

Mode of transport to hospital among patients with ST Elevation Acute Myocardial Infarction (STEMI) in the Emirate of Abu Dhabi: Correlates, physician and patient attitudes, and associated clinical outcomes

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Thesis Presented for the Degree of

Doctor of Philosophy

In the Division of Emergency Medicine

University of Cape Town

March 2017

Declaration

I declare that this thesis is work done solely by myself and in the case of publication that I was the first author. It is being submitted for the degree of Doctor of Philosophy (Emergency Medicine) to the Faculty of Health Sciences, University of Cape Town. It has not been submitted before for any degree or examination at any other educational institution

Signed by candidate

Edward L. Callachan

8 March 2017

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Abstract

Introduction: Acute coronary syndromes, including ST-elevation myocardial infarction (STEMI), are a leading cause of morbidity and mortality worldwide. Existing research shows that prehospital care provided by emergency medical services (EMS) can significantly improve outcomes. However, EMS remains grossly underutilised in Abu Dhabi despite a well-established presence.

Objectives: In this three-part quantitative, observational study, we sought to (1) assess physicians' perceptions of, and recommendations for, utilization and improvement of EMS, (2) assess patients' awareness of EMS, mode of transport use in decision to seek care and reasons for their decision, and (3) establish if in the current study setting, mode of transport used has implications for in hospital adverse events, as well as short and long term clinical outcomes. The goal was to investigate both physicians' and patients' perceptions of prehospital STEMI care, as well as to assess the clinical correlates of the mode of transport in a patient's decision to seek care.

Methods: We conducted the study in three phases. *Phase 1:* At four government-operated hospitals in Abu Dhabi, we administered surveys to a convenience sample of physicians involved in care of patients with acute coronary syndromes to measure (a) likelihood of recommending EMS, (b) satisfaction with EMS, (c) likelihood of using EMS for self or family, and (d) recommendations for prehospital care of acute coronary syndromes. *Phase 2:* We gathered mode of transport data from a purposive, non-random sample of 587 consecutive patients with STEMI over an 18-month period and conducted structured follow-up interviews to assess their perceptions of EMS. We conducted analysis to determine whether mode of transport was related

to demographic variables. *Phase 3:* We collected medical records from patient participants and conducted structured follow-up interviews at 1, 6 and 12 months post discharge. We conducted chi square difference testing to determine the relationships among mode of transport, treatment times, and short- and long-term clinical outcomes. Variables included treatment times and associated outcomes.

Results: Physician participants ($n = 106$) were most supportive of prehospital 12-lead ECG for STEMI, but indicated low satisfaction with existing EMS services in Abu Dhabi. Among STEMI patient participants ($n = 587$), EMS was underutilized in Abu Dhabi; over half (55%) of patients did not know the phone number to contact EMS, and only 14.7% used EMS in their decision to seek care. EMS-transported patients were more likely to receive timely treatment (door-to-diagnostic ECG time, door-to-balloon time) and had lower incidence of mortality compared to privately-transported patients.

Conclusions: These findings suggest a need to raise public awareness of EMS and its importance for coronary symptoms in Abu Dhabi. Broader application of prehospital ECG, including prehospital activation of cardiac catheterization labs, bypassing non-interventional cardiology centres, and admission directly to facilities that provide these services without initial admission to the emergency department, could help improve physicians' perceptions of EMS and outcomes for patients with STEMI.

Dedication

Mom and Dad, I made it, as we spoke about so many times. My only regret is that you are both not able to be here to see this day. I missed not being able to share my progress over the past 5 years. To my wife Leanne, for keeping me strong, dusting me off and putting me back on track and being the greatest mother to our daughter when I was not around. To my beautiful daughter Chloe, sorry for not being the daddy you deserved for the last 5 years, but now I am yours tooks, no more lap top!

Acknowledgments

Dr Alawi Alsheikh-Ali, for scrutinising every piece of work no matter how small, facilitating my contacts in the hospital networks and for being relentless in making sure that revisions were up to standard. I could not have reached this point without your guidance.

Professor Lee Wallis, talking me out of my original research idea which would have been impossible, making sure that this research was manageable, and getting me to where I am today, helping me realise a dream.

Dr Satish Chandra, for helping me navigate the ethics minefields and providing unwavering support when reviewing and commenting.

Dr Stevan Bruijns, for being “modest” in the amount of red in my revisions when needed, making sure that the revisions were up to par and recognising when a pick me up talk was needed, based solely on how I looked in VSEE

Dr Abdulmajeed Al Zubaidi, for not only authorising database access in SEHA, but also allowing me remote site access so I could work from home and be with my family. I could not have accessed the volume of information I required on patients without your kindness and support of my research

Clara Dmello RN, who I wish all researchers could have a version of for their projects. For consenting and following up on all my Al Ain City patients, designing the following up data base for all 4 hospitals and suggesting better ways for me to do things, and being correct about everything you suggested.

Vasiliza Morales RN, and Mylah Joy Aujero RN, for being invaluable in consenting so that I didn't have to come to Sheikh Khalifa Medical City every day and following up with the sheer volume of patient calls that had to be made

Wayne Hayman, allowing me time off to run around and collect data over the last 5 years, even when I should have been doing my actual job.

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List of Abbreviations

ACC-American College of Cardiology

ACS-Acute Coronary Syndromes

AHA-American Heart Association

ALS-Advanced Life Support

AMI-Acute Myocardial Infarction

BLS-Basic Life Support

CABG-Coronary Artery Bypass Grafting

CAD-Coronary Artery Disease

CDSS-Clinical Decision Support System

CVD-Cardiovascular Disease

DLP-Dyslipidaemia

DM-Diabetes Mellitus

EMS-Emergency Medical Services

GCC-Gulf Cooperation Council

HAAD-Health Authority Abu Dhabi

HTN-Hypertension

IHD-Ischemic Heart Disease

ISCH-Total Ischaemic Time

KM-Knowledge Management

NFR-No Flow Restrictions

NSTEMI-Non-ST Segment Myocardial Infarction

SEHA-Abu Dhabi Health Service Company (phonetic rendering of the Arabic word for “Health”)

STEMI-ST Segment Myocardial Infarction

PCI-Percutaneous Coronary Intervention

POBA-Plain Old Balloon Angioplasty

PHM-Prehospital management

Chapter 1: Introduction

Studies have reported high incidence of heart disease and associated co-morbidities such as obesity, diabetes mellitus (DM), and blood pressure in the Middle East. (1) Press reports have also highlighted that cardiovascular disease (CVD)-related mortality in the region not only is among the highest in the world, (2) but also has increased in recent years. Heart disease accounted for nearly a quarter of the deaths in Abu Dhabi in 2010.(3) It has also been reported that nearly 60% of Abu Dhabi's 1.9 million people are obese, while 18% have DM, 44% are diagnosed with hyperlipidaemia, and about 23% are hypertensive.(4) The Gulf Registry for Acute Coronary Events (RACE) studies confirm these high statistics and further conclude that, despite these high numbers, there remains room for improvement in reducing the time from symptom onset to coronary reperfusion, by improving both prehospital and in-hospital service.

(1)

The Government of Abu Dhabi has also recognized that the incidence of acute coronary syndromes (ACS) is one of the highest in the world, requiring urgent action. As a result, the Health Authority of Abu Dhabi (HAAD) established a programme with targeted guidelines to follow. This programme, known as "Weqaya" meaning "to protect", has established several targets, which are summarized in Table 1. (5)

Table 1. *Weqaya Cardiovascular Disease Reduction Target Guidelines*

	End of 2010	2015	2030
Outcome	Measurable reduction in deaths from heart attacks and strokes due to improved acute care	<ul style="list-style-type: none"> • 25% reduction in obese children • 10% reduction in obese adults • 10% reduction in smoking rate • 10% reduction in CVD events 	<ul style="list-style-type: none"> • 40% reduction in CVD events • 75% reduction in CVD mortality • 33% reduction in healthcare costs per diabetic patient

Source: Health Authority of Abu Dhabi Weqaya Screening (2008–09); international data from the World Health Organization and global experts (e.g., Johns Hopkins); Belgian Unal Coronary heart disease policy models: a 2006 systematic review.

The Emirate of Abu Dhabi has both well-established emergency medical services (EMS) and centres for the management of ACS. The benefits of using EMS during ACS are also well known; (6) however, they can only be realized if patients make use of EMS. In the Emirate of Abu Dhabi, the EMS only transports patients with suspected ACS to facilities with interventional cardiology services. In contrast, patients who self-transport or use non-EMS modes of transport might arrive at facilities without interventional cardiology services, which will result in delays due to interpretation of findings and transfer to facilities that can adequately manage these patients, in particular those with ST elevation myocardial infarction (STEMI).

It is therefore important to establish the current perceptions of both physicians and patients regarding the use of EMS as the mode of transport when seeking care. Good prehospital care and hospital services are also more difficult to provide if patients do not fully comprehend their symptoms and are not aware of the importance of using EMS.

Educating patients will provide a greater chance of surviving a cardiac event and returning to a normal healthy lifestyle. Only by reviewing the current trends in public education and awareness is it possible to improve existing services and education programmes.

Problem Statement

EMS in Abu Dhabi are developing based on evidence-based best practices and are comparable to that in many Western countries; however, they might be underutilized. There is insufficient knowledge about the outcomes for patients with STEMI in Abu Dhabi and the surrounding region as well as how to improve EMS in the region. Therefore, the benefits of EMS might be unrealized for many patients, and the critical ACS-related issues cannot be addressed and might continue to contribute to high CVD-related mortality.

Aim

The aim of this research project is to determine whether the mode of transport (EMS or private/self-transport) by which patients with STEMI in the Emirate of Abu Dhabi, present to the emergency department (ED), affects their outcomes, as measured by in-hospital events, mortality and clinical status at 30 days, 6 months, and 12 months after admission.

Research Objectives

The goal of this quantitative, observational study was to investigate both physicians' and patients' perceptions of prehospital STEMI ACS care, as well as to assess the clinical correlates of the mode of transport in a patient's decision to seek care. A secondary goal was to conduct analyses to explore the clinical profile of young STEMI patients in Abu Dhabi. To accomplish these objectives, we researched the following:

- Physician perceptions regarding EMS, emergency transport, and prehospital STEMI management in Abu Dhabi.
- Baseline demographics of patients admitted with STEMI with regard to gender, age, nationality, time of day, and day of the week of presentation.
- The prevalence of EMS use by patients with STEMI in the Emirate of Abu Dhabi and the rationale for the preferred mode of transport in their decision to seek care.
- Whether the mode of transport correlates with in-hospital events and mortality as well as short and long-term clinical outcomes for admitted patients, including readmission and post discharge mortality.
- For young patients (<40 years) that present with STEMI, what are the demographics, risk factor correlates and associated outcomes

Research Questions

To address the research objectives, we developed the following research questions to guide the study. Each research question addresses a single facet of the research objectives and answered in a separate chapter later in this thesis.

Question 1: *Physician perceptions and recommendations about pre-hospital emergency medical services for patients with ST elevation acute myocardial infarction in Abu Dhabi*

- a) What are physician attitudes toward the current EMS in Abu Dhabi, and what prehospital care actions are the most and least supported?
- b) What mode of transport would physicians recommend to patients, and does this differ compared to what they would recommend for their family or themselves?

c) Of all treatment and prehospital care protocols available for STEMI, which do physicians most and least support for use in Abu Dhabi?

Question 2: ***Utilization and perceptions of prehospital emergency services by patients with ST elevation myocardial infarction in Abu Dhabi: a multicentre study***

a) What are the admission demographics of patients who present with STEMI in Abu Dhabi?

b) What are the modes of transport utilized by patients with STEMI?

b) How many patients in the study are aware that the EMS number in Abu Dhabi is 999?

c) Is there a correlation between the knowledge of the EMS number and mode of transport selected in the decision to seek care?

Question 3: ***Mode of transport in the decision to seek care and associated clinical outcomes in patients with ST elevation myocardial infarction***

a) Are there differences in the key performance indicators of the management of STEMI, based on the mode of transport used by the patients (door to electrocardiogram [ECG], door to catheterization laboratory (cath lab) arrival, door to reperfusion)?

b) Are there differences with respect to in-hospital events, including mortality, based on the mode of transport used by patients?

c) Are there differences with respect to clinical status at follow up (i.e. at home, readmitted, deceased) based on the mode of transport used by patients during the original cardiac event?

Question 4: ***Demographics and clinical correlates of young patients who present with***

STEMI

- a) What are the admission profiles of young patients who present with STEMI?
- b) How do these young patients compare to older patients in the study, with regards to risk factors, co-morbidities and clinical outcomes

Research Design

This three-part, quantitative, observational study was conducted from April 2013 to June 2015. The use of a three-part design was justified by the necessity of sampling different populations to address the different parts of the research questions. A quantitative method was appropriate to study the measurable outcome variables after STEMI treatment and allowed the researcher to obtain an overview of physicians' and patients' perceptions of EMS. In contrast, a qualitative approach would not have allowed for the measurement of quantitative variables and would have provided insight into the specific participants' experiences, rather than an overview of perceptions general enough to make recommendations. Since one objective of this study was to generate recommendations for improving the prehospital treatment of EMS in Abu Dhabi, a quantitative method was deemed more appropriate for this study.

Qualitative exploration would, nevertheless, have enabled a more in-depth understanding of participants' perceptions of EMS, which could have yielded additional insights into the reasons for the current underutilization of EMS in Abu Dhabi. For this reason, a mixed-method approach was considered in the process of designing the study. However, owing to the multi-phase nature of the study, and to the resource intensivity and logistical complexity of engaging a relatively large sample of physicians and patients in in-depth, qualitative interviews, a mixed-method study was ultimately rejected. This represents a limitation to the current series of studies

in that the additional depth of understanding possible through qualitative research is not achieved. However, perceptions of EMS represent only one part of the research topic. Indeed, the relationships between mode of transport and clinical outcomes is of greater and more urgent interest here than a qualitative understanding of individuals' perceptions of EMS. These considerations mitigate the limitations inherent in a wholly quantitative design.

Ethical Considerations

Ethical approval to undertake the study was received from the University of Cape Town Faculty of Health Sciences Human Research Ethics Committee (286/2013). (Appendix A)

In Abu Dhabi, the regulating government body, the HAAD, does not require approval to conduct research beyond that of the institutions in which the research is being conducted. Each individual institution has its own ethics approval process, by means of an Institutional Review Board (IRB). All facilities that participated in this study provided ethics approval:

- Sheikh Khalifa Medical City (REC.21.10 [RS232])
- Mafraq Hospital (No approval reference number)
- Tawam Hospital (12/73[CRD 205/12])
- Zayed Military Hospital (ZMH 2012-008)
- Al Ain Hospital (No approval reference number)

These facilities required that we complete the United States National Institutes of Health Protecting Human Research Participants certification (Appendix B).

Data Security and Anonymity

The collected data were encrypted and stored on a password-protected computer and

portable hard drive to facilitate transfer of data between institutions. The portable hard drive was utilized for data back up in the event of primary hard drive failure.

Both the primary computer and portable hard drive were stored at the place of employment of the student (EC): Air Medical Section, Bateen Air Force Base, Abu Dhabi, UAE. Data will be maintained for 5 years and then destroyed.

Each patient was assigned a study number that corresponds to his or her hospital file number. Only the patient's first and family name initials were collected.

For the physician online survey, all identifiers were removed except age, nationality, gender, speciality of practice, and length of practice. These data were required for the research.

The collected data was not shared without express permission of each hospital's Institutional Review Board (IRB) or Research Ethics Committee (REC) and all were made aware that this research may generate publications in peer reviewed journals.

Chapter 2: Literature Review

Literature Search Strategy

This literature review begins with a discussion of ACS and STEMI, STEMI in the UAE and Abu Dhabi, and factors influencing STEMI outcomes. EMS, EMS and STEMI, physician and patient perceptions of EMS and EMS use, EMS in the UAE, challenges in EMS development, and other modes of transport for ACS are also discussed. The review concludes with a discussion and a brief summary.

The Medline, CINAHL, Cochrane, PubMed, Proquest, and Academic Search Premier databases were searched in three general areas: ACS, STEMI, and EMS. Initial searches were limited articles published between 2006 and 2016 to focus on recent research and theory from the last decade. The resulting articles were reviewed, and, in cases where these articles cited seminal older studies, these older studies were located and included in the present review where necessary to ensure completeness. Search keywords included coronary artery disease, cardiovascular disease, cardiovascular disease and risk factors, acute coronary syndrome, acute coronary syndrome and ST-segment elevation myocardial infarction, ST-segment elevation myocardial infarction United Arab Emirates (UAE), ST-segment elevation myocardial infarction Abu Dhabi, ST-segment elevation myocardial infarction management, primary percutaneous coronary intervention, emergency medical services history, emergency medical services UAE, emergency medical services Abu Dhabi, emergency medical services perceptions, and emergency medical services and self-transport.

Studies included in the review met the following criteria: (a) written in English, (b) overall focus was CVD in the general public, (c) studies of emergency services included these services in the UAE and Abu Dhabi, (d) investigation of attitudes and beliefs of particular

subgroups (e.g., physicians, patients) toward EMS, and (e) convenience sampling and not based on random or quota samples drawn from the general population. The researcher was responsible for making the decisions for inclusion.

Article sources included (but were not limited to) professional journals. Articles were read for content and the extent to which they supported this review. Those found most suitable were included in the review.

Acute Coronary Syndrome and STEMI

According to the World Health Organization, CVD is the number one cause of death globally. In 2013, it was estimated that 17.5 million people died of CVD, representing 31% of all global deaths. (7) Furthermore, CVDs are estimated to be the leading cause of mortality and morbidity in developing countries by the year 2020. (7) In the U.S between 2005 and 2010, the average annual rate of first cardiovascular events rose from 3 per 1000 men aged 35–44 years to 74 per 1000 men aged 85–94 years. For women, comparable rates occurred 10 years later in life. (8)

Mortality data from 2011 showed that CVD accounted for 786,641 (31.3%) of 2,515,458 deaths, or 1 of every 3 deaths. Per 100,000 deaths, death rates were 275.7 for men and 192.3 for women. The rates were 271.9 for White men, 352.4 for Black men, 188.1 for White women, and 248.6 for Black women. More than 2,150 Americans die of CVD every day, an average of 1 death every 40 seconds. (8) In the UAE, mortality statistics from 2008–2010 showed that CVD was the leading cause of death among both UAE nationals and expatriates. In Abu Dhabi, CVD was the most common cause of death during 2008–2010. (3,9)

The risk factors for CVD are considered either non-modifiable or modifiable. Family history, age, and ethnicity are non-modifiable risk factors. If a first-degree blood relative had

CVD before the age of 55 years (for a male relative) or 65 years (for a female relative), the risk for CVD increases. People of African or Asian ancestry are at a higher risk of developing CVD than other racial groups.

The incidence of CVD in younger people aged ≤ 45 years was as low as 2–6%, (10,11) but has recently increased because of an increased prevalence of risk factors, such as impaired glucose tolerance and obesity in adolescence. (12) Early recognition and modification of risk factors in this population are of key importance. (13)

Modifiable risk factors include hypertension, DM, high cholesterol levels, tobacco use, physical inactivity, obesity, and poor diet. Hypertension, high total cholesterol levels, high triglyceride levels, and high low-density lipoprotein (LDL) cholesterol levels or low high-density lipoprotein (HDL) cholesterol levels increase the risk of heart disease. The risk of CVD with tobacco use is especially high if the patient started smoking when young, smokes heavily, or is female. The risk of CVD is increased by 50% for patients who are physically inactive. Obesity predisposes patients to type 2 DM. A diet high in saturated fat is estimated to cause CVD in approximately 31% of patients with CVD. (14)

In the Gulf countries (i.e., Saudi Arabia, Bahrain, Oman, Qatar, the UAE, and Kuwait), the prevalence's of overweight and obesity ranged from 31.2% to 43.3% and 22% to 34.1% in men, respectively, and from 28% to 34.3% and 26.1% to 44% in women, respectively. In men, the prevalence's of hypertension and DM ranged from 26.0% to 50.7% and 9.3% to 46.8%, respectively; in women, the prevalence's of hypertension and DM ranged from 20.9% to 57.2% and 6% to 53.2%, respectively. The prevalence's of inactivity were 24.3–93.9% and 56.7–98.1% in men and women, respectively. More men (13.4–37.4%) than women (0.5–20.7%) are current smokers. (15)

Acute Coronary Syndrome

ACS, a type of CVD, is a leading cause of morbidity and mortality worldwide, (7) with approximately one-half of the deaths occurring in the prehospital setting. (8)

In 2009, approximately 683,000 patients discharged from U.S. hospitals were diagnosed with ACS. (14) ACS is associated with a sudden, reduced blood flow to the heart and symptoms may include chest pressure, that one may feel during a heart attack or while at rest or doing light physical activity (unstable angina). The location and duration of the blockage and amount of damage that occur determine the type of ACS. (16)

STEMI and Symptoms

STEMI is a type of heart attack resulting from an acute interruption of blood supply to a part of the heart and can be demonstrated by a change in ST-segment elevation on ECG. It has been defined as “a clinical syndrome defined by characteristic symptoms of myocardial ischemia in association with persistent ECG ST elevation and subsequent release of biomarkers of myocardial necrosis.” (14) On ECG, STEMI appears because of full thickness damage of the cardiac muscle, and it is more severe than non-ST segment elevation myocardial infarction (NSTEMI), in which partial thickness damage of heart muscle occurs. (17)

Patients exhibiting symptoms of STEMI present with chest pain often described as a tightness, heaviness, or constriction in the chest. The pain is usually located in the centre of the chest, but may radiate to the neck, jaw, shoulder, back, and arms (most commonly the left arm). Other symptoms include breathing difficulty due to left ventricular dysfunction, tachycardia, and bradycardia. (17)

Prevalence of STEMI

While STEMI is more common in older populations, younger persons can also exhibit symptoms of STEMI and mirror the risk factors for STEMI. Male sex, smoking, and a family history of early CVD are associated with STEMI in young patients. In a study of 86 patients with STEMI ≤ 44 years of age and 65 patients with STEMI aged 60–74 years, the proportions of men, smokers, and patients with a family history of early CVD were higher than those of age-matched controls (88.37 vs. 53.16%, 82.56 vs. 49.37%, and 54.65 vs. 32.91%, respectively). (13)

Twenty-five to 40% of all myocardial infarctions (MI) are diagnosed as occurring from STEMI, (18) with cardiogenic shock occurring in 5–9% of these patients. (19,20) Early reperfusion and evidence-based medical therapy have significantly decreased mortality, with reductions in in-hospital mortality in patients presenting with STEMI from 10% to 5%. (21)

Management of STEMI

Because STEMI is a more serious form of heart attack, patients should be hospitalized immediately, particularly because longer ischaemic times directly correlate with larger infarction sizes and poorer outcomes. (14) Treatment can include complete bed rest with continuous ECG monitoring, oxygen therapy, 300 mg aspirin in combination with 300 mg Clopidogrel, and opiate analgesics for pain relief. (14) Recent evidence from the AVOID trial has, however, called oxygen therapy into question, with some studies suggesting that oxygen can do more harm than good in acute coronary patients. Most current management strategies include the use of aspirin and fibrinolytic therapy as well as coronary angiography and angioplasty. The second International Study of Infarct Survival (ISIS-2), in which aspirin and streptokinase were used to manage STEMI, showed a 25% reduction in vascular death. (22) In addition, an 18% reduction

in mortality with fibrinolysis was achieved in the Gruppo Italiano per lo Studio della Streptochinasinell'Infarto Miocardico (GISSI) study. (23)

Reperfusion strategies such as primary percutaneous coronary intervention (PCI) and thrombolytic therapy are the most effective management techniques, (24-28) and primary PCI is the recommended therapy for patients presenting with STEMI, (28) because it is successful in establishing reperfusion in more than 95% of cases and can be performed in a timely manner. (28,29) Furthermore, compared with thrombolytic therapy, primary PCI reduces mortality and major adverse cardiovascular events. (27,30) In the GUSTO IIB trial, angioplasty was compared directly with thrombolytic therapy and resulted in a 33% reduction in the composite endpoint of death, nonfatal MI, and disabling stroke.

In a seminal trial for primary PCI versus thrombolytic therapy, the in-hospital mortality rates for 395 patients who presented with STEMI were 2.6% and 6.5%, respectively. Reinfarction or death occurred in 5.1% of those treated with primary PCI compared with 12% who were treated with thrombolytic therapy. Further, primary PCI was associated with less intracranial bleeding than thrombolytic therapy. (31)

The 2013 American College of Cardiology STEMI guidelines recommend the use of several therapies with reperfusion therapy. (14) In addition to aspirin, the use of a P2Y₁₂ receptor antagonist and anticoagulation therapy have a class one recommendation to support reperfusion with primary PCI. For patients with STEMI who require a stent, bivalirudin is the preferred anticoagulant. Anticoagulation therapy with unfractionated heparin, enoxaparin, and fondaparinux also has a class one recommendation to support reperfusion with fibrinolytic therapy. In the first 24 hours of presentation, the use of beta blockers, ACE inhibitors, and statins is recommended as an evidence-based therapy in patients with STEMI. (14)

Certain benchmarks are recommended for all healthcare systems in achieving the main goal of prompt reperfusion to reduce STEMI-related mortality and morbidity, including door-to-needle (DTN) time (i.e., time from hospital arrival to initiation of thrombolytic therapy) ≤ 30 minutes and door-to-balloon (D2B) time (i.e., time from hospital arrival to first balloon inflation in the cardiac cath lab) ≤ 90 minutes. (14) Similarly, the 2013 American College of Cardiology/American Heart Association (AHA) guidelines recommend a D2B time ≤ 90 minutes (14).

Delays in achieving reperfusion have been greatly reduced by implementing reperfusion strategies that incorporate the patient's first and subsequent medical contacts, including EMS transport between hospitals. (30) In addition, enthusiasm for developing systems of care has emerged. In Europe, it is common to have prehospital units manned by physicians, rather than only EMS technicians; however, this advanced system is not common in developing regions like the Arab gulf. (32)

However, barriers often exist to achieving reperfusion therapy, which include a delay in recognizing cardiac symptoms by the patient or failure to seek medical help even with recognition of symptoms, delays in transportation, failure to properly identify and subsequently manage STEMI upon first medical contact, and unavailability of medical and cardiovascular providers. (33)

As the elderly population increases, medical professionals are presented with special challenges for STEMI diagnosis and management that may result in inconsistent care and treatment delays. Other related issues that must be considered are the risks of antithrombotic and interventional therapies that may interact with other therapies or medication, patient frailty, and

advanced-care directives. Because clinical trials frequently include younger populations, effective treatments for these populations may not be suitable for the elderly. (14)

Clinical Decision Support Systems (CDSSs) that facilitate evidence-based medical practice can support guideline adherence for patients with STEMI. However, the use of CDSSs is limited, barriers to their use are unknown, and perceptions of barriers differ among nurses and cardiologists. One study explored the type of, number of, and differences in the perceived barriers for the use of a CDSS to treat patients between nurses and cardiologists using the constructs of trust, responsibilities, threats, resistance, and knowledge management (KM); barriers were present in all constructs for both cardiologists and nurses. Sixty-five percent did not want to be dependent on a CDSS; however, 36% of heart failure nurses and 50% of cardiologists stated that a CDSS could optimize medication. KM had a strong positive correlation with perceived barriers, indicating that increasing knowledge of CDSSs could decrease the barriers to their use. (34)

As a result, programs have been established to minimize such barriers, enhance the deliverability of reperfusion therapy, and improve patient outcomes; these include organizing the administrative support of STEMI care programs, adopting a team-based approach to STEMI management that involves collaboration between EMS and first medical contact primary PCI teams, using prehospital ECG, and implementing the 30-minute response time by the cardiac physician laboratory team. (14) Advanced prehospital management, including early diagnosis and care by EMS and fibrinolysis or triage directly to a tertiary care centre capable of primary PCI, can play a crucial role in access to care and reduced mortality rates for patients presenting with ACS. (35) However, STEMI systems of care cannot be implemented on a large scale without additional study of their practical effectiveness in pilot implementation

communities.(36) An AHA survey of 381 STEMI systems involving 899 PCI hospitals in 47 states regarding the processes of care for STEMI diagnosis, system activation, treatment of STEMI, resource allocation, financial considerations, and the most significant barriers to implementing systematic care provides a benchmark for existing systems and could guide healthcare providers in the process of organizing care for patients with STEMI. There were a number of common approaches to STEMI diagnosis and coronary reperfusion as well as major barriers to implementing systematic care. (32)

STEMI systems of care and best practices need to be designed to reduce mortality by allowing timely access to primary PCI. Further, broader use of reperfusion therapy should be promoted in all eligible patients, in addition to access to other evidence-based therapies. (32,33)

STEMI in the United Arab Emirates

Little is known about the CVD profile in the UAE and several medical registries have attempted to quantify the CVD incidence and address practice patterns in the UAE.

The Gulf RACE is a project of the Gulf Heart Association, the objective of which is to describe the characteristics, in-hospital outcomes, and associated risk factors of patients with ACS. (1) Between 2005 and 2009, the Saudi Project for the Assessment of Coronary Events (SPACE) and the Gulf RACE trials enrolled more than 8,000 patients with ACS in 65 participating hospitals in 6 countries. (37)

Knowledge from both the SPACE and RACE studies has raised concerns about the population's coronary artery disease risk profile and identified considerable gaps in the healthcare systems. The mean age at presentation (56 years) is considerably younger than that found in registries in North America. (36) The coronary artery disease risk factor profile is significantly higher, with more patients who have DM and who are smokers, compared with

other registries in the world. (36,38) EMS is underutilised, with only 20% of the entire ACS population reaching hospitals by EMS, (39) compared with EMS utilisations rates of up to 52% in North America. (40) However, when patients with STEMI arrived at hospitals in the UAE, evidence-based therapies were used at acceptable rates according to guidelines. (38,41)

Major gaps have been identified in the STEMI population from previous ACS registries in the Saudi Arabia/Gulf region. One third of patients presented at >12 hours from symptom onset, half received TT within 30 minutes of hospital arrival, less than one quarter underwent primary PCI, and less than one third of those who received primary PCI did so at <90 minutes after hospital arrival (38)

Several studies have explored STEMI in the UAE relative to the prevalence and impact of the cardiovascular risk factors (CVRFs) in patients presenting with ACS, effective management strategies for STEMI, and use of EMS and prehospital triage of patients with STEMI.

In the Gulf RACE-2 study, which involved 7,930 patients (mean age, 56 years; 78.8% men) from 65 hospitals in 6 countries, 45.6% of patients who presented with ACS presented with STEMI. Of these, 39.5% had DM, 22.3% underwent primary PCI, and 65.7% underwent TT. In-hospital mortality was 4.6%. In patients presenting with STEMI, 1-year mortality was 11.5%. (41)

The high prevalence of STEMI in Arab Gulf countries is likely related to the high prevalence of uncontrolled coronary artery disease risk factors and occurrence of metabolic syndrome at a younger age. Lifestyle, such as the adoption of a Western diet and lack of exercise, combined with oil wealth, introduction of labour-saving devices, and cheap, high-

calorie food, have contributed to an increasing rate of obesity among all sectors of the population, which is a major health concern. Genetics have also been cited as contributing to an environment that promotes weight gain. Efforts have been made to control obesity through diet and lifestyle changes and by surgical means, but these have had limited effect. (42) However, it has been shown that obesity predisposes persons to DM. (8) The prevalence of DM in Saudi Arabia is estimated at 23.7% and is considered one of the highest in the world. (43) Further, the prevalence of DM in patients with ACS is higher in Middle Eastern countries than in other regions, (44) and these patients have a poorer prognosis than patients without DM. (8)

In the SPACE study, 58.1% of the participants had DM; baseline demographic characteristics, clinical presentation, therapies, and in-hospital outcomes of 5,055 patients with DM (mean age 60.2 ± 11.5 , 71.6% men, and 87.6% Saudi nationals) and ACS were compared with those of patients without DM over a two-year period. Patients with DM had more risk factors for ACS and were more likely to present with NSTEMI (40.2% vs. 31.4%), heart failure (25.4% vs. 13.9%), significant left ventricular systolic dysfunction, and multi-vessel disease. Patients with ACS and DM also had higher rates of in-hospital heart failure, cardiogenic shock, and re-infarction rates. (38) The prevalence of smoking was also significant among Arab Gulf patients presenting with ACS; 35.7% were current smokers, while 17.2% were former smokers. Those factors probably led to the occurrence of STEMI at a much younger age (mean age, 56 years in the Gulf RACE registry vs 65 years in the Global Registry of Acute Cardiac Events [GRACE] registry). (44)

Patients with STEMI in Arab Gulf countries present later and receive poorer acute management than those in developed countries. In Arab Gulf countries, 79% of patients with STEMI present within 12 hours of symptom onset, and the median time from symptom onset to

arrival is 178 minutes. In comparison, 95% of patients with STEMI present within 12 hours of symptom onset in the U.S., and the median time from symptom onset to arrival is 89 minutes.

(45)

A contributing factor is the underdevelopment of EMS and the potential underestimation of patients' symptoms. Further, the lack of universal healthcare systems and traffic congestion in major cities delay the presentation of patients with STEMI symptoms. Only 34% of patients received TT within 30 minutes of hospital arrival. The long waiting time for TT was directly related with the waiting time for the hospital administration's approval for cardiology services.

(45)

Using data from the Gulf RACE 2 trial, another study explored the quality and effectiveness of primary PCI to manage STEMI in patients aged ≥ 18 years from 65 hospitals in 6 adjacent Middle Eastern countries (Bahrain, Saudi Arabia, Qatar, Oman, UAE, and Yemen).

Specifically, data were analysed for patients who underwent primary PCI, to assess the guideline-supported performance measure of $D2B \leq 90$ minutes and its effect on morbidity and mortality. (14) Of the 3,432 patients, 1,832 (53%) patients (predominantly men) with STEMI were admitted to a hospital with a cardiac cath lab, and primary PCI was used in a small group (198, 11%) of these patients, while 1,006 patients (55%) received reperfusion therapy. The median D2B time in the primary PCI cohort was 85 minutes; only 55% of the cases had a $D2B \leq 90$ minutes. Patients with timely primary PCI ($D2B \leq 90$ minutes) were less likely to have cardiogenic shock and require an intra-aortic balloon pump. Primary PCI was underused and was not timely, and rates of acute reperfusion were low. (46)

Saudi Arabia has recently joined “Stent for Life,” an initiative of the European Society of Cardiology involving a cross-sectional study to evaluate reperfusion therapy for patients with STEMI. (25) In Saudi Arabia, TT was still the main method of reperfusion in patients with STEMI, and DTN was still significantly prolonged. Further, the number of primary PCI centres and procedures per capita were more limited in Saudi Arabia than in other European countries, resulting in prolonged D2B times. (46)

STEMI in Abu Dhabi

While the number of studies focusing on CVD in the Gulf region countries has increased, data on STEMI in the Emirate of Abu Dhabi specifically are scarce. What is known, however, is that Abu Dhabi has high rates of lifestyle-related chronic diseases, such as CVD, obesity, and DM. In 2013, 36.7% of deaths were from CVDs. Nationals were first screened in 2008 for various health risk factors in the Weqaya (Arabic for ‘prevention’) program, which is part of the Abu Dhabi Cardiovascular Disease Program and overseen by the Health Authority of Abu Dhabi; of the individuals screened, 71% had at least one CVD risk factor.

Many of these individuals were unaware of the risk and were thus unable to seek care. Therefore, the prevalence of risk factors is projected to increase (5,47)

Factors Influencing STEMI Outcomes

Patients with successful versus failed PCI were compared in an examination of a clinical database of 2,900 patients who underwent primary or rescue PCI over an 8-year period. All procedures were performed according to the 2013 American College of Cardiology/AHA PCI guidelines. (14) Coronary angioplasty was performed by standard percutaneous techniques using the femoral approach and standard techniques for stent implantation. Either a bare metal or drug-eluting stent was used at the discretion of the practicing physician. Clinical follow-up occurred in

hospital, at 30 days, and at 1 year, and 111 (3.98%) patients had failed PCI. Patients with failed PCI were older (65 vs. 61 years) and were more likely to be women (46% vs. 32%), have previous peripheral vascular disease (19% vs. 11%), previous PCI (29% vs. 20%), and present with cardiogenic shock (25% vs. 11%). The in-hospital (18% vs. 4%) and long-term mortality (48% vs. 14%) were worse in the failed PCI group than in the successful PCI group. (27)

However, in the majority of countries, about half of patients present to hospitals that do not have a PCI capability; 91% of transferred patients have a D2B time greater than the recommended 90 minutes. (30) As D2B time increases, the mortality benefit of PCI over TT declines. (28) Because the guidelines do not state a preference between primary PCI and TT in patients with STEMI presenting within the first 3 hours, (29) TT remains the default reperfusion strategy for patients with STEMI in the majority of countries. In the Middle East, TT remains the major reperfusion strategy because of the scarcity of hospitals with 24/7 cath lab facilities. (48)

The prehospital ECG allows for earlier identification of acute STEMI, (49) and the majority of studies of prehospital ECGs have focused on this.

The prehospital ECG may also detect signs of transient ischaemia and arrhythmias, which may no longer present by the time the patient undergoes the first in-hospital ECG. (50 Drew)

A study compared the extent to which the prehospital ECG provides information on possible cardiac ischaemia and arrhythmias versus information provided with the first hospital ECG. Among the 82 patients who had an eventual hospital diagnosis of STEMI, 71 were identified as having ST-segment elevations on the ECGs examined by the cardiologists. The majority of the patients (97%) had ST-segment elevations observed on both ECGs; the prehospital ECG showed ST-segment elevation for two patients (3%). (49)

In an examination of the associations between non-chest pain presentations, prehospital ECG use, and reperfusion times among patients with STEMI undergoing PCI, 318 of the 2,639 patients (12.1%) presented without chest pain. A prehospital ECG was obtained in 2,021 of the 2,321 (87.1%) patients with chest pain, compared with only 230 of the 318 (72.3%) patients without chest pain. Among the patients without chest pain, those who underwent a prehospital ECG had significantly shorter first medical contact (FMC) to device times (30.9% <90 minutes vs. 11.4% >90 minutes). (51)

Higher in-hospital and all-cause mortality were observed at 6 months for patients admitted with anterior wall STEMI who underwent PCI. (52-54) In elderly patients (≥ 75 years) with STEMI who underwent PCI, early mortality rates over a 6-year period remained unchanged, despite advanced age; these patients had higher incidences of DM and comorbidities. The D2B time was significantly shorter, and a higher incidence of three-vessel coronary artery disease was observed in angiograms. No difference was found in 1-year post-discharge mortality. (54)

As part of the Gulf RACE trial, data were collected for 6,704 patients with ACS over a 5-month period in 2007. CVRFs were identified on admission, and patient characteristics and in-hospital outcomes were analysed across the types of ACS. Of the ACS patients, 61% had non-ST elevation ACS (NSTEMI), and 39% had STEMI. Patients with NSTEMI were more likely to be women, be older, be obese, and have DM, hypertension, or dyslipidaemia. Chronic renal failure (CRF) and DM predicted in-hospital heart failure in patients with NSTEMI. Patients with STEMI were more likely to be smokers and less likely to be taking aspirin prior to admission. CRF and hypertension were predictors of STEMI, with female sex and CRF independent predictors of mortality in STEMI. (16)

For patients with STEMI, advanced prehospital management, which includes fibrinolysis and/or triage directly to a tertiary care centre capable of primary PCI, reduced treatment delays and mortality. (55) While many EMS can perform pre-hospital ECGs, the information obtained from ECGs is often conveyed to and used by the hospitals in various ways. With paramedic reports of a positive ECG, some hospitals may activate the cardiac cath lab prior to patient arrival, while others wait and activate the cath lab after patient arrival, when ECGs can be interpreted by a physician. (56) For example, a study of the change in speed and rate of coronary reperfusion after a state-wide implementation of a STEMI treatment system in five regions in North Carolina showed a significant reduction in door-to-PCI and door-to-fibrinolysis times as a result of early STEMI diagnosis at each point of care, including EMS, emergency department, cath lab, and transfer. The results suggested that a state-wide program focused on regional systems for reperfusion for STEMI can significantly improve quality of care. (32s)

Compared to in-hospital fibrinolysis, administering de novo paramedic-based prehospital fibrinolysis reduced patient time-to-treatment by 1 hour, with favourable clinical outcomes, suggesting that paramedic-based prehospital fibrinolysis programs are feasible and desirable. (57,58) These studies show that early STEMI diagnosis and treatment have beneficial outcomes for patients.

Emergency Medical Services

The earliest reported EMS was the Vienna Voluntary Rescue Society in response to a disastrous fire at the Vienna Ring Theatre in 1881, which became the model for similar societies worldwide. The modern EMS has evolved from a system of ambulances that simply transport patients to a care facility to one that provides preliminary medical care at the location and during transport. In the 1960s, the development of cardiopulmonary resuscitation, defibrillation, and

new pharmaceuticals to treat out-of-hospital cardiac arrest played an influential role in changing the tasks of paramedics in ambulances. (59)

As the term implies, EMS are services for out-of-hospital acute medical care; transport to definitive care, such as a hospital; and other medical transport for patients with illnesses and injuries who cannot transport themselves. Typically, persons needing EMS call an emergency telephone number (e.g., 911 or 999), and an appropriate resource is dispatched. (40) In some parts of the world, EMS also moves patients from one medical facility to another in cases where more specialized care is needed. In cases where patients require less specialized care, such as after successful treatment for heart-related conditions, EMS may transport to a local hospital or nursing home. In such services, clinical professionals call EMS for the transport. (40,59)

Training and qualifications of EMS professionals vary widely worldwide. Some EMS personnel may have no medical training and only drive ambulances, while the qualifications of others range from basic first aid certifications to advanced life support personnel, including paramedics. In Europe, it is becoming increasingly common to staff EMS units with fully trained physicians. (40,60)

In the UAE, EMS has become more established. Most prehospital care and EMS fall under the authority of the respective Emirates police departments. Standardized protocols have been established for paramedic certification, triage, and destination decisions. Most ambulances offer basic life support (BLS/Type 2), with some offering advanced life support (ALS/Type 3). (60) In August 2012, the Emirates Society of Emergency Medicine (ESEM) was established with the following objectives: (a) develop and maintain high standards of emergency medicine practice; (b) promote networking among emergency medicine providers across the UAE; (c) facilitate collaboration among emergency department doctors, nurses, and paramedics through

scientific conferences, workshops, and meetings; and (d) encourage emergency medical research. ESEM also raises public awareness of the specialty of emergency medicine throughout the region as well as of emergency department utilization, injury prevention, and public safety.

(60) Currently, UAE medical dispatch is performed by police departments. However, emerging research from Denmark suggests that police dispatch of EMS may not be the most effective dispatch strategy; the Danish system now includes dispatch by medical professionals.

In Abu Dhabi, cardiac catheterization services are provided at five government-operated hospitals, four of which are operated by the Abu Dhabi Health Services Company (SEHA), and one is operated by the UAE Armed Forces. EMS is operated by the Abu Dhabi Police Emergency and Public Safety Department, in conjunction with the National Ambulance Company LLC, which provides emergency technicians and paramedics. EMS are able to provide advanced cardiac life support and early STEMI recognition by means of 12-lead ECG acquisition and paramedic interpretation. (60,61)

Emergency Medical Services and STEMI

Approximately one-half of the deaths from ACS occur in the prehospital setting. (62,63) STEMI can be treated more quickly when patients use EMS transportation to the hospital, particularly if a prehospital ECG is performed by EMS personnel to identify acute STEMI. (64) STEMI can be reversed if revascularization is initiated rapidly; increased mortality is associated with longer culprit vessel occlusion times. (63)

EMS can deliver treatment that enhances patient outcomes and reduces treatment delay with STEMI. Time to thrombolysis is a controllable variable for mortality in STEMI. (28) Prehospital diagnoses and paramedic-based prehospital fibrinolysis with trained paramedics

in ambulances were associated with an approximate 1-hour reduction time to thrombolysis and adjusted 30% reduction in 1-year mortality compared with regular in-hospital thrombolysis.

(57,58)

For the paramedic-based prehospital fibrinolysis group, the median time from symptom onset to treatment was 113 minutes compared with 165 minutes for the in-hospital group. (65)

Furthermore, patient use of EMS can result in more rapid receipt of initial reperfusion therapies. (66) Most ambulances are equipped with defibrillators, and paramedics trained in basic and advanced cardiac life support increase the patient's chance for survival. (40,60)

Implementing reperfusion strategies that incorporate the patient's first and subsequent medical contacts, including EMS transport between hospitals, have reduced delays in achieving reperfusion. (66,67)

Treatment decisions can be more effective and within a shorter time period because EMS can perform prehospital ECGs, alert the hospital that the patient is enroute, and minimize D2B times. (68)

Studies that examined the issue of EMS transport to the hospital versus self-transport found that patient characteristics, ACS characteristics, and patient's knowledge of ACS symptoms influence the use of EMS. (40,41,69), For instance, a 1-year study of 619 patients with STEMI in a Singapore hospital revealed that 58.6% arrived by EMS and 41.4% by self-transport. Emergency angiography was performed for 53.3% of the patients; of these patients, 94.9% were treated with PCI, 2.4% with coronary artery bypass grafting, and 2.7% conservatively. The D2B time was shorter in patients who arrived by EMS (60 vs. 82 minutes), but there was no difference in D2B time between patients who arrived during the day or night. (69)

Chest pain, shortness of breath, and diaphoresis were the three most common presenting symptoms in patients with STEMI whether they arrived by EMS or some other mode of transport. Patients who arrived by EMS had a higher incidence of cardiogenic shock (20.7% vs. 11.7%) and were older (63 vs. 59 years) than patients who arrived by self-transport. Although patients who arrived by EMS had a shorter D2B time than those who self-transported, the high incidence of cardiogenic shock in patients transported by EMS contributed to a higher in-hospital mortality rate (12.1% vs. 5.1%) and longer mean length of stay (6 vs. 4 days). (69) This lends equivocality to results on mortality and EMS, strengthening the need for further study, including the present study.

An observational analysis was conducted of the prevalence of EMS transport versus self-transport to the emergency department in 37,634 patients with STEMI treated at 372 U.S. hospitals participating in the National Cardiovascular Data Registry Acute Coronary Treatment and Intervention Outcomes Network Registry–Get with the Guidelines (ACTION Registry–GWTG) between January 2007 and September 2009; only 60% of patients with STEMI used EMS transport. Self-transport was defined as any mode of transportation that did not involve EMS services, such as taxi, public transportation, driven by self or others, or walked to the hospital.

Older patients with STEMI (mean age, 62 years), patients living farther from the hospital, and those with haemodynamic instability were more likely to use EMS transport. Compared with self-transported patients, EMS-transported patients had significantly shorter delays in both symptom-onset-to-arrival time (mean, 89 versus 120 minutes) and door-to-reperfusion time (mean D2B time, 63 versus 76 minutes; mean DTN time, 23 versus 29 minutes). (36)

Physician Perceptions of Emergency Medical Services

While some studies have focused on nurses' and other healthcare providers' perceptions, little research has focused on physicians' perceptions of best practices for treating patients with ACS. Most physicians believe that CVD prevention guidelines are useful; however, only 56.9% use guidelines, and 40.2% favour joint European guidelines. More primary care physicians use their own personal experience in prevention, while internists and cardiologists are more likely to use guidelines. Regarding the risk factors for CVD, 80.6% of physicians believe that they treat their patients with dyslipidaemia well. (70)

However, only 53.3% knew the goal LDL cholesterol value for high-risk patients, and only 56.2% knew which HDL cholesterol level is a marker of increased risk. Primary care physicians perceived hypertension as the most important risk factor, and cardiologists perceived DM as the major risk factor. Thus, while most physicians support the use of guidelines, only slightly more than half use guidelines, and on average, their knowledge of guidelines is not satisfactory. The primary reason for the failure of physicians to manage risk factors better is likely insufficient knowledge of the guidelines, in addition to a lack of time and finances and a perceived lack of patients' awareness of risk factors. (70)

Health system and organizational factors significantly influence the implementation and effectiveness of health interventions. (71,72)

For example, in ACS care, differences in organizational values and goals, senior management involvement, and expertise exist between high- and low-performing hospitals. (73) Further, physicians' best practices regarding the use of EMS for prehospital treatment may be influenced by organizational values. (71) However, few studies have addressed physician perceptions of EMS use.

It is essential that additional evidence related to drugs, devices, and procedures for the detection, management, and prevention of AMI be developed. Exploring physicians' perceptions of best practices will provide insight into their knowledge of the guidelines for managing risk factors for AMI and treating patients with AMI. Further, a thorough review of data gathered about physicians' perceptions can result in the development of best practices that not only assist physicians to select the best management strategy for an individual patient but also improve the quality of clinical decisions.

Patient Perceptions of Emergency Medical Services

The reasons for underuse of EMS are not clear, but in Canada and the United States for example, misinterpretation of symptoms, embarrassment about EMS arriving at the office or home, failure to acknowledge severity of symptoms were found to be barriers. (74) It was reported in a Turkish study that a lack of knowledge about ACS was seen as a barrier to EMS use, (75) and in other studies, a lack of ambulances or EMS was cited (76). Connolly et al. found that self-perception of the severity of symptoms and presence of chest pain was similar among EMS users (55%) and non-EMS users (53%); however, 53% of the non-EMS group perceived that EMS would take longer than self-transport. Reluctance to be a burden on the health care system was indicated by 35% of non-EMS users, compared with 3% of EMS users. Both users and non-users indicated that embarrassment about EMS arriving at their offices or homes was a factor for self-transport. (74)

In another study of ambulance use among 330 patients with ACS admitted to two Turkish hospitals, only 96 of the patients (29%) used ambulance services. Further, ambulance use was associated with knowledge of the risk for cardiac arrest or heart attack-related chest pain and the importance of quickly seeking medical care by calling an ambulance. (75)

Underdeveloped ambulance and EMS services, particularly in developing countries, may also explain why patients self-transport (76). For example, Nepal does not operate its own ambulance service; instead, ambulances are run either by private hospitals or nongovernment organizations and are not equipped with paramedics or basic resuscitation facilities such as oxygen, defibrillators, or medication. Therefore, patients in Nepal needing primary PCI must be airlifted by helicopter, an expensive and time-consuming transport mode. Further, patients must pay the cost of transportation. Thus, patients often travel by bus, taxi, motorcycle, or bicycle to the emergency room. Furthermore, Nepal has only two centres where PCIs are performed, both in Kathmandu, which is 10 hours from Eastern Nepal. Thus, few patients with ACS in Eastern Nepal are admitted to hospital; for those who are, treatment is often too late. (77)

These factors require further exploration and could become the basis of educational and information programs to change behaviour regarding ambulance use and to raise awareness that self-transport is an unsafe mode of transportation for ACS patients, may increase their time to arrival at the hospital, and compromise swift treatment.

Factors Influencing Patient Decisions to Use Emergency Medical Services

EMS underutilization by patients with ACS has been reported in different regions of the world, including Nepal, (77) Beijing, (78) and the Arab Gulf States. (39)

Evidence from the ACTION Registry-GWTG trial indicates that EMS transport is persistently underused among a contemporary cohort of patients with STEMI (36); the rate of underuse was similar to the 53.4% among patients with acute MI in the mid to late 1990s based on a survey of the National Registry of Myocardial Infarction conducted several years ago.(76) In Beijing, only

37% of patients with STEMI used ambulances, and ambulance users were on average older (mean age, 63.3 ± 12.4 years), at a relatively higher risk than non-ambulance users, and more likely to more quickly and frequently receive early reperfusion therapies for primary PCI.(78) In a study of 1,939 patients with ACS in Sweden, only 50–60% of patients with STEMI used EMS. Among the factors associated with EMS use were knowledge of the importance of calling for an ambulance when having chest pain, abrupt and rapid onset of pain within minutes, nausea or cold sweat, vertigo or near syncope, age, previous history of heart failure, and distance to the hospital.(79) In Nepal, lack of EMS use is attributed to the majority of the population living in poverty, lack of awareness by patients and their families about the symptoms and potential consequences of chest pain, inability of hospitals to adequately diagnose possible ACS, and lack of an insurance system. Even among patients who could afford the cost of treatment, 63% presented to the hospital at least 12 hours after the onset of symptoms. (77)

In the Arab Gulf states, little data have been published on EMS use to date. EMS use rates of 17% and 25% were found in the first Gulf RACE (61) and Gulf RACE-2 trials, (39) respectively; similarly, low rates were also found in other studies of Middle Eastern countries. (75) The results of the Gulf RACE-1 trial showed that fewer than 1 in 5 patients with ACS use EMS in Arab Gulf countries. (61)

Emergency Medical Services in the United Arab Emirates

Geography, economy, political boundaries, and population density influence EMS use in the Middle East, and prehospital care or emergency medicine varies throughout the Middle East. (80) Prehospital care has been one of the most challenging aspects of the emergency spectrum in the UAE, and the quality of prehospital care varies considerably among the emirates because of differences in EMS authorities, (60) which results in lack of coordination and synergy. EMS is

generally under the auspices of the police or public safety department. (81,82) Each emirate activates emergency response with a “999” or “998” telephone number, and a police dispatch centre dispatches ambulances, which in some instances, are staffed by police physicians and paramedics not trained in emergency medicine. (81,82) In larger cities, transport decisions are triaged; in smaller towns and rural areas, patients are usually transported to the nearest medical facility. Larger public and private medical facilities also own and run ambulance services, which are used mainly for interhospital transfers. (81,82)

During the past few years, several mass casualty incidents highlighted deficiencies in the EMS system, and efforts were initiated to overcome them. Larger emirates, such as Abu Dhabi and Dubai, have moved more quickly to define prehospital care as a profession. (80)

In Abu Dhabi, the HAAD and the emergency and public safety department of the Abu Dhabi Police collaborated to coordinate efforts and upgrade the EMS system. One aspect of this initiative was the adoption of guidelines from the Joint Royal Colleges Ambulance Liaison Committee (JRCALC), which are to be implemented throughout Abu Dhabi. (83) Another important step was the establishment of the National Ambulance Company in 2010, based in Abu Dhabi and with the objective of being the leading national provider of emergency prehospital care in the UAE. (84)

The Gulf countries also generally have a lack of qualified EMS-trained professionals.(65) The larger emirates have established a standardized curriculum that is based on an individual’s level of education, training, and experience. Qualification-based classifications of paramedics are emergency medical technician (EMT), EMT-Basic, EMT-Intermediate, and EMT-paramedic. Health authorities of the respective emirates (i.e., the HAAD and the Dubai Corporation for Ambulance Services) license and certify prehospital personnel. (81)

EMS in Arabian Gulf countries are dispersed and consist of two main health care providers: Red Crescent EMS, which transfers patients directly from the scene to the nearest hospital (PCI or non-PCI), and Inter-Hospital EMS, which transfers patients to the nearest PCI hospital. Of the 25.7% of patients with STEMI symptoms who used EMS in a 1-year study evaluating clinical arrival and acute care within 24 hours of presentation in 36 hospitals in 6 Arabian Gulf countries (Saudi Arabia, Oman, UAE, Kuwait, Qatar, and Bahrain), 22% used Inter-Hospital EMS (22%), and 3.7% used Red Crescent. In the comparison of patients transferred with or without EMS, the EMS group was more likely to arrive initially at a primary or secondary health care facility, resulting in longer median symptom-onset-to-emergency department arrival times (218 vs. 158 minutes; $p < .001$), a greater likelihood of undergoing primary PCI (62% vs. 40.5%; $p = 0.02$), shorter DTN times (38 vs. 42 minutes), and shorter D2B times (47 vs. 83 minutes). Education level and low or moderate socioeconomic status predicted high rates of EMS use, while a history of angina or PCI predicted low rates of EMS use. Both groups had similar in-hospital mortality and outcomes; this further equivocal result contrasts with studies that have shown both increased and decreased mortality among EMS-transported patients. (57,58,85)

The Al Habib et al. study (85) represents an important step toward understanding the relationship between mode of transport and outcomes for STEMI patients in the Arab Gulf region. However, this study was published in January, 2016, after primary data collection for the present study had already begun. Therefore, it was not possible to take account of this study in the design of the present study. Further, the present series of studies sheds further light on the findings from the Al Habib et al. study, in several ways. First, the present study focuses on EMS utilization and outcomes among STEMI patients in a much more specific geographic region

(Abu Dhabi, UAE), whereas Al Habib et al. focused on the Arab Gulf region overall, potentially limiting the applicability of results to specific healthcare systems such as that in Abu Dhabi. Next, the present study uses primary data, whereas Al Habib et al. conducted secondary analysis of data from the Third Gulf Registry of Acute Coronary Events. Hospital enrolment in this registry is voluntary, potentially leading to bias in the data. By contrast, this study included all government-operated hospitals in the area of interest, regardless of their enrolment in the registry. Third, the present study includes information on physicians' and patients' perceptions of EMS, revealing more concretely directions for improving EMS utilization in the region and going beyond mere description of the problem.

Challenges in Emergency Medical Service Development

Awareness, better referral and transport facilities, financial support for the needy, and the availability of on-site coronary angiography and angioplasty for selected patients should contribute to the treatment of more patients with ACS and improve their prognosis.(77) Community education efforts are needed to improve the use of EMS as part of system-wide strategies to improve STEMI reperfusion care, for example In Europe, strategies that preferentially direct eligible patients to PCI-capable hospitals through prehospital EMS protocols or interhospital transfer arrangements have been implemented successfully.(86)

Establishing STEMI systems of care to increase timely access to PCI will fundamentally affect the U.S. healthcare system and will depend on overcoming a number of practical barriers, including hospital and cardiology group competition and EMS transport and finances. (33) At present, the U.S. healthcare system, unlike other countries, is still largely unstructured and competitive. EMS providers and hospitals are heterogeneous and will need to be flexible to adapt to the local needs and resources of different communities.

The challenges faced in emergency medicine in the UAE and relative to the use of EMS by patients with STEMI are similar to those faced in the U.S. 30 years ago. Al Habib and colleagues found that approximately one in four patients with acute STEMI arrived at the emergency department by EMS. (85) Further, nearly all patients who used EMS were transported in ambulances operating under the authority of clinics or non-PCI hospitals and were transferred to other hospitals after arriving in their own cars. Ambulances operated by the Red Crescent transferred patients directly from the scene of the emergency to the hospital. However, only 10.2% of EMS use (3.7% of the overall acute STEMI cohort) was via the Red Crescent, an extremely low utilization rate. (85)

Further, a significant proportion of the ambulance paramedics lacked BLS and ACLS certifications. Most ECGs were performed in the clinics or non-PCI hospitals, rather than in the ambulance. (85) A severe shortage of emergency medicine-trained practitioners still exists; less than 10% of practicing emergency physicians are residency trained. These physicians do not have adequate skills to diagnose, stabilize, and treat complicated patient presentations.

The shortage of emergency medicine-trained, board-certified consultants has affected the quality of emergency medicine training. Consultants who teach or conduct research are not readily available. This shortage may worsen in the future if residents certified by the Arab Board are not recognized as having the same level of emergency medicine-certification as physicians trained in North America. Arab physicians may leave the UAE, complete residencies in North America, and anticipate being certified as a consultant/attendant when they return. Those who do not return may take jobs outside the UAE after completing their training. (60)

To ensure patient safety and positive clinical outcomes for acutely ill patients, emergency medicine-trained physicians must be well trained. Adopting best practices to enhance the skills

of emergency care providers and encourage them to work alongside EMS paramedics will not only strengthen the specialty's reputation but also ensure positive outcomes for patients with STEMI. (60)

Ambulance use may contribute to timelier reperfusion therapies, which are crucial in reducing the amount of myocardial damage in patients with STEMI.

Care of patients with ACS by EMS allows evidence-based therapies and treatment strategies to be initiated earlier and facilitates more efficient delivery of care. Numerous international guidelines support and emphasize the need for early activation of EMS in patients with ACS. (14,21)

Discussion

This review revealed that in the Gulf countries, the rates of ACS and associated risk factors appear to be very similar to those in other regions of the world (7) In the Gulf region, men start smoking cigarettes at an early age (<18 years old), while women generally start after the age of 30 years because of cultural views against cigarette smoking by younger and unmarried women.(15) Furthermore, the mean ages at presentation in the SPACE and Gulf RACE cohorts were approximately 10 years younger than those reported in the Euro heart survey and GRACE cohort,(1,15,21,37) potentially owing to the high rates of uncontrolled risk factors in the Gulf region and high percentage of younger populations in these countries.

Increased incidences of hypertension and DM, that are also associated with ACS in studies in the Gulf region, might be related to the high rates of undiagnosed hypertension and DM within the region which are then only diagnosed during ACS admission, (15,37) These include the relatively young age of patients with ACS as well as the high prevalence of obesity

and physical inactivity in the Gulf region. More than 50% of the Gulf Cooperation Council (GCC) population is physically inactive; this rate is higher in Saudi Arabia than in other Gulf countries. (3)

The 2013 American College of Cardiology and the AHA guidelines recommend that patients with ischemic symptoms should be transported to the hospital by ambulance. (14)

As noted previously, strategies to enhance patient outcomes and reduce treatment delay in patients with STEMI are essential. For maximum effectiveness, it is recommended that reperfusion therapy be initiated early, especially within the first 3 hours from symptom onset. (87)

Numerous studies have focused on the use of EMS by patients with STEMI and have generally concluded that EMS use is low. Literature about EMS use in the Gulf countries is scarce; however, EMS is significantly underused in Arab Gulf countries than in other EMS registries. In the ACS registry, which includes data for 5,184 patients between 2008 and 2009, only 25% arrived at the hospital via EMS. Patients who used EMS were more likely to be men, have cardiac arrests on presentation, have left ventricular systolic dysfunction, and have STEMI on discharge diagnosis. After adjustment, mortality rates were equal among patients who did or did not present through EMS. (39) Additionally, the mortality finding contrasted with other studies which have shown both increased and decreased mortality among EMS-transported patients (57,58,85), lending an equivocality to existing findings that calls for further research. EMS care for STEMI is also greatly underutilized in Abu Dhabi. Patient knowledge and perceptions of EMS use may be contributing factors to underutilization, and public education efforts about EMS use are needed. (1)

While study results have suggested that factors outside the control of patients (i.e., poverty, expense of EMS use) have played a role in the low usage of EMS, other researchers suggested that factors such as perception of and knowledge about symptoms, patient characteristics, and ACS characteristics influence the use of EMS. Thus, these factors need further exploration and could become the basis of educational and information programs to increase the use of ambulances and EMS by patients with STEMI and to promote more positive physician perceptions of EMS use by patients with STEMI.

This review has some limitations. A lack of recent nationally representative reports in the GCC countries poses difficulty in comparing the data among GCC countries.

Further, definitions of the risk factors, design, and population characteristics differ. A thorough review of data relative to mode of transport for patients with STEMI and EMS use in GCC countries can result in the development of best practices that not only encourage EMS use but also improve quality of patient outcomes. The strength of this review was that the literature search was conducted in multiple databases and focused on the most recent available research.

Summary

In response to the global increase in the demand for EMS, EMS communities must adapt and adhere to models that utilise unified standards of practice and training in prehospital care that will result in positive outcomes for patients. EMS personnel with knowledge of Basic Life Support (BLS), Intermediate Life Support (ILS), or Advanced Life Support (ALS) can quickly assess appropriate treatments and therapies for patients before transporting them to a hospital or clinic for further evaluation. (60)

Better transfer practices, including trained personnel and ECG equipment, are especially urgent in government-operated hospitals in Abu Dhabi. Further, EMS use for coronary symptoms should be encouraged among the general public to improve quality of clinical outcomes for patients presenting with STEMI.

This literature review discussed ACS, STEMI, and EMS, with a specific focus on the UAE and Abu Dhabi. Both qualitative and quantitative studies were reviewed. In chapter 3, a summary of the author's findings will be presented.

Chapter 3: Physician attitudes to EMS in prehospital STEMI care

Reference

Callachan EL, Alsheikh-Ali AA, Bruijns S, Wallis LA. Physician perceptions and recommendations about pre-hospital emergency medical services for patients with ST-elevation acute myocardial infarction in Abu Dhabi. *Journal of the Saudi Heart Association*. 2016;28(1):7-14.

Declaration of Author

In the case of chapter 3, the nature and extent of my work was as follows:

I was the primary author of this paper and responsible for the literature review, survey design, piloting of the survey, ethics approvals, consenting of participants and data collection. I also performed the data analysis and write up of manuscript drafts, while under the supervision of all co-authors. As primary author, I accept full responsibility for this paper being published. Extent of the work done by candidate: 80%. In the case of the co-authors the extent of the work is as follows: AAA 10%, LAW 5%, SRB 5%

Declaration of Coauthors

The undersigned hereby certify that:

1. The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
2. They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
3. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
4. There are no other author of the publication according these criteria;

5. Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and

6. The original data are stored at the following location and will be held for at least five years from date indicated below.

Location of stored data: Password protected portable hard drive at the candidate's place of employment, Bateen Air Force Base, Abu Dhabi, UAE

Signed:



Alawi Alsheikh-Ali

Date: 08 August 2016



Stevan R Bruijns

Date: 08 August 2016



Lee A Wallis

Date: 08 August 2016

Introduction

The present chapter presents a published paper containing a report of the first study in this research sequence. Prior to the presentation of the published paper, we present some supplemental material on the background, methods, and results, as well as a supplemental discussion. The following text is, therefore, intended to support and expand upon the information in the published paper, rather than to duplicate it. For a full understanding of the study, readers are advised to review both the supplemental material here and the published paper itself, which is the core of the chapter. Chapters 4 and 5 are structured in the same manner.

Background of the Study

Since the overall goal of this group of studies was to identify ways in which EMS for STEMI patients in Abu Dhabi might be improved, we began by investigating physicians' perceptions. Physicians involved in the treatment of STEMI patients are in a unique position with respect to the quality of pre-hospital care, because they treat patients who have had a variety of pre-hospital experiences and are thus aware of how treatment protocols and efficiencies might differ given differing pre-hospital scenarios. Additionally, their perspective involves an awareness of in-hospital STEMI treatment technologies and protocols, so they are in a position to recommend pre-hospital treatments that would support or augment the actual clinical situation in Abu Dhabi's government-operated hospitals. It was, therefore, necessary to approach physicians working specifically with STEMI patients in the setting of interest for this research.

This context-oriented approach allowed us to uncover issues and areas for improvement directly relevant to Abu Dhabi's growing population. Additionally, we were able to compare physicians' responses with existing literature from elsewhere to begin to develop an understanding of how STEMI treatment in Abu Dhabi conforms with and differs from STEMI

treatment in other regions of the world. Improving EMS care for STEMI patients involves at least two approaches: a medical approach, focusing on treatment times and outcomes, and a social approach, focusing on perceptions and utilization of EMS services among the population. This first study pertains primarily to the medical approach. However, inquiring into physicians' likelihood of recommending EMS to others, versus using EMS for themselves and their own families, represented the beginnings of an investigation into the place of EMS in social perception.

Since the problem at issue in this research is a lack of information on how to improve EMS for STEMI patients in Abu Dhabi, it made sense to begin with physicians. Given an understanding of physicians' perceptions, it was possible to compare outcome data from subsequent studies to reveal what might be driving physicians' perceptions and whether objective outcome data provide support for physicians' recommended improvements to EMS services.

In the paragraphs below, we describe aspects of the study's methods and findings which were not, owing to length limitations, included in the published report.

Methods

Surveys are important data collection tools. In healthcare, surveys can provide necessary information about delivery and use of healthcare services and issues related to quality of care. Our focus was on cardiac care and on perceptions towards EMS among physicians caring for patients with STEMI in Abu Dhabi. We believed that SurveyMonkey would be easier and more convenient to use and would encourage the physicians to respond to the survey. Survey questions were designed for this research in order to address the research question regarding physicians' perceptions. A question about steps to improve EMS for STEMI patients included several

possible responses; these responses were developed on the basis of the literature review, which revealed several best practices for pre-hospital treatment of STEMI patients. The survey was piloted with a sample of 10 STEMI physicians to ensure face validity.

For this paper, the population consisted of physicians employed at four hospitals in Abu Dhabi (see map, Figure 1) and involved in treating patients who present with ACS symptoms (including physicians in emergency medicine, cardiology, cardiothoracic surgery, and intensive care). Although there are five government-funded hospitals in Abu Dhabi, only four are operated by the Abu Dhabi Health Services Company (SEHA); the fifth is operated by the UAE Armed Forces. Although we considered including all five hospitals in the study to ensure the broadest range of physician experience, this fifth hospital does not receive patients by way of local EMS and was therefore excluded from study.

Figure 1. Study centre locations in the Emirate of Abu Dhabi



Sampling and Power Analysis

As mentioned in the published report, we used a non-random convenience sample of physicians. We asked the heads of each emergency, cardiology, cardiothoracic surgery, and intensive care department in each hospital to provide lists of the names and e-mail addresses of physicians involved in STEMI care. To minimize bias, all physicians whose contact information we received ($n = 195$) were invited to participate in the study. To further minimize bias, all physicians who agreed to participate in the study and who provided valid responses were included in data analysis ($n = 106$).

Inclusion criteria were as follows. Participants must have been employed in their capacity as physicians at one of the four SEHA-operated hospitals at the time of the study, and they must have worked in one of four specialties involved in STEMI treatment (emergency medicine, cardiology, cardiothoracic surgery, and intensive care). Physicians' e-mail addresses were obtained from the heads of each department, who provided lists of staff physicians.

The hypotheses tested related to the correlations between medical specialties (emergency medicine, cardiology, and other) and responses to survey questions. Each survey question had five possible responses, for a total of eight degrees of freedom in the analysis. Therefore, χ^2 contingency tables were used to test the data. A power analysis with eight degrees of freedom, a medium effect size ($w = .30$), and an alpha level of .05 revealed a minimum required sample size of 167 to achieve a power of 0.85. We used an effect size of .30 because we wanted to detect effect sizes large enough to make a difference in physician group opinions regarding EMS. Using the actual sample size of 106, power analysis revealed a statistical power of .80. This was considered sufficiently powerful to proceed with analysis.

Data Analysis

Data were analysed using a χ^2 contingency table. This method enables testing of quantitative hypotheses involving relationships between variables. If the values of one variable (presented as columns of the contingency table) are distributed across the values of another variable (presented as rows of the table) in a manner that is statistically significant (i.e., the differences in the variables could not be explained by chance), then we can conclude that the variables are related.⁽⁹¹⁾ For example, in a test to determine whether satisfaction with EMS service varies with medical specialty, the columns refer to satisfaction levels, the rows refer to specialties, and the number in each cell represent the frequencies of responses for each combination of satisfaction and specialty (see Table 2 in the published report, below).

Determining the statistical significance of the relationship involves calculating the χ^2 statistic. This statistic represents an overall view of the extent to which the values in the contingency table are different from the values one would expect if the distribution were uniform (i.e., if there were no statistically significant effects). Finally, the p value is computed, demonstrating the probability of the observed χ^2 value or a more extreme value under the null hypothesis. This procedure allowed us to investigate whether physicians' survey responses differed by medical specialty.

Results

Links to an online survey were sent via e-mail to 195 physicians, using each of the facilities' secure intranet systems. Of these, 106 physicians completed the survey, for a response rate of 54.3%. Physicians in four government facilities were surveyed over an 18-month period about the likelihood of their advising a patient with suspected ACS to use EMS to go to the hospital, satisfaction with the current EMS level of care given to ACS patients, likelihood of

using EMS for themselves or their families if ACS occurs, and steps they felt could be taken to further improve EMS and prehospital ACS care. Most of the physicians were male (82%), practicing in emergency medicine (47%) or cardiology (44%), and the majority (63%) had been in practice for >10 years. The results revealed variations in levels of satisfaction among the physicians, with 36.8% feeling neutral about the current EMS care given to ACS patients, 34.9% somewhat satisfied with the current care, and 15.1% somewhat dissatisfied. Only 6.6% were very satisfied and a similar minority were not satisfied with the current EMS care given to ACS patients. If contacted by a patient with a cardiac emergency, nearly nine out of ten physicians were either somewhat likely (21.7%) or very likely (67.0%) to advise the patient to use an ambulance for transport to a hospital.

Of the same respondents, about six out of ten were somewhat likely (22.6%) or very likely (38.7%) to do the same for themselves or a family member. Most respondents supported (strongly agree) the following steps to improve EMS care: 12-lead ECG and telemetry to ED by EMS (69%), EMS triage of STEMI to PCI facilities (65%), and activation of PCI teams by EMS (58%). Only 19% were supportive of prehospital fibrinolytics by EMS. No significant differences in the responses among the specialties were noted.

Discussion

The response rate of the physicians surveyed was only slightly more than half (54.3%) and may have affected the results of the descriptive statistics.

This percentage reflected results of studies of physician response rates demonstrating that physicians typically have low survey response rates. In one study, the survey response rate to an online survey administered to physician specialists in a large metropolitan Canadian city was only 35%, despite the use of a personalized email invitation and multiple follow up reminders.

Physicians who did not respond indicated either a lack of time or the burdensome nature of the survey. Another reason cited was the sensitive nature of the topic investigated (physician billing practices). (88)

A fax-back survey of family doctors and gynaecologists in British Columbia about side effects of hormonal contraceptives yielded only a 14% response rate; of 542 physicians who received surveys that were faxed three times, 76 responded. Follow up to non-responses revealed that 197, or 36.3%, of physicians had an office policy not to participate in any surveys. The trend toward office policies of non-participation showed that mail or fax surveys may no longer be effective for collecting data from physicians. (89) This trend may also indicate that physicians are inundated by survey requests and will only participate if the survey topic is relevant and beneficial to their practices (88,90)

Surveys of physicians and other healthcare professionals differ from surveys involving the general population. Physicians have demanding work schedules and their time is at a premium. Thus, participating in a survey means using precious time that they may believe could be better spent in other activities. Physicians represent a desirable study population and are frequently asked to participate in surveys. Further, they usually have receptionists or other staff that make it difficult to contact the physician directly. Therefore, methods to improve response rates among physicians and other healthcare professionals may not be as effective as those used to survey the general population. (90)

The majority of responses were received within the first month, reducing the possibility that results reflect changes to the system that occurred during the 18-month period of the study. However, the survey remained open for the entire 18-month duration of data collection for this thesis, so there is a possibility that the responses do not all reflect identical EMS systems, since

hospitals may have made changes during that time period.

The Gulf RACE study revealed that EMS was not a common mode of transport utilized by STEMI patients (chosen by only 17% of patients). (61) The present study suggests that physicians would be more likely than the general population to choose EMS, supporting increased efforts to promote EMS use by STEMI patients in the region. While the patient generally decides whether to use EMS or private transport, the physician also influences this choice with patient education and guidance at discharge. Given the paucity of data available about physician attitudes towards EMS care of patients with STEMI in general and in the Emirate of Abu Dhabi in particular, a recent study shed light on perceptions towards EMS among physicians caring for patients with STEMI in Abu Dhabi.

In the absence of any dedicated STEMI alert or networks in the city of Abu Dhabi, this paper was utilized in support of any recommendations regarding STEMI systems of care, both prehospitally and in the health care facilities themselves. It addressed perceived shortcomings of the current EMS as understood by physicians receiving cardiac patients. Exploring physicians' perceptions of best practices will provide insight into their knowledge of the guidelines for managing risk factors for STEMI and for treating these patients.

Further, a thorough review of data gathered about physicians' perceptions can result in the development of best practices that not only assist physicians to select the best management strategy for an individual patient but also improve quality of clinical decisions. For example, the physicians in this study clearly supported the increased implementation of 12-lead ECG during EMS transport. Nevertheless, the impossibility of conducting qualitative analysis in this case (see Chapter 1) to some degree limits the depth of the insight into physicians' perceptions. In the future, therefore, researchers could expand upon these findings by exploring the reasons for

physicians' perceptions and going into more depth to understand why many physicians in Abu Dhabi are hesitant to use EMS for themselves and their families.

A copy of the published paper follows over the next 8 pages.

Physician perceptions and recommendations about pre-hospital emergency medical services for patients with ST-elevation acute myocardial infarction in Abu Dhabi



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Introduction: Physician perceptions about emergency medical services (EMS) are important determinants of improving pre-hospital care for cardiac emergencies. No data exist on physician attitudes towards EMS care of patients with ST-Elevation Myocardial Infarction (STEMI) in the Emirate of Abu Dhabi.

Objectives: To describe the perceptions towards EMS among physicians caring for patients with STEMI in Abu Dhabi.

Methods: We surveyed a convenience sample of physicians involved in the care of patients with STEMI (emergency medicine, cardiology, cardiothoracic surgery and intensive care) in four government facilities with 24/7 Primary PCI in the Emirate of Abu Dhabi. Surveys were distributed using dedicated email links, and used 5-point Likert scales to assess perceptions and attitudes to EMS.

Results: Of 106 physician respondents, most were male (82%), practicing in emergency medicine (47%) or cardiology (44%) and the majority (63%) had been in practice for >10 years. Less than half of the responders (42%) were "Somewhat Satisfied" (35%) or "Very Satisfied" (7%) with current EMS level of care for STEMI patients. Most respondents were "Very Likely" (67%) to advise a patient with a cardiac emergency to use EMS, but only 39% felt the same for themselves or their family. Most responders were supportive (i.e. "Strongly Agree") of the following steps to improve EMS care: 12-lead ECG and telemetry to ED by EMS (69%), EMS triage of STEMI to PCI facilities (65%), and activation of PCI teams by EMS (58%). Only 19% were supportive of pre-hospital fibrinolytics by EMS. There were no significant differences in the responses among the specialties.

Conclusions: Most physicians involved in STEMI care in Abu Dhabi are very likely to advise patients to use EMS for a cardiac emergency, but less likely to do so for themselves or their families. Different specialties had concordant opinions regarding steps to improve pre-hospital EMS care for STEMI.

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Keywords: Emergency Medical Services, ST Elevation Myocardial Infarction, Survey

Disclosure: Authors have nothing to disclose with regard to commercial support.

Received 4 March 2015; revised 18 May 2015; accepted 20 May 2015.

Available online 28 May 2015

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Peer review under responsibility of King Saud University.

URL: www.ksu.edu.sa

<http://dx.doi.org/10.1016/j.jsha.2015.05.005>



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Introduction

According to the World Health Organization, cardiovascular disease is the number one cause of death globally. In 2013, it was estimated that 17.5 million people died of cardiovascular disease, representing 31% of all global deaths [1]. In the United Arab Emirates (UAE), mortality statistics from 2008 to 2010 showed that cardiovascular disease was the leading cause of death among both UAE nationals and expatriates in the Emirate of Abu Dhabi [2]. The *Weqaya* program, a preventive public health initiative established by Health Authority Abu Dhabi in 2008, sets targets to address cardiovascular disease in the emirate. By 2015, the aim is to reduce cardiovascular disease events by 10% and by 2030, an expected 40% reduction in events and 75% reduction in mortality [3].

In acute coronary syndromes (ACS), and in particular ST elevation myocardial infarction (STEMI), prompt reopening of occluded vessels is essential in order to restore myocardial perfusion [4]. Evidence has linked longer treatment delays with increased mortality [5,6]. Therefore, all possible measures should be undertaken to minimize the time from symptom onset to reperfusion of the ischemic area [7]. While improving door-to-balloon times is a critical component of STEMI care, it may not always translate into direct improvements in mortality, suggesting that the time before arrival at the hospital may be just as important [8]. Both the time from arrival to electrocardiogram (ECG) and the time from ECG to catheterization laboratory activation are shorter in patients transported by emergency medical services (EMS), with some data indicating an improved outcome in patients transported by EMS [9–12].

These findings highlight the importance of patients utilizing EMS, along with rapid and effective EMS treatment and transport, in minimizing total ischemic time [13,14].

A particular benefit of EMS transport of STEMI patients is the ability to acquire a 12-lead ECG before arrival at the hospital, where the ECG can be transmitted to the hospital, triggering the activation of the catheterization laboratory to be ready upon the patient's arrival and thereby significantly reducing the time from symptom onset to reperfusion [15]. A study showed that this process saved more time (up to 15.4 minutes) than any other intervention [16].

While private transport can be quicker, door-to-balloon time is considerably shorter for patients

Abbreviations

ACS	acute coronary syndromes
EMS	emergency medical services
Gulf RACE	Gulf Registry of Acute Coronary Events
UAE	United Arab Emirates
ED	emergency department
PCI	percutaneous coronary intervention

using EMS. This is particularly true in the West where many systems have excellent prehospital advanced life support [17]. However, these advantages gained by EMS transport are limited in many other countries. While EMS protocols in Abu Dhabi currently allow for the performance of a 12-lead ECG, there is no system to transmit data to receiving facilities. Systematic catheterization laboratory activation by both EMS and pre-hospital care physicians has been demonstrated to be both feasible and accurate [18].

The Gulf Registry of Acute Coronary Events (Gulf RACE), representing the Arab Gulf States, revealed that EMS was not a common mode of transport utilized by STEMI patients (chosen by only 17% of patients), similar to findings in other international studies [19–21]. While the patient clearly has a stake in making the decision to use EMS or private transport, the physician also plays an intimate role, with involvement in patient education and guidance at discharge. Understanding physicians' perceptions of transportation practices can ultimately help improve access for STEMI patients.

The objective of the present study is to describe perceptions towards EMS among physicians caring for patients with STEMI in Abu Dhabi.

Methods

Study setting

The Emirate of Abu Dhabi covers an area of 83,600 km² and has a population of 2.33 million (of which 475,000 are UAE nationals). There are five government-funded facilities that operate cardiac catheterization services, four of which are under the Abu Dhabi Health Services Company (SEHA) and one operated by the Directorate of Medical Services of the UAE Armed Forces. EMS are operated by the Abu Dhabi Police Emergency and Public Safety Department, in conjunction with National Ambulance Company LLC, which provides emergency medical technicians and paramedics. EMS are able to perform 12-lead ECG, but at the time of writing, there is no pre-hospital telemetry to catheterization

laboratory facilities. Approval to conduct the survey was obtained from the research ethics committees of all five facilities.

Design

Between June 2012 and December 2013, we administered a survey to a convenience sample “voluntary, non-random sampling” of 195 physicians typically involved in the care of patients who present to hospital emergency departments (ED) with suspected ACS. We included physicians from emergency medicine, cardiology, cardiothoracic surgery, and intensive care medicine. Prior to distribution, face validity was obtained by sending the survey to a pilot group of ten physicians involved in STEMI care. Distribution was performed using dedicated email links through SurveyMonkey (Palo Alto, CA, USA).

The survey utilized two five-point Likert scales, as well as general demographic questions. Frequencies and proportions were also computed for the following outcome variables:

1. The likelihood of advising an ACS patient to use EMS to go to hospital;
2. Satisfaction with the current EMS level of care given to ACS patients;
3. Likelihood of using the EMS for themselves or their family if a cardiac emergency occurs; and
4. Opinions regarding the steps that they felt could be taken to further improve EMS and prehospital ACS care.

Ethical considerations

The study was approved by the Research Ethics Committees/Institutional Review Boards of Sheikh Khalifa Medical City, Mafraq, Al Ain, and Tawam hospitals as well as the University of Cape Town Human Research Ethics Committee. All physicians were informed that submission of a completed survey implies consent to participate in the study.

Data analysis

Both descriptive and inferential statistical analyses were performed using SPSS Version 22.0 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were computed for the demographic and background characteristics of the participants including frequencies and percentages for sex, nationality, age group, native language, specialty, years in the current practice, and length of practice in the UAE.

Standard descriptive statistics were used to summarize the data. Mean ± standard deviation and proportions were used to summarize continuous and categorical variables, respectively. The

chi-square test was used to detect correlations between specialty (emergency medicine, cardiology, and other) and responses to survey questions about the likelihood of advising an ACS patient to use EMS to go to the hospital, satisfaction with the current EMS level of care given to ACS patients, likelihood of using EMS for themselves or their family if ACS occurs, and opinions regarding the steps they felt could be taken to further improve EMS and prehospital ACS care.

Results

Data were collected for a total of 106 physicians who responded, and descriptive statistics are presented in Table 1. Respondents were ethnically diverse, and predominantly male (n = 87, 82.1%). Most were practicing in emergency medicine (47%) or cardiology (44%), and the majority (63%) had been in practice for >10 years (Table 1).

Table 2 indicates respondents’ perceptions of EMS services and the likelihood of recommending

Table 1. Descriptive Statistics for Participant Demographic and Background Characteristics (n = 106).

Variable	n	%
Nationality		
India	17	16.0
Non-UAE Arab national	31	29.2
Other	31	29.2
Pakistan	13	12.3
UAE	13	12.3
United States	1	.9
Age group		
27 or younger	2	1.9
28 to 37	27	25.5
38 to 47	37	34.9
48 to 57	35	33.0
58 or older	5	4.7
Home language		
Arabic	50	47.2
English	30	28.3
Other	26	24.5
Specialty		
Cardiology	47	44.3
Emergency Medicine	50	47.2
Other	9	8.5
Number of years in this practice		
<2	4	3.8
2 to 5	15	14.2
5 to 10	20	18.9
>10	67	63.2
Length of practice in UAE		
Less than 2 years	17	16.0
2 to 5 years	39	36.8
5 to 10 years	27	25.5
More than 10 years	23	21.7

Table 2. Percentage of Cardiology Participants (n = 47), Emergency Medicine Participants (n = 50), and Other Participants (n = 9) Providing Each Response to Perceptions of Ambulance Services Items (N = 106).

		Very Unsatisfied	Somewhat Unsatisfied	Neutral	Somewhat Satisfied	Very Satisfied	p
How satisfied are you with the current ambulance services level of care given to Acute Coronary Syndrome (ACS) patients?	Cardiology	2.1	23.4	31.9	29.8	12.8	0.06
	Emergency medicine	12.0	8.0	42.0	36.0	2.0	
	Other	0.0	11.1	33.3	55.6	0.0	
	Total	6.6	15.1	36.8	34.9	6.6	
Item	Group	Very Unlikely	Somewhat Unlikely	Neutral	Somewhat Likely	Very Likely	p
If a patient with a cardiac emergency contacts you directly, how likely are you to advise that them to use the ambulance services to go to hospital?	Cardiology	2.1	6.4	8.5	27.7	55.3	0.43
	Emergency medicine	2.0	0.0	6.0	16.0	76.0	
	Other	0.0	0.0	0.0	22.2	77.8	
	Total	1.9	2.8	6.6	21.7	67.0	
How likely are you to use the ambulance services for you or your family, if a cardiac emergency occurs?	Cardiology	10.6	6.4	17.0	25.5	40.4	0.25
	Emergency medicine	10.0	10.0	28.0	14.0	38.0	
	Other	0.0	0.0	11.1	55.6	33.3	
	Total	9.4	7.5	21.7	22.6	38.7	

Notes: Table entries are percentages. p values are from chi-square tests of independence. Medians are presented in bold.

them to patients and family members. Physician satisfaction with EMS varied with approximately one third feeling neutral (36.8%), another third (34.9%) somewhat satisfied, and 15.1% somewhat dissatisfied. Only 6.6% were very satisfied and a similar minority were not satisfied. If contacted by a patient with a cardiac emergency, nearly nine out of ten physicians were either somewhat likely (21.7%) or very likely (67.0%) to advise the patient to use an ambulance for transport to a hospital. Of the same respondents, about six out of ten were somewhat likely (22.6%) or very likely (38.7%) to do the same for themselves or a family member.

Table 2 also includes the survey findings stratified by physician specialty. There were no significant differences between the specialist groups for any of the three survey questions or their opinions regarding steps to improve EMS care. Despite the above findings, several are worth noting. Emergency medicine doctors (76.0%) were more likely than cardiologists (55.3%) to advise patients with cardiac emergencies to use ambulance services to go the hospital. Emergency medicine doctors were also less satisfied with the level of care given to ACS patients through the ambulance service (with only 2.0% very satisfied) when compared to cardiologists (among whom 12.8% were very satisfied).

Table 3 shows the responses to the eight survey items related to specific steps that could be taken to improve ambulance services and prehospital ACS care. Physicians were the most supportive, with nearly nine out of ten responding with

“Agree” or “Strongly Agree”, of prehospital 12-lead ECG by EMS with telemetry to ED and of EMS triage of confirmed STEMI patients directly to PCI facilities. There was also strong support for better training of ambulance staff to care for STEMI patients, activation of catheterization laboratory teams by EMS services, and STEMI patients bypassing the ED to the catheterization laboratory directly. Prehospital fibrinolysis by EMS had the least support with one third of physicians having a “Neutral” response and about one in four (26.4%) disagreeing or strongly disagreeing with that intervention.

Discussion

EMS infrastructure is a critical component of improving EMS use, and physicians involved in STEMI care are natural advocates for improving EMS use and developing its infrastructure. Therefore, determining if a dissociation exists between physician attitudes and guideline recommendations is relevant.

Understanding how these “natural advocates” of EMS feel about the current status (perceptions) and how these can be improved (recommendations) is an important step towards improving EMS care in the region.

The current study was the first systematic description of physicians’ perceptions and recommendations regarding EMS care of patients with STEMI in the Emirate of Abu Dhabi. Physician satisfaction with the current status of EMS

Table 3. Percentage of Cardiology Participants (n = 47), Emergency Medicine Participants (n = 50), and Other Participants (n = 9) Providing Each Response to Items Related to Potential Improvements in Ambulance Services (N = 106).

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	p
More availability of ambulances	Cardiology	2.1	4.3	8.5	36.2	48.9	0.19
	Emergency medicine	4.0	0.0	26.0	32.0	38.0	
	Other	11.1	0.0	33.3	11.1	44.4	
	Total	3.8	1.9	18.9	32.1	43.4	
Better training of ambulance staff	Cardiology	2.1	0.0	10.6	27.7	59.6	0.12
	Emergency medicine	4.0	0.0	8.0	26.0	62.0	
	Other	11.1	0.0	11.1	22.2	55.6	
	Total	3.8	0.0	9.4	26.4	60.4	
EMS Use of 12 lead ECG and telemetry to ED	Cardiology	2.1	0.0	4.3	27.7	66.0	0.19
	Emergency medicine	4.0	0.0	10.0	12.0	74.0	
	Other	11.1	0.0	22.2	11.1	55.6	
	Total	3.8	0.0	8.5	18.9	68.9	
EMS use of fibrinolytic therapy	Cardiology	6.4	8.5	34.0	25.5	25.5	0.11
	Emergency medicine	20.0	16.0	40.0	8.0	16.0	
	Other	11.1	22.2	44.4	22.2	0.0	
	Total	13.2	13.2	37.7	17.0	18.9	
EMS triage of confirmed STEMI patients direct to PCI facilities	Cardiology	4.3	0.0	2.1	23.4	70.2	0.67
	Emergency medicine	4.0	2.0	12.0	20.0	62.0	
	Other	11.1	0.0	11.1	22.2	55.6	
	Total	4.7	.9	7.5	21.7	65.1	
Activation of cath lab by prehospital services	Cardiology	6.4	2.1	17.0	17.0	57.4	0.99
	Emergency medicine	6.0	4.0	14.0	20.0	56.0	
	Other	11.1	0.0	11.1	11.1	66.7	
	Total	6.6	2.8	15.1	17.9	57.5	
STEMI patients bypassing the ED to cath lab directly	Cardiology	2.1	8.5	8.5	25.5	55.3	0.24
	Emergency medicine	12.0	8.0	10.0	26.0	44.0	
	Other	11.1	0.0	33.3	33.3	22.2	
	Total	7.5	7.5	11.3	26.4	47.2	
Punctuality (speed with which ambulances arrive)	Cardiology	2.1	0.0	19.1	23.4	55.3	0.08
	Emergency medicine	8.0	0.0	18.0	22.0	52.0	
	Other	0.0	11.1	22.2	33.3	33.3	
	Total	4.7	.9	18.9	23.6	51.9	

Notes: Table entries are percentages. p values are from chi-square tests of independence. Medians are presented in bold.

STEMI care was variable and only a small minority was very satisfied. Nonetheless, most physicians would still advise patients with cardiac emergencies to use EMS, though they would less often do so for themselves or their families. There was strong support among the respondents for pre-hospital 12-lead ECG with telemetry to ED and triaging of STEMI patients to primary percutaneous coronary intervention (PCI) facilities, and bypassing of ED directly to catheterization laboratory and pre-hospital activation of primary PCI teams. Conversely, pre-hospital thrombolysis was not favored. Although there were some consistencies between cardiology and emergency medicine physicians, some differences were noted, including the finding that a higher percentage of emergency medicine physicians were very likely to advise a patient with a cardiac emergency to use the ambulance services to go to the hospital when compared to cardiologists. Thus, it appears that emergency medicine physicians are more confident in EMS than cardiologists. Emergency medicine physicians also appeared to be less satisfied with care for ACS patients than cardiologists.

The present report complements the existing literature of STEMI care in the Gulf region. The overwhelming majority of existing studies in the region focus on in-hospital care of patients with STEMI. Aside from the observation that EMS are underutilized by patients with ACS across the Gulf, we know very little about pre-hospital care of STEMI patients in the region.

While the present report does not describe pre-hospital care per se, it provides an equally important description of how physicians caring for STEMI patients perceive pre-hospital care and how they think it can be improved. Understanding these perceptions and recommendations is important for designing and implementing initiatives that would ultimately improve pre-hospital care of patients with cardiac emergencies.

The observation that physicians would still recommend EMS for their patients despite their modest level of satisfaction reflects a firm belief among them of the important role EMS can play in the pre-hospital care of patients with STEMI. This conviction should facilitate the active engagement of physicians from different specialties in system-wide initiatives to improve pre-hospital care of cardiac emergencies and raise public awareness of EMS role.

Several processes of pre-hospital care were favored by the physicians responding to the

present survey. The strongest support was for obtaining a 12-lead ECG by EMS personnel with direct telemetry to ED physicians. Pre-hospital 12-lead ECG has been shown to shorten both scene and transport times for patients with STEMI, potentially leading to a reduction in total ischemic time [22], and has also been associated with shorter door-to-balloon times [23]. Respondents were also in favor of pre-hospital triage of patients with STEMI to primary PCI facilities, a strategy that has been associated with improved survival in a large regional primary PCI program [24]. On the other hand, there was little support for pre-hospital thrombolysis by EMS, likely reflecting the uncertainty in the literature around this strategy, and possible concerns about the availability of the required expertise and infrastructure to implement such a strategy [25].

The positions of the responding physicians towards the various pre-hospital processes of STEMI care are useful in setting priorities for pre-hospital initiatives where the most favored evidence-based interventions would be most acceptable and more likely to secure physician engagement.

While nearly nine out of ten physicians will advise patients with a cardiac emergency to use EMS, only six out of ten would do the same for themselves or their families. In other words, one third of physicians gave conflicting advice to their patients versus themselves or a family member.

We have no explanation of this finding and can only speculate on what it may reflect. It is possible that the response to the "patient advice" question is driven by a physician's desire to follow practice guidelines, while the behavior with self or family is influenced by their lack of high satisfaction with the current state of EMS care. The discrepancy in the responses may also reflect some uncertainty towards evidence derived from developed health-care systems where EMS are more advanced and applied in less developed settings where further improvements are needed. Further studies are needed to understand the attitudes of physicians towards EMS.

The implementation of prehospital 12-lead ECG along with its routine use and early notification of the receiving facilities have long been recommended by the American Heart Association (AHA) [26]. While physician recommendations offered in this paper conform to those of the practice guidelines given for EMS by the AHA in their 2013 update [27], very few of these guidelines are applied as standard in this region.

Limitations

Our findings are limited by the use of a convenience sample from which the findings may not be generalizable to all practicing physicians. However, our respondents practice in major hospitals in the Emirate of Abu Dhabi, providing care to the majority of STEMI patients in the emirate. Lack of statistical differences in the responses among the different specialties may be a function of the sample size, and a larger survey may detect differences among specialists. The perceptions and responses reported here may not reflect the opinions of physicians practicing in other parts of the Gulf region. Future studies should utilize larger and random samples.

Conclusions

Professional practice guidelines recommend that patients make use of EMS during ACS, and most physicians involved in STEMI care in Abu Dhabi in this sample are very likely to advise patients to do so, but fewer are as likely to use EMS for themselves or their families. Most physicians were supportive of pre-hospital 12-lead ECG and triaging of patients to primary PCI centers. Different specialties had concordant opinions regarding steps to improve pre-hospital EMS care for STEMI. Feedback from physicians involved in the care of ACS patients can be used to further improve care provided by EMS as well as increase the use of EMS for themselves and their patients.

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Chapter 4: Mode of Transport Decisions by Patients with STEMI

Reference

Callachan EL, Alsheikh-Ali AA, Nair SC, Bruijns S, Wallis LA. Utilizations and perceptions of emergency medical services by patients with ST-Segments elevation acute myocardial infarction in Abu Dhabi: a multicenter study. *Heart Views*. 2016; 17:49-54

Declaration of Author

In the case of chapter 4, the nature and extent of my work was as follows:

I was the primary author of this paper and responsible for the literature review, survey design, piloting of the survey, ethics approvals, consenting of participants and data collection. I also performed the data analysis and write up of manuscript drafts, while under the supervision of all co-authors. As primary author, I accept full responsibility for this paper being published. Extent of the work done by candidate: 75%. In the case of the co-authors the extent of the work is as follows: AAA 10%, LAW 5%, CSN 5%, SRB 5%

Declaration of Coauthors

The undersigned hereby certify that:

1. The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
2. They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
3. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;
4. There are no other author of the publication according these criteria;
5. Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor

or publisher of journals or other publications, and (c) the head of the responsible academic unit;
and

6. The original data are stored at the following location and will be held for at least five years from date indicated below.

Location of stored data: Password protected portable hard drive at the candidate's place of employment, Bateen Air Force Base, Abu Dhabi, UAE

Signed:



Alawi Alsheikh-Ali

Date: 08 August 2016



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Date: 08 August 2016



Lee A Wallis

Date: 08 August 2016

Introduction

As with Chapter 3, the present chapter presents a published paper containing a report of the second study in this research sequence. Prior to the presentation of the published paper, we present some supplemental material on the background, methods, and results, as well as a supplemental discussion. The following text is, therefore, intended to support and expand upon the information in the published paper, rather than to duplicate it. For a full understanding of the study, readers are advised to review both the supplemental material here and the published paper itself, which is the core of the chapter.

Background of the Study

After examining physicians' perceptions of EMS for STEMI patients and eliciting their recommendations for improving EMS care, we turned to an examination of patients' perceptions of EMS. Whereas the physician study focused on the medical aspects of effective pre-hospital STEMI treatment (e.g., the use of pre-hospital 12-lead ECG), this study focused on the social aspects of effective EMS care. In order for EMS treatment to be effective, patients must be aware of and prepared to use EMS in case they experience symptoms of cardiac arrest. In Abu Dhabi, where rapid development has led to an increased need for EMS, the population may not be aware of the benefits of using EMS in medical emergencies, especially since the broad availability of EMS is a relatively new phenomenon. Therefore, we sought to determine the extent to which STEMI patients were aware of EMS and knew how to utilize the service. Additionally, we asked patients who did not use EMS (fully 85% of the participants) to state their reasons for choosing other modes of transport. This allowed us to begin to identify the most salient gaps in public awareness and perceptions, with the goal of understanding how best to improve overall EMS utilization among STEMI patients in Abu Dhabi. Additionally, placing this study next in the

sequence gave us the opportunity to compare objective outcome data (presented in the next chapter) with both physicians' and patients' perceptions of EMS, in order to uncover the most promising avenues of investment for EMS improvement. As in the previous chapter, we present some supplemental information on the methods and some results that were not included in the published report.

Methods

As with the physician study presented in the previous chapter, this study was conducted at four of the five government-funded facilities that operate cardiac catheterization services in Abu Dhabi. However, instead of physicians, the population consisted of STEMI patients in the Emirate of Abu Dhabi, UAE. See the published paper below for a full description of the methods and procedure for this study. The interviews are described as “semi-structured” in the published report because participants were not given a series of possible options to respond with; the form of the answers was left to their discretion. However, no questions other than the three listed in the paper were asked, and all participants were asked the same three questions. Therefore, one might consider these to have been structured interviews. The interviews were, in any case, not well suited to qualitative analysis because the participants did not give in-depth responses but rather answered briefly, making the data easy to aggregate and analyse quantitatively.

Sampling and Power Analysis

We used a purposive sampling strategy to select participants on the basis of one criterion: they must have been discharged from one of the four hospitals involved in the study during the 18-month duration of the study, with a discharge diagnosis of STEMI. Patients' contact information was obtained when they consented to treatment at each of the hospitals. If patients did not consent to be contacted for follow up, we followed the patients' electronic medical charts

to gather follow up data. All 587 STEMI patients who consented to the use of their medical records in this study were considered for inclusion, regardless of whether they also consented to follow up. By purposively selecting participants, we were able to focus on STEMI outcomes. A random sampling strategy would not have been appropriate to sample the target population, since we needed to guarantee that most or all of the sample consisted of STEMI patients.

Interview responses were brief, facilitating quantitative analysis. No special coding process was necessary to elicit categories, since participants' responses naturally fell into a small number of categories regarding their reasons for not using EMS. Simple aggregation was therefore used to quantify interview responses to the question about mode of transport choice. The objective of this study was to assess knowledge and perceptions of EMS, regardless of demographic or clinical variables. Therefore, all 587 STEMI patients were included in the study. I conducted power analysis for χ^2 and Kruskal-Wallis analysis of variance (ANOVA) tests. For the χ^2 test, with a medium effect size ($w = .30$), an alpha value of .05, and 25 degrees of freedom, the minimum sample size is 254 to achieve a power of .80. Therefore, the actual sample size of 587 was more than sufficient. For the ANOVA test, given a medium effect size ($f=.25$) an alpha value of .05, and 5 groups (corresponding to the reasons for using private transport instead of EMS), the minimum sample size is 200 to achieve a power of .80.

Again, the actual sample size is adequate.

Data Analysis

The goal of this study was to determine whether reasons for using EMS differed among patients based on demographic variables. Therefore, in addition to descriptive statistics, I conducted χ^2 difference tests to investigate whether differences in reasons for using private transport (as opposed to EMS) were statistically different for various demographic variables

(gender, nationality, language, and whether English was the native language). See Chapter 3 (55,56) for a detailed description of χ^2 difference tests and their statistical interpretation. The χ^2 test is appropriate in cases where both the dependent and independent variables are categorical (i.e., not sequentially ordered or mathematically distinguishable). In this study, the introduction of the non-categorical (i.e., continuous) variable age necessitated the use of ANOVA to test for differences in reasons for using EMS by age. The one-way ANOVA examines whether the categories of a categorical independent variable with more than two categories (in this case, reasons for using EMS) have different means with respect to a continuous dependent variable (in this case, age). If there is a relationship between the two variables, researchers can expect the means for each group to be statistically different. The null hypothesis for one-way ANOVA tests is that the means are identical across all groups. (92)

Traditionally, the one-way ANOVA test assumes that data are approximately normally distributed about the mean. For the patient perception data, the assumption for normality was not met. In such cases, the Kruskal–Wallis ranks test can be used as a non-parametric modification of the ANOVA procedure. The Kruskal–Wallis ANOVA, instead of using the original values for the skewed variable, replaces the data with their ranks. (93) This non-parametric test does not assume normality, so it was appropriate to test differences with respect to age in this study.

The drawback of the Kruskal–Wallis test is that, like other non-parametric tests, it is not as powerful as the parametric ANOVA. However, it allows researchers to test hypotheses in the absence of the normality requirement.

Results

As expected, the results revealed broad underutilization of EMS among Abu Dhabi residents. Only 15% of STEMI patients included in the study arrived at the hospital via EMS,

and over half (55%) did not know how to contact EMS in case of need. Knowledge of the EMS number was assessed by a yes/no question asking whether they knew the number; if yes, participants were asked to produce the correct number. Only participants who knew the correct number were tabulated as a “yes” answer to the above question. The survey was provided in participants’ native language to ensure understanding. In addition to the findings in this paper, during review of public education materials for patients once discharged, we found that incorrect information was being provided to patients at one facility regards using EMS in the future for any ACS symptoms. The contact number for EMS was shown to be 911 and not 999 (Figure 2).

Figure 2. Excerpt from patient information booklet given at discharge

Contact your PHP if:

- You have questions or concerns about your condition or care.

Seek care immediately or call 911 if:

- **You have any of the following signs of a heart attack:**
 - Squeezing, pressure, or pain in your chest that lasts longer than 5 minutes or returns
 - Discomfort or pain in your back, neck, jaw, stomach, or arm
 - Trouble breathing
 - Nausea or vomiting
 - Lightheadedness or a sudden cold sweat, especially with trouble breathing.

A copy of the published paper follows over the next 6 pages

Utilizations and Perceptions of Emergency Medical Services by Patients with ST-Segments Elevation Acute Myocardial Infarction in Abu Dhabi: A Multicenter Study

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ABSTRACT

Background: Data on the use of emergency medical services (EMS) by patients with cardiac conditions in the Gulf region are scarce, and prior studies have suggested underutilization. Patient perception and knowledge of EMS care is critical to proper utilization of such services.

Objectives: To estimate utilization, knowledge, and perceptions of EMS among patients with ST-elevation myocardial infarction (STEMI) in the Emirate of Abu Dhabi.

Methods: We conducted a multicenter prospective study of consecutive patients admitted with STEMI in four government-operated hospitals in Abu Dhabi. Semi-structured interviews were conducted with patients to assess the rationale for choosing their prehospital mode of transport and their knowledge of EMS services.

Results: Of 587 patients with STEMI (age 51 ± 11 years, male 95%), only 15% presented through EMS, and the remainder came via private transport. Over half of the participants (55%) stated that they did not know the telephone number for EMS. The most common reasons stated for not using EMS were that private transport was quicker (40%) or easier (11%). A small percentage of participants (7%) did not use EMS because they did not think their symptoms were cardiac-related or warranted an EMS call. Stated reasons for not using EMS did not significantly differ by age, gender, or primary language of the patients.

Conclusions: EMS care for STEMI is grossly underutilized in Abu Dhabi. Patient knowledge and perceptions may contribute to underutilization, and public education efforts are needed to raise their perception and knowledge of EMS.

Key words: Emergency medical services, perceptions, ST-elevation myocardial infarction

INTRODUCTION

Acute myocardial infarction (AMI) is a leading cause of morbidity and mortality worldwide with approximately one-half of deaths occurring in the prehospital setting.^[1,2] In the United Arab Emirates,

mortality statistics from 2008 to 2010 showed that cardiovascular disease was the leading cause of death among both the United Arab Emirates nationals and expatriates. In the Emirate of Abu Dhabi,^[3] early diagnosis and care by emergency medical services (EMS) can play a crucial role in improving the management and ultimate outcome of patients with AMI.^[4-8] Use of EMS may result in the faster initiation of

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10.4103/1995-705X.185113

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How to cite this article: Callachan EL, Alsheikh-Ali AA, Nair SC, Bruijns S, Wallis LA. Utilizations and perceptions of emergency medical services by patients with st-segments elevation acute myocardial infarction in Abu Dhabi: A multicenter study. Heart Views 2016;17:49-54. © Gulf Heart Association 2016.

reperfusion therapies, and facilitate quicker and more efficient treatment decisions.^[8,9] Of particular importance is the role of EMS in caring for patients with ST-segment elevation myocardial infarction (STEMI), the most serious and time-sensitive type of AMI.^[10] STEMI is potentially reversible provided that revascularization is initiated rapidly, as evidence has shown increased mortality associated longer culprit vessel occlusion times.^[11,12]

While several international studies have emphasized the need for early activation of EMS in patients with AMI, EMS use is generally low in patients with STEMI.^[3,6-9,13] These low EMS use rates were also found in the first Gulf Registry of Acute Coronary Events (Gulf RACE)^[3] and again in the second Gulf RACE-2,^[14] which reported EMS use rates of 17% and 25%, respectively, as well as in other studies of Middle Eastern countries.^[15] Several studies have examined the issue of EMS transport to the hospital versus self-transport and found that patient characteristics, American Community Survey (ACS) characteristics, and patient's knowledge of ACS symptoms, influence the use of EMS as well.^[16-18]

Patient perception and knowledge of EMS care is critical to proper utilization of such services. The purpose of this study was to estimate the utilization, knowledge, and perceptions of prehospital EMS among patients with STEMI in the Emirate of Abu Dhabi to determine if demographic and background variables or event characteristics were related to these factors.

METHODS

Study setting

Cardiac catheterization services are provided at five government operated hospitals, four of which are under the Abu Dhabi Health Services Company (SEHA) and one operated by the United Arab Emirates Armed Forces. EMS is operated by the Abu Dhabi Police Emergency and Public Safety Department, in conjunction with National Ambulance Company LLC, which provides emergency technicians and paramedics. The EMS is able to provide advanced cardiac life support and early STEMI recognition by means of 12 lead ECG acquisition and paramedic interpretation.

Design

This was an 18-month, multicenter, prospective study of consecutive patients admitted with STEMI to four government hospitals in the emirates of Abu Dhabi. The United Arab Emirates Armed Forces Hospital, Zayed Military Hospital, was excluded from our research due to EMS not transporting to this hospital. We performed telephonic or face-to-face semi-structured interviews, to assess their rationale for choosing their prehospital

mode of transport and their knowledge of EMS contact details.

Mode of transport was ascertained by the way of both EMS and hospital electronic medical record data and confirmed with the patient at interview. The following questions were asked of all patients regardless of mode of transport utilized:

- Do you know what the emergency number is to call an ambulance?
- When you decided to go to the hospital, how did you get there, by ambulance or did you use private transport?

Patients who made the use of private transport instead of EMS were asked the following additional question:

- What made you not call for an ambulance, but instead make use of private transport?

These questions were asked in the patient's native language with the assistance of staff in the hospital or with the assistance of follow-up investigators if the patient was discharged before interview.

Statistical analysis

Analyses consisted of both descriptive and inferential statistics. Descriptive statistics were computed for all the study variables including the demographic and background variables as well as the reasons for using private transportation. Inferential analyses were performed to determine if relationships existed between the demographic and background variables, on the one hand, and the reasons for taking private transportation on the other.

The dependent variable, reason for taking private transportation, was categorical. Most of the demographic and background variables were also categorical, and therefore, a series of Chi-square tests of independence were performed.

One demographic variable, age, was continuous, and therefore, a one-way ANOVA was performed to determine if the participants' reasons for using private transportation differed according to their age. Analyses were performed using SPSS Version 22.0 (IBM Corporation, Armonk, NY, USA) and a $P \leq 0.05$ was considered to be statistically significant.

Ethics

The study protocol was approved by the Research Ethics Committees of Sheikh Khalifa Medical City, Mafraq, Al Ain, and Tawam hospitals as well as the University of Cape Town Human Research Ethics Committee (HREC 286/2013). Written consent to follow-up was obtained from patients before discharge, and an explanation of the research was provided in the patient's native language. EMS and in-hospital

electronic medical records were also utilized for patients' data collection.

RESULTS

Baseline demographics

The study yielded 587 patients for inclusion. Most participants ($n = 557$, 94.9%) were male, and the average age was 51 (± 11) years. However, this finding is not surprising considering that the United Arab Emirates has a large expatriate workforce which is predominately male.^[19] The most common countries of origin were the India subcontinent ($n = 421$, 71.7%). Arabic was the most common language ($n = 183$, 31.2%), with substantial percentages of these participants being able to comprehend basic English ($n = 96$, 16.4%), Hindi ($n = 104$, 17.7%), and Urdu ($n = 100$, 17.0%).

English was the first language of only 23.7% ($n = 139$) of the participants [Table 1]. Most participants ($n = 501$, 85.3%) used private transportation to get to the hospital, and only a small percentage ($n = 86$, 14.7%) used EMS.

Transport demographics

The reasons for using private transportation are shown in Table 2. The most common responses were that it was quicker (232, 46.3%) and easier (67, 13.4%) to go through private means. A smaller percentage of participants stated that they had not called EMS because they did not think their symptoms were cardiac-related (40, 8.0%). Patients with missing data were excluded from analysis.

Over half (323, 55.0%) of the participants stated that they did not know the telephone number for EMS in Abu Dhabi.

There were no differences between males and females in terms of their reasons for using private transportation rather than EMS ($P = 0.26$). There was also no statistically significant differences in age between individuals citing different reasons for using private transportation ($P = 0.68$) participants from Pakistan were less likely to feel that it was quicker to go through private transportation (37.2%) compared to between 42.3% and 56.6% for individuals from other countries, and individuals from the United Arab Emirates and Syria were less likely to feel that it was easier to go through private transportation (3.8% and 5.6%, respectively, compared to between 12.2% and 16.8% for individuals from other countries).

Participants with knowledge of the EMS number and those without that knowledge were compared in terms of their reason for using private transportation, and the results indicated a significant difference between the groups ($P = 0.03$) [Table 3]. Participants who knew the number for EMS 15.4% (but nevertheless

took private transportation) were more likely to think that their event was not a cardiac event or did not warrant an EMS call than those who did not know the number 7.1% [Table 4].

There was a significant difference in reasons for using private transportation between the two cities ($P < 0.001$) [Table 4]. Residents of Abu Dhabi City were more likely to feel it was quicker to use private transportation (50.9%). However, the residents of Al Ain City were more likely to feel it was easier to use private transportation (27.8%). There was no significance difference in reasons for using private transportation and those who were transferred ($P = 0.75$).

DISCUSSION

Our findings showed persistent underuse of EMS, with rates comparable to those of previous regional studies. It has been shown that EMS use rates vary between countries but were predominantly low, including 2% in

Table 1: Descriptive statistics for reasons for mode of transport ($n = 587$)

Mode	Frequency	Percentage
Gender		
Male	557	94.9
Female	30	5.1
Nationality		
UAE	46	7.8
Indian subcontinent	421	71.7
Non-UAE Arab	120	20.4
Language		
Arabic	183	31.2
Hindi	104	17.7
Urdu	100	17.0
English	96	16.4
Bengali	73	12.4
Other	31	5.3
English as the first language		
Yes	139	23.7
No	448	76.3
Mode decided to use		
Private	501	85.3
EMS	86	14.7

EMS: Emergency medical services, UAE: United Arab Emirates

Table 2: Descriptive statistics for reasons for using private transportation ($n = 501$)

Reasons for using private transportation	n	Percentage
Quicker to go private	232	46.3
Easier to go private	67	13.4
Did not think was cardiac/did not warrant EMS call	40	8.0
Other reason	20	4.0
No reason given	142	28.3
Total	501	100.0

EMS: Emergency medical services

Table 3: Cross-tabulation of gender, nationality, language, and English as the first language versus reasons for using private transportation (n = 501)

Variable	Reasons for using private transportation (%)				
	Quicker to go private	Easier to go private	Did not think was cardiac/ did not warrant EMS call	Other reason	No reason given
Gender					
Female	12 (46.2)	3 (11.5)	0 (0.0)	0 (0.0)	11 (42.3)
Male	220 (46.3)	64 (13.5)	40 (8.4)	20 (4.2)	131 (27.6)
Nationality					
UAE	30 (56.6)	2 (3.8)	4 (7.5)	0 (0.0)	17 (32.1)
Indian	69 (52.7)	16 (12.2)	11 (8.4)	7 (5.3)	28 (21.4)
Pakistan	42 (37.2)	19 (16.8)	9 (8.0)	2 (1.8)	41 (36.2)
Bangladesh	33 (42.3)	12 (15.4)	3 (3.8)	8 (10.3)	22 (28.2)
Syria	10 (55.5)	1 (5.6)	2 (11.1)	1 (5.6)	4 (22.2)
Other	48 (44.4)	17 (15.7)	11 (10.2)	2 (1.9)	30 (27.8)
Language					
Arabic	79 (53.7)	17 (11.6)	12 (8.2)	4 (2.7)	35 (23.8)
Hindi	44 (48.9)	12 (13.3)	6 (6.7)	6 (6.7)	22 (24.4)
Urdu	36 (40.9)	14 (15.1)	7 (7.5)	1 (1.1)	33 (35.5)
English	36 (44.4)	12 (14.8)	12 (14.8)	1 (1.3)	20 (24.7)
Bengali	26 (41.3)	8 (12.7)	3 (4.8)	6 (9.5)	20 (31.7)
Other	9 (33.3)	4 (14.8)	0 (0.0)	2 (7.4)	12 (44.4)
English as the first language					
No	179 (46.5)	51 (13.2)	2 (7.0)	16 (4.2)	112 (29.1)
Yes	53 (45.7)	16 (13.8)	13 (11.2)	4 (3.4)	30 (25.9)

For gender $P=0.26$; for Nationality, $P=0.04$; for language, $P=0.07$; for English as the first language, $P=0.66$. EMS: Emergency medical services, UAE: United Arab Emirates

Table 4: Cross-tabulation of city of event, transfers, and knowledge of the emergency medical services number versus reasons for using private transportation*

Variable	Reasons for using private transportation (%)				
	Quicker to go private	Easier to go private	Did not think was cardiac/ did not warrant EMS call	Other reason	No reason given
City of event (n=501)					
Al Ain city	65 (37.6)	48 (27.8)	7 (4.0)	14 (8.1)	39 (22.5)
Abu Dhabi city	167 (50.9)	19 (5.8)	33 (10.1)	6 (1.8)	103 (31.4)
Transfer status, n=486					
Not transferred	155 (46.1)	48 (14.3)	28 (8.3)	15 (4.5)	90 (26.8)
Transferred	68 (45.3)	19 (12.7)	10 (6.7)	5 (3.3)	48 (32.0)
Knowledge of EMS number, n=417					
Did not know the number for EMS	164 (55.8)	47 (16.0)	21 (7.1)	18 (6.1)	44 (15.0)
Knew the number for EMS	68 (55.3)	20 (16.3)	19 (15.4)	2 (1.6)	14 (11.4)

*Information on city and knowledge of EMS number was not available for all the patients. For city of event, $P<0.001$; for transfers, $P=0.75$; for knowledge of the EMS number, $P=0.03$. EMS: Emergency medical services

Yemen, 7% in Kuwait, 17% in the United Arab Emirates, 23% in Bahrain, and 30% in Qatar.^[14] Interestingly, a study conducted in Turkey found that despite a high knowledge of the emergency services number, only 29% of STEMI patients used EMS.^[15]

In other countries such as the United States and China, EMS utilization rates varied between 20% and 50%.^[20-23] However, higher rates of EMS have been reported in other studies. For example of 619 patients with an STEMI presenting to a Singapore hospital, 58.6% arrived by EMS.^[17] Mathews *et al.* reported that in data from the National Cardiovascular Registry (ACTION Registry-GWTG), detailing almost 40,000 STEMI patients, EMS transport was used by 60%.^[16]

Our study also indicated that public awareness of how to access EMS was a barrier to utilization. A high percentage of patients were not aware of the emergency contact number for the EMS in Abu Dhabi. This included patients for whom EMS was called on their behalf. Our research found that majority of the patients who used private transport did so as they thought that it would be a quicker means to access emergency health care.

In our study, we found that many participants were from foreign countries and with Arabic or English not as their first language, raising the question could complicate any public education campaigns to benefit future cardiac patients? Our findings emphasize the need for greater public education and awareness, with

regards to not only the benefits of using EMS during chest pain events but also the signs and symptoms of cardiac emergencies.

The public should be educated to the fact that EMS is not only a transport modality, but that early treatment can be initiated en route, and cardiac interventions services can be activated before patient arrival. Education should also be directed at lower-income patients such as those involved with manual labor and encompass languages including Urdu, Hindi, Malayalam, and Bengali, as these patients comprised a large percentage of our study population. Strategies should focus on enhancing awareness of this particular population demographic, in their native languages dialects, with greater emphasis perhaps placed on newspapers and television as well as education in the workplace and the accommodations facilities under the auspices of government health-care programs. The internet and electronic social media platforms may not be the best way to educate these potential patients.

Limitations

We acknowledge the potential for referral bias, as a disproportionate number of patients may also have presented to private facilities that have interventional cardiology services in these two cities. We also acknowledge that despite previous research in the Middle East describing low EMS use rates, our results may not be generalizable due to postresearch recommendation changes in these countries having been initiated.

CONCLUSIONS

EMS care for STEMI is grossly underutilized in Abu Dhabi. Patient knowledge and perceptions may contribute to this underutilization, and public education efforts are needed to raise awareness of both the signs and symptoms of ACS and the importance of EMS utilization. Current public education appears to be ineffective and needs to target more specific demographic groups. It is hoped that the results of this study can be used as a foundation for future research and assist with public education strategies.

Acknowledgments

The authors gratefully acknowledge the invaluable assistance provided by the following nursing staff without whom this research would not have been possible. 1) C. DMello RN, BSN, Invasive Cardiology Department, Al Ain Hospital, Al Ain, UAE. 2) V. Morales RN and M. Aujero RN, Coronary Care Unit, Sheikh Khalifa Medical City, Abu Dhabi, UAE.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Chapter 5: Correlation of Mode of Transport and Outcomes in Patients with STEMI

Reference

Callachan, E. L., Alsheikh-Ali, A. A., Bruijns, S., Chandrasekhar-Nair, S., & Wallis, L. A. (2016). Mode of transport decisions and clinical outcomes correlation for patients with STEMI. *Western Journal of Emergency Medicine (in peer review)*

Declaration of Author

In the case of chapter 5, the nature and extent of my work was as follows:

I was the primary author of this paper and responsible for the literature review, survey design, piloting of the survey, ethics approvals, consenting of participants and data collection. I also performed the data analysis and write up of manuscript drafts, while under the supervision of all co-authors. As primary author, I accept full responsibility for this paper being published. Extent of the work done by candidate: 75%. In the case of the co-authors the extent of the work is as follows: AAA 10%, LAW 5%, CSN 5%, SRB 5%

Declaration of Coauthors

The undersigned hereby certify that:

1. The above declaration correctly reflects the nature and extent of the candidate's contribution to this work, and the nature of the contribution of each of the co-authors.
2. They meet the criteria for authorship in that they have participated in the conception, execution, or interpretation, of at least that part of the publication in their field of expertise;
3. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

4. There are no other author of the publication according these criteria;
5. Potential conflicts of interest have been disclosed to (a) granting bodies, (b) the editor or publisher of journals or other publications, and (c) the head of the responsible academic unit; and
6. The original data are stored at the following location and will be held for at least five years from date indicated below.

Location of stored data: Password protected portable hard drive at the candidate's place of employment, Bateen Air Force Base, Abu Dhabi, UAE

Signed:



Alawi Alsheikh-Ali

Date: 08 August 2016



Stevan R Bruijns

Date: 08 August 2016



Satish Chandrasekhar Nair

Date: 08 August 2016



Lee A Wallis

Date: 08 August 2016

Background of the Study

Whereas the studies presented in the previous two chapters focused on participants' perceptions and awareness of EMS and potential improvements, this third study turned to an analysis of objective outcomes. The goal was to determine whether established key performance indicators in STEMI management, such as door-to-balloon time, suggested by the AHA and ACC, were associated with modes of transportation. This was an essential step in the overall research process, because it established a concrete need for change and began to indicate the potential improvement in outcomes possible from EMS use. Although, as the first study showed, there is ample room for improvement in pre-hospital treatment of STEMI patients, this third study reveals that EMS can lead to better outcomes for patients, even in its current state. Taken together with the preceding two studies, this provides ample justification for taking action to improve EMS care and utilization in Abu Dhabi.

Methods

As with the previous chapters, the full description of the methods is found in the published paper, presented below. The sample consisted of 587 consecutive STEMI patients presenting to four hospitals in Abu Dhabi. Consent was obtained at the time of treatment. The researcher and research assistants collected data in the form of medical records and self-reported outcome data (obtained through structured follow-up interviews). Outcome variables included treatment times (e.g., door-to-balloon and symptom-onset-to-balloon times) and clinical outcomes (e.g., reinfarction, stroke, death). See the published paper, below, for a full list of variables studied.

Conclusions were drawn after correlation with in-hospital events and short- and long-term outcomes. The primary data for the above research was collected from hospital records,

interactions, interviews, original works, and questionnaires. These data were captured and entered in to the study case report form (CRF) (Appendix C). For data analysis, the information obtained in the CRFs and the patient interviews was entered into a Microsoft Excel® (Microsoft Corporation, Redmond, WA, USA) spreadsheet for further comparison.

Sampling and Power Analysis

The sampling procedure for this study is the same as that for the study presented in the previous chapter. However, the actual sample size for this study was smaller ($n = 455$). Of the original sample, 132 patients were excluded because they did not consent to be contacted for follow up, arrived in cardiac arrest, did not have STEMI on arrival or had missing or incomplete data in their paper or electronic medical records with regards to door, ECG or balloon times. Not all participants were available for follow up. Hypotheses tested involved correlations among modes of transport (EMS, private, transfer) and the outcome variables. Therefore, Kruskal-Wallis and χ^2 contingency tests were used to test hypotheses.

The sample sizes for 30-day, 6-month, and 1-year follow up were 379, 319, and 224, respectively. We conducted power analyses to determine required sample sizes for the Kruskal-Wallis and χ^2 contingency tests. For the Kruskal-Wallis ANOVA test, assuming a medium effect size ($f = .25$), $\alpha = .05$, statistical power of .80, and three groups (privately transported, EMS-transported, and transferred patients), the minimum required sample size is 159. For the χ^2 contingency table, assuming a medium effect size ($w = .30$), $\alpha = .05$, $df = 2$, and a power of .80, the minimum required sample size is 108. Therefore, the sample sizes at all time points were adequate for all data analysis for Part 3. Table 2 presents a summary of demographic data for responders and non-responders at all three time points.

Table 2. Demographics by Follow-Up: Responders and Non-Responders at 30 Days, 6 Months, and 1 Year

Follow-up time:	30-day				6-month				1 year			
	Responders		Non-responders		Responders		Non-responders		Responders		Non-responders	
Age	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)	<i>n</i>	Mean (SD)
	388	50.1 (9.8)	84	51.4 (11.4)	292	50.5 (10.3)	175	50.1 (10.4)	220	50.9 (9.7)	243	49.8 (10.3)
	Gender											
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Female	19	86.40%	3	13.60%	15	68.20%	7	31.80%	12	54.50%	10	45.50%
Male	352	81.30%	81	18.70%	277	64.00%	156	36.00%	208	48.00%	225	52.00%
	Nationality											
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Arab Countries	102	64.60%	56	35.40%	78	49.40%	80	50.60%	59	37.30%	99	62.70%
Bangladesh	57	63.30%	33	36.70%	42	46.70%	48	53.30%	33	36.70%	57	63.30%
Egypt/Africa	29	64.40%	16	35.60%	19	42.20%	26	57.80%	17	37.80%	28	62.20%
India/Sri Lanka/S. Asia	97	58.10%	70	41.90%	81	48.50%	86	51.50%	62	37.10%	105	62.90%
Pakistan	73	61.30%	46	38.70%	58	48.70%	61	51.30%	40	33.60%	79	66.40%
USA/Canada/Europe	5	50.00%	5	50.00%	3	30.00%	7	70.00%	3	30.00%	7	70.00%
	Language											
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Arabic	121	66.10%	62	33.90%	88	48.10%	95	51.90%	65	35.50%	118	64.50%
Bengali	48	65.80%	25	34.20%	36	49.30%	37	50.70%	30	41.10%	43	58.90%
English	55	57.30%	41	42.70%	43	44.80%	53	55.20%	32	33.30%	64	66.70%
Hindu	63	60.00%	42	40.00%	52	50.00%	52	50.00%	41	39.00%	64	61.00%
Malaysian	9	45.00%	11	55.00%	7	35.00%	13	65.00%	5	25.00%	15	75.00%
Urdu	59	59.00%	41	41.00%	48	48.00%	52	52.00%	36	36.00%	64	64.00%
Other ^a	24	68.60%	11	31.40%	17	48.60%	18	51.40%	11	31.40%	24	68.60%

Note. ^a Other = Punjabi, Tagalog, Language not given

Data Analysis

As with the study presented in the previous chapter, data were analysed using χ^2 contingency tables and Kruskal–Wallis non-parametric ANOVA tests. In all cases, the independent variable was mode of transport, which was categorical. For categorical dependent

variables, such as in-hospital events, χ^2 tests were used. When the dependent variable was continuous, such as door-to-balloon time, the Kruskal–Wallis test was used. This non-parametric ANOVA variant was appropriate because the data did not meet the assumption of normality required by parametric ANOVA. As described in the previous chapter, the Kruskal–Wallis test does not assume normal distribution.

Discussion

The main findings and discussion for the study are presented in the submitted manuscript, which is reproduced later in this chapter. We would like to add, however, an acknowledgement of the fact that our study does not account for many confounding variables that may have influenced the results, and we did not adjust for any variables that differed between them. For example, EMS users may be more highly educated or more affluent in general than those who use private transportation. Similarly, EMS users may be more compliant with medication after hospitalization. Although our findings reveal an association between mode of transport and in-hospital events, we cannot definitively assert a causal relationship owing to the fact that we did not consider these potential confounding factors. Future research should include more confounding variables in an attempt to clarify the relationship between EMS use and outcomes among STEMI patients in Abu Dhabi.

Supplemental Analysis

In addition to the main findings, presented in the published manuscript below, we conducted supplemental analyses using the data from this chapter and the previous chapter to explore factors related to mode of transport among STEMI patients whose country of origin was the United Arab Emirates, and among those who experienced cardiac arrest while in hospital. The purpose of this supplemental analysis was to look at the data collected from different angles

and to generate further insights that might reveal important directions for future research.

Although this analysis is not part of the core study presented in this chapter, it is our hope that readers will gain a broader understanding of the data, as we did in conducting this supplemental analysis.

Methods

We conducted descriptive analysis on a subset of the full sample, consisting only of UAE nationals ($n = 61$). The goal of the analysis was to describe the sample of UAE nationals with respect to mode of transport (EMS, private, or transfer), treatment times, treatment variables (infarction site, PCI type, and stent type), and in-hospital events. We therefore calculated descriptive statistics to examine these variables and to better understand the characteristics of UAE national STEMI patients in Abu Dhabi. We also calculated descriptive statistics among a subsample of patients who experienced cardiac arrest while in hospital, in order to better understand the disease, treatment, and outcome statistics among this subsample. The goal was to generate potential insights and research directions for reducing the risk of in-hospital cardiac arrest among STEMI patients in Abu Dhabi.

Results

Table 3 summarizes the descriptive statistics with respect to treatment times and STEMI characteristics for the UAE national sample.

Table 3. UAE National Patients Door to Treatment and STEMI infarct sites

Variable	Median	IQR ^a	Min	Max	w/in 90 min	w/in 10 min
Door to ECG, <i>n</i> = 60	5.0	4.0, 8.3	1	128	97.6%	85.2%
Door to Cath, <i>n</i> = 58	52.5	38.3, 70.0	14	180	83.6%	0.0%
Door to Balloon, <i>n</i> = 50	81.0	61.5, 103.3	37	199	54.1%	0.0%
ISCH, <i>n</i> = 54	4.0 hr	3.0, 7.4	77	1440		
Variable				<i>n</i>	%	
STEMI infarct site, <i>n</i> = 60, 1 deceased						
Anterior				34	56.7	
Inferior				17	28.3	
Anterolateral				5	8.3	
Anteroseptal				2	3.3	
Inferolateral				1	1.7	
Inferoposterior				1	1.7	
PCI type <i>n</i> = 60, 1 deceased						
Primary				53	88.4	
NFR				5	8.3	
No Intervention				2	3.3	
Stent type, <i>n</i> = 59						
DES				46	69.9	
BMS				2	3.4	
POBA				3	5.1	
NFR				7	11.9	
ANGIO ONLY				1	1.7	

^a IQR = interquartile range (third quartile - first quartile)

There were 61 patients, of whom 53 (86.9%) were male and 33 (54.1%) were smokers.

The average age was 61 (SD = 15.6), and the average BMI was 29.5 (SD = 5.8). These statistics closely mirror those of the full sample, with the exception of age; the average of the full sample was 51. Eighty-five percent (*n* = 51) of UAE nationals experienced anterior or inferior STEMI, and 69.9% of those who survived (*n* = 46) received drug-eluting stents.

Compared with the full sample, more UAE nationals knew the emergency phone number for requesting EMS (*n* = 36, 60.0%, compared with *n* = 264, 45.0% of full sample).

Nevertheless, 40% of UAE nationals in this study still reported not knowing the number.

Interestingly, despite having greater knowledge of the EMS number, proportionally fewer UAE nationals decided to use EMS (*n* = 4, 6.6%) compared with the full sample (*n* = 86, 14.7%).

With respect to treatment times, the sample of UAE nationals exhibited a median door-to-

balloon (D2B) time of 81 minutes (IQR = 61.5–103.3). Proportionally, more UAE nationals experienced cardiac arrest in hospital compared with the full sample ($n = 8$, 13.1%; compared with 8.1% of the full sample). The same is true of mortality; 8.2% ($n = 5$) of UAE nationals died in hospital, compared with only 3.3% ($n = 15$) of the full sample.

Data on medications given at discharge were available for 56 of the UAE nationals (all those who survived to discharge). All patients were given aspirin, 98.2% ($n = 55$) were given statins, and 85.7% ($n = 48$) were given beta blockers. All other medications were prescribed to 50% or fewer of discharged patients.

We also sought to analyse data with respect to patients who either arrived in cardiac arrest or who experienced an episode of cardiac arrest during their hospital stay and the findings are presented in the subsequent tables.

Table 4. *Cardiac arrest patient door to treatment times, STEMI infarct sites and PCI information*

Variable	Median	IQR ^a	Min	Max	w/in 90 min	w/in 10 min
Door to ECG, $n = 60$	5.0 min	2.0, 7.0	1	59	94.2%	87.8%
Door to Cath, $n = 58$	66.0 min	41.3, 80.8	8	196	84.8%	2.2%
Door to Balloon, $n = 50$	86.5 min	64.3, 106.5	30	221	63.2%	0.0%
ISCH, $n = 54$	3.9 hr	3.2, 8.0	74	1440		
Variable				<i>n</i>	<i>%</i>	
STEMI infarct site, $n = 52$						
Anterior				28	53.8	
Inferior				17	32.7	
Anterolateral				4	7.7	
Inferoposterior				3	5.8	
PCI type, $n = 50$						
Primary				40	80.0	
Rescue				6	12.0	
None				4	8.2	
Stent type, $n = 44$						
DES				37	84.1	
BMS				1	2.3	
POBA				6	13.6	

^a IQR = interquartile range = first quartile, third quartile

Table 5. *In-hospital events among patients with cardiac arrest*

Event	<i>n</i>	%
Bypass Graft, <i>n</i> = 46	1	2.2
Intra-aortic balloon pump, <i>n</i> = 48	12	25.0
Reinfarction, <i>n</i> = 46	2	4.3
Bleed, <i>n</i> = 46	2	4.3
Thrombosis, <i>n</i> = 46	3	6.5
Stroke, <i>n</i> = 46	2	4.3
Arrest, <i>n</i> = 52	51	98.1
Death, <i>n</i> = 52	22	42.3

Fifty-two patients experienced cardiac arrest while in the hospital. Of these, 92.3% (*n* = 48) were male, and 51.9% (*n* = 27) were active smokers. The average age was 52.2 (SD = 12.3), and the average BMI was 26.6 (SD = 4.2; BMI data were only available for 33 patients). These statistics are similar to those of the full sample. The decision to use private transportation was also proportionally similar to the full sample, with 82.7% (*n* = 43) of patients opting not to use EMS.

A majority of the patients who experienced cardiac arrest arrived at the hospital after hours, between 17h00 and 08h00 and on weekends (*n* = 38, 73.1%). This proportion was greater than among the full sample, where only 62.9% (*n* = 291) of patients arrived after hours. Patients who later experienced cardiac arrest may have waited longer to seek treatment (deciding to go to the hospital only when symptoms became very severe), or, if their symptoms were initially severe, they may have decided not to wait for normal hours before seeking care. Not enough data are available on symptoms to assess this hypothesis; 92.3% (*n* = 48) of cardiac arrest patients reported chest pain on arrival, which is similar to the full sample (95.0% experiencing pain on arrival, *n* = 440). Severity of the pain was not recorded, so further research is needed to determine whether severity of symptoms, waiting to go to the hospital, and other factors are related to cardiac arrest in STEMI patients.

Patients with cardiac arrest were re-vascularized less promptly, than those who did not arrive in cardiac arrest despite this however the median door-to-balloon time was 86.5 minutes (IQR = 64.3–106.5), which is still within the 2013 guidelines of the American College of Cardiology/American Heart Association, which recommend a D2B time of within 90 minutes. (14) This could be due to the fact that these patients would require resuscitation prior to being transported to the cath lab. The overall sample of privately transported patients had a median D2B time of 81 minutes (IQR = 64–105), which was the highest median time of any patient subset. Thus, cardiac arrest patients had longer treatment times than the sample overall. Untreated STEMI can be a cause of cardiac arrest; although there are insufficient data available to determine whether longer treatment times were associated with in-hospital cardiac arrest among the patients in this study, this result further underscores the importance of prompt treatment, which can be achieved with more reliability using EMS.

As with the full sample, the majority of patients had anterior or inferior STEMI (86.5%, $n = 45$) and received primary PCI (80.0%, $n = 40$); 84.1% ($n = 37$) of those who received stents were given drug-eluting stents. Cardiac arrest patients were treated using intra-aortic balloon pumps more often than the full sample (25.0% [$n = 12$] vs. 5.6% [$n = 26$] of the full sample).

Cardiac arrest patients had a strikingly higher in-hospital mortality rate than the overall sample. Nearly half of the cardiac arrest patients died (42.3%, $n = 22$), compared with only 3.2% of the full sample.

Of those who were discharged to home and for whom medication data were available, 100% ($n = 24$) were given aspirin, 91.7% ($n = 22$) were given statins, 87.5% ($n = 21$) were given beta blockers and Clopidogrel, and 58.3% were given angiotensin converting enzyme inhibitors.

Discussion

The older age of the UAE sample can perhaps be attributed to the fact that, among the 77 participants in the full sample who were under 40, only 12 were from all Arab nations combined (including the UAE). The low proportion of UAE nationals knowing the number for EMS suggests a need to educate the full populace of the UAE on the process for and benefits of using EMS. In Abu Dhabi, which has a large population of immigrant labourers, focusing education on the immigrant population may be warranted, but such a focus should not exclude UAE nationals.

Researchers in Turkey have found a low proportion of EMS usage despite good knowledge of the EMS number (75). As with the Turkish patients in that study, it is possible that UAE nationals making use of private transport have less severe symptoms than those who use EMS; further research will be required to confirm this. In our research on reasons for utilizing EMS versus private transport, we found that, among patients who used private transport, around half believed that private transport would be quicker than EMS, regardless of whether they knew the EMS number (Chapter 4). This suggests that public education should focus especially on the benefits of using EMS for cardiac events, not just learning the number to call.

The median D2B time of 81 minutes among UAE nationals falls within the guidelines of the American College of Cardiology/American Heart Association, which recommend a D2B time of within 90 minutes, (6) and is cited in a paper based on UAE findings (94) Additionally, it closely mirrors the D2B times observed among the full sample, indicating that UAE nationals were treated as promptly as other patients.

The higher mortality rate among UAE nationals could be attributable to the higher average age of the UAE sample; research indicates that the survival rate for STEMI patients under 40 is significantly higher than that among older patients. (95-99) However, when

considered alongside the results for mode of transport, which showed a decreased tendency to use EMS among UAE nationals, it appears possible that increased use of private transport among this sample was partly associated with increased incidence of negative outcomes. This hypothesis is supported by research indicating that prehospital ECG (such as might be performed during EMS transport) can lead to shorter treatment times (49,51,54). Further research is still required to demonstrate this connection and definitively link shorter treatment times (within the 90-minute recommended window) to improved outcomes.

Although post-discharge medications and follow-up treatments are only tangentially related to the research question (which focuses on mode of transport), we include some data on these issues in order to add to the published profile of STEMI treatment in Abu Dhabi. The results regarding medications can be compared with the discharge data for the sample of young STEMI patients (Chapter 6). Although statins and beta blockers were common among both populations, a majority of young STEMI patients also received Clopidogrel (85.3%) and angiotensin converting enzyme inhibitors (70.7). This indicates that, at the four hospitals included in the study, post-discharge medication regimens are strikingly different for young versus older patients. This is consistent with recommendations and trends published elsewhere. (96)

Given existing data on survival to discharge of in-hospital cardiac arrest patients, the high in-hospital mortality among cardiac arrest patients is not surprising. However, the survival-to-discharge rate of 57.7% is quite high compared with in-hospital cardiac arrest survival rates reported in other studies, which range from 0%–42% (100).

These other studies may not have focused specifically on STEMI or other cardiac patients, which could explain the lower survival rates, since STEMI patients in a cardiac unit

may receive more efficient treatment for cardiac arrest, which is not entirely unexpected in such a setting. In his study (101), Peberdy found that survival of in-hospital cardiac arrest was less likely after hours (during nights and weekends). This has significance for our findings because a greater percentage of cardiac arrest patients arrived after hours, and a greater percentage died, than among the full sample. There may, therefore, be cause to investigate the after-hours survival rate of in-hospital cardiac arrest at Abu Dhabi hospitals.

A copy of the paper currently under peer review follows.

MODE OF TRANSPORT DECISIONS, AND CLINICAL OUTCOMES IN STEMI PATIENTS

ABSTRACT

Introduction. The purpose of this multicenter, prospective study was to assess differences in treatment times and health status based on mode of transport (EMS, private transport, or transfer) among patients with ST-elevation myocardial infarction (STEMI).

Methods. Our sample consisted of 455 patients admitted to 4 hospitals in “blinded for peer review.” We collected electronic medical records from EMS and hospitals, and conducted interviews with patients in-person or via telephone. Chi-square tests and Kruskal–Wallis tests were used to examine differences in variables by mode of transportation.

Results. Results indicated significant differences in modes of transportation when considering symptom-onset-to-balloon-time ($p < 0.001$), door-to-balloon time ($p < 0.001$), and health status at 6-month and 1-year follow-up ($p < 0.001$). In all cases, EMS transportation was associated with a shorter time to treatment than other modes of transportation. However, the EMS group experienced greater rates of in-hospital events, including cardiac arrest and mortality, than the private transport group.

Conclusion. Our results contribute data supporting EMS transportation for patients with acute coronary syndrome. Although a lack of follow-up data made it difficult to draw conclusions about long-term outcomes, our findings clearly indicate that EMS transportation can speed time to treatment, including time to balloon inflation, potentially reducing readmission and adverse events. We conclude that future efforts should focus on encouraging the use of EMS and improving transfer practices. Such efforts could improve outcomes for patients presenting with STEMI.

Keywords: acute coronary syndrome; emergency medical services; door-to-balloon time; modes of transportation; ST-elevation myocardial infarction

INTRODUCTION

Acute coronary syndrome (ACS) is a leading cause of morbidity and mortality worldwide,¹ with approximately half of these deaths occurring in the prehospital setting in the Arab Gulf region.² For patients presenting with ST-elevation myocardial infarction (STEMI), percutaneous coronary intervention (PCI) is recommended.^{3,4,5} The short- and long-term mortality of STEMI patients can be reduced with PCI and coronary artery bypass grafting (CABG),⁴ with studies suggesting that primary PCI reduces mortality and major adverse cardiovascular events, when compared with thrombolytic therapy.^{5,6} The updated 2015 guidelines of the American College of Cardiology/American Heart Association and the 2013 guidelines from the European Society of Cardiology recommend a door-to-balloon (D2B) time of less than 90 minutes.^{6,7} When this goal is met, PCI for STEMI reduces mortality and morbidity.⁸

Advanced prehospital management by emergency medical services (EMS) plays a crucial role in facilitating access to care and reducing mortality rates for STEMI patients.⁷⁻¹¹ Studies have shown that transport by EMS is associated with quicker treatment, including shorter symptom-onset-to-arrival time and door-to-reperfusion time, when compared to private transport.^{12,13} Several studies have found that among patients who underwent emergency angiography, D2B times were shorter in EMS-transported patients.¹³⁻¹⁵

With EMS transport, treatment decisions can be made more quickly and more effectively, as EMS can perform a prehospital electrocardiogram (ECG) and alert the hospital that the patient is enroute, thereby minimizing door-to-reperfusion times.¹⁶⁻²⁰ Prehospital ECG may also detect signs of transient ischemia and arrhythmias, which may no longer be present when the patient receives the first in-hospital ECG.^{21,22}

The purpose of this multicenter study was to assess, within the “blinded for peer review” medical

system, differences in patient demographics, medical history, symptoms, treatment times, and follow-up status among patients transported via EMS, those using private transport, and those transferred from other medical facilities.

METHODS

Sample and Study Setting

This study was set in the “blinded for peer review,” where both government and private hospitals provide cardiac catheterization services. Government hospitals are operated by the “blinded for peer review” Health Services Company, while the EMS is operated by the “blinded for peer review” Police Emergency and Public Safety Department and staffed by paramedics from the “blinded for peer review.” For patients with suspected STEMI, 12-lead ECG is performed and interpreted by paramedics. This interpretation involves paramedics activating the receiving hospital catheterization lab through a central activation number. Patients who are transferred by EMS from non-PCI centers receive advanced life support care, including cardiac care (e.g. arrhythmia management), but the responsibility for catheterization lab activation lies within the inter-hospital transfer pathway, and not the EMS.

Procedures

The study was conducted over a period of 18 months, with follow-up interviews at 30 days, 6 months, and 1 year after initial discharge. Follow-up data were obtained by contacting participants by phone at each of the specified follow-up time points. We recorded mode of transport (EMS, private, or transferred from other medical facility) and in-hospital events for each patient using electronic medical records from both EMS and hospitals. Data included sex, age, past medical history (including history of 11 related conditions, such as hypertension, angina, diabetes mellitus types 1 and 2, and stroke), time of arrival, pain on arrival, door-to-ECG

time, door-to-catheterization lab arrival time, D2B time, symptom-onset-to-balloon inflation time (total ischemic time), hospital events (including 8 related events, such as bypass surgery, reinfarction, and mortality), 30-day follow-up status, 6-month follow-up status, and 1-year follow-up status.

Statistical Analysis

Sample descriptive statistics are reported in a previously published article.²³ Inferential statistics were calculated to determine whether significant differences existed between EMS-transported and privately transported patients with respect to the variables of interest. The Kruskal–Wallis rank test was used to estimate differences in continuous variables (door-to-first ECG, door-to-catheterization lab arrival, D2B time, and symptom-onset-to-balloon time) between modes of transportation. All other variables were categorical and were compared with chi-squared tests of independence. All analyses were performed using SPSS Version 22.0 (IBM Corporation, Armonk, NY, USA). All p values ≤ 0.05 were considered significant.

RESULTS

Demographics and History

We enrolled 455 consecutive patients with STEMI treated at 4 public hospitals in “blinded for peer review.” A minority of patients ($n = 53$, 12%) arrived via EMS, and the remainder via private transport ($n = 274$, 60%) or transferred from other facilities ($n = 128$, 28%). The majority of patients were male (94%), and half (52%) were active smokers. The average age was 51 ± 11 years, with 13% of patients younger than 40 years.

We observed no significant differences with respect to in-hospital events and discharge outcomes according to age ($p = 0.121$). No significant differences were noted in variables of health history according to mode of transportation, indicating that previous conditions did not affect the choice

of transportation method.

Patients who arrived via private transportation were significantly more likely ($p = 0.005$) to arrive after hours (between 1700 and 0800 or weekends). Other modes of transportation were approximately equal with respect to after-hours arrival.

For all modes of transportation, a high percentage (97%) of patients reported experiencing pain on arrival. We observed no significant differences in pain on arrival as a predictor of mode of transport among the groups ($p = 0.16$).

Time to Treatment

Door-to-ECG time was available for all patients, with the median time being 4 minutes (interquartile range [IQR] 2 to 7 minutes). At the time of this study, a 12-lead ECG was repeated for all patients in triage, prior to transport to the catheterization lab. The median door-to-ECG time was significantly higher for patients who used private transportation and EMS (both 5 minutes; IQR 2-8 and 2-6, respectively) than for transfer patients (4 minutes) ($p = 0.005$). A door-to-ECG time of 10 minutes or less was achieved in 89% ($n = 405$) of patients. It is important to note that patients were also transferred from smaller clinic-type centers, requiring confirmation of STEMI, thereby justifying the rationale for adding door-to-ECG as a variable. Door-to-catheterization lab arrival time data were available for 99% ($n = 450$) of patients. We found that privately transported patients had the longest door-to-catheterization lab arrival time (median = 74 minutes); this duration was significantly higher than that noted for EMS or transfer patients ($p < 0.001$). There was no significant difference observed for door-to-catheterization lab arrival times between EMS-transported and transfer patients (median = 45 minutes [28, 69] and 36 minutes [23, 55], respectively) ($p = 0.462$).

D2B time data were available for 96% ($n = 438$) of patients, with 76% ($n = 334$) of patients

having a D2B time of 90 minutes or less. Privately transported patients had the longest D2B time (median = 81 minutes [64, 105]), which was statistically significant when compared to other modes of transportation ($p < 0.001$). We observed no significant difference between EMS and transfer patient D2B times (median = 70 minutes [48,89] and 62 minutes [46,77], respectively). Results related to treatment times are summarized in Table 1.

Table 1. Statistics from door-to-ECG, door-to-catheterization lab, and door-to-balloon time in minutes. (D2B, door-to-balloon; ECG, electrocardiogram; EMS, emergency medical services; IQR, interquartile range).

Variable	Mode	N^a	Median	IQR^b	<i>p</i>
Door-to-ECG	EMS	53	5	2, 6	0.005
	Private	274	5	2, 8	
	Transfer	128	4	2, 6	
Door-to-cath lab arrival	EMS	51	45	28, 69	< 0.001
	Private	274	74	55, 96	
	Transfer	125	36	23, 55	
D2B	EMS	49	70	48, 89	< 0.001
	Private	265	81	64, 105	
	Transfer	124	62	46, 77	

Note: All times presented in minutes.

^a Data were not available for all patients^b Interquartile range (first quartile, third quartile).

There were significant differences among modes of transport with respect to symptom-onset-to-balloon times ($p < 0.001$). Patients transferred from other medical facilities had the highest

symptom-onset-to-balloon time (median = 4.5 hours [IQR 3.0–7.5]). Patients transported by EMS (median = 3.1 hours [IQR 1.8–4.3]) and privately (median = 3.2 hours [IQR 2.1–5.3]) had significantly shorter symptom-onset-to-balloon times (Table 2).

Table 2. Symptom-onset-to-balloon time in hours according to mode of transportation. (EMS, emergency medical services; IQR, interquartile range).

Mode	N^a	Median	IQR^b	Min	Max	<i>p</i>
EMS	49	3.1	1.8, 4.3	1.1	24	< 0.001
Private	268	3.2	2.1, 5.3	0.9	16.3	
Transfer	128	4.5	3.0, 7.5	1.5	19.0	

Note: All times presented in hours.

^aData were not available for all patients. ^b Interquartile range (first quartile, third quartile).

In-Hospital Events and Follow-Up

Data for in-hospital events were available for 97% of patients. For the entire cohort, the rates of in-hospital events were as follows: cardiac arrest, 8.0% (n = 37); intra-aortic balloon pump, 5.6% (n = 26); CABG, 3.7% (n = 17); death, 3.2% (n = 15); in-stent thrombus, 1.1% (n = 5); stroke, 0.6% (n = 3); reinfarction, 0.2% (n = 1); bleeding, 0.2% (n = 1).

We observed a significant difference among the 3 modes of transportation with regards to the percentage of patients who required bypass surgery during their hospital stay ($p = 0.017$). Of the 17 patients who required bypass surgery, 11.3% arrived via EMS, 2.6% arrived by private transport, and 3.1% were transferred (Table 3).

Table 3. Cross-tabulation for mode of transport and in-hospital events (n = 455). (EMS, emergency medical services; CABG, coronary artery bypass grafting; IABP, intra-aortic balloon pump; REINF, reinfarction; Bleed, any kind of bleed; Stent Throm, formation of an in-stent thrombus; Arrest = cardiac arrest).

Event	EMS^a	Private	Transfer	Total	p
CABG	6 (11.3%)	7 (2.6%)	4 (3.1%)	17 (3.7%)	0.017
IABP	5 (9.4%)	16 (5.8%)	4 (3.1%)	26 (5.7%)	0.296
REINF	0 (0%)	1 (0.4%)	0 (0%)	1 (0.2%)	0.875
Bleed	0 (0%)	1 (0.4%)	0 (0%)	1 (0.2%)	0.875
Stent Throm	1 (1.9%)	3 (1.1%)	1 (0.8%)	5 (1.1%)	0.915
Stroke	1 (1.9%)	2 (0.7%)	0 (0%)	3 (0.7%)	0.536
Arrest	7 (13.2%)	23 (8.4%)	7 (5.5%)	37 (8.1%)	0.281
Death	4 (7.5%)	7 (2.6%)	4 (3.1%)	15 (3.3%)	0.282

Column values indicate the number of individuals from each corresponding mode of transport to experience a given in-hospital event, with the percentage indicating the proportion these individuals represent within each mode of transport.

We did not observe any significant differences with respect to transportation when considering any of the 7 other in-hospital events studied. Patient follow-up status was categorized as follows: (1) no data or missing record, (2) home at follow-up, (3) readmitted to the catheterization lab since last follow-up, and (4) new disease event (includes reinfarction, stroke, and angina) or (5) death since last follow-up. These statistics should not be confused with discharge-to-home status after the initial STEMI event; such discharge data are not available for the present study. There

were no significant differences in health status at 30-day follow-up, with 75.4% of patients at home.

At 6-month follow-up, differences in at-home status among the modes of transportation were significant ($p < 0.001$). Of the 390 patients available for follow-up at 6 months (85.7% of the original sample), 268 (58.9%) were at home and 21 (4.6%) had been readmitted since the 30-day follow-up. Of the patients originally transported via EMS, 18 (34.0% of EMS sample) were at home at the 6-month follow-up, compared to 180 of those privately transported (65.7% of private transport sample) and 70 of those originally transferred (54.7%). These differences were significant ($p < 0.001$).

At the 1-year follow-up, such observations remained consistent, but with fewer follow-up records available. Of the patients originally transported via EMS, 20.8% were at home (79.2% of records unavailable), compared with 52.2% of those privately transported (41.2% of records unavailable) and 34.3% of those originally transferred (62.5% of records unavailable). These differences were significant ($p < 0.001$).

At the 1-year follow-up of patients originally transported privately, 13 had been readmitted between 6 months and 1 year after the initial treatment; 1 transfer patient and no EMS-transported patients exhibited similar readmission. This difference could, however, reflect the decreased availability of data for the EMS and transfer groups. Results from 30-day and 1-year follow-ups are summarized in Table 4. All follow-up data are provided for completeness, despite a considerable loss to follow-up at 1-year.

Table 4. Cross-tabulation for mode of transport and 30-day and 1-year status (n = 455). (EMS, emergency medical services).

	30-day			1-year		
	EMS	Private	Transfer	EMS	Private	Transfer
Death	0 (0 %)	0 (0%)	1 (0.8%)	0 (0 %)	5 (1.8%)	3 (2.3%)
Readmission	1 (1.9%)	19 (6.9%)	15 (11.1%)	0(0%)	6 (2.2%)	0 (0%)
Reinfarction	0 (0 %)	12 (2.4%)	0 (0 %)	0(0%)	6 (2.2%)	0 (0%)
Lost to follow-up	16 (30.2%)	60 (21.9%)	8 (6.2%)	42 (79.2)	105 (38.3%)	74 (57.8%)

Statuses (e.g., stroke) which are not listed were not relevant to any patients at follow-up. ^a

Column values indicate the number of patients exhibiting the relevant status at a given follow-up duration. All percentages reflect original, not follow-up, sample sizes.

DISCUSSION

In this prospective, multicenter study of patients presenting with STEMI to a large network of public hospitals in “blinded for peer review,” we observed that time-sensitive processes of care differed significantly according to the mode of transportation to the emergency department.

Overall, total ischemic time (symptom-onset-to-balloon) was shortest among patients arriving by EMS, and longest among those transferred from other facilities.

While in-hospital processes (door-to-ECG, catheterization lab, and balloon times) were shortest among those transferred from outside facilities, these were offset by longer pre-hospital transfer times. Patients transported by EMS experienced a total ischemic time that was 1.4 hours (84 minutes) shorter than those transferred from elsewhere. Additionally, D2B and door-to-catheterization lab arrival times were 11 and 20 minutes shorter, respectively, among EMS-

transported patients than privately transported patients; these differences were statistically significant.

These results are consistent with previous research showing that EMS transport is associated with shorter symptom-onset-to-hospital arrival and D2B times.^{12,13} Although there was also a statistically significant difference in door-to-ECG times when comparing transferred patients to non-transferred (EMS and private), this difference amounted to only 1 minute. These findings highlight the need to improve pre-hospital transport networks for patients with STEMI, in addition to efforts that aim to streamline the in-hospital processes of care.

This finding is especially interesting in the context of the 2015 updated guidelines from the American College of Cardiology/American Heart Association, which recommend transferring STEMI patients promptly to achieve a D2B time of less than 90 minutes from arrival at the initial facility.⁶ Although all groups in this study had median D2B times within this recommended range, the 84-minute difference when considering time-to-balloon inflation from symptom onset shows that the mode of transportation is an important variable for timely STEMI care. This is most important among patients who must be transferred from non-PCI capable facilities.

It is worth noting that the rates of in-hospital events, including cardiac arrest and mortality, were higher among the EMS group than among the privately transported group. This finding is, perhaps, partly accounted for by the relatively sicker population that EMS is likely to engage; younger, healthier patients with the ability to transport themselves privately may constitute a higher percentage of privately transported patients. Owing to the unavailability of specific clinical data (e.g., hypotension, tachyarrhythmia), however, this hypothesis cannot be confirmed and interpretation is limited; future research is required to understand the difference in outcomes

observed in this study. Similarly, the follow-up results provide little room for clear interpretation, owing to the large percentage of loss to follow-up.

It is important to promote the use of EMS, particularly for STEMI, among the general public, especially given recent findings indicating an underuse of EMS among ACS patients in the Arabian Gulf region.^{24,25} Other findings made in this study with respect to specific trends of EMS use may be relevant in the promotion of EMS. Privately transported patients were more likely to arrive after hours (i.e., at night and on weekends). Existing research suggests that cardiac patients may be reluctant to bother EMS providers, and tend to wait to seek treatment until they are certain that their symptoms warrant medical attention.²⁶ Such observations could explain our findings with respect to after-hours EMS use; indeed, reluctance to engage EMS providers is likely to be exacerbated outside of normal business hours.²⁶

Another possible explanation of this finding is an increased tendency to visit emergency departments during times when primary care physicians are unavailable, suggesting a lack of access to after-hours care for non-emergent medical concerns.²⁷ However, given that all patients in this study had STEMI and that there was no significant difference in the proportion of patients who reported pain on arrival, this possibility is unlikely for our sample. Therefore, improving public utilization of after-hours EMS could reduce time to reperfusion among STEMI patients. Additionally, facilities without interventional cardiology services urgently need to improve policies for the transfer of STEMI patients. Al Habib et al. recently emphasized the fact that, in the Arabian Gulf region, many of the vehicles used to transfer patients from primary care clinics to hospitals lack the equipment and personnel necessary to provide adequate prehospital STEMI care.²⁴

In “blinded for peer review”, the setting of the present study, there is a large expatriate

workforce, which is composed predominately of males in industries like construction. This perhaps accounts for the large majority of male patients in the present study. In addition, medical services are more developed in this area than in many areas of the region, suggesting that these issues may also need to be addressed outside the urban area. Without organized systems to provide pre-hospital ACS care, the existence of PCI-capable facilities may not lead to associated improvements in ACS outcomes. In particular, in countries where EMS services are new or newly developing, public awareness and perception of EMS resources may lag behind actual service availability.

Researchers elsewhere noted that, when transferring patients to PCI centers for treatment, the time required to begin the transfer can significantly delay the overall time to treatment.²⁸ Our findings clearly show that transfer practices to government-operated hospitals in “blinded for peer review” should be improved to ensure adequate care for STEMI patients. Increased resource availability and training of professionals qualified for prehospital ACS treatment and diagnosis could lead to reduced treatment times and improved outcomes. Better transfer practices, including faster recognition and transfer policies, are urgently needed.

LIMITATIONS

Our data are subject to limitations, which should be accounted for when interpreting the findings. Notably, many patients in the original sample were unavailable for follow-up, making it difficult to draw conclusions regarding the long-term impact of the differences observed. This is particularly true for 1-year follow-up data. Additionally, when considering transfer patients, we did not record the source or reason for transfer. These factors could affect both transportation decisions and treatment times. We did not have access to data on first medical contact to device time, which would have examined the particulars of care within each hospital, isolating

healthcare factors from patient factors. Finally, because information on the prehospital treatment provided by EMS per patient is unavailable, it is not known how prehospital treatment differences might affect outcomes.

CONCLUSION

In conclusion, we observed significantly increased symptom-onset-to-balloon inflation times among patients transferred to hospitals in “blinded for peer review.” We also observed significantly increased D2B times among those transported privately. These findings support previous research showing that EMS care of ACS patients facilitates a more efficient delivery of care. Future efforts to promote the use of prehospital ECG are still needed. EMS use for coronary symptoms should be encouraged among the general public to improve the quality of clinical outcomes for patients presenting with STEMI.

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Chapter 6: Clinical profile of young patients presenting with STEMI in

Abu Dhabi

Introduction

The research questions and objectives for the present study centred on EMS and other modes of transport and their association with outcomes among STEMI patients. However, the large, unique dataset also enabled the subsidiary exploration of several important issues related to STEMI in Abu Dhabi. In particular, we considered it worthwhile to examine clinical profiles of subsets of the overall population to add to the existing body of knowledge new evidence on how clinical profiles might differ in Abu Dhabi compared with other areas and the region as a whole. Thus, this chapter presents the results of one such subsidiary investigation.

Coronary artery disease (CAD) is becoming an epidemic in the developing countries of the Indian subcontinent. (77,102) Further, CAD is affecting younger persons at greater rates. (77,103) Traditional risk factors for CAD, such as male sex, smoking and family history, are prevalent in young patients with acute STEMI. In an observational study of 111 patients with aged 40 years or less with ACS, patients were evaluated for traditional risk factors (i.e., smoking, diabetes mellitus [DM], hypertension [HTN], dyslipidaemia [DLP], gender, family history and prior coronary events). Out of 111 patients, 82.80% presented as STEMI. Smoking was the most common risk factor (83.78%); 37.83 % presented with DN, 12.6 % were hypertensive, 8.1% were diabetic, and 13.5% had a family history of ischemic heart disease (IHD). (102) A number of studies have compared the differences in profiles of risk factors, clinical presentation and in-hospital outcomes between young and older patients with acute STEMI (11,13,102)

More studies have also focused on the relationship of DLP, HTN, and DM to STEMI in patients aged 40 and younger. In most of these studies, young patients were grouped with

patients older than 35 years. (13,96-98,104) In one study undertaken in Gujarat, India, 200 patients were classified into two age groups, 100 patients aged ≤ 40 years and 100 patients aged >40 years and were evaluated for conventional risk factors. Older patients (32%) had a higher frequency of hypertension compared to younger patients (16%). Family history of CAD was greater among younger patients (19%) compared to older patients (9%). No significant difference was found between the two groups for incidence of DM, DLP, smoking, and tobacco chewing.

The younger group showed significantly higher total cholesterol and low-density lipoprotein cholesterol levels. (99) In a cross-sectional study that compared the clinical profile of ACS in male and female young adults, the male sample was ≤ 40 years of age, and the female sample was ≤ 55 years of age. The percentage of male patients presenting with symptoms of chest pain was higher (83.78%) compared to female patients (46.15%). However, female patients presented with chest discomfort in 38.46% of the sample compared to 5.41% of males. A significantly higher incidence of STEMI was evident in males, and 48.65% of males had DLP. Only 38.46% of female patients had DLP. (95)

Younger patients present with a different pattern compared to older patients, resulting in different treatment strategies and outcomes in younger patients. (13,77,103) Young patients with STEMI are of particular interest because of the potentially long lives they have ahead of them. Although the studies cited above have examined the risk factor profiles and clinical characteristics of young patients with STEMI, the importance of the topic warrants continued attention. In particular, this topic is understudied in the Arab Gulf region, where the clinical presentation of this population may be different than in other regions. Further, we sought to determine whether our large, primary dataset would yield similar results to studies that have

examined STEMI in young patients through secondary data analysis. We therefore examine the clinical features, risk factors, medical history, in-hospital events, prognosis and mortality in young AMI patients aged 40 years and younger. We also examine the correlation of DLP, HTN, and DM in these patients, to medical history of these, i.e. that the condition was only detected on admission and remained previously undiagnosed. Because other demographic characteristics, such as sex and ethnic origin, were examined in this dataset in previous chapters, we did not include those characteristics in this subsidiary exploration of a subset of the full sample.

Methods

Sample and Setting

This study was conducted using a sample of 77 consecutive STEMI patients under 40 years old who were admitted to four hospitals in Abu Dhabi, United Arab Emirates (UAE). The four hospitals included in the study are operated by the Abu Dhabi Health Services Company (SEHA). This sample was a subset of the full cohort from the 18-month multicentre study reported in previous chapters. For this study, only patients under age 40 were included. Other inclusion and exclusion criteria are the same as those reported in Chapters 4 and 5. Table 6 summarizes the demographic characteristics, arrival modes, and times to treatment for this subset of the full cohort sample.

Table 6. *Young STEMI patient demographics and modes of transport*

Variable	<i>n</i>	%
Demographics		
Gender, <i>n</i> = 77		
Male	76	98.7
Female	1	2.3
Age Bracket, <i>n</i> = 77		
20-29 years	11	14.3
30-39 years	66	85.7
Nationality, <i>n</i> = 76		
Bangladesh	27	35.5
India/Sri Lanka	19	25.0
Pakistan	13	17.1
Arab Countries	12	15.8
Egypt	4	5.3
Canada	1	1.3
Language, <i>n</i> = 75		
Bengali	23	30.6
Arabic	18	24.0
Hindi	13	17.3
Urdu	11	14.7
English	8	10.7
Malayalam	2	2.7
Arrival modes		
Decision Mode <i>n</i> = 77		
Private	72	93.5
EMS	5	6.5
Arrival Mode, <i>n</i> = 77		
Private	49	63.6
EMS	27	35.1
Helicopter	1	1.3
Knowledge of Emergency Number, <i>n</i> = 72		
No	51	70.8
Yes	21	29.2

As previously described, EMS, including pre-hospital treatment for STEMI patients, are provided by the Abu Dhabi Police Emergency and Public Safety Department, along with National Ambulance Company, LLC, which provides emergency technicians and paramedics. During ambulance or helicopter transport, paramedics may perform and interpret 12-lead ECGs.

Procedures

As reported previously, data were collected using electronic medical records from both EMS and the hospitals. See Chapters 4 and 5 for a detailed description of data collection procedures. This descriptive study sought to characterize the most prevalent medical history

factors and risk factors, the frequency of in-hospital events, and the discharge status among the young STEMI sample. The variables used were as follows. Demographic variables included gender (male, female), age (20-29, 30-39), nationality, language, decision mode (private, EMS), arrival mode (private, EMS, helicopter), and knowledge of emergency number (yes, no).

Variables related to treatment time included door-to-ECG time, door-to-balloon (D2B time), and total ischaemic time. Treatment related variables included STEMI site, number of vessels (single or multiple), and stent type (bare-metal or drug-eluting).

Data were obtained for 12 STEMI-associated medical history factors, including smoking and hypertension (defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg). Five dyslipidaemia risk factors were obtained (elevated cholesterol [> 5.0 mmol/l], elevated triglyceride [> 1.7 mmol/l], decreased HDL [< 1.0 mmol/l], elevated LDL [> 3.0 mmol/l], and body mass index [BMI]). Smoking status was self-reported at treatment, and all other risk factors were measured at hospital intake. Data for all risk factors were input into the hospitals' electronic medical records system, where they were gathered during data collection. Finally, data were gathered related to eight in-hospital events (e.g., death, cardiac arrest), 15 discharge statuses (e.g., discharged to home, discharged with statins, discharged with aspirin), and the number of days spent in the coronary care unit. These were also gathered from patients' electronic records.

In addition, to more closely examine the lipid profiles of young STEMI patients, medical history and status at the time of STEMI presentation were compared for the following five variables: elevated total cholesterol, elevated LDL cholesterol, low HDL cholesterol, elevated triglycerides, and hypertension. These variables were examined to determine whether patients who had a history of these conditions still had the conditions at the time the STEMI event.

Hypertension at time of treatment, caused by acute pain of the STEMI event could not be excluded from the in-hospital data for hypertension; this is discussed further in the Discussion section, below. Similarly, inferior AMI might have artificially lowered blood pressure, and AMI may have altered lipid profiles before blood tests were done. These possibilities should be taken into consideration when interpreting the results. For medical history, records on file with the hospitals of the study were used, as were self-reported histories taken during patient consultation. Primary care records were not obtained for this study. This introduces the unavoidable possibility of under-reporting of risk factors in medical history.

Owing to the preliminary nature of this study and to the fact that the small sample was extracted as a subset of a larger STEMI sample, only descriptive statistical analyses were conducted. All statistical tests were conducted using SPSS version 23.0 software.

Results

Demographics

This sample found that that, 98.7% ($n = 76$) of STEMI patients under 40 were male. The majority (85.7%, $n = 66$) were between 30 and 39 years of age; the remainder were 20-29 years old. About two-thirds of patients (77.6%, $n = 59$) were from Bangladesh, India, Sri Lanka, and Pakistan. This is not surprising, given the UAE's large population of immigrant workers. Only 12 patients (15.8%) were from all the Arab Gulf nations combined, including the UAE. The language profile mirrored the nationality distribution.

Regarding modes of transport to the hospital, most (63.6%, $n = 49$) patients arrived via private transportation such as personal car or taxi. Of the remainder, all but one arrived via EMS. One patient arrived via helicopter. The high number of private transport arrivals may be partially attributable to the fact that only 29.2% ($n = 21$) of patients reported knowing the telephone

number to dial to access emergency services in Abu Dhabi.

Medical History and Risk Factors

Fifty-nine patients (76.6%) had at least one modifiable risk factor. Smoking was by far the most common heart-disease-associated history factor, with 61.0% ($n = 47$) of patients reporting that they were active smokers at the time of admission. The next most common history factor was hypertension, which affected 19.5% ($n = 15$) of patients. Diabetes Mellitus was present in only 5 (6.5%) patients. Of the risk factors that were measured in-hospital, decreased HDL affected the youngest STEMI patients (70.1%, $n = 54$), followed by elevated LDL (29.9%, $n = 23$). However only 19.5% ($n = 15$) had elevated overall cholesterol. Additionally, body mass index (BMI) data were available; the mean for the sample was 26.3 ± 4.4 . This falls in the overweight range, indicating that the sample was slightly overweight on average. Table 7 summarizes these results.

Table 7. *Young STEMI patient medical history and risk factors*

Variable	N	%
Medical history, ^a n = 77		
Smoking	47	61.0
Hypertension	15	19.5
Lipid	7	9.1
Percutaneous coronary intervention	7	9.1
Acute Myocardial Infarction	6	7.8
Diabetes Mellitus Type 2	4	5.2
Angina	4	5.2
Coronary Artery Bypass Graf	1	1.3
Diabetes Mellitus Type 1	1	1.3
Stroke	0	0.0
COPD	0	0.0
Dialysis	0	0.0
Risk Factors ^a		
Elevated cholesterol	15	19.5
Elevated triglyceride	11	14.3
Decreased HDL	54	70.1
Elevated LDL	23	29.9
BMI n = 76		
Underweight	2	2.6
Normal	34	44.7
Overweight	29	38.2
Obese Class I	10	13.2
Obese Class II / III	1	1.3

^aPatients may have more than one medical history and/or risk factor

STEMI Profile and Treatment Times

The majority of STEMIs were located at the anterior (47.4%, n = 36) or inferior walls (30.3%, n = 26). At least one patient experienced STEMI at each of the other locations (see Table 3). Forty-seven patients (61.8%) had STEMI in a single vessel, the remainder in multiple vessels involvement. Drug eluding stents were most commonly inserted (72.7%, n = 56), followed by bare metal stents (11.7%, n = 9). Only two patients (7.5%) died in the hospital; five (6.5%) experienced cardiac arrest.

The median door-to-ECG time was 5 minutes (SD = 15.0), and the median door-to-balloon (D2B) time was 86.5 minutes (SD = 46.4). This is within the American College of Cardiology/American Heart Association guideline of 90 minutes' maximum D2B time. Average total ischaemic time was 377.3 minutes (SD = 343.0). On average, patients spent 7.2 days (SD = 13.4) in the coronary care unit. For the smaller sample of 62 patients, the mean coronary unit stay was 4.4 days (SD = 2.7). Of the surviving patients, 100% ($n = 75$) were discharged to home. The majority were discharged with prescriptions for statins (94.7%, $n = 71$), beta blockers (90.7, $n = 68$), Clopidogrel (85.3%, $n = 64$), and angiotensin converting enzyme (70.7%, $n = 53$). Table 8 lists the frequencies of other medications and summarizes the results described in this section.

Table 8. Young STEMI profile, times to treatment, in-hospital events, and discharge data

Variable	<i>n</i>	%
STEMI Site, <i>n</i> = 76		
Anterior	36	47.4
Inferior	23	30.3
Inferoposterior	6	7.9
Anterolateral	5	6.6
Anteroseptal	2	2.6
Inferolateral	2	2.6
Antero-inferior	1	1.3
Infero-septal	1	1.3
Single vessel, <i>n</i> = 76	47	61.8
Multiple vessel, <i>n</i> = 76	29	38.2
Stent type, <i>n</i> = 77		
Drug-eluting stent	56	72.7
Bare-metal stent	9	11.7
POBA	7	9.1
Angiography only/no flow restriction	5	6.5
In-hospital events, <i>n</i> = 77		
Death	2	7.5
Arrest	5	6.5
Bypass Graft	1	1.3
Intra-aortic balloon pump	1	1.3
Reinfarction	0	0.0
Bleed	0	0.0
Stent thrombosis	0	0.0
Times to Treatment		Median, IQR ^b
Door to ECG	77	5.0, (2.0, 8.0)
Door to Balloon	71	70.0, (54.0, 88.0)
ISHC	71	233.0, (130.0, 467.0)
Days in coronary care unit	77	5.0, (4.0, 6.0)
Discharge status, <i>n</i> = 75 ^a	<i>n</i>	%
To home	75	100.0
Statins	71	94.7
Beta blocker	68	90.7
Clopidogrel	64	85.3
Angiotensin converting enzyme inhibitor	53	70.7
Nitrates	15	20.0
Aspirin	9	12.0
Ticagrelor	9	12.0
Angiotensin 2 receptor blocking drug	3	4.0
Warfarin	3	4.0
Antiarrhythmic	2	2.7
Digoxin	2	2.7
Diuretics	2	2.7
Ca channel blocker	1	1.3
Insulin	1	1.3

^a Two of the patients were deceased, the *n* and % are for the remaining 75

^bIQR = interquartile range (1st quartile, 3rd quartile)

Lipid History versus lipid status during hospital testing

Table 9 presents a cross-tabulation of four lipid statuses (overall cholesterol, triglycerides, LDL, and HDL) according to whether patients had a history of the condition or whether first detection was made at the time of the STEMI event.

Table 9. *Lipid history by hospital profiles*

Hospital Profile	History of Condition			
	No		Yes	
	<i>n</i>	% ^a	<i>n</i>	% ^b
Cholesterol, <i>n</i> = 71				
Elevated	10	14.1	5	7.0
Triglycerides, <i>n</i> = 71				
Elevated	7	9.9	4	5.6
LDL, <i>n</i> = 70				
Elevated	18	25.7	5	7.1
HDL, <i>n</i> = 71				
Low	12	16.9	5	7.0
Not low	52	81.3	2	28.6
Hypertension, <i>n</i> = 75				
Yes	22	29.3	8	11.3

^aPercent of total sample presenting condition for negative history of condition

^bPercent of total sample presenting condition for positive history of condition

Interestingly, of the 60 patients who had no history of hypertension, 36.7% (*n* = 22) were diagnosed with hypertension during their STEMI treatment. Elevated LDL and lowered HDL were also concerns; 28.6% and 18.8% of those with no history, respectively, were diagnosed in hospital. These findings are discussed in more detail in the following section.

Discussion and Conclusions

Recent research has characterized the clinical profile of acute coronary syndrome in young adults in developing countries. (95,99) However, existing reports have tended to focus on single treatment centers, whereas this study was a multicenter study. Additionally, to our knowledge, no such studies have specifically focused on STEMI among young adults.

Because STEMI is one of the most common causes of cardiac mortalities, (8) it is important to understand the clinical characteristics and risk factors involved in STEMI among young adults.

Demographics and Clinical Profile

Among this sample of young adults presenting with STEMI at four hospitals in Abu Dhabi, STEMI patients were much more frequently men than women. This confirms previous findings, which have shown that, among young patients, STEMI and other acute myocardial infarctions (AMIs) are significantly associated with male gender (97,98). Other demographic data also confirmed findings from previous studies. Among patients under 40, AMI is most prevalent among the 31-40 group; the same was true in this study, where only 14.3% of patients were under 30. (102)

Again, closely mirroring results from other studies (99,104) single-vessel STEMI was the most commonly observed in this study. As with this sample, anterior and inferior STEMI were found to be most prevalent among young patients in several studies (95,99) These considerations suggest that the clinical profile of STEMI in young patients is similar to that of AMI generally in the young adult population.

Treatment

Existing studies on young AMI patients in the Arab Gulf and Indian subcontinent regions have not examined treatments. A recent analysis of STEMI patients from the Second Gulf Registry of Acute Coronary Events (Gulf RACE-2) revealed that, in patients who received percutaneous coronary intervention for STEMI, drug-eluting and bare-metal stents were used in 56.6% and 40.6% of cases, respectively (45). Among the young patients in this study, drug-eluting stents were used more frequently (72.7%).

Using the first Gulf RACE dataset, (1) found that Angiotensin converting enzyme inhibitors were used in 69% of STEMI patients of all ages, similar to the rate of 70.7% observed in this study. However, beta blockers were prescribed in only 74% of cases, compared with 90.7% in this study. Aspirin was used in 94% of cases in the Zubaid et al. study (1), compared with only 12% of this young STEMI sample. These differences may be attributable to national differences or to the increased availability of beta blockers in Abu Dhabi compared with other places in the region. However, it may also reflect a tendency to focus on shorter-term therapies with an increased emphasis on risk factor reduction among young AMI patients. (96)

Risk Factors

The importance of tobacco use as a risk factor among young STEMI patients is well documented (98). In this study, as in several others, smoking was the most prevalent medical history factor among the sample, affecting 61% of patients. A majority of patients in this study were from the Indian subcontinent (Bangladesh, India, Sri Lanka, and Pakistan). In one study of 109 young adults with AMI in India, only 19.3% of patients were smokers. However, as the researchers noted, many of their patients may have chewed tobacco instead. (99) The proportion of smokers among this study's sample is closely in line with other recent studies of young AMI patients from the Indian subcontinent. (95,103) This confirms the continued importance of efforts to reduce smoking among the younger population, both in the Indian subcontinent and in the Arab Gulf region.

Dyslipidaemia and hypertension in conjunction with smoking are strongly associated with premature CAD (98) Less than 10% of the sample in this study had a documented history of dyslipidaemia. However, at the time of presentation in the emergency department, 70.1% of patients had low HDL cholesterol and 29.9% had elevated LDL cholesterol. Similarly, only

about one-fifth of patients had a documented history of hypertension, but twice that many presented with hypertension (see Table 6). This suggests that, among young adults who use tobacco, there is a need for improved screening for the major risk factors involved in CAD and STEMI. The in-hospital figures for lipid status and blood pressure were taken at the time of presentation and the figures at discharge are not available. Therefore, it is impossible to exclude the possibility that the pain of the STEMI event itself caused a temporary increase in blood pressure, accounting for some of the difference in history of hypertension versus observed hypertension at presentation. This limitation does not apply to dyslipidaemia, and earlier detection and treatment of dyslipidaemia and hypertension could prevent acute cardiac events among individuals under 40 with multiple risk factors.

Limitations

This study is subject to certain limitations that should be considered when interpreting the results. First, the sample size of 77 is smaller than required to draw generalizable conclusions; future research should confirm these findings in larger samples. However, this sample confirmed findings from other researchers regarding AMI in young patients, adding to the available evidence on the clinical profile in this population. Second, some variables which might have shed light on the findings were unavailable, notably family history of coronary disease and hypertension status at discharge. Third, owing to the demographic makeup of Abu Dhabi, the majority of patients in this study came from the Indian subcontinent; therefore, this study may obscure regional differences in patients hailing from the United Arab Emirates. To confirm the clinical profile of STEMI among young Emiratis, future research should limit samples to UAE nationals.

Finally, because this study was preliminary and descriptive in nature, no data are presented regarding statistical significance or correlations; further analysis would be required to uncover such effects.

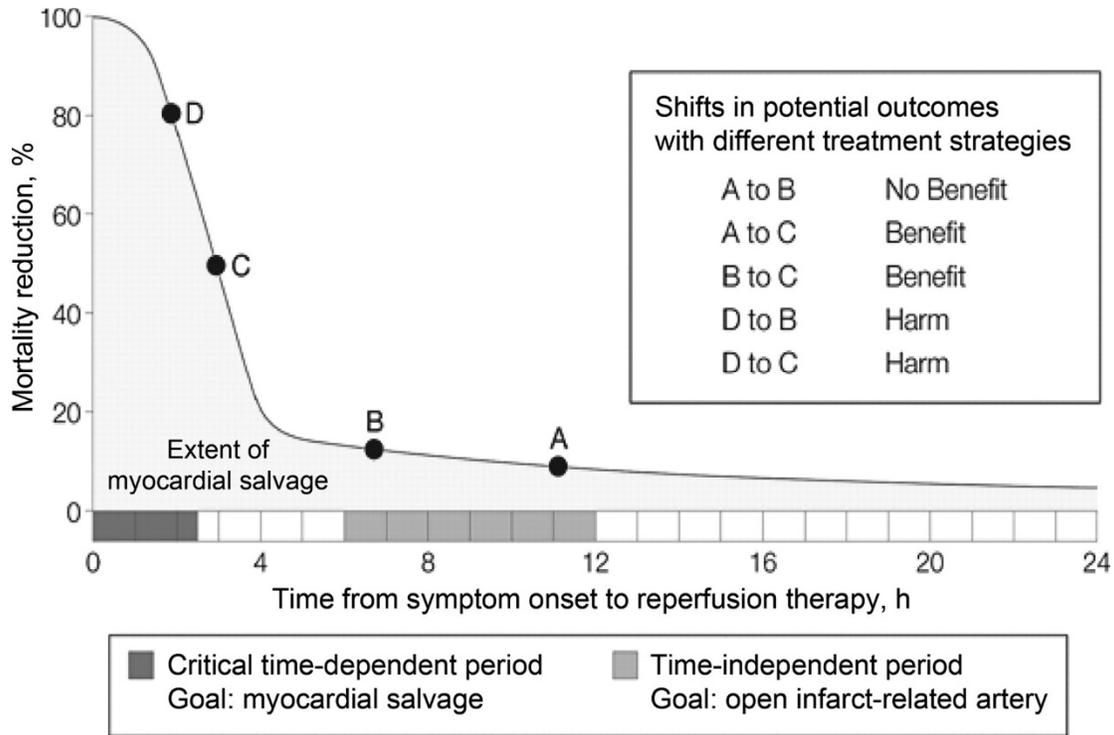
Chapter 7: Contribution to the Abu Dhabi STEMI Alert Network

Introduction

During this research project, we were able to present our findings at various events and meetings in Abu Dhabi. During these meetings, we were invited to become a member of the SEHA task force responsible for setting up a prehospital STEMI activation protocol. Our research had shown that total ischaemic times were prolonged, and that more had to be done to expedite EMS arrival STEMI patients through the reperfusion process. Our data were included in the STEMI task force charter and we formally joined the task force in January 2014. This chapter presents data and reflections from our research and a description of task force initiatives to improve STEMI care. In all cases, this researcher was actively involved as a member of the task force.

While there had been great improvements in reducing door to balloon time and other STEMI key performance indicators, in-hospital mortality remains unchanged. A possible reason for this is that patients wait too long before seeking care in not only STEMI, but in ACS in general. Patient delays in initiating transport result in greater the myocardial damage as a result of hypoxia, however that these delays could also be as result of patients presenting to non-PCI centres and then requiring transfer. Total ischaemic time and not door to balloon time is a far better tool for evaluating success and minimizing missed opportunities for prompt revascularization. Literature has shown that myocardial salvage potential decreases markedly over time as shown in figure 2.

Figure 2. Relationship between duration of symptoms of AMI and extent of myocardial salvage.



Source: Gersh B. Pharmacological Facilitation of Primary Percutaneous Coronary Intervention for Acute Myocardial Infarction: Is the Slope of the Curve the Shape of the Future? (105)

Although at the time, primary PCI was available at several healthcare services within the Abu Dhabi Emirate, patients with STEMI identified by EMS were taken to the nearest SEHA hospital, regardless of whether that facility offers a Primary PCI service. This resulted in further delays due to the time taken to confirm STEMI, arrange for referral to a cardiologist at a PCI facility and transferring of the patient to that facility. This project arose from collaboration between SEHA, HAAD Trauma Initiative, UAE Air Force HEMS and AD Police Ambulance

who operate the ground EMS, and aimed to ensure that all patients with STEMI and transported only to a facility with 24 hour primary PCI service.

Primary PCI within SEHA

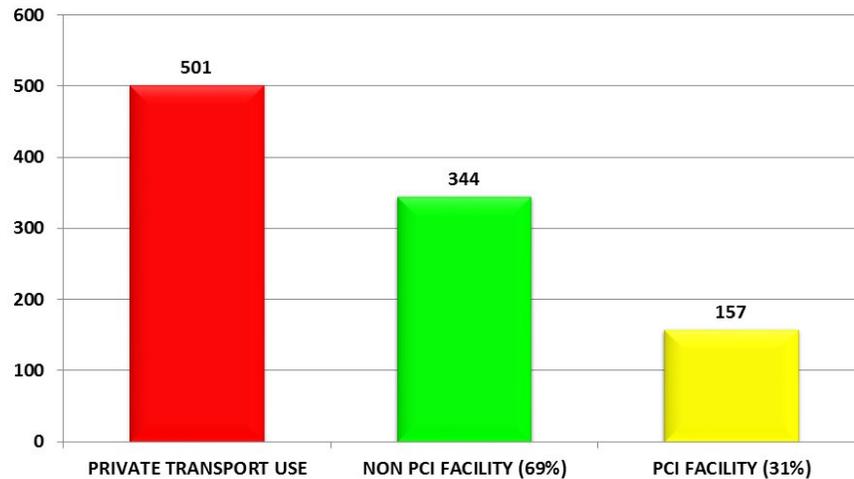
In 2010, SKMC became the first SEHA hospital to implement a 24 hour Primary PCI program within Abu Dhabi city. In 2013, the Heart & Vascular Service Line established a STEMI Taskforce initiative to implement a SEHA wide Primary PCI program. This led to the Interventional Cardiologists at SKMC and Mafraq joining forces and implementation of a 24-hour primary PCI program at Mafraq Hospital. In 2014, Rahba Hospital joined the program with the aim to transfer all STEMI patients to Mafraq for primary PCI within 120 minutes of presentation at Rahba Hospital. Mafraq hospital is approximately 33 km or 25 minutes' drive from Al Rahba Hospital.

As our research has shown an underutilization of EMS and that privately transported patients were frequently presenting at non-PCI hospitals, it was decided to first adopt policies for rapid transfer to PCI facilities.

A further concern was that of the 501 patients who used private transport in our research, more than half ($n = 344$) presented to facilities that do not provide cath labs services and in many instances, these were non SEHA facilities, which further delayed the transfer process

Figure 3. Initial destination of privately transported patients

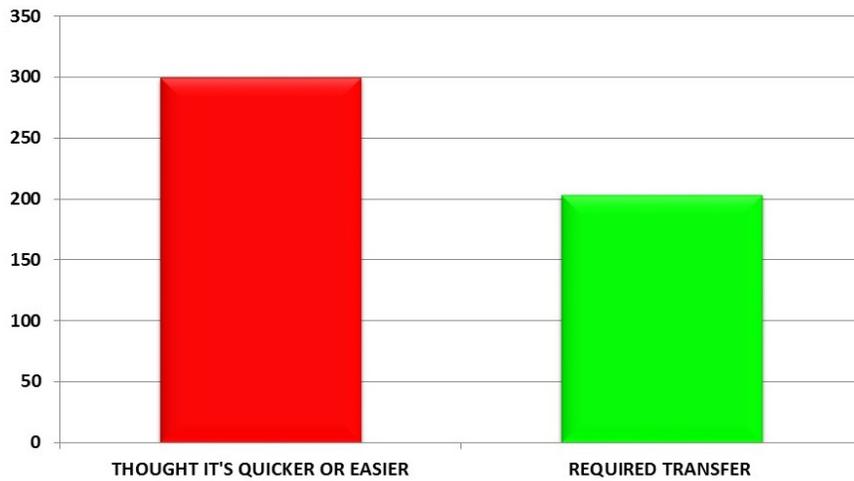
Destination of Privately Transported Patients



Interestingly, when we evaluated the number of patients who thought it was quicker or easier to use private transport and not call EMS ($n = 299$), more than two thirds of these required transfer to a PCI facility ($n = 203$). Figure 4 visually presents this proportion, graphing the number who thought private transport was quicker or easier against the number who required transfer. This demonstrates that some patients may not be aware of the differences in PCI availability at various medical centres, inadvertently increasing their own treatment times by transporting themselves to non-PCI centres. Thus, among those who find it quicker or easier to use private transport, the majority in fact experience treatment delays, contrary to their stated opinions.

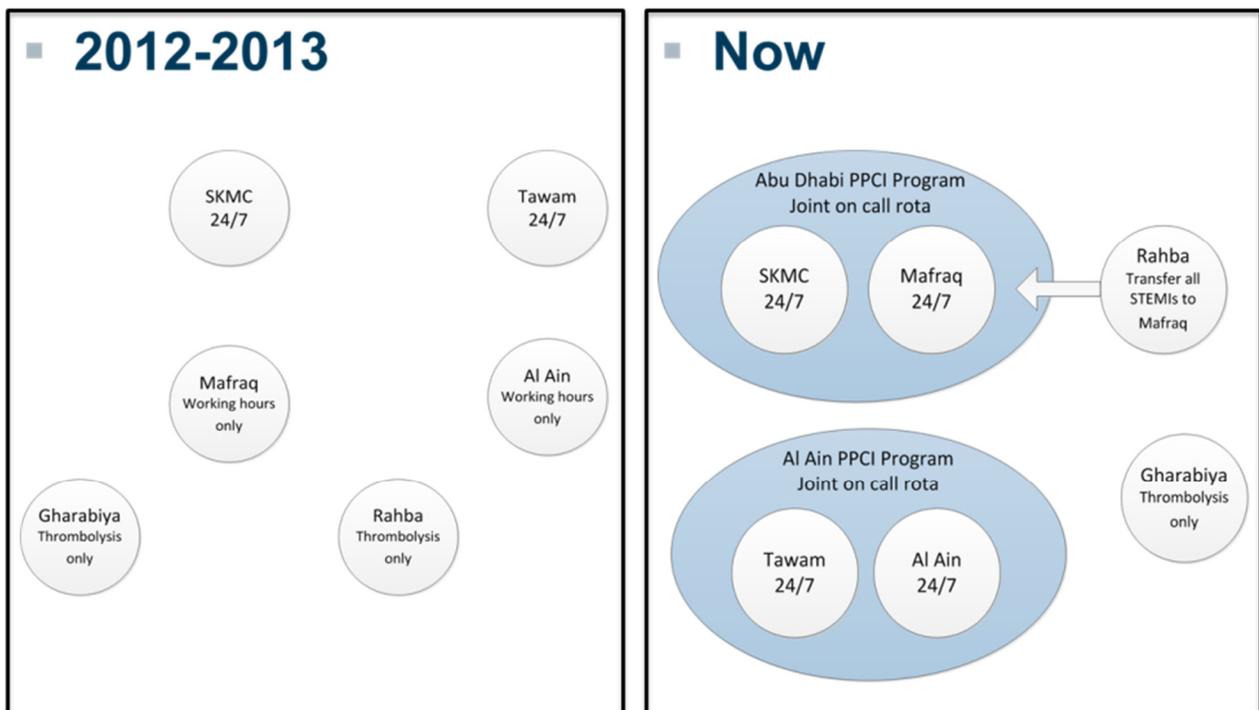
Figure 4. Proportion of patient who thought it was quicker/easier to self-transport that required secondary transfer

Patients who thought it was quicker/easier



Note: The right-hand column consists entirely of patients who believed private transport would be quicker or easier, but presented to non-PCI facilities, which required a secondary transfer.

Figure 5. Status of primary PCI facilities in Abu Dhabi, 2012 to 2016



Figures 6 and 7 below demonstrate the progress made within SEHA by showing the increasing number of STEMI patients receiving Primary PCI.

Figure 6. Percentage of patients receiving primary PCI at SEHA facilities in 2014

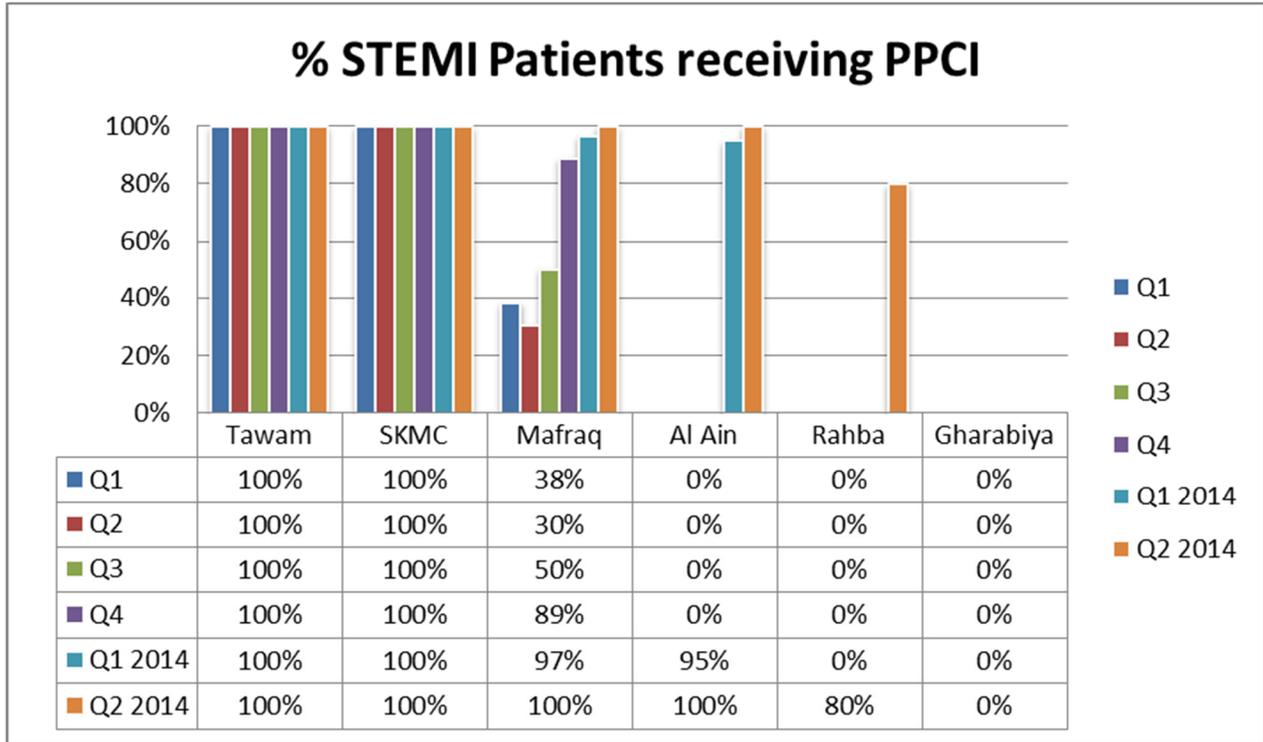
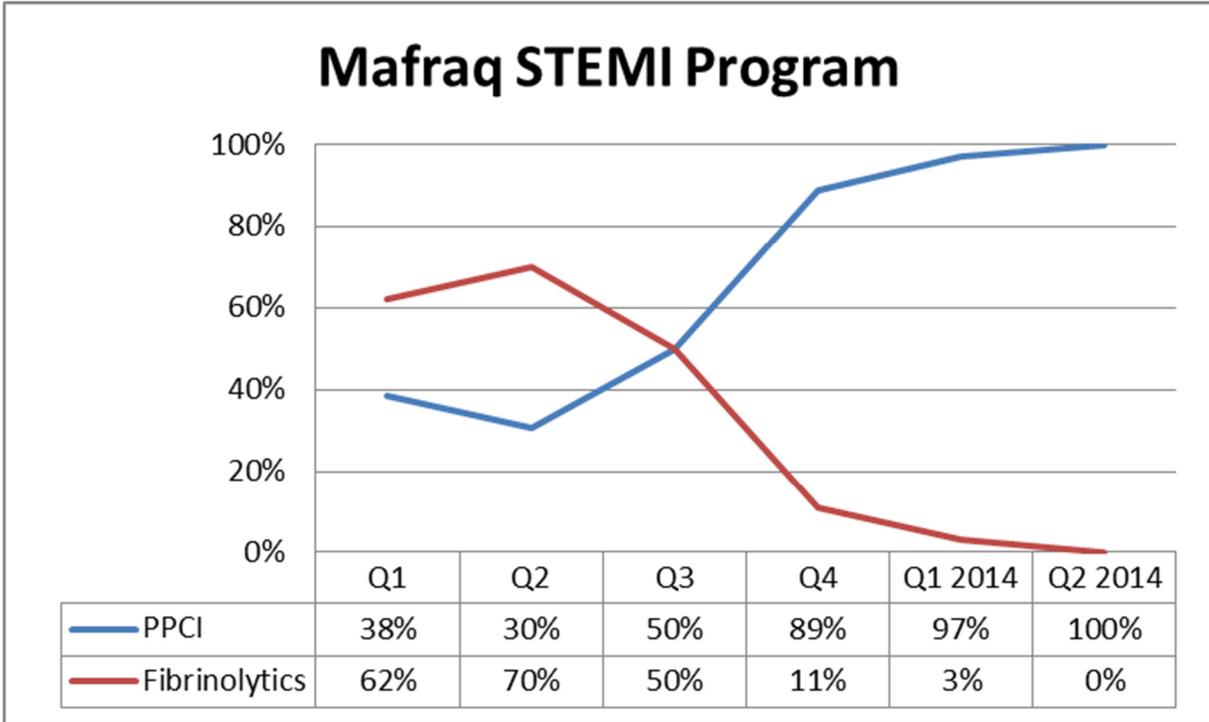


Figure 7 represents a decrease in the number of patients who present and are then managed by fibrinolytic therapy, and an increase in those managed by primary PCI, as a result of the change to 24 hour cath labs services as Mafraq hospital

Figure 7. Percentage of patients receiving Primary PCI vs. Fibrinolytics in 2014



Once the process for expedited transfer of patients from non-PCI to PCI facilities was formalized, the focus then shifted to out of hospital STEMI network activation. Paramedics in the existing EMS who have an advanced life support background were targeted for more intensive 12 lead teaching, the point of them being able to adequately interpret 12 lead ECGS. Based on their interpretation, the following plan would be established:

- Activation of a central STEMI alert number in Abu Dhabi through SEHA
- Respective cath lab activated by way of the SEHA STEMI alert network
- EMS being directed to the activated interventional cardiology facility
- Bypassing non-interventional cardiology facilities
- Bypassing the ED and going direct to the cath lab
- Aim to achieve onset to reperfusion in 120 minutes or less

In conjunction with various stakeholders, milestones for this process were established and are shown in Table 10.

Table 10. *Project summary milestone schedule*

Task Name	Start	Finish	Resource Names
Process flow agreed	Fri 03/10/14	Sun 30/11/14	STEMI Taskforce
OCC telephone number finalized	Thu 16/10/14	Thu 20/11/14	*OCC
Identify information needed by Cardiologist on call	Thu 16/10/14	Thu 20/11/14	STEMI Taskforce
Ambulance protocol agreed	Fri 03/10/14	Sun 30/11/14	EMS
Paramedic training completed	Sun 02/11/14	Sun 30/11/14	EMS
'Dry Runs' completed	Sun 30/11/14	Sat 06/12/14	SEHA, EMS, OCC
'Dry Runs' experience reviewed	Sun 07/12/14	Sat 13/12/14	STEMI Taskforce
Pilot completed	Sun 14/12/14	Sat 31/01/15	SEHA, EMS, OCC
End of Pilot review by STEMI Taskforce completed	Sun 01/02/15	Sat 28/02/15	STEMI Taskforce
Phase II planning begun	Sun 01/02/15	Sat 28/02/15	STEMI Taskforce
Process rolled out to wider Abu Dhabi city	Sun 01/03/15	Tue 31/03/15	SEHA, EMS, OCC
Phase III planning - roll out to rest of SEHA Network in Abu Dhabi emirate	Wed 01/04/15	Sun 31/05/15	STEMI Taskforce
Project rolled out to SEHA Network	Mon 01/06/15	Tue 30/06/15	SEHA, EMS, OCC
Review project progress in STEMI Taskforce meetings on a monthly basis			STEMI Taskforce

*OCC- Operations Control Centre SEHA

The Abu Dhabi STEMI Project covers the geographical region of Abu Dhabi Emirate. The initial pilot phase included Abu Dhabi island area (excluding Bain Al Jessrain), with SKMC as the main SEHA facility to receive STEMI patients.

Upon completion of the pilot phase, the project will extend to the wider Abu Dhabi city area and later to rest of SEHA healthcare network in Abu Dhabi emirate including Mafraq hospital. At present, data on the effectiveness of the program are still forthcoming, so it cannot be stated with certainty that it is effective for patients. However, results from the research presented in this thesis, as well as current recommendations for best practices for STEMI treatment, suggest that these initiatives may yield positive results.

Ambulance services personnel will be responsible for diagnosing a STEMI using a 12-lead ECG. A checklist outlining symptoms of a STEMI has been developed. This was based on the ACCF/AHA Guidelines, as well as AHA/American College of Cardiology (14) and agreed by the STEMI Taskforce. It has also been agreed that left bundle branch block (LBBB) in presence of chest pain will be treated as a STEMI and that there would be a blameless culture and no set maximum rate for false positive STEMI network activation. This decision was made despite the above guidelines stating that new or presumed new LBBB was no longer a barrier to STEMI diagnosis and that paramedics should follow Sgarbossa's criteria (106) as well as Smith's modification thereof. (107)

It was however determined that to obtain paramedic buy in, for the purposes of interpretation of STEMI, the task force would only adopt the criteria laid out by the 2013 AHA guideline for the management of STEMI. (6,14)

We were also fortunate to be involved in the design and implementation of introductory and advanced 12 lead ECG courses for existing paramedics in Abu Dhabi, as well as designing the STEMI activation data sheet and case report form for SEHA OCC. Again, data on the effectiveness of this program are still pending.

Implementation Phases for EMS

Phase 1

- Finalize and agree to the activation process by end November 2014
- Agree to the process and tools for collection of data during pilot phase
- Complete training and education of paramedics in basic and advanced 12 ECG interpretation
- Carry out activation 'dry runs' in first week of December
- Pilot the new process from week beginning mid-December to end of January 2015
- Collate data and feedback and modify as appropriate

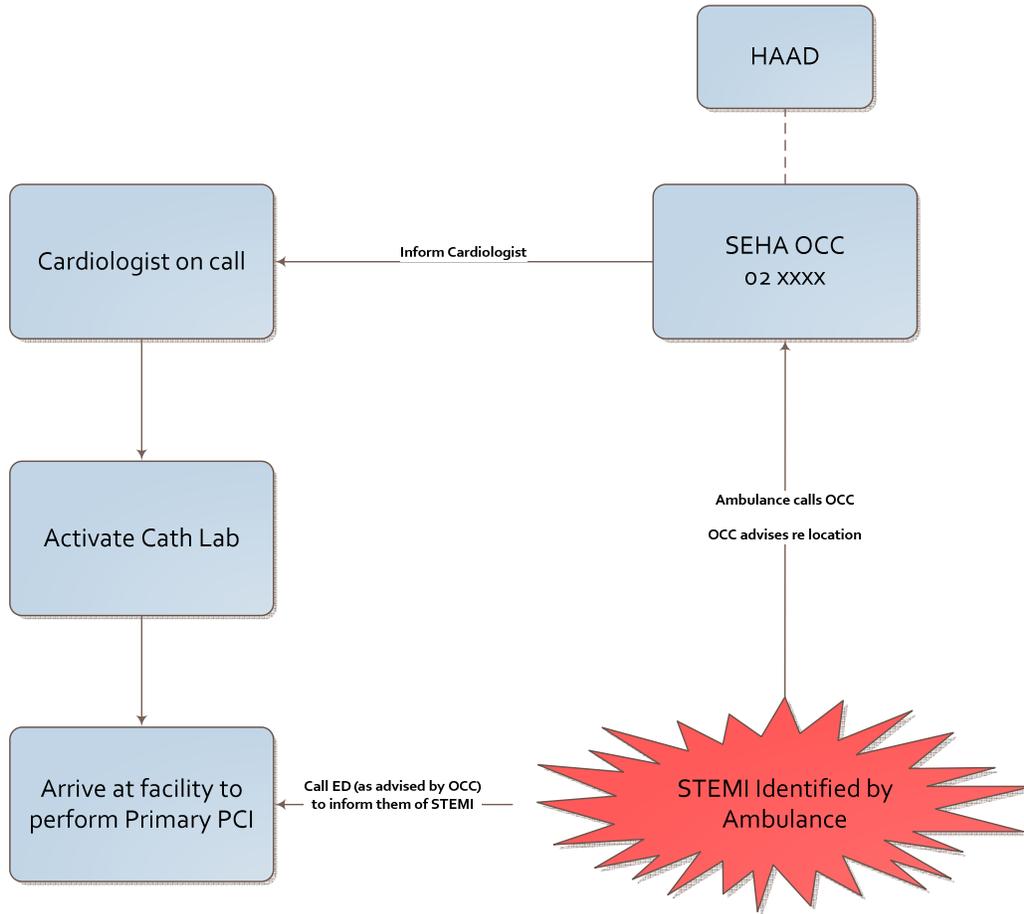
Phase 2

- Roll out project to wider Abu Dhabi city including EMS stations in Shahama, Shamkha and Mafraq

Phase 3

- Plan phased roll out to SEHA network in the Middle, Western and Eastern regions of the Emirate of Abu Dhabi
- Complete the roll out by December 2015

Figure 8. STEMI activation process for EMS



Chapter 8: Summary

Assumptions, Limitations, and Delimitations

This study assumed that the sample is representative of patients with STEMI in Abu Dhabi. Although this assumption cannot be empirically confirmed, owing to the lack of prior research on patients with STEMI in Abu Dhabi, the assumption is justified by the inclusion of five hospitals and by sampling all patients who presented with STEMI during the study period. Additionally, the study assumed that the patients' self-reported follow-up status is sufficiently reliable and that patients were honest in their interview answers. We anticipated no significant bias or error in self-reported status; nevertheless, the potential for error is present.

In addition to the potential unreliability of self-reported follow-up status, the study with the physicians was subject to the limitations inherent to convenience sampling, including possible selection bias. Because we e-mailed all physicians listed by hospital department heads as involved in the treatment of STEMI, the sampling strategy limited bias.

However, the physicians self-selected to participate in the study; therefore, they were highly motivated to assist in research to improve the quality of EMS. This could have biased results, because physicians with no strong opinions about or motivation for improving EMS in Abu Dhabi may have chosen not to participate. Furthermore, the study is not generalizable to other geographic locations. This limitation recommends cautious interpretation of results and their applicability to settings outside Abu Dhabi. However, we considered this limitation to be justified because our research objective was specific to Abu Dhabi and the Arabian Gulf region.

A final limitation to the current study is the large loss of patient participants with STEMI to follow up. This phenomenon might be attributable to the employment-based structure of residency in the UAE. Employers sponsor employees' permits, and residents may lose their

residency permits if they lose their jobs. In the event of the employee not being able to continue working, such as in the case of a patient with STEMI undergoing stenting or coronary artery bypass grafting, the residence visa is cancelled, and the employee returns to his home country. This presented a number of challenges to the present study, most importantly the inability to contact patients for follow up after discharge; in many cases, STEMI events led to their leaving the UAE. Many were from the Indian subcontinent, with no telecommunication structure in their hometowns, so contacting them at home was not feasible. This is a possible cause of the large loss to follow up, particularly at 1 year, and limits the reliability of the data for interpreting long-term follow-up clinical variables.

The study was delimited as follows. We only researched patients diagnosed with STEMI (as opposed to other forms of ACS and other conditions), and the scope of the study did not extend beyond Abu Dhabi. For the patient studies, data collection was limited to an 18-month period, and all data collection ceased one year after the last patient with STEMI was discharged.

To research the potential improvements to EMS care for patients for STEMI, physicians' perceptions constituted the only data source, and the cross-sectional analysis was conducted at a single point in time.

Recommendations for Further Research

Our research confirmed gross underutilization of EMS for patients with STEMI and we also established the rationale for why an overwhelming number of patients chose to use private transport which has not been previously studied. The initial focus should be placed on educating the public as to the awareness of signs and symptoms of ACS, and that these may be associated without chest pain. Our research showed that many patients did not go to hospital as they thought their symptoms were not cardiac in origin. The public needs to be aware that ACS symptoms

may present as nothing more than nausea and vomiting, and that coupled with diaphoresis and shortness of breath, may be an indicator or an acute cardiac event. With the high prevalence of diabetes reported in the UAE (108), there should also be education that in such patients, the risk of ACS in the absence of chest pain is of particular importance. Focus topics should also incorporate that age is not a rule out for ACS. A public perception that “I am too young to be having a heart attack” needs to be addressed. The concern for younger patients with cardiovascular disease and in particular AMI has also been reported in the press. (109) In Chapter 6 of our research, we found that eighty patients comprising 14% of our sample were under the age of 40 years, which is a disturbing finding.

The 2nd strategy should focus on the importance of not using private transport, and in particular not driving oneself, but also as to the benefits that calling EMS can provide, such as early medications, early 12 lead ECG and arrhythmia management, along with the fact that EMS only transport to facilities that are most appropriate for management of ACS. These programs should also target not only social media, but also local print media and handouts in labour camps, which is where patients were also transported from.

We found that many patients did not speak Arabic or English, so ACS education should be provided in other languages that they may understand, such as Urdu, Malayalam, Bengali and Hindi and in local language newspaper and TV channels. Education should also address that despite the fact that the Police operate the EMS, there are no repercussions for calling an ambulance for symptoms that turn out to be of non-emergent causes

Public education focus points

The following are recommended for public education in Abu Dhabi. Although these points do not represent new understandings from a scientific perspective, the contribution of the

present work is to underscore the continued necessity for public education on these points. Especially in developing, ethnically diverse regions like Abu Dhabi, public education is required to ensure that the populace is able to benefit from advances in EMS and cardiac treatment. Although more developed countries have already implemented early detection and screening programs for many of the risk factors identified here, our research advances knowledge by showing that there is a need to implement such programs in Abu Dhabi.

- Early detection of risk factors such as hypertension, dyslipidaemia and diabetes by way of screening programs
- The dangers of tobacco use and the importance of healthy lifestyles
- Early recognition of signs and symptoms of ACS and that it occurs in young patients too
- The importance of EMS use in ACS and deterring the use of private transport

Future research focus points

- Determine the effect of the above education strategies by establishing mode of transport decision making in ACS
- Evaluate risk factor screening processes and future patient medical history demographics
- Continuing education programs for EMS and 12 lead ECG interpretation
- Monitor future false positive cath lab activations in the current STEMI network
- Establishing easily accessible ACS databases on a nationwide basis

Reflections

Our research highlighted some challenges to conducting clinical research in Abu Dhabi. Ethics committees were closed over the holy month of Ramadan and the public holidays associated with the Eid holidays after Ramadan. This affected the approval times, especially as it was anticipated that this study would start before Ramadan.

At one facility, there was a backlog of applications after the holy month of Ramadan which further delayed approval at this institution. One of the facilities where the research was conducted provided incorrect information regarding the ethics process and despite approval being given for the Al Ain Medical district, on study commencement at this institution, it was found that they had an internal ethics committee. The study was halted while approval was obtained, resulting in a delay of 5 weeks, before data collection could continue.

As mentioned in chapter 1, We expected challenges with conducting following up interviews and as anticipated there was extensive loss of data at 6 months and 1 year. Loss to follow up was determined as 159 (27%) patients at 30 days, 336 (57%) patients at 6 months and 443 (75%) of patients at 1 year. This information should be considered by future researchers wishing to conduct short and long term follow up studies. When considering a willingness to participate in our research, only 25 (4%) patients did not consent were thus excluded from this study.

Apart from English and Arabic, the patients in our research spoke other languages that required translation. While research ethics committees required all consenting documentation to be in Arabic and English, a large percentage of our patients did not understand either, which required verbal translation. Research committees also required that patients receive a copy of the consent, but many patients may not be able to read, despite understanding verbal English or Arabic. We found a large number of patients speaking Urdu, Punjabi, Bengali and Malayalam.

While illiteracy was not found to be high in our participant population, we did encounter patients' who could not read or write, and consented by use of thumb print. These findings could be of benefit to future researchers wishing to conduct clinical studies in the UAE.

We also found the need to rely on the kindness of hospital staff to assist with this

research. Being an unfunded researcher and conducting multicentre data collection presented its own challenges. The two facilities in Al Ain were 160km from the two facilities in Abu Dhabi. It was therefore impossible to physically consent patients at all these facilities prior to discharge. Without the help of staff at these facilities, this research would not have been possible, and they are mentioned in the acknowledgements, as a very small gesture, of their overwhelming contribution to this research.

Chapter 9: Conclusion

What did our research contribute?

- Physicians were most supportive of widely accepted prehospital STEMI practices such as early 12 lead acquisition and triage to PCI facilities with activation by paramedics. They were not supportive of prehospital thrombolytic therapy. Possible reasons for this is the excellent saturation by EMS and HEMS as well as PCI facilities.
- A well-developed STEMI activation network is now in place in Abu Dhabi, with paramedics acquiring and interpreting ECGs, and then activating PCI facilities. Thrombolytic therapy is not performed prehospitally in Abu Dhabi.
- We found that despite previous research stating that more needs to be done to educate the public on the importance of using EMS, these recommendations have not been put in to place. EMS use not only remains low, and has in fact decreased since the GULF RACE 1 paper on EMS Use. Fares et al. found that EMS use was 17%, (61) and in our research, it appeared to have decreased to 14%. It is of particular concern as his findings were published five years ago, from research that was conducted in 2008. This further emphasizes the need for aggressive public education policies which clearly have not been effective to date.
- The above findings of this research were presented at both Emergency Medicine and Cardiology conferences in Abu Dhabi to highlight the need for better public education in ACS. These findings were also presented to SEHA at the STEMI network monthly meetings as an information tool.

- Despite patients thinking that it is quicker to use private transport, very few present to facilities that have PCI services, further prolonging the time to reperfusion
- Patients who use EMS in their decision to seek care in Abu Dhabi, have better outcomes with regards to accepted KPI's in STEMI e.g. Door to ECG and Door to Balloon time.
- As with the above recommendations, the importance of EMS use needs to be established and reinforced
- Large, prospective studies like this one can yield important insights into clinical profiles and treatment patterns of patient subsets, such as young STEMI patients

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Appendix A: Human Research Ethics Committee Approval Letter

UNIVERSITY OF CAPE TOWN



Faculty of Health Sciences
Faculty of Health Sciences Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • Facsimile [021] 406 6411
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06 June 2013

HREC REF: 286/2013

Mr E Callachan
c/o Prof L Wallis
Emergency Medicine
J-47
OMB

Dear Mr Callachan

PROJECT TITLE: MODE OF TRANSPORT TO HOSPITAL AMONG PATIENTS WITH ST ELEVATION AMI (STEMI) IN THE EMIRATE OF ABU DHABI: CORRELATES, PHYSICIAN ATTITUDES AND ASSOCIATED CLINICAL OUTCOMES

Thank you for your letter dated 24 May 2013, addressing the issues raised by the Human Research Ethics Committee.

It is a pleasure to inform you that the HREC has **formally approved** the above mentioned study.

Approval is granted for one year till the 15 June 2014.

Please submit a progress form, using the standardised Annual Report Form, if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

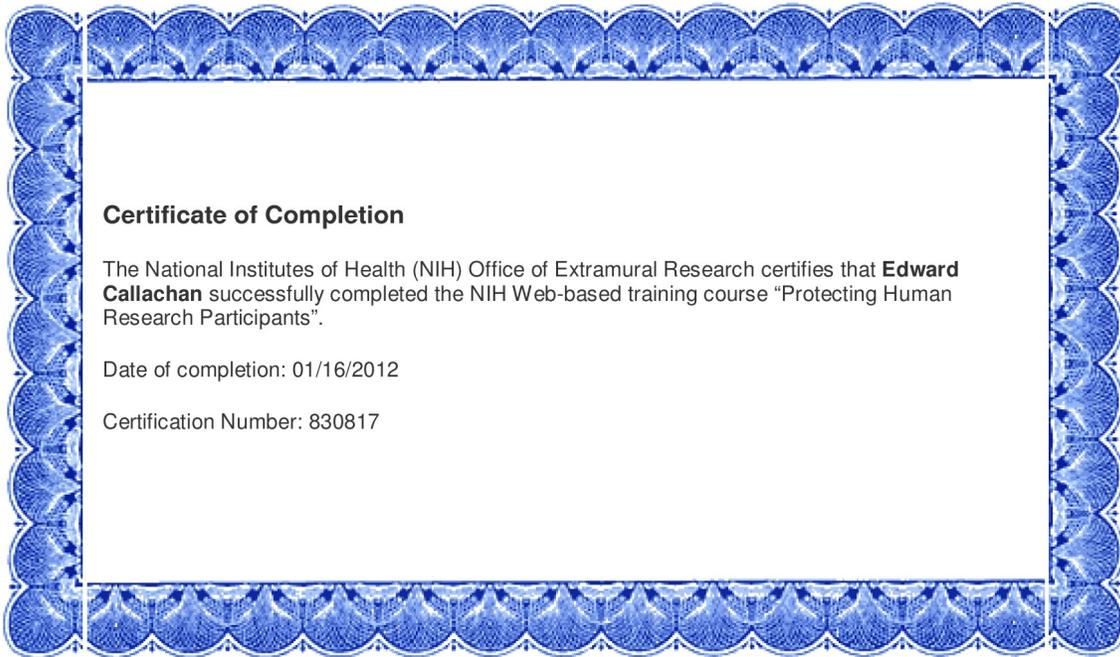
sAriefdien

This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Appendix B: “Protecting Human Research Participants” Training

Certificate of Completion



Appendix C: Sample Case Report Form for Medical Data Collection

Patient Initials _____	Facility File Number _____	Participant Number _____
------------------------	----------------------------	--------------------------

Inclusion Criteria	
Admission diagnosis	<input type="checkbox"/> ACS <input type="checkbox"/> Other → Excluded

Demographic Information	
Date of birth	<input type="text"/> / <input type="text"/> / <input type="text"/> day/mm/year
Age	<input type="text"/>
Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female
Ethnicity	<input type="checkbox"/> Arab Emirati <input type="checkbox"/> Arab Non Emirati <input type="checkbox"/> Caucasian <input type="checkbox"/> Other: _____

Emergency Department Information and Assessment	
Time of symptom onset	<input type="text"/> : <input type="text"/> <input type="text"/> / <input type="text"/> / <input type="text"/> Date symptom onset
Time ED arrival	<input type="text"/> : <input type="text"/> <input type="text"/> / <input type="text"/> / <input type="text"/> Date of ED arrival
Area of ED arrival	<input type="checkbox"/> Main Triage <input type="checkbox"/> Ambulance/Resuscitation Entrance
Mode of Arrival	<input type="checkbox"/> Ambulance <input type="checkbox"/> Private Vehicle <input type="checkbox"/> Helicopter If private drove self? <input type="checkbox"/> Yes <input type="checkbox"/> No
Ischaemic symptoms on arrival	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="text"/> . <input type="text"/> ICD 9 Code
EMS Data	<input type="checkbox"/> Oxygen <input type="checkbox"/> IV <input type="checkbox"/> Nitrates <input type="checkbox"/> Narcotics <input type="checkbox"/> Aspirin <input type="checkbox"/> Fibrinolytics
	<input type="checkbox"/> 3 Lead ECG <input type="checkbox"/> 12 lead ECG ECG Rhythm: _____ ST Changes <input type="checkbox"/> ↓ <input type="checkbox"/> ↑
Vital signs	<input type="text"/> Heart Rate <input type="text"/> Respiratory Rate <input type="text"/> / <input type="text"/> Blood Pressure
	<input type="text"/> GCS <input type="text"/> Oxygen saturation %
Patient History	<input type="checkbox"/> Angina <input type="checkbox"/> AMI <input type="checkbox"/> Hypertension <input type="checkbox"/> Stroke <input type="checkbox"/> PCI <input type="checkbox"/> CABG <input type="checkbox"/> CHF
Allergies	<input type="checkbox"/> Yes <input type="checkbox"/> No Allergy type: _____
Provisional Diagnosis:	_____ <input type="text"/> : <input type="text"/> Diagnostic ECG Time
ST Changes	<input type="checkbox"/> ↓ <input type="checkbox"/> ↑ Lead changes: _____ <input type="checkbox"/> Killip Class
ED Management	<input type="checkbox"/> Oxygen <input type="checkbox"/> IV <input type="checkbox"/> Nitrates <input type="checkbox"/> Narcotics <input type="checkbox"/> Aspirin <input type="checkbox"/> Fibrinolytics
Fibrinolytic name:	_____ <input type="text"/> : <input type="text"/> Fibrinolytic time
	<input type="text"/> : <input type="text"/> Cardiologist called time <input type="text"/> : <input type="text"/> Cardiologist arrival time

In Hospital Data	
Cath lab	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="text"/> : <input type="text"/> Cath Lab arrival time <input type="text"/> : <input type="text"/> Needle stick time
PCI Status	<input type="checkbox"/> Elective <input type="checkbox"/> Urgent <input type="checkbox"/> Emergency <input type="checkbox"/> Salvage
	<input type="text"/> : <input type="text"/> Balloon inflation time <input type="text"/> : <input type="text"/> Total ischaemic time
CABG Performed	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="text"/> / <input type="text"/> / <input type="text"/> Date
IABP Performed	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="text"/> / <input type="text"/> / <input type="text"/> Date
Transferred to department/ward: _____	
AHA door to balloon guideline met? <input type="checkbox"/> Yes <input type="checkbox"/> No	
1 st ECHO done	<input type="text"/> / <input type="text"/> / <input type="text"/> Date performed <input type="text"/> EF %
Medications	<input type="checkbox"/> Aspirin <input type="checkbox"/> Clopidogrel <input type="checkbox"/> GP IIb/IIIa inhibitor <input type="checkbox"/> Anti Arrhythmics <input type="checkbox"/> Beta Blockers <input type="checkbox"/> Inotropes <input type="checkbox"/> Nitrates <input type="checkbox"/> Diuretics <input type="checkbox"/> ACE I <input type="checkbox"/> AIIRB <input type="checkbox"/> Other medications: _____
Events	<input type="checkbox"/> Reinfarction <input type="checkbox"/> Rescue PCI <input type="checkbox"/> Reischemia <input type="checkbox"/> Cardiogenic shock <input type="checkbox"/> VTACH or VFIB <input type="checkbox"/> AFIB or SVT <input type="checkbox"/> Heart Failure <input type="checkbox"/> Required pacing <input type="checkbox"/> Arrhythmia requiring treatment <input type="checkbox"/> Stroke Type of stroke: _____ <input type="checkbox"/> Other bleed <input type="checkbox"/> Other event: _____
Ventilation	Required ventilation? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="text"/> / <input type="text"/> / <input type="text"/> Start date of ventilation <input type="text"/> Ventilator number of days
Outcome	<input type="checkbox"/> Death <input type="text"/> / <input type="text"/> / <input type="text"/> Date <input type="checkbox"/> Reinfarction <input type="text"/> / <input type="text"/> / <input type="text"/> Date
Recurrent rest angina	<input type="checkbox"/> Yes <input type="checkbox"/> No With ECG Changes <input type="checkbox"/> Yes <input type="checkbox"/> No
Stroke	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Haemorrhagic <input type="checkbox"/> Non-haemorrhagic

Discharge Data	
Discharge Medications	<input type="checkbox"/> Aspirin <input type="checkbox"/> Clopidogrel <input type="checkbox"/> Beta Blocker <input type="checkbox"/> ACE-I <input type="checkbox"/> AIIRB <input type="checkbox"/> Nitrates <input type="checkbox"/> Diuretics <input type="checkbox"/> Anti-arrhythmics <input type="checkbox"/> Bivalirudin <input type="checkbox"/> Statins <input type="checkbox"/> Other medication: _____
Pre-discharge tests	<input type="checkbox"/> EST <input type="checkbox"/> ECHO <input type="checkbox"/> <input type="checkbox"/> ECHO EF%
Discharge destination	<input type="checkbox"/> Home <input type="checkbox"/> Other facility <input type="checkbox"/> Death in hospital <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Days in ICU <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Days in CCU
Final diagnosis	<input type="checkbox"/> STEMI <input type="checkbox"/> NSTEMI <input type="checkbox"/> BBB Uncertain type <input type="checkbox"/> Unstable Angina <input type="checkbox"/>
Consent to contact for follow up?	<input type="checkbox"/> Yes <input type="checkbox"/> No

Clinical Outcomes 30 day (Expected date _____)	
Remained stable/at home	<input type="checkbox"/>
Readmitted	<input type="checkbox"/>
Reason for admission	<input type="checkbox"/> AMI <input type="checkbox"/> Unstable angina <input type="checkbox"/> Angina (Without AMI) <input type="checkbox"/> PCI <input type="checkbox"/> CABG <input type="checkbox"/> CHF (Without AMI) <input type="checkbox"/> Arrhythmia (Without AMI) <input type="checkbox"/> Other cardiovascular <input type="checkbox"/> Other non cardiovascular <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> Date of readmission
EMS utilized	<input type="checkbox"/> Yes <input type="checkbox"/> No If No, reason: _____
Deceased	<input type="checkbox"/> Cardiac <input type="checkbox"/> Non Cardiac <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> / <input type="checkbox"/> <input type="checkbox"/> Date of death

Clinical Outcomes 6 Months (Expected date _____)	
Remained stable/at home	<input type="checkbox"/>
Readmitted	<input type="checkbox"/>
Reason for admission	<input type="checkbox"/> AMI <input type="checkbox"/> Unstable angina <input type="checkbox"/> Angina (Without AMI) <input type="checkbox"/> PCI <input type="checkbox"/> CABG <input type="checkbox"/> CHF (Without AMI) <input type="checkbox"/> Arrhythmia (Without AMI) <input type="checkbox"/> Other cardiovascular <input type="checkbox"/> Other non cardiovascular <input type="text"/> / <input type="text"/> / <input type="text"/> Date of readmission
EMS utilized	<input type="checkbox"/> Yes <input type="checkbox"/> No If No, reason: _____
Deceased	<input type="checkbox"/> Cardiac <input type="checkbox"/> Non Cardiac <input type="text"/> / <input type="text"/> / <input type="text"/> Date of death

Clinical Outcomes 1 Year (Expected date _____)	
Remained stable/at home	<input type="checkbox"/>
Readmitted	<input type="checkbox"/>
Reason for admission	<input type="checkbox"/> AMI <input type="checkbox"/> Unstable angina <input type="checkbox"/> Angina (Without AMI) <input type="checkbox"/> PCI <input type="checkbox"/> CABG <input type="checkbox"/> CHF (Without AMI) <input type="checkbox"/> Arrhythmia (Without AMI) <input type="checkbox"/> Other cardiovascular <input type="checkbox"/> Other non cardiovascular <input type="text"/> / <input type="text"/> / <input type="text"/> Date of readmission
EMS utilized	<input type="checkbox"/> Yes <input type="checkbox"/> No If No, reason: _____
Deceased	<input type="checkbox"/> Cardiac <input type="checkbox"/> Non Cardiac <input type="text"/> / <input type="text"/> / <input type="text"/> Date of death

Appendix D: Conference Presentations

20th Asia Pacific Cardiology Congress (April 2015)

Sofitel Abu Dhabi, UAE

- 1) Physician perceptions of prehospital care in patients with STEMI
- 2) EMS Utilization in ST elevation AMI: A multicenter study

6th SEHA Research Conference on Health Research Outcomes (December 2015)

ADNEC, Abu Dhabi

Underutilization of EMS in acute coronary syndromes and improvement strategies in
Abu Dhabi

2016 International Conference on Emergency Medicine (April 2016)

Cape Town, South Africa

- 1) Utilization and perceptions of prehospital emergency services by patients with
ST elevation myocardial infarction in Abu Dhabi: a multicenter study.
- 2) Mode of transport in decision to seek care and associated clinical outcomes in
patients with ST elevation myocardial infarction