original article

Door-to-balloon time in the treatment of ST segment elevation myocardial infarction in a tertiary care center in Saudi Arabia

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BACKGROUND: Atherosclerotic heart disease is still a leading cause of mortality despite improvements in cardiovascular care. Percutaneous coronary intervention (PCI) is the recommended reperfusion therapy in acute ST-elevation myocardial infarction (STEMI), and the international guideline is to achieve a door-to-balloon (D2B) time within 90 minutes of patient arrival to an emergency department (ED).

OBJECTIVES: Describe interventions, data for the study period, challenges in ensuring 24/7 patient access to PCI and quality indicators.

DESIGN: Retrospective observational study.

SETTING: Tertiary care institution in Riyadh, Saudi Arabia.

PATIENTS AND METHODS: We included all acute coronary syndrome patients from 2010-2018 who presented or were transferred to our ED from nearby non-PCI capable hospitals, and for whom a 'code heart' was activated. Electronic medical records and the patient care report from the ambulance services were accessed for data collection.

MAIN OUTCOME MEASURES: D2B time, readmission and mortality rate.

SAMPLE SIZE AND CHARACTERISTICS: 354 patients, mean age (standard deviation) 55.6 (12.6) years, males 84.5% (n=299).

RESULTS: STEMI patients constituted 94% (n=334) of the study group; the others had non-STEMI or unstable angina. Hypertension (51%) was the most prevalent risk factor. Coronary artery stenting was the most frequent intervention (77.4%) followed by medical therapy (14.7%). The most common culprit artery was the left anterior descending (52.5%) followed by the right coronary artery (26.0%). A D2B time of within 90 minutes was achieved in over 85% of the patients in four of the years in the 278 patients who underwent PCI. The median D2B time (interquartile range) over 2010-2018 was 79 (31) minutes.

CONCLUSION: Meeting the international benchmark of D2B time within 90 minutes for STEMI patients is achievable when the main stakeholders collaborate in patient-centric care. Our patient demographics represent regional trends.

LIMITATIONS: Patient acceptance to our institution is based upon eligibility criteria. Transfer of 'code heart' patients from other institutions was carried out by our ambulance team. The credentials and experience of cardiologists, emergency physicians, and ambulance services are not standardized across the country. Therefore, the results may not be generalizable to other institutions.

CONFLICT OF INTEREST: None.

Coronary artery disease (CAD) is one of the leading causes of death globally.[1] According to a 2016 update from the American Heart Association (AHA), CAD is associated with over 500 000 deaths yearly in the United States alone.[2] World Health Organization data released in 2018 revealed that cardiovascular diseases (CVD) deaths in Saudi Arabia reached 37% of total deaths in 2016.[3] WHO estimated that 54% of deaths from non-communicable diseases in the Eastern Mediterranean region are due to CVD. The mortality rate from CVD ranges from 49% in Oman to 13% in Somalia.[4] Recently, improvement in cardiovascular care and awareness of the modifiable risk factors has decreased the cardiovascular mortality in high-income countries.[5]

One form of CVD is coronary artery disease, which can manifest as myocardial infarction. Immediate treatment of myocardial infarction is usually necessary to prevent sudden death. The door-to-balloon (D2B) time is the time from the arrival at the emergency department of patients with ST segment elevation myocardial infaction (STEMI) until a catheter guidewire crosses the culprit lesion in the cardiac catheterization lab. D2B times of ≤90 minutes for at least 85% of patients is a well-established cardiovascular goal for patients with STEMI undergoing primary percutaneous coronary intervention (PCI).[6] In observational studies, shorter D2B periods are associated with lower in-hospital mortality.[7-9] A recent 2019 study found that a 1-hour delay in D2B time was associated with an increase in mortality of 55 percent by 1 year, and reducing D2B time to within 45 minutes decreased mortality risk overall relative to a D2B time of more than 90 minutes, and a reduction in D2B time by 30 minutes showed a consistent reduction in 1-year mortality.[10] However, several studies including the CathPCI Registry data (ACC/AHA) of over 96 000 admissions for patients undergoing primary PCI for STEMI indicate that despite improvement in D2B times, the in-hospital mortality has not changed over the years.[11]

King Faisal Specialist Hospital and Research Centre (KFSHRC) in Riyadh is a tertiary care, teaching, and referral hospital that has all the resources to establish a comprehensive system to improve care for acute coronary syndrome (ACS), but PCI was not available to all patients on a 24-hour basis and there was no unified data collection platform, quality measures, policy or dedicated team until 2010. Almost all research on D2B times has been widely published by leading international institutions in the West; this is the first report from KFSHRC.

Our journey started in 2010 when the Emergency Department (ED) identified the need to improve CVD patient care in the institution. The ED collaborated with key stakeholders and solicited their support. A chest pain program was established to address the compartmentalized ACS care in the hospital and to ensure 24/7 patient access to PCI as opposed to thrombolytic therapy. Since then, D2B has become a key performance indicator reported regularly to the hospital administration. Several new protocols and staff competencies specific to the care of ACS patients have been developed and implemented. This program has become a model for interdepartmental collaboration and a reference for other acute care initiatives in the hospital. Although KFSHRC is a flagship hospital in the country, a third party validation was required to endorse the achievements of our chest pain program. We communicated with the Society of Cardiovascular Patient Care in Dublin, Ohio in the United States to begin our accreditation journey. Since, we have been recognized three times (2012, 2015 and 2019) as the only accredited chest pain center in Saudi Arabia. The purpose of this report is to share our experiences in the development of the chest pain center (CPC) as a reference for other national and international institutions, outline the CPC structure, and examine our results in achieving core quality indicators.

PATIENTS AND METHODS

This retrospective study of all STEMI, non-ST elevation myocardial infarction (non-STEMI) and unstable angina (UA) patients who underwent cardiac catheterization after activation of a 'code heart' at KFSHRC in Riyadh from 2010 to 2018 was conducted after obtaining approval from the Research Advisory Council (RAC) #2181207. Since patient consent was not required, data was retrieved from the secured password-protected emergency medical record (EMR) and patients were not contacted for any missing information. Patient confidentiality was maintained.

Patients included in the study were all ED patients with STEMI, inpatients who were admitted with a non-cardiac diagnosis and developed STEMI, and ACS patients transferred from another hospital for PCI for whom 'code heart' was activated. Patients with D2B times greater than 90 minutes due to non-system reasons for the delay (for example, patient refusal or cardiac arrest before the procedure) were excluded. The medical records of all eligible patients were reviewed and the information was added to our database. STEMI was defined on the ECG as an elevation of the ST segment greater than 2 mm for men or 1.5 mm for women in two consecutive precordial leads V2-V3 and/or 1 mm elevation in either, two or more consecutive or contigu-

ous limb leads. Additionally, ST depression in at least two precordial leads V1-V4 or ST depression in several leads plus ST elevation in lead AVR or a new left bundle branch block in the appropriate clinical setting.[6]

We collected data on patient demographics, cardiac risk factors, angiography findings, door-to-ECG (D2ECG) time, D2B time, door-to-artery access (D2AA) time, interventions performed, length of stay, mortality rate and discharge status by using the EMR and the ambulance patient care report. D2ECG time is the difference between ED registration to the 12-lead ECG interpretation time by the ED consultant and is applicable for ED walk-in and patients arriving by ambulance. D2B time is the time-difference between ED registration to the guidewire passing through the culprit lesion except for those who did not receive PCI. D2AA time, the time difference from ED registration to the artery access time, is an internally developed process indicator to evaluate performance by predicting D2B time for patients who underwent diagnostic cardiac catheterization and did not receive PCI. Had these patients required intervention then the intervention time would be within 15 minutes of the artery access time (average procedure time). The target for D2AA time is within 75 minutes. Procedure time is the time from arterial access to the balloon inflation time. D2B for inpatients is from STEMI recognition time to reperfusion time. The mortality rate is all causes of death (cardiac and non-cardiac causes) for the patient during hospitalization or within 30 days from the date of code heart activation and the diagnosis of STEMI.

The elements of a chest pain center include the following:

- *CPC Accreditation Committee*: A multidisciplinary group was established to review and evaluate ACS patient care throughout the hospital.The committee monitors processes and outcome measures, implementing and monitoring improvement projects, and retrospectively reviewing the care of all STEMI patients. The committee is led by the ED, meets on a monthly basis, and includes representation from the cardiology, anesthesia, laboratory, catheterization lab, hospital quality management, nursing, paramedics and perfusionists.
- *CPC Director and Coordinator*: Two new positions were established to facilitate and manage the key elements of ACS patient care in the organization. The director is an active staff physician with a keen interest in improving ACS patient care. The coordinator is a full-time registered nurse or a paramedic, with excellent communication skills and knowledge of quality improvement methodologies, who works office hours to support the entire program.
- *CPC Charter:* The roles and responsibilities of each CPC committee member, authority, annual budget, and the reporting structure are outlined in a charter which was developed and approved by the CPC Committee.
- *Intranet Portal Development*: The portal was developed to enable universal access to information for all hospital employees. All relevant documents and flow charts are uploaded by the CPC coordinator.
- *Quality Improvement Plan*: FOCUS (Find, Organize, Clarify, Understand, Select)- PDCA (Plan, Do, Check, Act), and LEAN (reduce and eliminate non-value adding activities and waste) methodologies are used for process improvement.[12]
- *Burst Page System*: To ensure 24/7 timely availability of PCI for all STEMI patients, a burst page system was developed. During working hours, if the ECG reveals a STEMI, the ED consultant will call the cardiology consultant and the cath lab. After working hours and on weekends, the ED consultant will activate the 'code heart' by calling the operator. The burst page will activate the interventional cardiologist, case manager, coronary care unit (CCU) charge nurse, and the cath lab team, who report within 30 minutes to the cath lab.
- *Staff Education*: All new clinical and non-clinical Hospital employees receive mandatory education on early heart attack care. The new nursing staff receive additional education on STEMI patient care and flow. Cardiovascular and emergency nurses complete further online education through the iLearn module.
- *ED Wayfinding*: To improve patient access, an annual review of the internal and external hospital signage to the ED is conducted.
- *Outreach*: Following are some of the initiatives undertaken to improve the community understanding of the risk factors and signs and symptoms of a heart attack: cardiovascular health assessment surveys; cardiovascular risk screenings and awareness day; diabetes and obesity awareness day; anti-smoking awareness day; Women Heart Health Day; Healthy Lifestyle Awareness Day; hands-only CPR education in malls, schools, universities, and private companies, and early heart attack care brochures in Arabic and English.
- *Prehospital ECG Transmission:* Hospital ambulances can transmit a 12-lead ECG directly to the ED for early activation of the code heart team by the ED consultant.

- *Interdisciplinary Learning:* To improve staff understanding of the internal processes, paramedics can observe in the cath lab and vice versa.
- *Triage ECG Decision Rule:* When a patient presents to ED with symptoms consistent with ACS, a 12-lead ECG must be completed by nursing and interpreted by the ED consultant within 10 minutes of arrival. To quickly identify patients with possible ACS, ED triage nursing staff are educated on the clinical criteria to obtain ECG, empowered to interrupt and present to the ED consultant. A poster was placed in the triage zone as a visual reminder (**Figure 1**).[13]

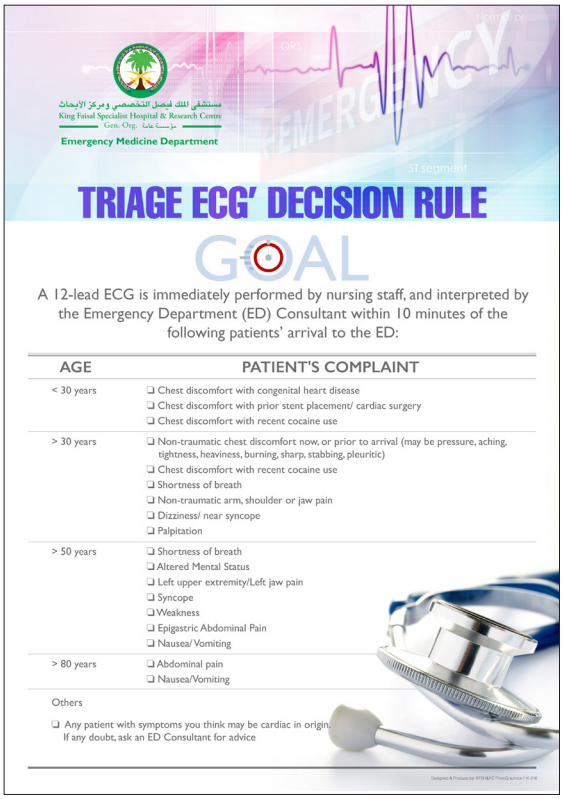

Figure 1. Triage decision rules for electrocardiography.

- *ECG documentation:* ECG completion time, reading time and physician name are now entered in the patient EMR by the nurse performing the ECG. All the ECG machines and hospital computers are now synchronized with the global satellite time throughout the organization.
- *Bedside Registration:* The first contact for patients presenting to the ED with chest pain is with a registered nurse. A poster is placed in the ED entrance asking patients to contact a healthcare provider directly (**Figure 2**). The registration process for ACS

Figure 2. Chest pain poster in the ED entrance for patients.

patients occurs after the initial ECG and at the patients' bedside.

- *Risk Stratification*: The ED patient ACS risk stratification documentation is now made available in the EMR by using the HEART score. This has improved staff documentation compliance and patient disposition.
- *Inter-hospital ACS Patient Transfer Program*: The CPC developed an outreach program where patients presenting with ACS to non-PCI capable hospitals are transferred to our institution for definitive care. The interventional cardiologist activates the "Transfer Code Heart" on receiving a referral through the WhatsApp group from one of our partner hospitals. Recent data supports the use of such cross-platform instant messaging applications to shorten the D2B times.[14]
- *Troponin Assays:* The hospital has switched to high sensitivity cardiac troponin on the recommendation of the CPC Committee. This allows rapid and confident rule-out of acute myocardial injury with an ability to quickly discharge patients from a busy ED.
- *Chest Pain Care-Set*: All ED orders including ECG,

cardiac labs, chest x-ray, and blood type and screen are now available as a care set. This allows for reducing the variability and speeding up the ordering process.

- *Discharge Instructions*: All ACS patients are provided with individualized education and discharge instructions on hospital discharge.
- *Policies and Procedures*: All current evidence-based guidelines from the American College of Cardiology (ACC) and AHA are used to govern the development of hospital protocols and policies.

Statistical analysis was done using SAS 9.4. Descriptive statistics for the continuous variables are reported as median and interquartile range (IQR) for non-normally distributed data (D2B and D2AA times) or mean and standard deviation (SD). Categorical variables are summarized as frequencies and percentages. The D2AA versus dates of artery access are analyzed by the Spearman's rank correlation coefficient. A *P* value of <.05 was used as the cut-off for statistical significance.

RESULTS

During the study period of 8 years, 354 patients underwent cardiac catheterization after activation of a code heart at KFSHRC. Males accounted for the majority of our patients (84%) (**Table 1**). The mean age (standard deviation) of the 354 patients was 55.6 (12.6) years and most were in the 50-60 age group. The mean age (SD) was 54.8 (12.7) years for males and 59.8 (11.7) years for females. Ninety-four percent (n=334) were identified as STEMI and the others as non-STEMI or UA. The majority (88%) were Saudi. Citizens of Pakistan and the Philippines were equally represented as the next most frequent patients presenting with ACS (2.3%). The majority of our patients presenting to the ED with STEMI were designated as a walk-in (60%), transferred patients accounted for the next major group (39%), and in-patients were only 1%. Hypertension (51%), diabetes (43%) and smoking (38%) were the top three risk factors in our patient population while family history (5.6%) of CAD was the least common risk factor.

Stenting of a coronary artery was the most frequently used intervention to restore coronary blood flow (77.4%) followed by recommendations for medical treatment (15%) (**Table 2**). Coronary artery bypass graft (CABG) was performed in 23 patients (6.5%). In addition, one patient each required thrombus aspiration (0.3%), implantable cardioverter-defibrillator implantation (0.3%) and simple balloon angioplasty (0.3%). The median length of stay for patients undergoing PCI was 3 days (mean 5 days). However, the patients who underwent CABG had a median length of stay of 13 days. Our median D2ECG time during the study period for STEMI patients was 5.5 minutes (mean 6 minutes). The ECG evidence of ST elevation in anterior (33.3%) and inferior (31.1%) leads were almost equally represented. The anterolateral (11.9%), anteroseptal (6.2%) and inferolateral (3.4%) STEMI were the next most frequent presentations. ST elevation in the posterior leads with or without other regions involvement was noted in around 1% of the study patients. The most commonly stented culprit artery in the STEMI patients was the left anterior descending (LAD) (52.5%) followed by the right coro-

Table 1. Demographic and clinical characteristics of the study group (n=354).

Gender	
Male	299 (84.0)
Female	55 (16.0)
Age	
<30	5 (1.4)
≥30-40	35 (9.9)
>40-50	86 (24.3)
>50-60	105 (29.7)
>60- 70	78 (22.0)
>70	45 (12.7)
Nationality[a]	
Saudi Arabia	311 (87.9)
Philippines	8 (2.3)
Pakistan	8 (2.3)
Egypt	6 (1.7)
Yemen	4 (1.1)
Syria	4 (1.1)
India	3 (0.8)
Risk factors	
Hypertension	181 (51.1)
Diabetes mellitus	152 (42.9)
Smoking	134 (37.9)
Dyslipidemia	89 (25.1)
Coronary artery disease	83 (23.4)
Family history	20 (5.6)

Data are number (%).[a]One each from Germany, South Africa, Indonesia, Thailand, Morocco, Kuwait, United States, Bangladesh, France.

Table 2. Cardiovascular characteristics of the study group (n=354).

Interventions	
Stent	274 (77.4)
Medical treatment	52 (14.7)
Coronary artery bypass graft	23 (6.5)
Intra-aortic balloon pump/temporary pacing wire	1 (0.3)
Balloon angioplasty	1 (0.3)
Thrombus aspiration	1 (0.3)
Implantable cardioverter-defibrillator	1 (0.3)
Wire w/ heparin and ticagrelor[a]	1 (0.3)
STEMI ECG Pattern/ACS type	
Anterior	118 (33.3)
Inferior	110 (31.1)
Anterolateral	42 (11.9)
Anteroseptal	22 (6.2)
Inferolateral	12 (3.4)
Inferior-posterior	8 (2.3)
Septal	7 (2.0)
Anterior-inferior	4 (1.1)
Posterior	4 (1.1)
Lateral	2 (0.6)
Left bundle branch block	2 (0.6)
Inferoposterolateral	2 (0.6)
Posterolateral	1 (0.3)
NSTEMI	11 (3.1)
Unstable angina	9 (2.5)
Stent location	
LAD	141 (52.5)
RCA	72 (26.0)
LCX	29 (10.4)
LAD/LCX	5 (1.8)
RCA/LAD	5 (1.8)
LAD/Diagonal	3 (1.1)
LAD, RCA , LCX	2 (0.7)
OM1	2 (0.7)
Diagonal + PLV	2 (0.7)
LAD – RCA	1 (0.4)
LAD – RCA/ LCX-OM1	1 (0.4)
LAD – RCA/OM2	1 (0.4)
LM	1 (0.4)
Ramus intermedius	1 (0.4)
RCA/LCX	1 (0.4)
RCA/PLV	1 (0.4)
RCA/RAMUS	1 (0.4)
RCA, LAD, Diagonal	1 (0.4)
RCA, LAD, OM1	1 (0.4)
RCA, LCX, OM1	1 (0.4)
RCA, LCX, OM2	1 (0.4)
RCA, OM1	1 (0.4)
Stents per patient (n=311)	
1 stent	246 (89.8)
2 stents	20 (7.3)
3 stents	7 (2.6)
4 stents	1 (0.4)

Data are number (%) LAD: left anterior descending, RCA: right coronary artery, LCX: left circumflex artery, OM: obtuse marginal, LM: left main, PLV: posterior left ventricle. [a]Patient received heparin and ticagrelor before being taken to cath lab. After a balance middle weight guidewire crossed the LDA, the blood flow improved significantly without the use of angioplasty or stent placement.

nary artery (RCA) (26.0%) and left circumflex (10.4%). A total of 311 stents were placed in 274 patients who underwent PCI. Drug eluting stents were the most frequently implanted (99%). Bare metal and bioresorbable stent were used in one patient each. The median stent diameter, length, fluoroscopy exposure, and contrast volume are shown in **Table 3**.

The median (IQR) D2AA time was 68 (32) minutes (range, 26-199). The correlation coefficient between D2AA and date (r^2=-0.362) shows a reduction in D2AA with time (P<.01) (**Figure 3**).

For the 278 patients who underwent PCI, a D2B time of within 90 minutes was achieved in more than 85% of the patients in the years 2011, 2016, 2017, and 2018. The median (IQR) D2B time was 83.0 (16.5) minutes for walk-in patients and 53 (22) minutes for transfer patients. The overall median (IQR) D2B time for the

study period was 79 (31) minutes, while the annual trend improved in meeting the international benchmark of within 90 minutes (**Figure 4**).

The readmission rate within 30 days of hospital discharge was 9/354 (2.5%) and chest pain in 5 patients (55.6%) was the most common presenting symptom followed by ACS in 2 patients (22.2%), dyspnea, and pneumonia in one patient each (11%). The 30-day all-cause mortality rate among the study group was 10/354 (2.8%), mortality due to cardiac causes was 9/354 (2.5%) and one death was considered noncardiac (0.28%).

DISCUSSION

Patients presenting to the ED with symptoms of ACS require time-sensitive and coordinated care. According to the AHA and the ACC guidelines, the D2B should be within 90 minutes for 85% of STEMI patients.[6] Although, for a variety of reasons, outside North America and Europe, most STEMI patients do not meet this target.[15] Delays in initiating PCI with balloon angioplasty increase morbidity and mortality for a patient with STEMI.[7-10]

In the Gulf Registry of Acute Coronary Events published in 2014, less than 11 percent of patients received PCI and of these, only 55 percent achieved D2B within 90 minutes; in Saudi Arabia, less than 41 percent of STEMI patients underwent PCI within 90 minutes.[16] Since then, we have been able to meet and maintain the internationally accepted benchmark mostly by collaborating in a huge organization and bringing all stakeholders together on one platform.

The development of our chest pain program is in line with the hospital's mission to serve society with the highest level of healthcare and best patient experience in an integrated education and research setting. This program brought a multidisciplinary team of healthcare providers together to improve ACS patient care. The ED took the lead and established direct lines of communication between the cardiology department, the hospital administration, and all other stakeholders. The CPC Committee was established to carry out all necessary interventions for achieving our goals. It was quickly realized that a full-time coordinator was required to monitor, collect data, liaison between various departments to assure hospital-wide ACS patient care process development, and staff and community education for CAD risk factors modification. The ED consultant is responsible for activating the "code heart" based upon identification of appropriate ECG findings in ED patients, while inpatient activation is the responsibility of the hospital rapid response team. This process ensures rapid mobilization of the team and timely patient access to a life-saving procedure.

Table 3. Characteristics of stents.

Stent diameter (mm)	3
Stent length (mm)	18
Fluoroscopy dose (mGy)	1550.08
Contrast volume (mL)	173
Procedural time (minutes)	14

Median values.

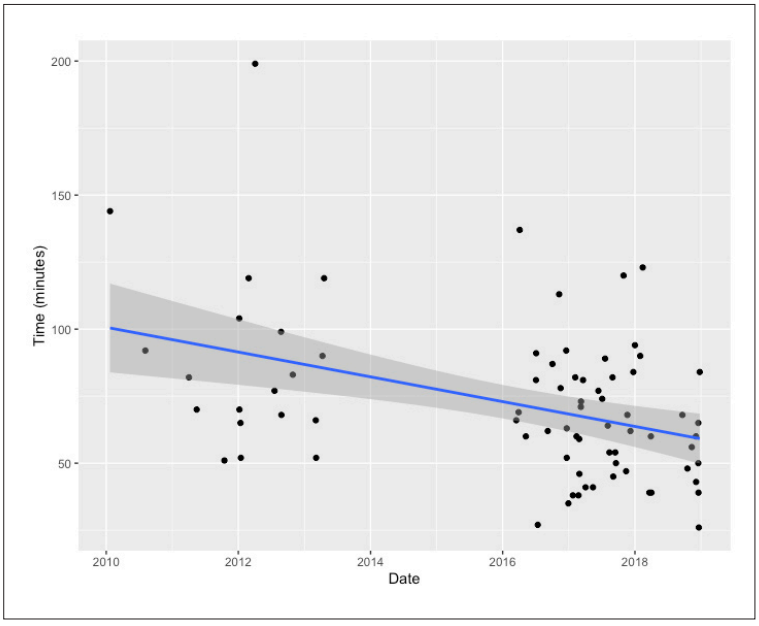

Figure 3. Door-to-artery access times from 2010 to 2018 (rho =-0.362, *P*<.01).

KFSHRC is a referral hospital but is not open to the general public. Saudi patients with STEMI are accepted, but not all patients with chest pain will present to our hospital. During the study period of 8 years, 'code heart' was activated for 354 patients while over 400 000 patients were treated in our ED. All patients were taken to the cardiac catheterization lab and none received thrombolytic therapy. This rate of ED STEMI patients (8.8/10 000) is similar to a typical chest pain center in the United States.[17] The mean age of 55.6 years (male 54.8 years, female 59.8 years) of our patients is lower than the reported mean age (men 65.1 years, women 72 years) in the United States.[2] However, it is similar to the reported age from south Asia and Egypt.[18,19] These findings may indicate a higher genetic risk, lack of preventive care and or a need for addressing modifiable risk factors in our population.

The majority of our patients were Saudi nationals (88%), followed by citizens of Pakistan, Philippines, and Egypt. The diversity of patient citizenship in our results

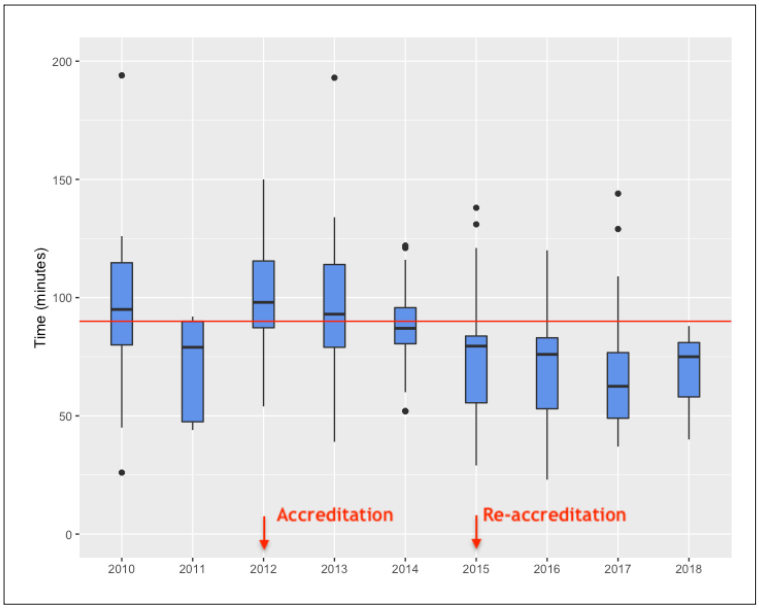

Figure 4. Door-to-balloon access times from 2010 to 2018 for patients who under percutaneous intervention (n=278) (median, interquartile range, and outlying values; red line is ACC/AHA guideline recommendation of ≤90 minutes).

is representative of employees from the 52 different nationalities in our hospital. In our study, 308 patients (87%) had at least one risk factor. This finding is similar to the study by Roe et al in the United States, who reported 85% of patients to have at least one risk factor.[20] The Saudi Ministry of Health survey of over 1.4 million people and other recent publications from the gulf region indicate a high prevalence of hypertension, diabetes, and smoking in an otherwise young population.[21,22] In our patient population, a similar trend in risk factors was noted. Our healthcare facility offers a smoking cessation clinic, anti-smoking and other ACS risk factors awareness/screening days, work-life balance seminars and has implemented a no smoking policy on the premises, but in the authors' experience the results of these efforts are variable. These findings reiterate a need for further efforts in the country towards modifying CAD risk factors.

The CPC committee initiated several performance improvement projects. D2ECG time within 10 minutes, high sensitivity cardiac troponin turnaround time within 60 minutes, and transfer STEMI programs were some of the key initiatives. ED overcrowding due to boarding of admitted patients was our biggest challenge, which resulted from a lack of inpatient bed capacity. A designated room with an ECG machine in the triage area, a nursing care technician trained to obtain an ECG and empowering nurses to interrupt the ED consultants improved D2ECG times. Our internal audit suggested that reliance on a single phlebotomist delayed the blood draws in our ACS patients. This was overcome by having the emergency nurses order a chest pain care set and draw the blood upfront. Due to the inconsistent availability of advanced life support ambulance crews at the referring hospitals and to maintain patient safety, hospital ambulances are used for transfer (our ambulance crews have internationally recognized standard training and protocols). Although our ambulances used the Google Maps with live traffic updates for the quickest routes, it is conceivable that sending an ambulance could cause a delay.

In conclusion, through a multidisciplinary collaboration, KFSHRC in Riyadh achieved and maintained an international benchmark of D2B time within 90 minutes for STEMI patients presenting to the ED for PCI, which is the institution's choice of treatment. A burst page system improved after-hours and weekends staff response times. Our patient characteristics and demographics are representative of regional trends. Community cardiovascular risk mitigation, early patient identification, and continuous staff education are integral to the success of our program. However, further efforts are needed to improve modifiable CAD risk factors in the country. Future research is recommended to highlight the country's efforts in improving preventive care to modify CAD risk factors and improving citizens and residents access to secondary and tertiary care by transforming the healthcare delivery system in the country into various pods and clusters. Further studies of symptom onset to contact with the first medical provider or balloon time on the clinical outcome are also needed.

Some limitations are that patient acceptance to our tertiary care institution is based upon eligibility. The transfer of 'code heart' patients from other institutions by our ambulance team rather than the other hospital's ambulances is inefficient because of the delay caused by the round trip. Ideally, other hospitals would have adequate resources to transfer STEMI patients. The credentials and quality of cardiologists, emergency physicians, and ambulance services are not standardized across the country. Therefore, the results may not be generalizable to other institutions.

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