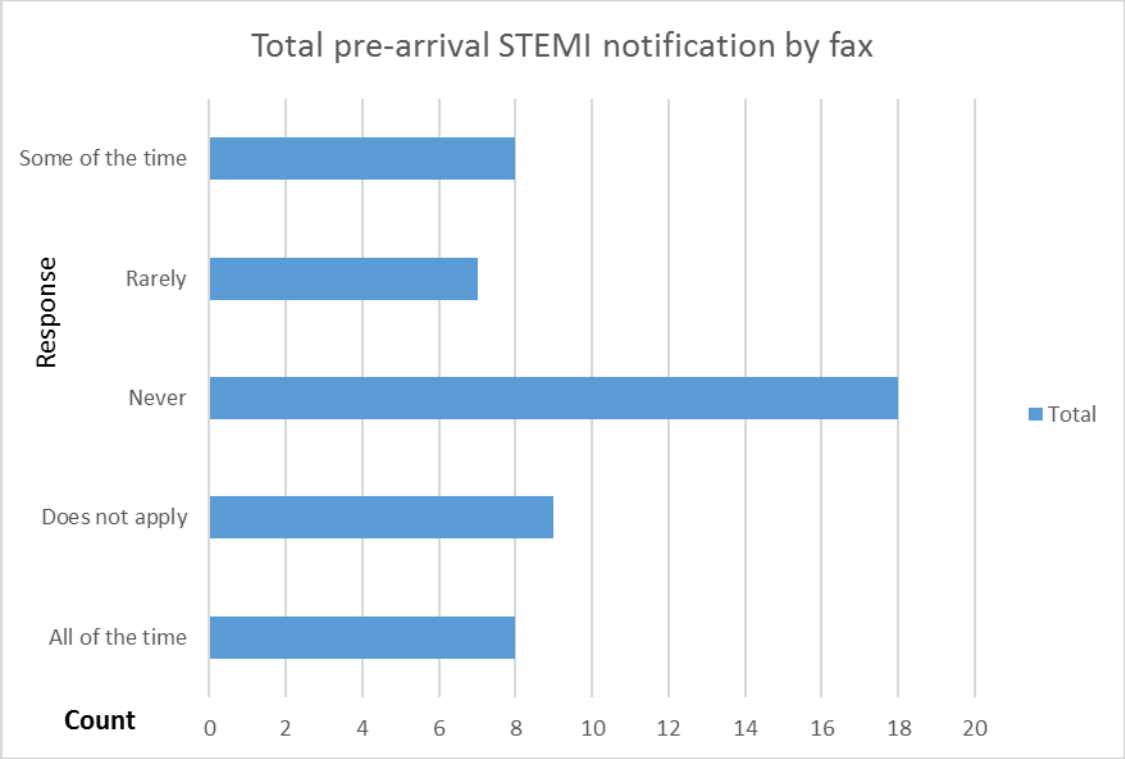
Row Labels	Count of Dispatch	%
All of the time	13	26
Does not apply	5	10
Never	7	14
Rarely	7	14
Some of the time	18	36
Grand Total	**50**	100



APPENDIX 4c: STEMI pre-notification, fax transmission

Fax

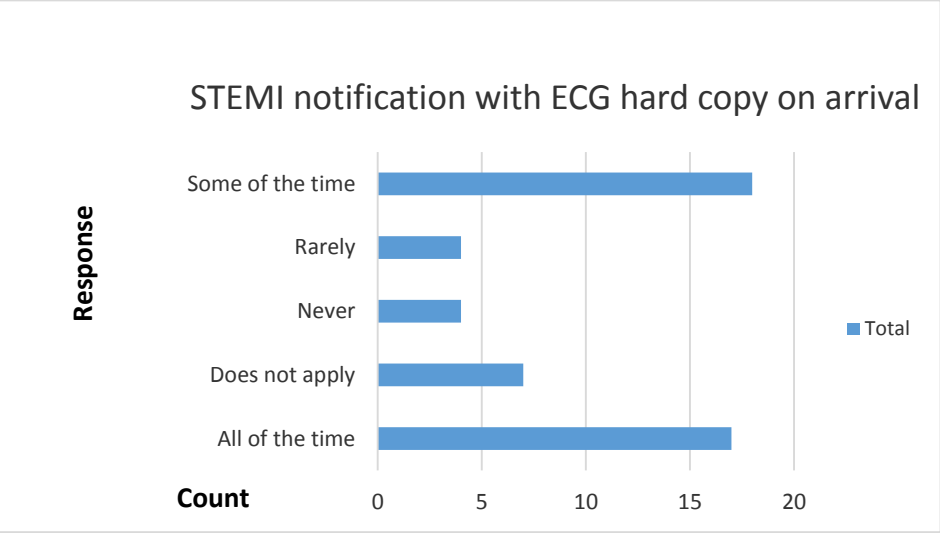
Row Labels	Count	%
All of the time	8	16
Does not apply	9	18
Never	18	36
Rarely	7	14
Some of the time	8	16
Grand Total	**50**	100



APPENDIX 4d: STEMI pre-notification, hard copy transmission

Hard Copy

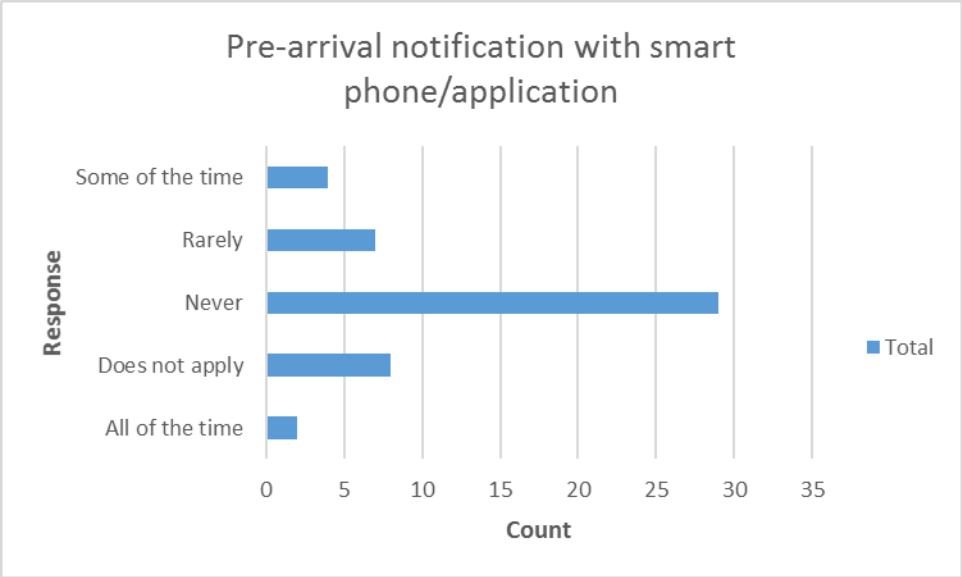
Row Labels	Count	%
All of the time	17	34
Does not apply	7	14
Never	4	8
Rarely	4	8
Some of the time	18	36
Grand Total	**50**	100



APPENDIX 4e: STEMI pre-notification using smart phone application or cell phone

"Smart phone"

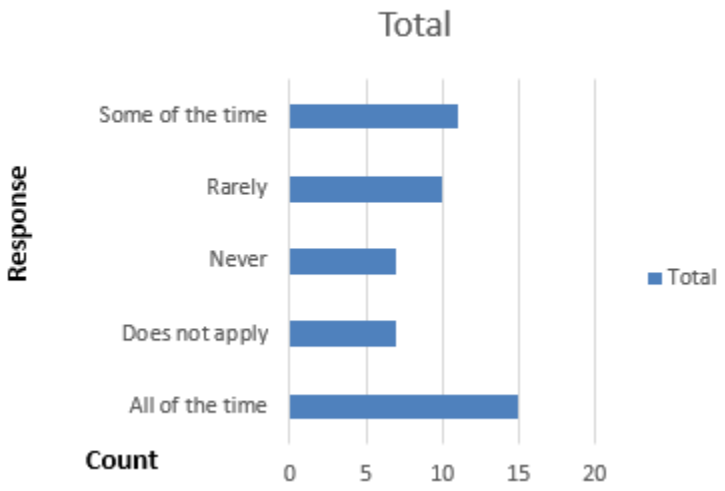
Row Labels	Count	%
All of the time	2	4
Does not apply	8	16
Never	29	58
Rarely	7	14
Some of the time	4	8
Grand Total	**50**	100



APPENDIX 4f: STEMI pre-notification, direct phone call to physician

Direct call to physician

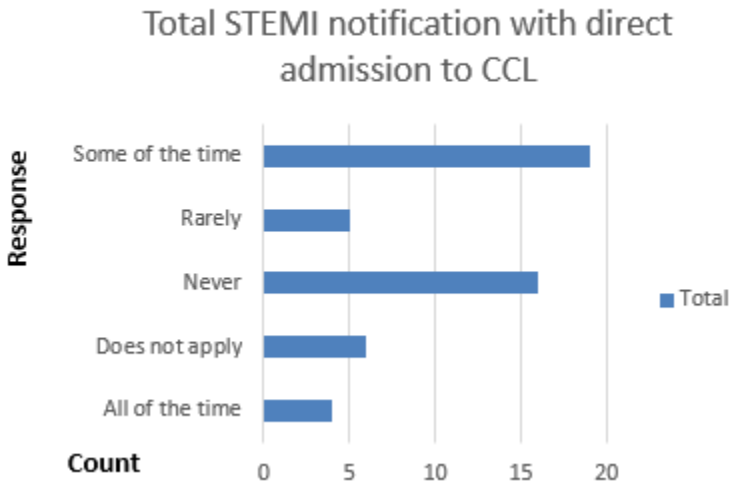
Row Labels	Count	%
All of the time	15	30
Does not apply	7	14
Never	7	14
Rarely	10	20
Some of the time	11	22
Grand Total	**50**	**100**



APPENDIX 4g: STEMI pre-notification with EMS direct admission to CCL

EMS to CCL

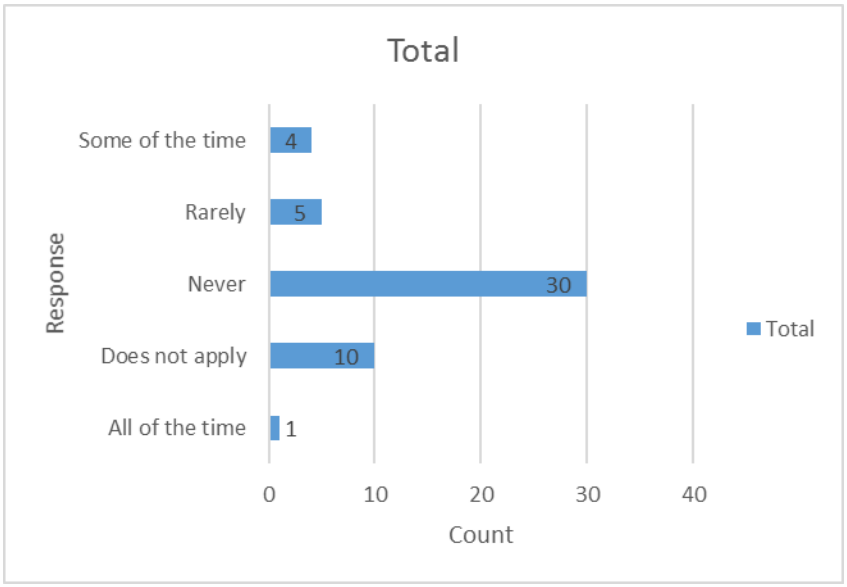
Row Labels	Count	%
All of the time	4	8
Does not apply	6	12
Never	16	32
Rarely	5	10
Some of the time	19	38
Grand Total	**50**	100



APPENDIX 4h: **STEMI pre-hospital notification utilizing Telehealth confirmation**

Telehealth

Row Labels	Count	%
All of the time	1	2
Does not apply	10	20
Never	30	60
Rarely	5	10
Some of the time	4	8
Grand Total	**50**	100



APPENDIX 5. Qualitative open-ended responses

APPENDIX 5a: Additional comments

1. Lack of integration of technology with hospital EMR/CPAC
2. No EMS ECG b/o finances
3. As a rural outlying hospital fed by critical access EMS, some of which are basic responders, some are EMT-A and some are paramedics.
4. I was just informed by my charge nurse that one of the county EMS services does have the capability to transmit EKG, I was not aware of this. Our facility has a cath lab but it is diagnostic only, so if a STEMI is identified in the field, they will divert to the larger hospitals that are 15-25 miles away. It would be helpful for EMS agencies to have more funding for better ECG devices and better transmission or at least consistent means of pre-notification
5. We are limited by STEMI EKG transmission due to limited mobile phone coverage in rural areas and not wanting to take the time to transmit via land lines.
6. Satellite transmission sounds like a good option in the rural areas.
7. Lack of resources and education, lack of funding to optimize care, no budget for equipment, too many different levels of emergent care in our area, poor coordination of care. EMS is phoned, they take over and we call ER with info
8. No one- no ECG's are done pre-hospital
9. EMS does not have 12 lead capability; EMS interprets from 3 lead strip
10. We are rural; ECG done on pt arrival.If STEMI, we contact transport and totor transport s to nearest PCI/80 mi away. May need lytics if delays.
11. We call cardiologist and send hard copy with patient

APPENDIX 5b: Education requests

ECG training

Causes of ST elevation besides AMI on ECG tracing

ECG STEMI confounders that contribute to False STEMI activation

APPENDIX 6: Correlated tables

Appendix 6a: Role and geographic location responses

Row Labels	EMS	MD	NP	Other	PA	RN	Grand Total
Frontier		1					1
Rural	3	10	7		3	7	30
Suburban		3				7	10
Urban	1	4	1	1		4	11
Grand Total	**4**	**18**	**8**	**1**	**3**	**18**	**52**

Appendix 6b: Finance limitations, responses by geographic location responses

Count of 11 Financial issues Row Labels	Column Labels 1. Urban	2. Suburban	3. Rural	Grand Total
1. All of the time	2	1	6	9
2. Some of the time	5	5	6	16
3. Rarely	2	2	5	9
4. Never		2	4	6
5. Does not apply	2		9	11
Grand Total	**11**	**10**	**30**	**51**

Appendix 6c: Financial concerns correlated with role responses, full data and adjusted table.

Full data:

Row Labels	All of the time	Does not apply	Never	Rarely	Some of the time	Grand Total	%
EMS	1	1			2	4	8
MD	2	5	2	3	6	18	34
NP	2	3	1	1	1	8	15
Other					1	1	2
PA		2	1			3	7
RN	4	1	2	5	6	18	34
Grand Total	**9**	**12**	**6**	**9**	**16**	**52**	100

Adjusted table excludes "does not apply" and "never"

Count of Financial issues	Column Labels				
Row Labels	All of the time	Rarely	Some of the time	Grand Total	%
EMS	1		2	3	15.8
MD	1	1	2	4	21
RN	3	4	5	12	63.2
Grand Total	**5**	**5**	**9**	**19**	100

Appendix 6d: Transport "to" and geographic location responses

Count	Column Labels				
Row Labels	**Frontier**	**Rural**	**Suburban**	**Urban**	**Grand Total**
CAH		9		1	10
CAH.Frontier	1				1
Does not apply		1	4	4	9
Metropolitan/Urban areas		13	5	3	21
Metropolitan/Urban areas.CAH		1		2	3
Metropolitan/Urban areas.rural		1			1
Metropolitan/Urban areas.rural.clinic.UC.CAH			1		1
Metropolitan/Urban areas.Rural.Clinic.UC.CAH.Frontier				1	1
Rural		2			2
Rural CAH		1			1
Rural.Clinic.UC.CAH		2			2
Grand Total	**1**	**30**	**10**	**11**	**52**

Appendix 6e: EMS direct admission to CCL and geographic location responses, full data and adjusted table:

Adjusted table deleting "never" and "does not apply"

Count of EMS to CCL	Column Labels				
Row Labels	All of the time	Rarely	Some of the time	Grand Total	%
Rural	2	2	6	10	36
Suburban	1	3	5	9	32
Urban	1		8	9	32
Grand Total	**4**	**5**	**19**	**28**	**100**

Full data

Row Labels	All of the time	Does not apply	Never	Rarely	Some of the time	Grand Total	%
Frontier			1			1	2
Rural	2	6	13	2	6	29	56.8
Suburban	1		1	3	5	10	19.6
Urban	1	1	1		8	11	21.6
Grand Total	**4**	**7**	**16**	**5**	**19**	**51**	100

Appendix 6f: STEMI pre-arrival notification and satellite transmission with geographic location responses, full data followed by adjusted table

Full table:

Row Labels	Frontier	Rural	Suburban	Urban	Grand Total	%
All of the time		4	1		5	10
Does not apply	1	8	1	2	12	24
Never		14	3	5	22	44
Rarely			1	1	2	4
Some of the time		2	4	3	9	18
Grand Total	**1**	**28**	**10**	**11**	**50**	**100**

Adjusted, deleting "never" and "does not apply:"

Count of Satellite	Column Labels					
Row Labels	All of the time	Rarely	Some of the time	Grand Total	%	
Rural	4		2	6	37.5	37.5
Suburban	1	1	4	6	37.5	
Urban		1	3	4	25	62.5
Grand Total	**5**	**2**	**9**	**16**	100	

Appendix 6g: STEMI pre-arrival notification hard copy hand off on arrival to hospital with geographic location responses, adjusted and full data

Adjusted data excludes "does not apply" and "never" responses:

Row Labels	All of the time	Does not apply	Rarely	Some of the time	Grand Total	%
Frontier			1		1	2.5
Rural	9	1	2	7	19	47.5
Suburban	4		1	5	10	25
Urban	4			6	10	25
Grand Total	**17**	**1**	**4**	**18**	**40**	**100**

Full data:

Count of Hard Copy	Column Labels						
Row Labels	All of the time	Does not apply	Never	Rarely	Some of the time	Grand Total	%
Frontier				1		1	2
Rural	9	6	4	2	7	28	56
Suburban	4			1	5	10	20
Urban	4	1			6	11	22
Grand Total	**17**	**7**	**4**	**4**	**18**	**50**	**100**

Appendix 6h: STEMI pre-arrival notification by dispatch call with geographic location response data, adjusted data and full data

Adjusted data excludes "does not apply" and "never:"

Count of Dispatch	Column Labels					
Row Labels	All of the time	Does not apply	Rarely	Some of the time	Grand Total	%
Rural	9	1	5	7	22	**56**
Suburban	2		2	4	8	**21**
Urban	2			7	9	**23**
Grand Total	**13**	**1**	**7**	**18**	**39**	**100**

Full data:

Row Labels	Frontier	Rural	Suburban	Urban	Grand Total	%
All of the time		9	2	2	13	26
Does not apply	1	3		1	5	10
Never		4	2	1	7	14
Rarely		5	2		7	14
Some of the time		7	4	7	18	36
Grand Total	**1**	**28**	**10**	**11**	**50**	**100**

Appendix 6i: STEMI pre-arrival notification by direct phone call to physician with geographic location response

Row Labels	Frontier	Rural	Suburban	Urban	Grand Total	%
All of the time		8	4	3	15	**30**
Does not apply		5		2	7	**14**
Never		5	1	1	7	**14**
Rarely	1	4	3	2	10	**20**
Some of the time		6	2	3	11	**22**
Grand Total	**1**	**28**	**10**	**11**	**50**	**100**

Appendix 6j: STEMI pre-arrival notification by smart phone/application/cell phone use, with correlation to geographic location response

Row Labels	All of the time	Does not apply	Never	Rarely	Some of the time	Grand Total	%
Frontier			1			1	2
Rural		6	20	1	1	28	56
Suburban	1		4	3	2	10	20
Urban	1	2	4	3	1	11	22
Grand Total	**2**	**8**	**29**	**7**	**4**	**50**	**100**

Appendix 6k: First ECG pre-arrival analysis by health care professional, with correlation to geographic location response

Row Labels	Frontier	Rural	Suburban	Urban	Grand Total	%
Computer		1			1	3.1
EMS		9	5	3	17	53.1
NP		1			1	3.1
PA		1			1	3.1
Paramedic		1		1	2	6.3
Physician	1	3	1		5	15.6
RN		2			2	6.3
Unknown.none or does not apply		2		1	3	9.4
Grand Total	**1**	**20**	**6**	**5**	**32**	**100**